The NIOSH Traumatic Injury Research and Prevention Program
Evidence Package

March 2007

Preface

In 2005, the National Institute for Occupational Safety and Health (NIOSH) requested that the National Academies (NA) undertake a review of NIOSH research programs with respect to their relevance, impact, and future direction. One of the programs scheduled for review was the Traumatic Injury (TI) Research Program.

Since the creation of NIOSH in 1970, work-related traumatic injuries have slowly gained stature among Institute priorities. At its inception, NIOSH largely adopted the organizational structure and activities of its predecessor agency, the Bureau of Occupational Safety and Health (BOSH), which resulted in an early Institute focus upon toxic exposures and occupational illnesses. In the 1970s, the Institute consolidated its fragmented, decentralized TI research efforts into the Division of Safety Research. In the 1980s, severe traumatic occupational injuries comprised one of the NIOSH "Top Ten"—i.e., the ten leading occupational safety and health problems. In the 1990s, traumatic injury was included with 20 other priority areas under the National Occupational Research Agenda (NORA) initiative.

Over the years, the TI Program has evolved into an important "cross-cutting" research program in both the recently launched NIOSH Program Portfolio Matrix Management Initiative and the industry-sector-based NORA 2 effort, which is intended to guide the nation's occupational safety and health research agenda for the next decade. The TI Program has sought to ensure its relevance and impact through:

- A multidisciplinary public health-based approach
- Reliance on data as a principal program driver
- Innovative programs (which will be spelled out and described later) such as NTOF, FACE, and the Alaska Field Station
- A collaborative approach to research and prevention via active multi-sector partnerships, and
- Innovations in targeted dissemination, technology transfer, and other "research-to-practice" efforts.

Because the TI has historically been a learning and adaptive program, we welcome the NA review, and the objective, expert insight it promises to bring to bear upon the evidence presented herein. We see this review as an opportunity to look impartially and realistically upon where we've been and what we've done, and to ultimately improve the TI Program. Improvements in the relevance and impact of the TI Program hold the potential to reduce risks, injuries, and deaths among workers in the U.S. and around the globe.

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I. Introduction

The Traumatic Injury (TI) Research and Prevention Program of the National Institute for Occupational Safety and Health (NIOSH) is seeking external review by the National Academies (NA) to assess its contribution to the public good and to improve its research and management. There are three objectives for this review, to assess:

- **Progress in reducing acute traumatic workplace exposures, injuries, and deaths** that can be attributed (wholly or partially) to the activities, findings, outputs, and influence of the NIOSH TI Research and Prevention Program during the evaluation period—1996 through 2005. Progress will be measured through an assessment of the contribution of the TI Program toward intermediate and end outcomes. This will include analysis of links between the TI Program and the research and prevention activities of others, including further distribution, promotion, use, or adoption (intermediate outcomes) of TI findings and products; and analysis of relevant data about workplace exposures, injuries, and fatalities (end outcomes).

- **Progress in targeting new research** to the areas of traumatic occupational injury and death most relevant to future improvements in workplace protection.

- **Identification of emerging research areas** that appear especially important in terms of their relevance to the mission of NIOSH.

NIOSH believes that the Framework for the Review of NIOSH Research Programs[1] ("Framework") developed by the Committee for the Review of NIOSH Research Programs will result in a fair evaluation of the TI Program. NIOSH expects that the work of the NA Evaluation Committees (ECs) will also help TI managers assess, adjust, and manage its research programs.

TI was guided in the preparation of this evidence package by the 12/19/2005 evaluation Framework.1 The Framework outlines a process for review of NIOSH programs and an organized list of examples of the kinds of evidence that the research programs could provide to assist with that process.

The Executive Summary (Section II) outlines key points regarding the history, the drivers, the strategies, the activities, the outputs, and the outcomes—in short, the main contributions of the TI Program to the safety of U.S. workers.

In sections of the package that follow the Executive Summary, we provide a brief overview of NIOSH (Section III), followed by an overview of the TI Program (Section IV).

NIOSH believes that the TI research program may be most coherently presented in terms of eight research goals. These goals were used to organize Section V of this evidence package.

1.Reduce injuries and fatalities due to motor-vehicles
2.Reduce injuries and fatalities due to falls from elevations
3.Reduce injuries and fatalities due to workplace violence
4.Reduce injuries and fatalities due to machines
5.Reduce acute back injury

6.Reduce injuries and fatalities among workers in Alaska
7.Reduce injuries and fatalities to emergency responders
8.Reduce injuries and fatalities to working youth

These goals have emerged principally from surveillance data on fatal and nonfatal traumatic injuries (motor-vehicle crashes, falls, violence, machines, back injuries, Alaska), and from Congressional directives (emergency responders, violence, working youth).

Descriptions of each sub goal include at least these parts:

- Issue—the research need addressed by this part of the TI Program.
- Approach—the overall strategy and research activities undertaken both by TI staff and extramural grantees.
- Outputs and Transfers—a description of the research outputs (e.g., reports and journal articles) and activities by the TI Program and grantees to transfer the outputs to others.
- Intermediate Outcomes—the actions of other individuals and organizations after they receive the outputs of the TI research program. Examples of intermediate outcomes are standards, technologies, training methods, analytic methods, and control strategies—in short, any response indicating further distribution, use, or adoption of NIOSH-funded outputs by others.
- End Outcomes—changes related to worker health, including decreases in injuries and deaths, or decreases in exposures or risk factors resulting from TI research and prevention efforts.
- What's Ahead—activities planned to extend the research program and potential outputs and intermediate outcomes that may result.
- External Factors—circumstances and forces that typically are beyond program control or influence that nevertheless currently (or could) impact the program (negatively or positively).
- References—a list of citations of source material keyed to reference numbers in the text of the evidence package.

Section VI presents the latest set (December 2006) of the TI Program's interim research goals for the future.

Appendix 1 contains the supporting evidence for the research goals, including bibliographic citations of outputs described in each goal/sub goal narrative, as well as other evidence such as lists of partners, cooperative agreements, extramural projects, legislative actions or standards, etc. Subsequent appended information—all available on the CD and Web versions of this evidence package—provides more detail about the following topics:

- Specific relevant TI projects, both intramural and extramural (Appendix 2)
- TI management and research staff (Appendix 3)
- TI informational resources (Appendix 4)
- TI laboratory facilities and specialized equipment (Appendix 5)
- TI partners and stakeholders (Appendix 6)
- TI-sponsored or supported workshops and conferences (Appendix 7)
- Previous or current program evaluations (Appendix 8)
- Citation and dissemination data for TI-related NIOSH publications (Appendix 9)

What is meant by "work-related traumatic injury" in this evidence package?
"Trauma," from the Greek word meaning "wound," is commonly defined in English usage as "an

injury or wound to a living body caused by the application of external force or violence."[2] Throughout this evidence package, "work-related traumatic injury" refers to any damage inflicted to the body by energy transfer during work with a short duration between exposure and the health event.[3]

Traumatic injury as described herein is distinguished from psychological trauma—i.e., a wound to the psyche resulting from a deeply disturbing experience or the emotional shock following a stressful event or a physical injury. Acute traumatic injury includes acute injuries to the musculoskeletal system caused by one-time exposures to forces that exceed the body's capacity, such as may occur during lifting and handling tasks. However, acute musculoskeletal injuries are distinguished herein from musculoskeletal injuries that are caused by repetitive trauma—exposures or motions that alone are not sufficient to cause acute injury, but that cumulatively may produce an injury to the musculoskeletal system. Musculoskeletal disorders that result from repetitive or cumulative trauma are the focus of a separate NIOSH research program.

The NIOSH research programs selected for evaluation, including TI, are not all mutually exclusive; in fact, TI overlaps with sector-specific programs, such as Agriculture, Construction, and Mining. The Mining Safety and Health Program, in particular, includes a substantial traumatic injury research component. Although the current NIOSH Pittsburgh and Spokane Research Laboratories (PRL and SRL, respectively), joined NIOSH in Fiscal Year 1997, the budget and function of the two mining research laboratories (formerly of the U.S. Bureau of Mines) have remained relatively independent of other NIOSH research divisions and programs, due largely to stakeholder interest and Congressional oversight. Thus mining-related Traumatic Injury research (which was previously reviewed by NA with the other Mining programs[4]) is not included here.

Throughout this evidence package, the terms "traumatic injury" and "safety" are often used in ways that make them interchangeable (e.g., read "safety" research as "TI" research).

II. Executive Summary

Traumatic injuries incurred during work represent an age-old affliction of humankind. In the United States, employers and government administrators were rarely concerned about workplace safety prior to the latter half of the 19th century, when the increasing frequency and scale of industrial disasters and the availability of injury and fatality data, brought into focus the plight of workers in high-risk jobs such as mining, railroad work, manufacturing, and construction. The first Federal law addressing work injury (particularly in mining and railroad work) was the Safety Appliance Act of 1893. The first agency with a safety mission was the U.S. Bureau of Mines (USBM), established in 1910 partly in response to one of the worst workplace disasters in U.S. history—the 1906 explosion and fire at a Monongah, West Virginia coal mine that claimed the lives of 362 miners.

The earliest agency with a responsibility for occupational safety and health research, including traumatic injury (TI) research, was the Office of Industrial Hygiene and Sanitation created in the Public Health Service in 1914. Although often relocated, renamed, and transformed, this research organization survived to eventually become the Bureau of Occupational Safety and Health (BOSH) in 1968. When the Occupational Safety and Health Act (OSH Act) of 1970 created the NIOSH, the new Institute absorbed the principal functions of BOSH.

Largely patterned upon the organizational and functional model of its immediate predecessor BOSH, the Institute initially focused most of its resources upon occupational health issues. In particular, NIOSH developed an extensive list of research priorities in support of criteria development efforts that fed the standards development program of the Occupational Safety and Health Administration (OSHA). Although NIOSH acknowledged its "safety" research mandate in the initial OD staffing plan (an Associate Director for Safety in the Office of the Director and shortly thereafter a Coordinator for Safety Standards Development in the Office of Research and Standards Development), early TI research was piecemeal and scattered across the Institute in a handful of sections and labs.

Examples of early TI-related research and prevention efforts in NIOSH included a personal protective equipment (PPE) testing and certification program inherited from the USBM, a small research section that studied behavioral and motivational factors associated with TI, and a small branch that provided workplace safety consultation to other government agencies and corporations. Both of the latter were located in the large Division of Laboratories and Criteria Development in Cincinnati. A small task force in the Division of Technical Services produced dozens of industry-specific safety and health manuals called Health and Safety Guides (HSGs), which partially addressed TI hazards and provided TI prevention recommendations.

TI research priorities for NIOSH were initially developed based upon the opinions of a sample of safety professionals obtained by survey and a review of literature. Early NIOSH TI research strategies consciously omitted consideration of high-risk occupational activities such as motor-vehicle operation and mining, mainly due to the large research efforts of other agencies in these areas. It was not until 1977 that NIOSH formed the Division of Safety Research, the first Division-level focus for the TI Research Program. The new Division carried on the testing and certification program for respirators and other PPE, but in its attempt to address the broader array of TI issues, recognized the need for a systematic approach to identifying and prioritizing problems. TI sought to apply the public health approach to TI research and prevention, and to base TI Program priorities and direction upon injury and fatality data. Responding to the lack of national data systems that precluded even a basic count of worker deaths in the U.S., TI created the National Traumatic Occupational Fatalities (NTOF) surveillance system in 1984. NTOF verified the huge death toll caused by motor-vehicles, industrial machines, and falls from elevation, and revealed the importance of violence as a cause of traumatic occupational fatalities.

Responding to the lack of more detailed, circumstantial information on traumatic work injuries, TI initiated a workplace fatality investigation program known initially as the Fatal Accident Circumstances and Epidemiology (FACE) Program, and later as Fatality Assessment and Control Evaluation program. FACE enabled clearer understanding of fatality causation and opportunities for prevention.

Other gaps in the TI Program's public health approach were gradually perceived and addressed by TI Program managers. Gaps in analytic epidemiology research, which enables more precise characterization of risk, and intervention evaluation research, which provides data on prevention effectiveness, were addressed by the formation of a new research branch—Analysis and Field Evaluations Branch—in the early 1990s.

A large gap in the ability of the TI Program to identify and develop prevention options through engineering and other safety sciences analyses was addressed by the development of a research strategy and the formation of the Protective Technology Branch.

Difficulties in providing relevant risk and prevention information to the individuals, organizations, and companies—particularly those at risk—prompted the development of a targeted dissemination approach in TI, which, along with experimentation with health communication, social marketing, and technology transfer approaches, fed the development of what ultimately became the NIOSH-wide Research-to-Practice(r2p) initiative.

Finally, the lack of a national forum to facilitate information sharing and research collaboration among the nation's occupational injury researchers prompted TI to organize the National Occupational Injury Research Symposium (NOIRS). The first NOIRS was conducted in Morgantown, the home of DSR, in October 1997. Subsequent NOIRS were held in Pittsburgh in 2000 and 2003.

TI has used data from the NTOF Surveillance System and the BLS Census of Fatal Occupational Injuries (CFOI), as well as nonfatal occupational injury data from BLS and the National Electronic Injury Surveillance System (NEISS) managed by the Consumer Product Safety Commission (CPSC), to identify major TI problem areas, set program priorities, and establish research goals. Other inputs to the TI Program include Congressional directives and research needs outlined by the National Occupational Research Agenda (NORA) Traumatic Injury team in a 1998 white paper. Assessment of these inputs led TI to establish eight main research goals that have dictated TI efforts during most of the evaluation period for the NA review—i.e., 1996 through 2005. The eight research goals are:

1. Reduce injuries and fatalities due to motor-vehicles
2. Reduce injuries and fatalities due to falls from elevations

3. Reduce injuries and fatalities due to workplace violence
4. Reduce injuries and fatalities due to machines
5. Reduce acute back injury
6. Reduce injuries and fatalities among workers in Alaska
7. Reduce injuries and fatalities to emergency responders
8. Reduce injuries and fatalities to working youth

Outputs. Since 1996, TI has authored 55 NIOSH documents addressing the eight research goals. More than 1.7 million copies of these documents have been distributed to date. TI researchers have authored 120 journal articles addressing the eight research goals; these articles have been cited in other literature at least 583 times. TI publications and other outputs have been reprinted, redistributed, and incorporated into training courses, campaigns, and informational products by other organizations.

TI has also employed engineering approaches to study and design new protective technologies and products. For example, TI researchers have

- Made recommendations for redesigned patient compartments in ambulances incorporating enhanced safety features
- Developed sizing schemes based more closely upon today's workforce to ensure that new fall-arrest harnesses that will be more appropriately sized, and recommended design features to reduce the risk of "suspension trauma"
- Designed and tested new automatically deploying roll-over protective structures (ROPS) for agricultural tractors
- Developed safety interventions to prevent injuries and deaths from using winches on the decks of commercial fishing vessels.

Outcomes. These outputs have been used by other researchers, manufacturers, employers and others in their own prevention efforts and products. For example, TI program data, findings, recommendations, and direct staff participation have contributed to or influenced:

- Increased awareness of traumatic occupational injury and fatality risks and prevention options
- Increased research and subsequent research publication by other researchers and research organizations
- Development of new or modified products featuring improved safety-enhanced design
- Acquisition and use of new equipment and products
- Adoption of safe work procedures
- Direct compliance or inspection activities by agencies with specific jurisdictional authority
- Promulgation of new or changed regulations, standards, and guidance issued by various standards-setting agencies
- Reductions in numbers and rates of specific types of traumatic occupational injuries and fatalities.

TI findings, recommendations, and direct participation have contributed to promulgation of Federal and State regulations, national voluntary consensus standards, and compliance guidelines. For example, research and recommendations from the TI Program were cited among the justifications for new Federal child labor regulations that went into effect in February 2005. These changes have the potential to reduce young worker deaths and injuries associated with working on roofs, compactors and balers, driving, and the manufacture of explosives. The Department of Labor reports that they continue to consider NIOSH recommendations for child labor law changes and will be proposing additional rule changes in the future. TI staff members were instrumental in the development and passage of the first occupational safety standard aimed at protecting workers who drive motor-vehicles as part of their jobs, but who are not covered by the Federal Motor Carrier Safety Regulations that cover professional drivers (ANSI Z15.1—Safe Practices for Motor-Vehicle Operation). TI data, investigations, and recommendations (and collaborative efforts with OSHA and the National Association of Tower Erectors (NATE)) informed both the OSHA guidance issued on safe telecommunications tower construction and maintenance and the first State telecommunication tower standard (North Carolina).

TI research and outreach efforts also informed State legislators who recently enacted laws in six States addressing safe patient lifting practices in nursing homes. Findings from TI research on baler safety have been used by the ANSI Z245.5 standards committee in a revision of the Baling Equipment Safety standard. Baler manufacturers are already providing purchasers of new balers with safety equipment and safety instructions that meet the revised standard's requirements. The National Fire Protection Association (NFPA) 1982 PASS standard was recently revised and issued (effective December 20, 2006) based upon TI information from its investigations of fire fighter fatalities.

As a result of safety conferences and workshops and interagency collaborations that were organized and led by TI in Alaska, certain agencies with specific inspection and compliance mandates directly intervened to halt hazardous operations. For example, after participating in a Vessel Loss Prevention Working Group at the November 1997 FISH Workshop in Seattle, the U.S. Coast Guard (USCG) designed and implemented a Dockside Pre-season Boarding program to perform safety inspections in order to identify and correct safety hazards known to exist in the Bering Sea crab fisheries. Similarly, after a rash of fatal crashes of helicopters engaged in logging operations, TI convened emergency meetings of an interagency working group which led to direct intervention by the U.S. Forest Service, the Alaska Department of Labor (AKDOL), and the Federal Aviation Administration (FAA). On-site inspections led FAA and AKDOL to close down dangerous helicopter logging operations.

TI research and development activities, and partnerships with other safety researchers and vehicle and equipment manufacturers have resulted in, or are leading toward, the availability of new and modified products with enhanced safety features, including:

- New ambulances with redesigned patient compartments incorporating enhanced safety features that are based upon TI recommendations
- New fall-arrest harnesses that will be more appropriately sized for today's workforce, and will incorporate design features to reduce the risk of "suspension trauma"
- New automatically deploying roll-over protective structures (ROPS) for agricultural tractors designed and tested by TI
- New TI-developed safety interventions to prevent injuries and deaths from using winches on the decks of commercial fishing vessels

TI research outputs are often used to develop training materials and courses and safety guidance in many other forms. For example, an encouraging preliminary finding from a recent evaluation of the TI Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) is that TI recommendations have been used by approximately 11,000 fire departments to update the content of their training programs.

Also, the American Road and Transportation Builders Association (ARTBA) and the National Safety Council (NSC) consulted with TI researchers in developing an OSHA 10-hour training course specifically for the road construction industry. Key measures from a NIOSH document on work zone safety were incorporated in the course training materials.

The contribution of TI surveillance and research likely contributed to an increase in research addressing workplace violence (WPV). The number of WPV-related publications increased dramatically from 1970 to 2004 in the Medline database following media attention to TI surveillance reports on the scope and characteristics of WPV. Similar trends have been noted in the business, occupational safety and health, and legal literature. The dramatic upturn in interest in WPV, expressed in a high volume of published literature, occurred in the period from the late 1980s to the early 90s, coincident with TI surveillance findings and early reports in the literature indicating that homicide was a leading cause of traumatic occupational fatality.

From 1996 to 2005, traumatic occupational fatalities among the U.S. workforce declined 39 percent. It is likely that the TI Program has contributed to this decline. While efforts of many external entities have also influenced the reduction in worker deaths, the TI contribution to this decrease is reinforced by decreases in specific goal areas where TI has concentrated efforts. For example, TI surveillance, research, intervention evaluation, and national leadership efforts addressing workplace violence have contributed to a reduction in the number of workplace homicides. TI efforts in Alaska have likely contributed to an overall reduction in fatal work injuries, with specific reductions in the number and rate of commercial fishing fatalities (especially among crab fishermen), and helicopter logging crashes and related deaths. TI research has also contributed to reductions in back injuries in nursing home employees, and injuries to youth working on farms. These are a few of the ways in which the NIOSH TI Research and Prevention Program has contributed toward reducing the risk and the actual toll of traumatic occupational injuries in the U.S. The narratives describing TI activities, outputs, and outcomes that are presented in this evidence package present these and other positive impacts on worker safety. TI is dedicated toward increasing program impact and welcomes the scrutiny that the National Academies Evaluation Committee will bring to bear on the program.

III. Overview of the National Institute for Occupational Safety and Health

When the Occupational Safety and Health Act (OSH Act) of 1970[5] was signed into law by President Richard Nixon on December 29, 1970, NIOSH came into being. The Institute was officially initiated 120 days later (April 29, 1971). Since then, NIOSH has been the Federal agency responsible for conducting research and making recommendations for the prevention of occupational injury and illness.

Over a half century earlier, in 1914, the first Federal occupational safety and research program was initiated with the establishment of the Office of Industrial Hygiene and Sanitation in the Public Health Service Division of Scientific Research.[6] This early precursor to NIOSH was located at the U.S. Marine Hospital in Pittsburgh, Pennsylvania until it was transferred to Washington, D.C. in 1918.

This early Federal occupational safety and health research program went through various organizational, name, and location changes from 1937 through 1968, ultimately becoming (in December 1968) the Bureau of Occupational Safety and Health (BOSH) in the Environmental Control Administration. The Environmental Protection Agency (EPA) was established in 1970 and assumed most of the functions and offices of the Environmental Control Administration, except for a few offices, including BOSH.[6] Upon the passage of the OSH Act, BOSH was assimilated into the new Institute.

Legislative Authorities

The OSH Act created NIOSH in the Department of Health, Education and Welfare (DHEW) and the Occupational Safety and Health Administration (OSHA) in the U.S. Department of Labor (DOL). OSHA is responsible for developing and enforcing workplace safety and health regulations in industries other than mining.

Among other things, the OSH Act authorizes NIOSH to:

- Conduct research on worker safety and health, including new safety and health problems
- Develop recommendations for occupational safety and health standards
- Conduct training and employee education
- Develop information on safe levels of exposure to toxic materials and harmful physical agents and substance
- Conduct on-site investigations to determine the toxicity of materials used in workplaces
- Fund research by other agencies or private organizations through grants, contracts, and other arrangements.

The Federal Mine Safety and Health Amendments Act of 1977[7] (which superseded the Coal Act of 1969[8]) assigns additional authorities for NIOSH in coal mining health research. Among these health-oriented responsibilities, NIOSH was given a responsibility that had traumatic injury prevention implications: the testing and certification of personal protective equipment (along with hazard-measurement instruments).

Mining safety and health remain an ongoing concern of NIOSH. In 2006, the Mine Improvement and New Emergency Response (MINER) Act was enacted in the wake of the Sago Mine explosion. The MINER Act amends the Federal Mine Safety and Health Act of 1977. The act creates regulations enforceable by MSHA to improve accident preparedness and response. The act also specifies that NIOSH create an Office of Mine Safety and Health. The purpose of the office is, "to enhance the development of new mine safety technology and technological applications and to expedite the commercial availability and implementation of such technology in mining environments." The office is to achieve this purpose through competitive grants, contracts, and by establishing an interagency working group for mine safety.

Through the legislative authorities that underpin NIOSH, Congress has set a clear division between the research function of NIOSH and the regulatory and enforcement functions of MSHA and OSHA. Although NIOSH works together with MSHA and OSHA to achieve the common goal of protecting worker safety and health, NIOSH simultaneously maintains its unique identity as the sole Federal government organization primarily charged to conduct occupational safety and health research.

Mission and Values

To meet the challenges of occupational safety and health, NIOSH is guided by its mission to provide national and world leadership to prevent work-related illnesses and injuries.[9] In carrying out this mission, NIOSH adheres to a core set of values:

- Relevance – Our programs are responsive to the occupational safety and health problems that are found in today's workplaces and the workplaces of tomorrow.
- Diversity – Our employees reflect the full spectrum of diversity found in the U.S. workforce and our research and interventions reflect the diversity of solutions needed for the U.S. workplace.
- Quality – We utilize only the best science, the highest level of data quality, and the most transparent and independent peer-review.
- Partnership – We accomplish our mission in partnership with employers and workers as well as in academia, industry, government, and scientific and professional communities, both nationally and internationally. These partnerships are formed strategically to improve planning, execution, and review of NIOSH research. They also help translate and transfer research outputs to the workplace.
- Access – Our customers can obtain all NIOSH products and services through expanded traditional and electronic access.
- Performace – Our programs are results-oriented.
- Accountability – Our programs are evaluated by how ell they solve the occupational safety and health problems found in today's workplaces and the workplaces of tomorrow .[10]

Organization and Management

NIOSH is now part of the Centers for Disease Control and Prevention (CDC) in the U.S. Department of Health and Human Services (DHHS). The NIOSH Director is appointed by the DHHS Secretary and reports to the CDC Director. DHHS has recently implemented performance-based management, in which management responsibilities cascade through the administrative structure. Thus, each manager has formal responsibilities written into his or her performance plan specifically tailored to support the responsibilities of others higher in the management chain. Under this system of management, responsibilities ultimately derive from priorities established by the Office of Management and Budget (OMB), a component of the White House.

The administrative structural components of NIOSH are shown in Figure 1. The main organizational units are divisions and laboratories. These are a mixture of disease and injury-specific divisions (safety research, respiratory diseases), expertise-specific divisions (applied research and technology, laboratory research, surveillance and field studies, education and information dissemination), and industry-specific units (mining). The divisions and laboratories are geographically dispersed in Cincinnati, Morgantown, Pittsburgh, and Spokane. NIOSH leadership is located in Washington, D.C. and Atlanta. To coordinate across these geographically dispersed units, NIOSH makes extensive use of modern information technology, including e-mail and video conferencing.

Beginning in 2005, NIOSH developed and implemented a matrix management structure to coordinate cross-Institute programmatic activities. This Program Portfolio created formal management for such activities.[11] One of the cross-Institute activities within the matrix management structure is the Cross-Sector Traumatic Injury (TI) Research Program, which will be described in more detail in the next section. The matrix management structure of the NIOSH cross-Institute Program Portfolio is depicted in Table 1.

NIOSH is committed to performance-based management and has recently developed several key indicators to track organizational performance. Examples include tracking financial performance by establishing and monitoring the percent of total funding to divisions/laboratories used for discretionary purposes (i.e., not personnel, salary, and benefits). The NIOSH target is 25 percent discretionary by 2010. The FY 2006 ratio was 20 percent. Another example is optimizing the ratio of supervisory staff to non-supervisory staff. CDC established a FY 2006 goal of 1:10. In FY 2006, the NIOSH ratio was 1:13.

NIOSH management occurs within the context of broader Federal management requirements and initiatives. The 1993 Government Performance and Results Act (GPRA)[12] mandated that Federal agencies develop multiyear strategic plans, annual performance plans, and annual performance reports.

Another management requirement is responsiveness to the OMB Program Assessment Rating Tool (PART) (A1-2)[13] used by OMB to assess Federal agency performance on measures including strategic planning, program management, and results. PART performance ratings are an important consideration in budget requests by the President. Current NIOSH key performance measures for PART, established in 2004, target the following safety and health-focused achievements by 2014 (note that two of the three are relevant to traumatic injuries):

- 50 percent reduction in the respirable coal dust overexposures of operators of longwall and continuous mining machines, roofbolters, and surface drills
- 40 percent reduction in the number of workers being struck by construction vehicles and equipment in the road construction industry, and
- 75 percent of professional fire fighters and first responders have access to CBRN respirators.

A PART planning performance measure requires targeting 95 percent of new research to the areas of occupational safety and health most relevant to future improvements in workplace protection by 2009, as judged by independent panels of external customers, stakeholders, and experts. Finally, a PART training performance measure requires that 80 percent of companies employing those with NIOSH training rank the value added to the organization as good or excellent, and that 15 percent of practicing health and safety professionals have academic or continuing education training by 2009.

NIOSH receives external guidance and advice from two Federal Advisory Committees. The Board of Scientific Counselors (BSC)[14] is composed of external authorities from a variety of fields related to occupational safety and health. The BSC members provide advice and guidance to NIOSH in developing and evaluating research hypotheses, systematically documenting findings, and disseminating results that will improve the safety and health of workers. They also evaluate the degree to which NIOSH activities:

1. Conform to standards of scientific excellence in accomplishing objectives in occupational safety and health
2. Address currently relevant needs in the field of occupational safety and health, either alone or in collaboration with activities outside of NIOSH, and
3. Produce their intended results in addressing important research questions in occupational safety and health, both in terms of applicability of the research findings and dissemination of the findings.

The Mine Safety and Health Research Advisory Committee performs a similar function, except it is focused on issues related to occupational safety and health in mining.

Another source of external input is the National Advisory Committee on Occupational Safety and Health (NACOSH).[15] NACOSH was created under Section Seven of the Occupational Safety and Health Act of 1970 to advise NIOSH and OSHA on occupational safety and health programs and policies. Members of the 12-person advisory committee are chosen on the basis of their knowledge and experience in occupational safety and health. Two members represent management, two members represent labor, two members represent the occupational health professions, two members represent the occupational safety professions and four members represent the public. Two of the health representatives and two of the public members are designated by the Secretary of Health and Human Services, although actual appointment of these members, as well as all other members, is by the Secretary of Labor. The members serve two-year terms. NIOSH and OSHA provide staff support for NACOSH. The Director of NIOSH and the Assistant Secretary of Labor for Occupational Safety and Health both usually attend NACOSH meetings. It is not only a vehicle for external input for the agencies but also a body to whom the agencies must be responsive. NACOSH meetings are held twice each year and are open to the public.

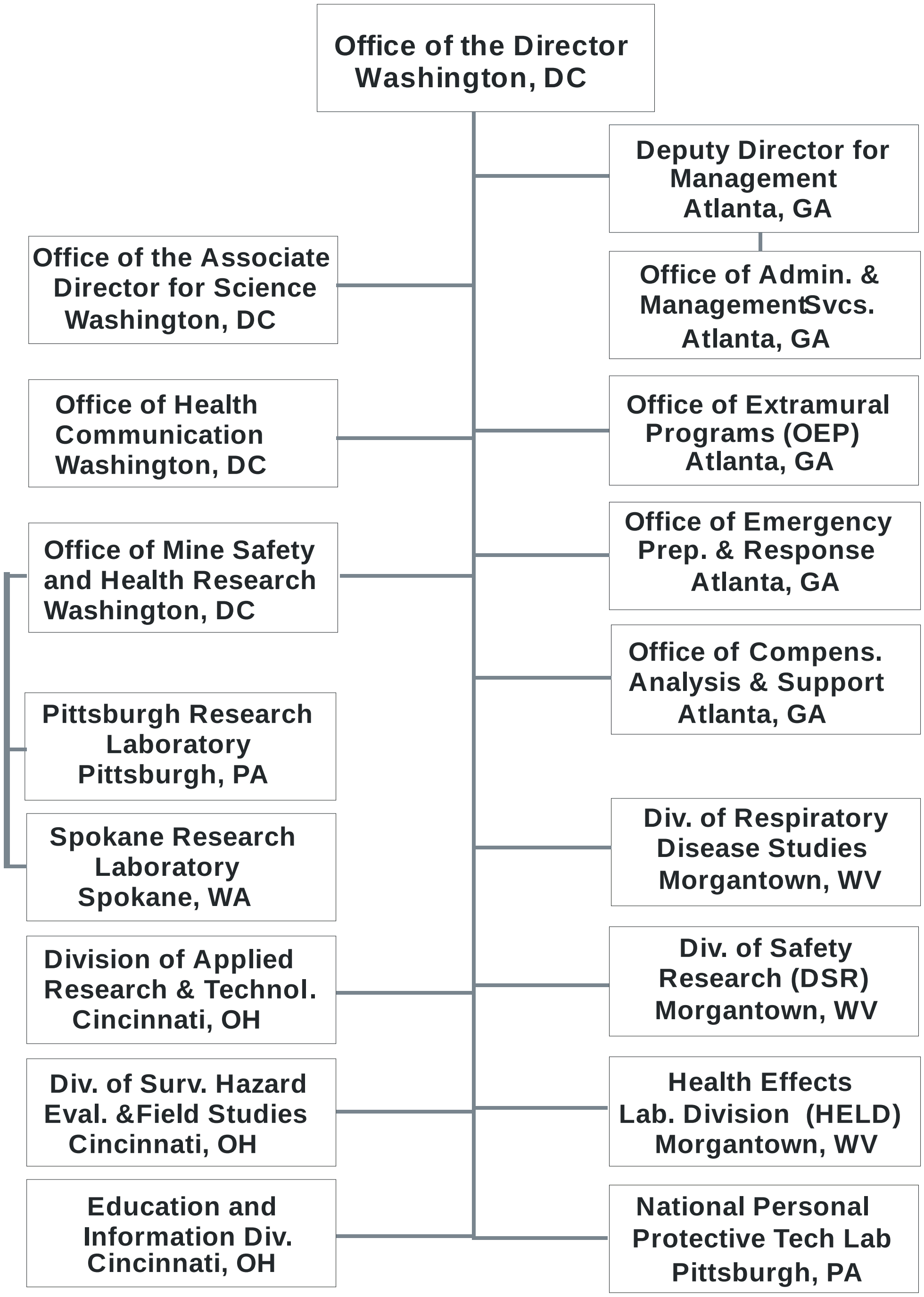

Figure 1: Organizational Components of NIOSH

Table 1: Matrix Management Components of NIOSH Program Portfolio.[13]

NORA Sector Programs	NIOSH Cross-Sector Programs	NIOSH Coordinated Emphasis Areas
Agriculture, Forestry and Fishing	Authoritative Recommendations	Economics
Construction	Cancer, Repro and Cardiovascular	Exposure Assessment
Healthcare and Social Assistance	Communications and Information Dissemination	Engineering Controls
Manufacturing	Emergency Preparedness/Response	WorkLife Initiative
Mining	Global Collaborations	Occupational Health Disparities
Services	Health Hazard Evaluation (HHE)	Small Business Assistance and Outreach
Wholesale and Retail Trade	Hearing Loss Prevention	Surveillance
Transportation, Warehousing and Utilities	Immune and Dermal	
	Musculoskeletal Disorders	
	Personal Protective Technology	
	Radiation Dose Reconstruction	
	Respiratory Diseases	
	Training Grants	
	Traumatic Injury	
	Work Organization and Stress-Related Disorders	

Resources

The NIOSH budget is a direct appropriation from Congress, as a specific line item in the DHHS/CDC appropriation. The Congressional language which accompanies the funding appropriation often contains specific directives about the intended use of portions of the funds. These directives—or "earmarks"—instruct NIOSH to use specific portions of the funds to conduct research which targets certain industries such as agriculture or construction, or specific populations, such as young workers or fire fighters; or supports research or surveillance initiatives such as the National Occupational Research Agenda (NORA), Emergency Preparedness, the DOE special exposure cohort study, or the enhanced coal workers' health surveillance program.

In addition, NIOSH may be charged by Congress or DHHS to lead or participate in evolving public health activities such as the World Trade Center health surveillance efforts. Prior to Fiscal Year 2006, the CDC tapped a portion of the NIOSH budget to offset the cost of administrative and infrastructure support provided by the CDC and to fund the NIOSH portion of costs associated with business consolidations established under the President's Management Agenda.[16] Beginning in 2006, Congress moved the charges associated with business support services from the NIOSH appropriation and directly to the CDC (approximately $35 million). Continuing "earmark" obligations, coupled with escalating personnel costs and projections of diminished appropriations, create significant challenges as NIOSH strives to fulfill its mission and optimize its impact on occupational safety and health problems.

In Fiscal Year 2006, $255 million was appropriated for NIOSH. Table 2 shows NIOSH funding for the years 1996 through 2006, with adjustments for inflation and application of the biomedical research index. (Note that funding targeted to the World Trade Center Response discussed in Chapter 10 is not reflected in these figures.) The reduction between 2005 and 2006 reflects costs to NIOSH of CDC business consolidations. After adjustment of funding for the Biomedical Research and Development Price Index,[17] which adjusts not only for inflation but also for increased costs of conducting scientific investigation due to new technologies, etc., NIOSH has had only a modest increase in funding since 1996. Essentially all of the increase is the result of funding earmarked for NORA priorities.

Table 2: NIOSH Budget, 1996 – 2007

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Budget (in millions)	$161	$173	$184	$204	$226	$260	$276	$273	$277	$286	$255*	$253
Adjusted (BRDPI)**	$161	-	-	-	$199	$221	$227	$217	$212	$211	$182	-

** In 2006, Congress redirected $35M from the NIOSH budget appropriation to CDC for Business Support Services.*
*** NIH-Biomedical Research and Development Price Index (BRDPI).[17] Figures shown as millions of 1996 dollars.*
- Data not provided to allow calculation of index: http://officeofbudget.od.nih.gov/UI/GDP_FromGenBudget.htm

The NIOSH staffing level is approximately 1,414 Full-Time Equivalents (FTE). This level has fluctuated over the past decade from a low of 1364 FTE in 1996 to a peak of 1521 FTE in 2003 and then a subsequent steady decline to the current level. The increases leading to the peak in 2003 can be attributed, in part, to NIOSH absorbing the research teams of the former U.S. Bureau of Mines (USBM) and the establishment of a new Health Effects Laboratory Division (HELD) and National Personal Protection Technology Laboratory (NPPTL). A breakdown of NIOSH research staff by professional discipline is shown in Figure 2.

NIOSH has a long history of organized planning to optimize its relevance and impact. During the 1980s, NIOSH conducted two national symposia on the leading causes of occupationally-related illness and injury. Those meetings resulted in 10 written strategies for prevention that guided NIOSH research programs during the early 1990s (including severe traumatic occupational injuries).[18-27]

In April 1996, NIOSH and its partners unveiled NORA, a framework to guide occupational safety and health research into the new millennium—not only for NIOSH but for the entire occupational safety and health community.[28] Approximately 500 organizations and individuals outside NIOSH provided input into the development of NORA. The NORA process resulted in a list of 21 research priorities (including traumatic injuries) in occupational safety and health.[29] Teams of researchers and other stakeholders were organized primarily according to types of health problems or disciplinary approaches for each of these priority areas. Many of the teams published agendas for research. NIOSH researchers were prominent in those efforts.

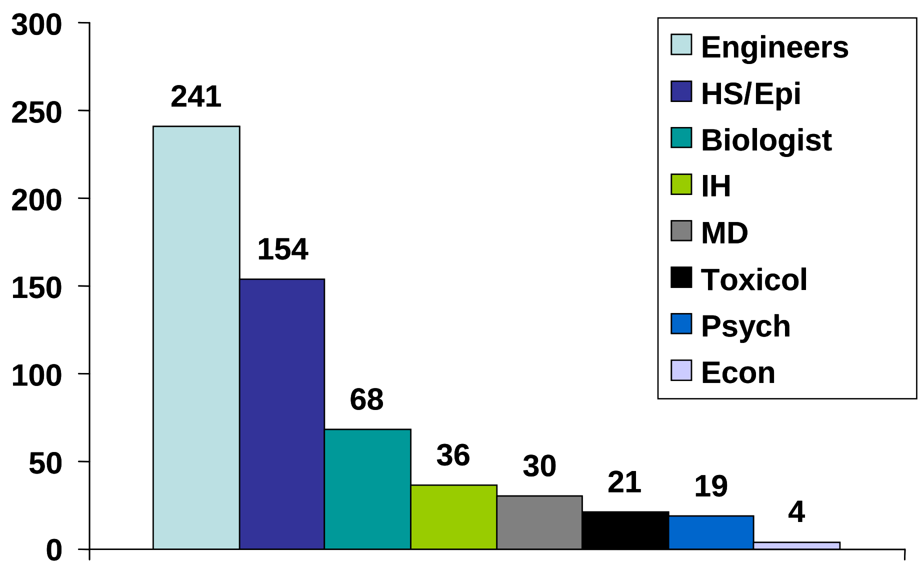

Figure 2: NIOSH Research Staff by Professional Discipline.

Planning and Logic Model

During the NORA process, NIOSH developed a strategic plan from 1997 and followed it until 2002.[30] A new plan was developed for 2004 to 2009.[10] The strategic goals of this plan are to:

Goal 1: Conduct research to reduce work-related illnesses and injuries.

- Track work-related hazards, exposures, illnesses and injuries for prevention.
- Generate new knowledge through intramural and extramural research programs.
- Develop innovative solutions for difficult-to-solve problems in high-risk industrial sectors.

Goal 2: Promote safe and healthy workplaces through interventions, recommendations, and capacity building.

- Enhance the relevance and utility of recommendations and guidance.
- Transfer research findings, technologies, and information into practice.
- Build capacity to address traditional and emerging hazards.

Goal 3: Enhance global workplace safety and health through international collaborations.

- Take a leadership role in developing a global network of occupational health centers.
- Investigate alternative approaches to workplace illness and injury reduction and provide technical assistance to put solutions in place.
- Build global professional capacity to address workplace hazards through training, information sharing, and research experience.

NORA has recently been updated to address the needs of another decade.[31] The second decade of NORA is being organized to prepare research agendas primarily along the lines of major industrial sectors. As was the case in the initial NORA process, research agendas are being developed with broad involvement and input from all parties with an interest in occupational safety and health. This renewal for NORA is intended to bring NIOSH even closer to the problems of U.S. industries and workers.

NIOSH has developed an operational logic model to assure that its strategic planning activities are logical and appropriate, and that they optimize NIOSH relevance and impact (Figure 3). The logic model formally depicts the NIOSH operational process. It moves from left to right across the chart, beginning with production and planning inputs. Those inputs lead to NIOSH research activities. The outputs of NIOSH research activities lead to customer activities. Some NIOSH customers are intermediaries who use or adapt NIOSH outputs before they reach the final customers: employers, employees, industries, educators, and regulators. Their actions help NIOSH to contribute to the improvement of safety and health in the workplace. This process is affected by a variety of external factors including economic and social conditions and the regulatory environment.

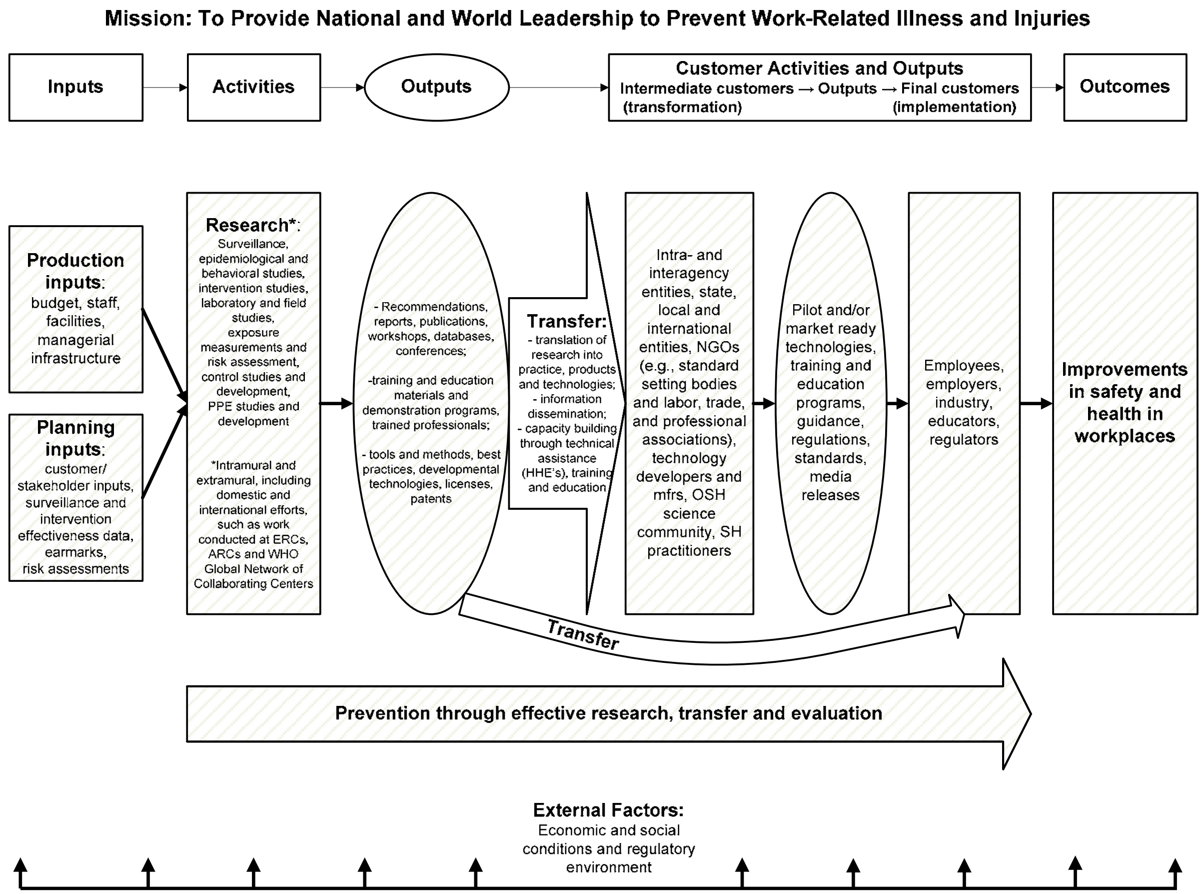

Figure 3: The NIOSH Operational Logic Model.

A brief discussion of logic model elements follows.

Planning inputs are data that guide NIOSH to research action. Many sources, in addition to NIOSH sources, build these data summaries. They come from workplaces, surveillance, risk assessments, intervention effectiveness data, and from the Institute's stakeholders and customers. One of the major planning activities for NIOSH is the collection, analysis, and interpretation of illness, injury, fatality, exposure, and hazard data for those purposes. NIOSH actively engages in surveillance to obtain data that can guide its efforts. The NIOSH Worker Health Chartbook,[32] now in its second edition, is an important source of occupational health surveillance data.

An often-overlooked issue is that inputs are not only used to determine which activities should occur, but also which activities should not occur because they have been completed, have become lesser priorities, or have otherwise outlived their usefulness.

Activities encompass a broad range, including many types of research, field investigations of workplaces, surveillance, policy development, and health communications. More than 1,000 active research projects are being conducted at NIOSH by researchers in a broad array of disciplines, including (but not limited to): behavioral scientists, biologists, chemists, economists, engineers, epidemiologists, toxicologists, etc. In broad terms, these projects encompass a diverse set of areas, such as:

- Performance of research—both laboratory- and field-based research; both intramural and extramural; both domestic and international
- Development of practical hazard controls and other workplace interventions, testing them, and when they are effective, promoting their adoption in the workplace
- Development and testing of personal protective equipment
- Development of environmental sampling and testing methods,
- Field investigations of injuries, fatalities, and workplace hazards.

An example of the latter activity is the Health Hazard Evaluation (HHE) Program.[33] Under Section 20 of the Occupational Safety and Health Act of 1970, NIOSH performs inspections and investigations into workplace hazards. This activity frequently results in development of research knowledge that is beneficially applied in the workplace. All programs contribute to this effort, and a broad range of expertise is required. The goal is to assist employers and employees by evaluating and recommending solutions to workplace safety and health issues. Typically between 300 and 500 HHE requests are received annually. HHE reports are available to other customers and stakeholders.

Another NIOSH activity in a similar vein is represented by two programs in fatality investigations, both a part of the TI Research Program—one which investigates selected fatalities among all groups of workers, and another which investigates line-of-duty fatalities among fire fighters. The former program, known as the Fatality Assessment and Control Evaluation (FACE) Program,[34] currently focuses on deaths of workers under 18 years of age, deaths of Hispanic workers, deaths in roadway construction work zones, and deaths involving machinery. In addition to the in-house program, a State-based program is currently active in nine States. In both programs, investigators assess the circumstances surrounding each fatality to formulate strategies to prevent future similar deaths. Plans are then designed to disseminate those strategies. The fire fighter fatality investigations seek causal information for deaths from trauma (fire ground deaths, motor-vehicle deaths, etc.) and from line-of-duty cardiovascular events.[35] Reports and alerts, with risk information and prevention recommendations are then distributed widely to the fire service.

Another activity supported by NIOSH is training of occupational safety and health professionals. NIOSH-supported training prepares professionals in occupational safety and health and also serves the function of transferring NIOSH research into the workplace. NIOSH developed university-based Education and Research Centers (originally named Educational Resource Centers) in 1977 to meet the needs for trained safety and health professionals.[36] NIOSH currently funds 16 Education and Research Centers at leading universities to provide graduate and continuing education programs in occupational medicine, occupational health nursing, industrial hygiene, safety, engineering, epidemiology, and other related disciplines. These centers also serve as regional resources for all those involved with occupational safety and health including industry, labor, government, academia, and the general public. The centers are funded for up to five years through a competitive peer-review process. NIOSH also supports approximately 40 smaller training project grants that are also focused on providing qualified professionals for the field.

Outputs and Transfer: A principal activity of NIOSH is research, and the desired result of research is new knowledge. New knowledge serves society by providing practical guidance on matters of importance to the population. Research programs are obligated to contribute to the advancement of society by integrating this new knowledge. NIOSH carries out the responsibility to disseminate results of its research with a variety of outputs such as reports, publications, recommendations, workshops, databases, tools and methods, training and education materials, demonstration projects, best practices, developmental technologies, and licenses and patents.

Efforts to maximize the impact of NIOSH outputs through effective transfer to customers are coordinated by the Office of Health Communications (OHC). The NIOSH OHC works with each research program to plan and execute communications strategies designed to reach a variety of customers for those outputs. Customers include employers and their groups, employees and their groups, standards-setting organizations, professional associations, and the general public. NIOSH researchers publish in peer-reviewed publications and present their work at conferences. They also publish NIOSH documents and other information products. The NIOSH Publications Office stocks more than 4,200 NIOSH document titles. It distributed nearly a million printed publications and CD-ROMs in 2003. A survey of four occupational safety and health professional organizations indicated that NIOSH is effectively reaching several of its intended audiences with credible and useful information.

A special kind of output is NIOSH documents, testimony, and other communications on criteria for recommended standards for safety and health hazards in the workplace. These criteria represent the formal link between NIOSH and OSHA or MSHA, and between research and rule-making.

Since its inception, NIOSH has been strongly committed to transferring its outputs to customers. In recent years, this effort has been enhanced by newer electronic media. NIOSH has a Website that supports approximately 500,000 user sessions (and about 2.8 million page views) per month.[37] NIOSH also operates a technical information inquiry service that includes an 800 number and an Internet inquiry response service.[38] In FY 2003, NIOSH responded to more than 100,000 inquiries by phone and almost 3,800 by Internet.

In 2004, NIOSH created an Office of Research and Technology Transfer to provide formal administrative support for the concurrently developing NIOSH Research-to-Practice (r2p) Initiative.[39] The office and r2p policies help ensure that NIOSH considers these issues in making funding decisions and that NIOSH researchers consider issues such as translating their research findings into best practices, products, and technologies and transferring knowledge and products to those who can implement them in the workplace. A key to the r2p process is involving appropriate partners at the appropriate stages of research projects.

Outcomes: As NIOSH research is transferred, the Institute often moves into more dependent partnerships with others and has less control of what happens. The resources required to produce an effect are less predictable, the outcomes are less certain, and the results harder to verify. These partners include employers, labor and industry groups, and regulatory bodies. In addition, there are manufacturers who adopt new NIOSH technologies as products for the marketplace, or help develop them further. These customer activities and outputs are crucial to NIOSH having real-world impact. Influencing and motivating the actions of others may result in **intermediate outcomes**.

It is often difficult to effectively trace the NIOSH contribution to reductions in morbidity or mortality due to occupational injuries or diseases, or **end outcomes**. Many groups contribute to reducing occupational injuries and illnesses and to creating safer places to work. Still, NIOSH is strongly committed to developing objective measures of its real-world performance. If the best measures of performance relate to motivating and enabling others to make work safer, this in no way diminishes the importance of the accomplishment.

IV. Overview of Traumatic Injuries (TI) Research Program

Background: Traumatic Occupational Injuries

According to U.S. Bureau of Labor Statistics (BLS) data for 2005, there were 5,702 occupational fatalities in the private-sector, an average of 15 per day.[40] In 2005, there were also 4.2 million nonfatal injuries and illnesses in the private-sector.[41] The Liberty Mutual 2005 Workplace Safety Index estimated that employers spent $50.8 billion in 2003 on wage payments and medical care for workers hurt on the job.[42] Although recent decades have exhibited steady reductions in the numbers and rates of traumatic occupational injuries and fatalities (see Figure 4, for example), the toll remains far too high. The NIOSH TI Program is the Federal program with the mission of reducing this toll through research, collaboration, and knowledge transfer.

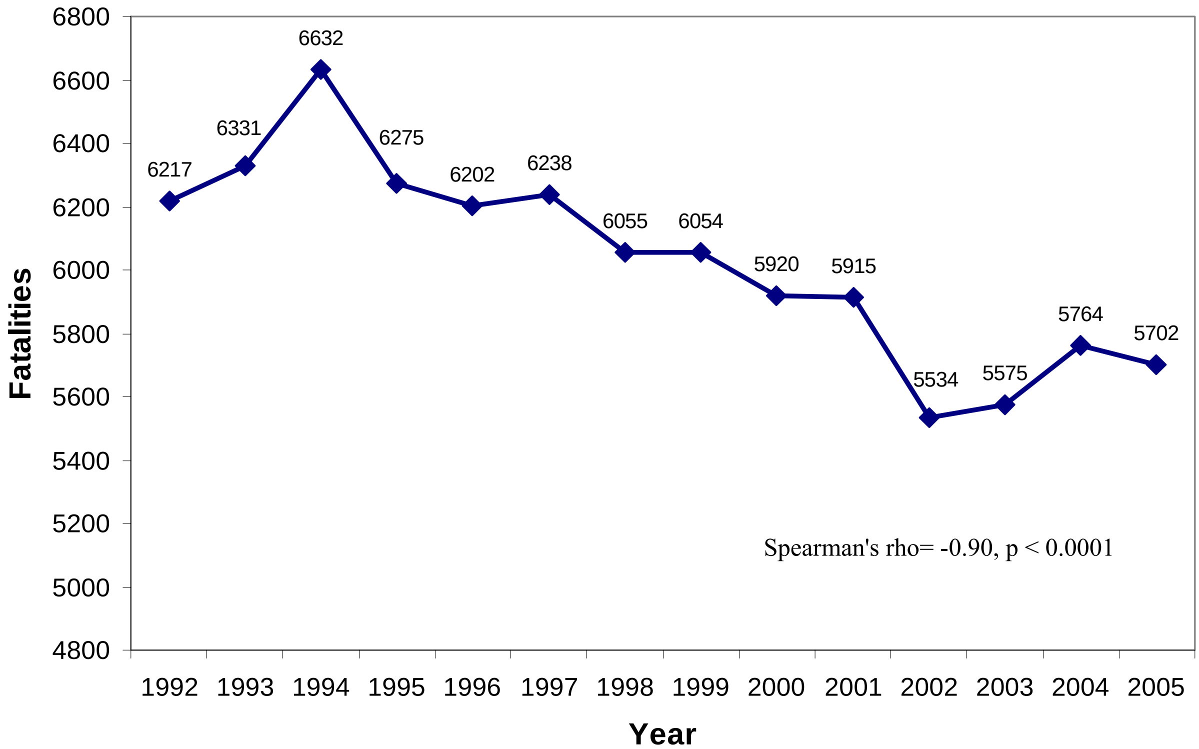

Figure 4. Number of Fatal Work Injuries, United States, 1992-2005.

Brief History of the NIOSH TI Research and Prevention Program

In the 1970s, NIOSH safety research efforts emerged slowly, partly because the Institute was initially organized along the lines of a predecessor—the Bureau of Occupational Safety and Health (BOSH)—that leaned more toward the study and prevention of occupational illnesses.[43]

Early project-level TI prevention research and communication activities were not centrally managed, but dispersed throughout a handful of NIOSH divisions, branches, offices, and laboratories. In 1971, NIOSH hired A.D. Little, Inc. to survey the safety research literature, identify the gaps, and develop a list of safety research priorities. The contractor reported that the status of occupational safety research was "limited" in the areas that NIOSH considered within its scope (i.e., research into the development of criteria and standards, and research in areas related to psychology, behavior, motivation, engineering, equipment, and education).[44] Substantial research was being done by other agencies in areas that NIOSH had already decided to exclude from consideration—i.e., mine safety and highway traffic safety.[44]

The contractor developed an algorithm for prioritizing research topics, based upon need, potential success, and cost. When contractor staff members tested the algorithm on a sample list of research topics, they concluded that the scheme was "workable, although factual data on incidence and severity is difficult to obtain from available statistics."[44] This lack of data prompted A.D. Little to conclude that one area where additional occupational research was needed could be labeled "accident causative factors, accident investigations and statistical studies."[44] With inadequate injury and fatality data, more weight was given to the opinions of safety professionals in the identification of safety research priorities. Resulting occupational safety research priorities included studies of company incentives and other reinforcement and punishment methods in safety, risk taking behavior of workers, worker motivation regarding the use of protective equipment, management practices, the economics of safety, overexertion injuries (especially related to lifting and moving objects), falls, "struck by" and "caught in" injuries related to machines, and "struck by" vehicle injuries.[44]

Early on, the Institute focused primarily on studying toxic exposures and health concerns, and providing criteria for OSHA health standards.[45] Even in 1973, the NIOSH safety engineering program was described as "a small research effort,"[49] although "initial steps were taken to establish a NIOSH occupational safety research laboratory."[45]

A handful of productive TI-related programs were in operation during the early 1970s, including a program involving the testing of personal protective equipment (PPE). This program originated in the U.S. Department of Interior's (DOI) Bureau of Mines (USBM) in 1919, but a series of legislative actions and governmental reorganizations, including the OSH Act, brought the program, which focused mainly upon respirator performance testing, to NIOSH. Also during the 70s, another NIOSH program incorporated industry-specific hazard, injury prevention, and health information into small, lay-oriented manuals called health and safety guides (HSGs). All told, 56 HSGs were prepared and distributed within the targeted industries during the 1970s. Two other NIOSH groups were organized to: 1) study the contribution of behavioral and motivational factors to occupational TI and health risks, and 2) provide injury prevention technical assistance and consultative services to government and industry.

Here are some "firsts" in the NIOSH TI effort:

- A 1974 gathering entitled Occupational Safety Research Specifically Related to Personal Protection—A Symposium was described as "the very first NIOSH Symposium devoted to occupational safety research."[46]

- In 1975, one of the first published NIOSH technical reports specifically and solely covering a safety topic (machine safety) was "believed to be the first organized effort to assess the relative hazard levels of currently used machines in the United States."[47]

- In 1976, the first Criteria Document focusing strictly on safety—"Criteria for a recommended standard…Logging from Felling to First Haul"[48]—was published by NIOSH. (Other safety-related CDs were subsequently published,[49,50] but injury topics in general continued to take a back seat to health-related CDs and other types of NIOSH publications throughout the 1970s.)

- Finally, in 1977, the first division-level focus on TI research in NIOSH—the Division of Safety Research (DSR)—was established as part of ALOSH in Morgantown.

Although other divisions and laboratories within NIOSH continued to include some efforts focusing on traumatic injury risks and prevention, particularly the divisions which focused upon surveillance, protective technology (general and personal), and education and communication, DSR became the central location of the NIOSH TI Research Program.

TI Strategic Planning and Program Direction from 1979 through 1995: Laying the Foundation

The first published program plan for DSR was for Federal Fiscal Year 1979.[51] Nearly 70 employees (55 civil servants and 12 commissioned corps officers) staffed the division at that time. The program addressed traditional high priority areas, such as falls from elevation (scaffolding and handrail design), machines (safeguarding metal-cutting lathes and power presses), and low-back injuries (assessing countermeasures), along with a variety of miscellaneous efforts such as studies of warning devices, signs, and labels; explosives and pyrotechnics; the safety functions of occupational health nurses, and so on. A project aimed at development of an accident investigation methodology is noteworthy as a precursor to the Fatal Accident Circumstances and Epidemiology (FACE) Program initiated in 1982. (FACE was later renamed "Fatality Assessment and Control Evaluation," due to the undesirable connotation that "accidents" are random, unpredictable, and therefore unpreventable events.)

In a 1979 article in *Professional Safety*, managers of the Division of Safety Research described the NIOSH Strategy for occupational safety research.[52] The authors pointed out barriers to scientific advances in occupational injury research and recommended the development of a national surveillance database to identify research needs and track progress, increased evaluation of effectiveness (including cost effectiveness) of hazard control strategies and techniques, establishment of technology transfer mechanisms, and increased coordination and collaboration with other agencies. Although the article does not mention epidemiology or public health, it clearly expresses the need for improved surveillance, evaluation, dissemination and technology transfer, and collaboration.

In the program plans for FY 1980, the NIOSH Director outlined a shift of emphasis across the Institute toward more field studies, epidemiology studies, and surveillance studies.[53] Funding was provided for initiating new Institute projects in five areas, including safety hazards. As mentioned previously, the earliest TI research priorities in NIOSH were based not upon injury and fatality data (which was inadequate), but upon the opinions of safety professionals obtained via surveys. Managers of the TI Program in the new division, however, decided to focus their attention and the resources they were allocated upon the "types of accidents that contribute most to workers' compensation costs."[53] This "data-driven" approach prefigured the current TI approach, which relies heavily upon injury and fatality data for identifying problems and setting priorities. The top seven TI Program priorities in 1979 included types of injuries ("falls from elevations," "caught-in injuries," "overexertion injuries," and "struck-by injuries") which were generally very costly due to their severity and sometimes chronic effects. High priority was also given to both “injury epidemiology” and “technology transfer.”[68]

Under the heading of “Injury Epidemiology” was the item “report on feasibility of using death certificate data for safety studies.”[53] The idea of using death certificate data for national occupational fatality surveillance became a reality a few years later with the development of the National Traumatic Occupational Fatalities (NTOF) surveillance system.

At the same time the TI Program was changing its focus toward increased surveillance, epidemiology and field studies, some of the in-house, laboratory-based activities were winding down, in particular a portion of the PPE testing and certification program. Due to resource constraints, the TI Program decided to focus its PPE research upon respirators and related technologies alone, and drop the testing of other PPE gear such as industrial and fire fighter helmets; safety glasses, goggles and face shields; gloves; industrial footwear; etc.[54] Fiscal Year 1981 was the last year a project addressing these devices was part of the Institute plan, and that project was designated to “wrap up” activities in this area.[55]

In 1983, NIOSH leadership published a suggested list of “The Ten Leading Work-Related Diseases and Injuries” including “Fractures, amputations, eye losses, and traumatic deaths.”[56] An internal working group was established to develop a strategy for the control of these traumatic injuries. The strategy was finalized at a 1985 conference of more than 50 expert panelists and 450 other occupational safety and health professionals co-sponsored by NIOSH and the Associated Schools of Public Health (ASPH). By the time the “Proposed National Strategy…” had been published, the topic area had been broadened to incorporate all “severe occupational traumatic injuries.”[21] This publication was the first national-level strategy for addressing TI by means of research and prevention activity. The TI strategy outlined the use of epidemiology methods in “charting the course.”[21]

In 1987, TI leadership began developing an internal implementation strategy for the “Proposed National Strategy” for severe occupational traumatic injury. An analysis of the proposed national TI strategy and realignment of existing and creation of new TI Program areas were conducted. The set of program areas identified for the TI Program included: agriculture/pesticides, certification, chemical protective clothing (CPC), construction, dissemination, industrial machine safety, musculoskeletal injuries, personal protective equipment, respirator research, surveillance, and trauma epidemiology.[57]

This list is noteworthy because it identifies major high-risk sectors (agriculture and construction) as a focus for programmatic thinking, for the inclusion of high-risk topics such as machine safety and acute musculoskeletal injury, and a growing awareness that surveillance, trauma epidemiology, and dissemination of risk and prevention information represented major gaps in the existing TI Program. Four of the program areas (certification, respirator research, chemical protective clothing, and personal protective equipment) would be removed from the TI Program in 1996, and eventually form the functional basis for the NIOSH Personal Protective Technology program now housed in the National Personal Protection Technology Laboratory (NPPTL) in Pittsburgh.

Over the course of the next decade, in order to fill crucial shortcomings in its capacity to apply an effective public health approach to TI research, TI management would:

- Design and develop new surveillance systems to address the dearth of useful data on injuries and fatalities
- Develop a fatality investigation program and methodology to address the lack of detailed information on injury causation and prevention
- Create new organizational structures and expertise to strengthen its capacity to conduct analytic epidemiology studies and evaluation research, to study and develop protective technology applications, and to transfer TI risk and prevention knowledge and products
- Develop new approaches to collaboration and communication with the occupational traumatic injury research community.

Surveillance. As the NIOSH TI efforts were ramping up in the late 1970s and early 1980s, no system existed that enabled an actual count of fatal workplace injuries. Estimates of the number of occupational injury fatalities, published by organizations such as the National Safety Council (NSC) and the Federal Bureau of Labor Statistics varied widely. For example, the NSC estimated that there were 13,000 occupational injury deaths in 1980, whereas the BLS estimated that there were only 4,400 that same year. NIOSH concluded that: "While the difference between these two estimates is due partly to different survey populations and differences in estimation procedures, more information is needed to properly assess the true extent of occupational fatalities."[58] In Fiscal Year 1984, the National Traumatic Occupational Fatalities (NTOF) surveillance system was initiated by TI to collect "injury-at-work" death certificates, retrospective to 1980, from the State vital registrars in all 50 States, New York City, and the District of Columbia. The objective was to establish the first accurate national count of work-related deaths.

In a 1987 MMWR article, the Centers for Disease Control reported that about 7,000 workers die on the job annually, and that 42 percent of female workers who die on the job are murdered.[59] These data came from the first five years' data from the NTOF Surveillance System. This first ever count of work-related deaths from traumatic injury, and the new knowledge about the workplace violence as the leading cause of death for female workers, are considered by CDC as significant accomplishments in its 60-year history by virtue of their inclusion on the "CDC Timeline" Website.[60] In September 1989, TI published "National Traumatic Occupational Fatalities: 1980-1985."[61] This report provided data that influenced planning and priority-setting in the TI Program and nationally. For example, the NTOF data showed that fully 13 percent of the worker deaths identified for the six-year period were homicides. NTOF data was instrumental in identifying the importance of homicide as a leading cause of traumatic injury death in the U.S.

When a decades' worth of NTOF data was reported in 1993, homicide was the third leading cause of death (12 percent of total) behind motor-vehicle crashes (23 percent) and machine-related deaths (14 percent).[62]

NTOF also enabled researchers to calculate frequency and rates of TI deaths by State. Not surprisingly, the largest number of occupational TI deaths was seen in large, highly populated States such as Texas and California. However, Alaska (34.2 deaths per 100,000 workers) exhibited the highest rates of TI deaths by far.[63] This finding led to a Congressional initiative to establish the Alaska Field Station in Anchorage, Alaska in 1991 to study high-risk Alaskan industries such as commercial fishing, logging, and aviation.

In the 1990s, the BLS initiated data collection for a new surveillance system for fatal occupational injuries—the Census of Fatal Occupational Injuries (CFOI)—which eventually superseded the NTOF system.[40] CFOI, which includes data from 1992 onward, uses multiple State and Federal sources of case reports, and cross-references source documents to ensure that cases are counted as accurately as possible without duplication. NTOF, which remains the only source of fatal occupational injury data for years prior to 1992, was discontinued by TI management in 2003 after working with BLS to ensure that CFOI could adequately bridge the resultant gap.

Causation Research. Although injury and fatality surveillance systems are useful in identifying cases and provide some basic information that may suggest causation, TI Program management recognized that more detailed information is needed about the circumstances surrounding an event that results in traumatic injury death to a worker. Acquiring information about the factors associated with the victim, the task, the machines/equipment, the work environment, the company, as well as the sequence of events leading to a fatal event can lead investigators to better understand causation and recommend prevention options. The TI Fatality Assessment and Control Evaluation (FACE) Program was begun as a pilot project to fill the gap in knowledge about the causation of traumatic occupational fatalities.[54]

Initial investigations targeted confined space fatalities, electrocutions, and falls from elevation. For each area, a point in time was reached when TI recognized that investigations were not yielding new risk or prevention knowledge. At these times, TI summarized the investigative findings for each area in compendium reports[64-66] and new targets were established. Subsequent targets suggested by NTOF findings included logging, agriculture, and machines. The FACE Program has proven flexible in shifting to new targets in response to emerging issues and this flexibility has increased the responsiveness and relevance of the TI Program. For example, when analysis of surveillance data demonstrated high fatality rates among Hispanic workers, the TI Program added this high-risk population as a FACE target. The 1998 National Research Council report, "Protecting Youth at Work,"[63] as well as input from the Wage and Hour Division of the U.S. Department of Labor, prompted TI Program managers to begin investigating young worker deaths. Stakeholder encouragement to improve highway work zone safety prompted this focus as a current target.

In addition to providing more detailed, circumstantial information about fatal occupational injuries, the FACE Program has enabled researchers to detect and address clusters of similar cases in well-known hazard areas, such as falls and electrocutions in tree trimming, asphyxiation deaths in manure pits on farms, electrocutions from boomed vehicle contact with overhead power lines, and worker deaths from excavation cave-ins. FACE has also served to detect and address emerging problems. Some examples include falls through skylights in building construction and maintenance, falls from telecommunications towers, and caught-in/crushing deaths to operators of skid-steer loaders.

The FACE model is also the basis for cooperative agreements between TI and selected States (currently nine) that enable State investigators to conduct FACE investigations in their States. Additionally, the FACE model has been used as the basis for the Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) that Congress directed NIOSH TI to undertake in 1998.

The FACE Program has been a cornerstone of the TI Program, producing a steady stream of publications providing risk and prevention information. As of November 1, 2006, there were nearly 2,500 fatality investigation reports available on the TI FACE Website (http://www.cdc.gov/niosh/face/).[67] Of total investigation reports, 598 were produced by the internal TI-FACE Program, 1,557 reports were produced by the State FACE Program, and 333 were produced by the FFFIPP. The FACE and FFFIPP programs have also produced NIOSH Alerts, Workplace Solutions, and other publications that recommend prevention strategies based on findings from multiple investigations.

Analytic and Evaluation Research. In the early 1990s, the TI Program developed a strategic plan that called for the expansion of analytical epidemiology research aimed at identifying the causes of injury.[68] In a realignment of the TI Program, the Analysis and Field Evaluation Branch was created in DSR with a mission defined as "determining causes and risk factors for work-related trauma, and evaluating the efficacy of interventions through epidemiologic field studies."[69] This branch has been the focus of epidemiologic investigations of risk and causal factors associated with homicides in retail establishments. Intervention evaluation studies have included determining the efficacy of back belts and of safe patient lifting programs in nursing homes.

Protective Technology Research. As the program evolved, TI Program managers realized that the public health approach to occupational injury research and prevention would require increasing collaboration between public health researchers and practitioners (epidemiologists, biostatisticians, health information specialists, etc.) and safety analysis researchers and practitioners (engineers, ergonomists, industrial hygienists, safety specialists, etc.). Although the new knowledge generated by surveillance, investigations, and analytic epidemiology was valuable, a critical gap remained in the quest for workplace impact—researchers in the safety analysis disciplines were needed to identify or develop, analyze, and evaluate protective interventions. The TI multidisciplinary approach also involved a focus upon the "hierarchy of controls"—giving higher priority to "engineering out" the hazards through design modification or intervention controls than to approaches that require behavior changes by the workers or reliance upon personal protective equipment.

In 1993, when NIOSH was planning for a new laboratory facility in Morgantown, TI developed a protective technology research plan, which largely focused upon the programs it still managed in respiratory testing, certification, and research; and chemical protective clothing (CPC).[70] In addition to those programs, which were relocated a few years later, the plan proposed addressing traditional traumatic injury hazards with high technology approaches to research and prevention. The plan included concepts such as using virtual reality to study falls from elevation and using 3D scanning technology to collect anthropometric data on worker populations. Many of the current TI laboratories and protective technology research activities have evolved from that plan and the laboratories that were subsequently designed and built within the new and renovated facilities.

Dissemination and Transfer. In the mid-1980s, TI began to take a broader, more proactive, and targeted approach to disseminating program outputs. Strategic dissemination stressed identification and communication with potential constituencies and audiences early in the planning process. TI recognized that publishing research results in peer-reviewed journals should not be the sole output of a project. New knowledge about workplace risk and prevention must be disseminated broadly in products that are useful and meaningful to those who can take preventive actions. Aside from publishing findings in peer-reviewed journals, typical NIOSH dissemination at the time consisted of mailing copies of each new NIOSH publication to a standard list of "Friends of NIOSH," approximately 1,000 individuals and organizations.

The strategic approach to dissemination placed emphasis on identifying target worker and employer audiences and the organizations that represented them, developing custom mailing lists for each publication, and sending customized cover letters that outlined what individuals and specific organizations could do to address and implement prevention recommendations. Certain comprehensive mailing lists were obtained and used multiple times, such as a list of agricultural extension agents and of professional and volunteer fire departments. The current NIOSH Research-to-Practice initiative[39] originated in a TI proposal to develop even more systematic ways to transfer prevention information and influence its adoption in the workplace.

TI Strategic Planning and Program Direction from 1996 through 2007: Ensuring Relevance and Impact

The TI Program conducts applied public health research to make workplaces safer by identifying, developing, and evaluating strategies for preventing traumatic occupational injuries. As the only Federal program charged with the responsibility of conducting research to prevent occupational injuries, the NIOSH TI Program extends to every industry sector and every working man and woman in the nation. The breadth and complexity of this responsibility, coupled with the resources allocated to it, require a systematic and strategic approach to planning, prioritizing, conducting, and transferring research in order to maximize its relevance and impact. The TI Program Operational Logic Model (Figure 5) depicts the TI Program's systematic approach.

This logic model is based upon the NIOSH Operational Logic Model. The program **inputs** include production inputs (e.g., funding, staffing, physical infrastructure, management structure, and planning and evaluation processes), and planning inputs (e.g., injury and fatality data, the public health framework, strategic plans, legislative mandates, and stakeholder input).

Program efforts run the gamut of public health **activities**—from surveillance to causal research, from prevention strategy development to intervention evaluation, and from dissemination to technology transfer.

Outputs include a range of products such as:

- Peer-reviewed and trade journal articles
- A variety of NIOSH publications
- Presentations and exhibits at conferences and workshops
- Press releases
- New designs for products, practices, and technologies
- Recommendations for improved standards.

TI Program data, findings, recommendations, and direct staff participation have contributed to **end outcomes**, including reductions in specific types of traumatic occupational injuries and fatalities.

Data, findings, recommendations and direct staff participation have also contributed to **intermediate outcomes**, including:

- Promulgation of new standards and guidance issued by various standards-setting agencies
- Direct compliance or inspection activities by agencies with specific jurisdictional authority
- Development of new or modified products featuring improved safety-enhanced design
- Acquisition and use of new equipment and products
- Adoption of safe work procedures
- Increased awareness of TI risks and prevention options

- Increased research and subsequent research publication by other researchers and research organizations

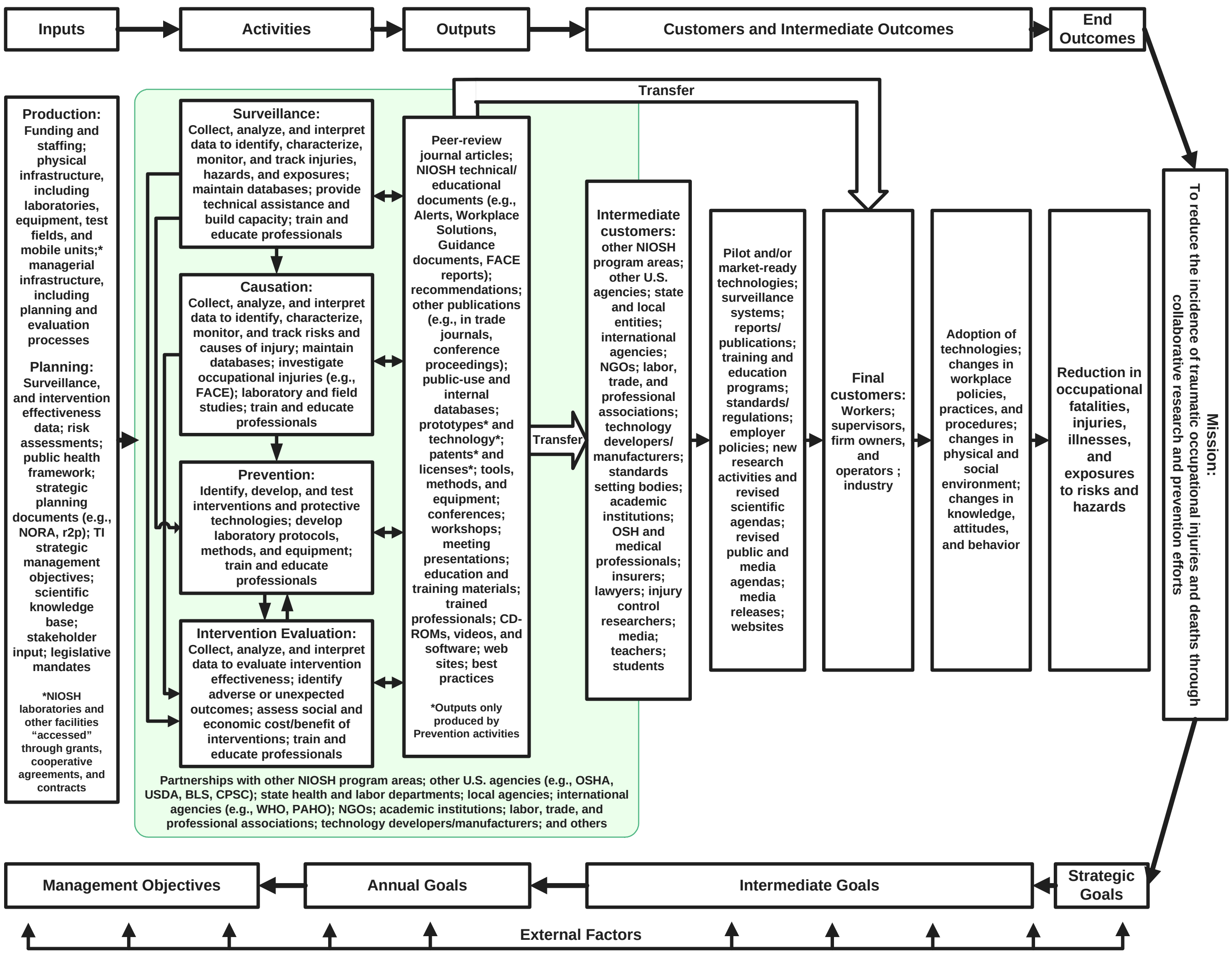

Figure 5. The TI Program Logic Model

Production inputs

Funding. Figure 6 shows the intramural and extramural funding for the TI Program. Over the course of the evaluation period (1997 to 2005), funding allocated to the eight goals increased from $8.7 million in Fiscal Year 1997 to $17.4 million in FY 2005, peaking at $18.8 million in 2002. Table 3 presents the TI budget for each of the eight research goals for each year from 1997 through 2005. The table also shows the relationship between intramural and extramural spending for TI research and the intramural Full-Time Equivalent (FTE) staff allocations.

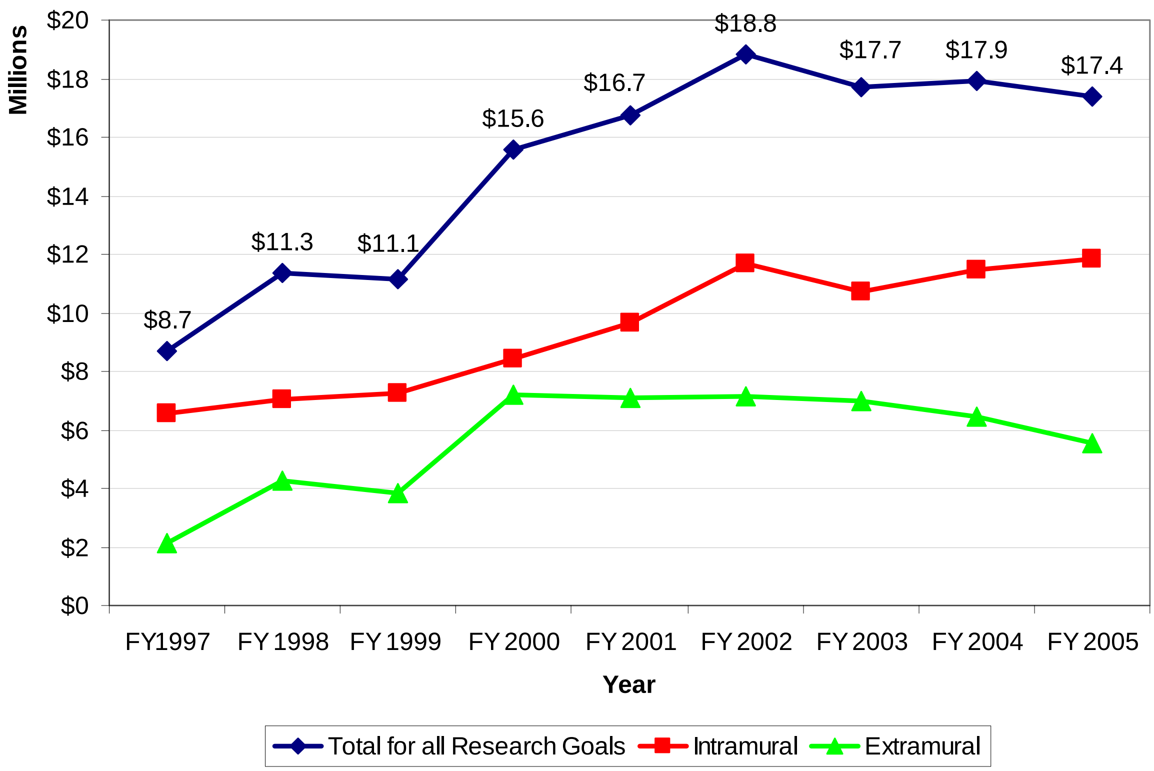

Figure 6. Total, Intramural, and Extramural Funds for the 8 TI Research Goals, 1997-2005

Staffing. The core group of research scientists, engineers, and technical support staff for the TI Program resides within the Division of Safety Research. This research cadre represents a balance between the public health and the safety science fields (see Figure 7). Seventy-five current FTE research and research support positions are filled by individuals in a variety of disciplines, including epidemiology (17), safety engineering (12), safety management (11), statistics (10), general engineering (7), and health science (4). Other current staff disciplines include industrial hygiene, economics, kinesiology, and physiology. Technical support is provided by four information technology (IT) specialists, two physical science technicians, an engineering technician, a project specialist, and a technical writer-editor. Nine staff members provide administrative support. TI research staff CVs are included in Appendix 3.

Physical infrastructure. TI Program research facilities include laboratories and associated equipment that provide unique tools for injury prevention research. Specialized facilities include

Table 3. NIOSH Traumatic Injury Research Program Budget by Research Goals, 1997-2005

Goal	FY1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	Total
1. Reduce injuries and fatalities due to motor-vehicles										
FTEs	5.44	4.27	7.99	4.93	7.90	9.95	10.80	14.18	14.79	80.25
Intramural $	$318,528	$364,968	$497,628	$669,190	$855,111	$1,318,354	$1,229,997	$1,606,772	$1,907,736	$8,768,284
Extramural $	$253,962	$244,912	$229,942	$69,679	$927,921	$984,331	$877,727	$299,919	$1,250	$3,889,643
Total	$572,490	$609,880	$727,570	$738,869	$1,783,032	$2,302,685	$2,107,724	$1,906,691	$1,908,986	$12,657,927
2. Reduce injuries and fatalities due to falls from elevations										
FTEs	8.31	8.03	13.42	15.43	13.56	9.39	14.03	10.79	15.25	108.21
Intramural $	$1,276,334	$922,468	$907,054	$1,459,034	$1,315,445	$1,237,968	$1,568,049	$1,693,086	$1,769,344	$12,148,782
Extramural $	$253,962	$463,061	$229,942	$225,879	$289,011	$278,004	$285,319	$275,532	$250	$2,300,960
Total	$1,530,296	$1,385,529	$1,136,996	$1,684,913	$1,604,456	$1,515,972	$1,853,368	$1,968,618	$1,769,594	$14,449,742
3. Reduce injuries and fatalities due to workplace violence										
FTEs	8.02	4.51	7.28	6.98	6.66	7.75	7.56	9.48	8.61	66.85
Intramural $	$602,689	$482,026	$509,517	$653,934	$839,148	$1,490,096	$1,063,828	$1,273,771	$1,102,187	$8,017,196
Extramural $	$253,962	$511,907	$229,942	$225,879	$289,011	$281,754	$333,389	$275,532	$250	$2,401,626
Total	$856,651	$993,933	$739,459	$879,813	$1,128,159	$1,771,850	$1,397,217	$1,549,303	$1,102,437	$10,418,822
4. Reduce injuries and fatalities due to machines										
FTEs	11.21	9.63	12.77	14.43	12.81	14.78	10.48	13.13	12.09	111.33
Intramural $	$993,113	$1,044,805	$941,902	$1,283,376	$1,160,389	$1,593,009	$1,169,991	$1,514,190	$1,479,104	$11,179,879
Extramural $	$253,962	$235,037	$365,826	$365,942	$289,011	$278,004	$933,245	$890,920	$1,033,342	$4,645,289
Total	$1,247,075	$1,279,842	$1,307,728	$1,649,318	$1,449,400	$1,871,013	$2,103,236	$2,405,110	$2,512,446	$15,825,168
5. Reduce acute back injury										
FTEs	13.54	15.74	14.72	6.00	5.16	4.46	5.05	4.83	3.60	73.10
Intramural $	$1,196,364	$1,356,204	$1,150,931	$597,615	$615,257	$625,395	$647,926	$618,559	$521,036	$7,329,287
Extramural $	$620,369	$654,095	$628,253	$392,677	$194,526	$99,990	$107,222	$0	$231,250	$2,928,382
Total	$1,816,733	$2,010,299	$1,779,184	$990,292	$809,783	$725,385	$755,148	$618,559	$752,286	$10,257,669

Table 3. NIOSH Traumatic Injury Research Program Budget by Research Goals, 1997-2005 (continued)

Goal	FY1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	Total
6. Reduce injuries and fatalities among workers in Alaska										
FTE's	10.58	9.74	6.56	6.58	12.04	12.80	11.09	11.49	11.81	92.69
Intramural $	$1,023,592	$1,109,425	$405,931	$757,099	$1,493,700	$1,546,891	$1,494,324	$1,400,061	$1,701,203	$10,932,226
Extramural $	$253,962	$228,024	$229,942	$575,870	$729,000	$568,419	$296,425	$275,532	$0	$3,157,174
Total	$1,277,554	$1,337,449	$635,873	$1,332,969	$2,222,700	$2,115,310	$1,790,749	$1,675,593	$1,701,203	$14,089,400
7. Reduce injuries and fatalities to emergency responders										
FTEs	2.60	2.45	15.03	13.77	12.32	12.49	18.49	15.02	13.84	106.01
Intramural $	$154,230	$187,711	$1,074,781	$1,284,491	$1,521,576	$2,305,996	$1,932,990	$1,780,148	$1,848,856	$12,090,779
Extramural $	$12,450	$390,299	$480,565	$494,238	$300,972	$376,491	$101,250	$726,364	$806,938	$3,689,567
Total	$166,680	$578,010	$1,555,346	$1,778,729	$1,822,548	$2,682,487	$2,034,240	$2,506,512	$2,655,794	$15,780,346
8. Reduce injuries and fatalities to working youth										
FTEs	11.92	9.71	13.28	12.63	12.71	8.16	8.14	8.29	7.72	92.56
Intramural $	$978,455	$1,586,394	$1,778,041	$1,697,255	$1,839,280	$1,561,840	$1,607,812	$1,597,210	$1,507,439	$14,153,726
Extramural $	$253,962	$1,559,694	$1,470,082	$4,841,179	$4,075,188	$4,277,831	$4,078,410	$3,694,796	$3,491,227	$27,742,369
Total	$1,232,417	$3,146,088	$3,248,123	$6,538,434	$5,914,468	$5,839,671	$5,686,222	$5,292,006	$4,998,666	$41,896,095
Total FTEs for All Research Goals	71.62	64.08	91.05	80.75	83.16	79.78	85.64	87.21	87.71	731.00
Total Intramural $	$6,543,305	$7,054,001	$7,265,785	$8,401,994	$9,639,906	$11,679,549	$10,714,917	$11,483,797	$11,836,905	$84,620,159
Total Extramural $	$2,156,591	$4,287,029	$3,864,494	$7,191,343	$7,094,640	$7,144,824	$7,012,987	$6,438,595	$5,564,507	$50,755,010
Total $ for all Research Goals	$8,699,896	$11,341,030	$11,130,279	$15,593,337	$16,734,546	$18,824,373	$17,727,904	$17,922,392	$17,401,412	$135,375,169

Note: FTE's are totaled for all projects within each Research Goal. The Intramural $ row includes intramural contract funds, interagency agreements, and CRADA's. The Extramural $ row includes all grants and extramural contracts.

an anthropometry scanning lab, a virtual reality simulations lab, and a high bay lab (for research requiring a 37-foot ceiling, overhead crane, and overhead catwalk). Other laboratories feature research oriented toward human factors, protective systems, and safety engineering. Special mobile research units have been designed to support studies of emergency medical service (EMS) workers' safety in ambulance patient compartments and safety in highway construction work zones. Descriptions of TI research laboratory facilities and associated equipment, with examples of related research efforts, are included in Appendix 5.

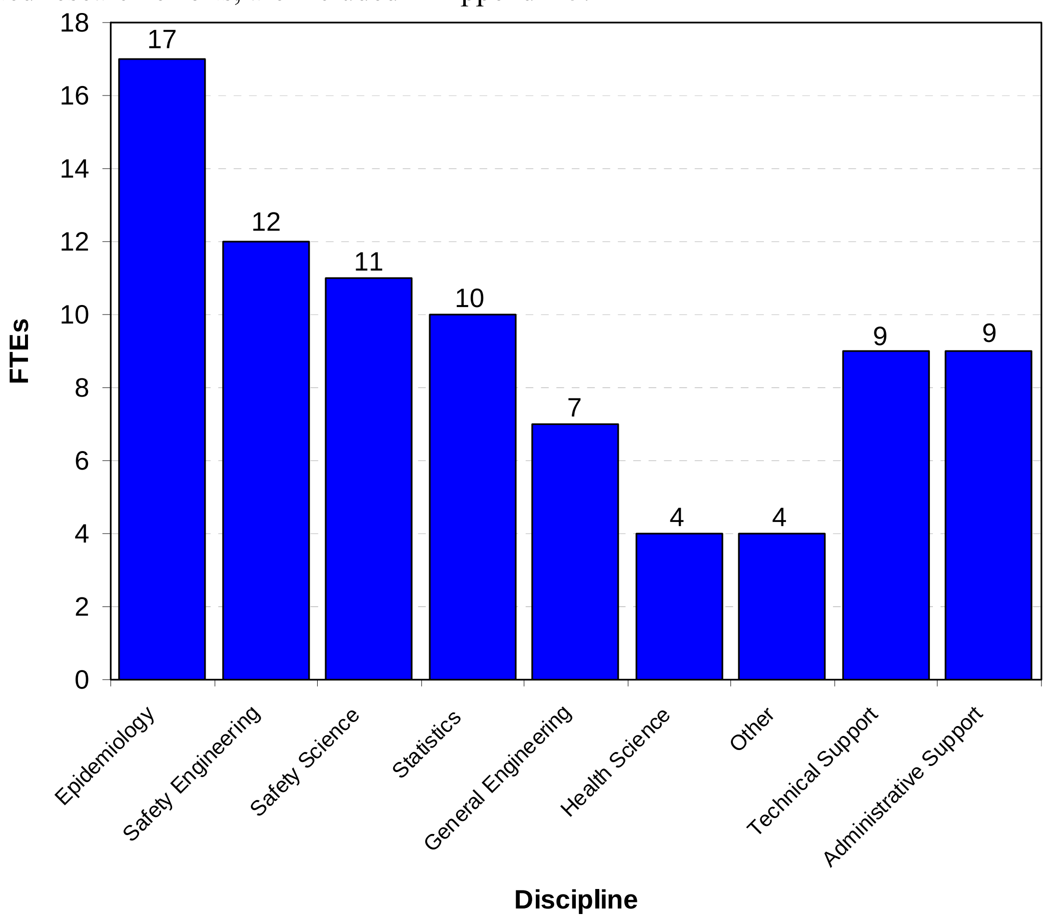

Figure 7. TI Research and Support Staff by Discipline

Planning Inputs

Strategies to ensure relevance of the TI Program include the program planning process, external input and partnerships, and transfer activities.

The primary planning drivers of the TI Research Program are:

- The occupational injury and fatality data indicating the leading causes of occupational injuries and deaths and highest-risk industries and worker populations

- The public health model as research framework, to ensure a multidisciplinary approach and commitment to follow-through from data-driven conceptualization to workplace implementation

- The recommendations described in the NORA Traumatic Injury Team document, “Traumatic Occupational Injury Research Needs and Priorities”[71] (http://www.cdc.gov/niosh/traumado.html)

- The NIOSH priorities of Research-to-Practice (r2p) and impact of results, which must be a critical component of every research project.

Injury and fatality data. Data on the frequency, severity, and rates of traumatic occupational injuries and deaths comprise a principal driver of TI Program priority-setting, decision making, tracking, and evaluation. Prior to 1985 and the development of the NTOF, TI relied primarily on the Bureau of Labor Statistics’ Annual Survey of Occupational Injuries and Illnesses and Supplemental Data System[72] and the Consumer Product Safety Commission’s National Electronic Injury Surveillance System (NEISS)[73] for data on nonfatal traumatic occupational injuries. As previously stated, prior to 1985 there were no national data that provided accurate counts of traumatic injury deaths, although a number of organizations (e.g., BLS, National Safety Council, and NIOSH) provided estimates. Since the development of the TI NTOF system, and subsequently the BLS Census of Fatal Occupational Injuries (CFOI), frequency, rate, and causal information have helped to guide TI Program activities. Both the numbers of deaths (magnitude) and the fatality rates (risk) are important considerations in prioritizing problems to address.

A brief presentation of recent BLS CFOI[40] and Annual Survey[41] data will show the statistical basis of the current TI Program direction. Figure 8 shows the ranking of major industry sectors by numbers and rates of traumatic injury deaths for 2005.

The construction sector experienced 1,186 fatalities in 2005, followed by transportation and warehousing (881), and agriculture, forestry, fishing and hunting (714). The highest rates of TI deaths (deaths per 100,000 workers) in 2005 occurred in agriculture, forestry, fishing and hunting (32.5) and mining (25.6). Transportation and warehousing, and construction followed, with rates of 17.6 and 11.0, respectively. Comparing these rates to the overall rate across all sectors (4.0), the high-risk nature of these sectors is evident. In Figure 8, the major industry sector services are broken out by sub-sectors (e.g., professional and business services, educational and health services, other services, etc.). In the 2004 data from BLS that follow, note that the services sector is presented in aggregate.

Table 4 shows that the highest number of fatal traumatic occupational injuries in 2004 resulted from transportation incidents (2,480) which accounted for 43.5 percent of the total. Contact with objects and equipment (1,004, 17.6 percent), falls (815, 14.3 percent), and assaults and violent acts (795, 13.9 percent) caused most of the remaining fatalities.

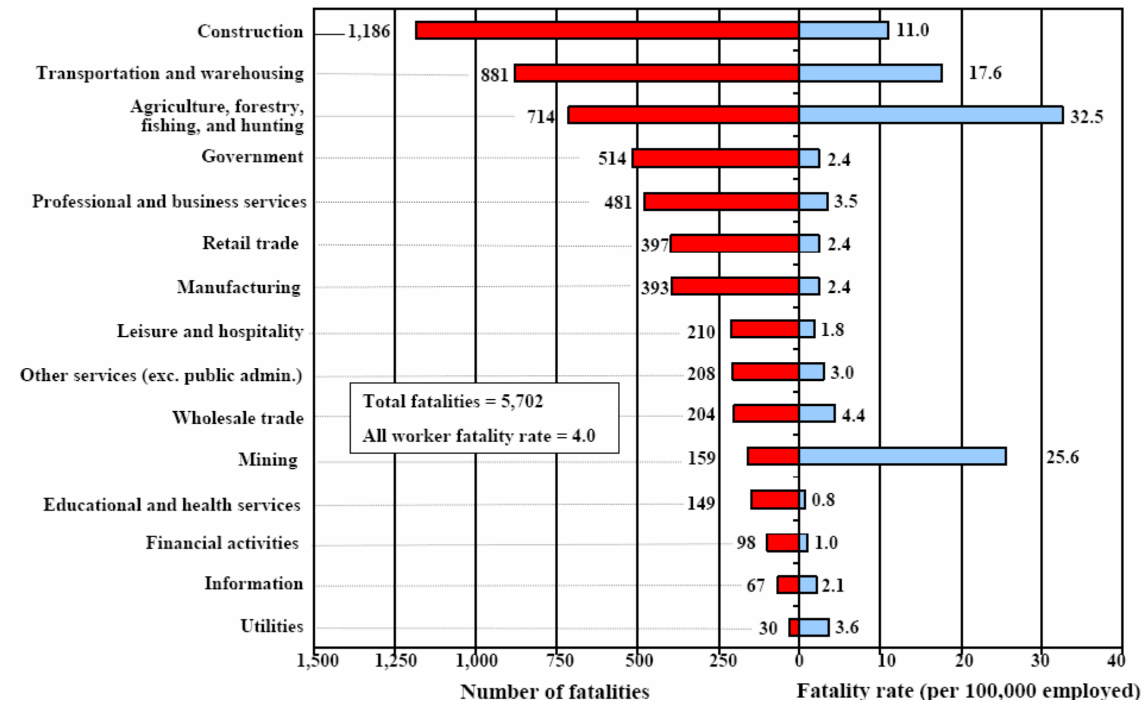

Figure 8. Numbers and Rates of Fatal Work Injuries by Industry Sector, United States, 2005
Source: US Department of Labor, Bureau of Labor Statistics, Census of Fatal Occupational Injuries, Preliminary Data for 2005

Table 4. Number of Fatal Occupational Injuries by Type of Event/Exposure, 2004

Type of Event/Exposure	**Number of Fatal Injuries**
Transportation Incidents	2460
Contact with Objects & Equipment	1004
Falls	815
Assaults & Violent Acts	795
Exposure to Harmful Substances or Environment	459
Fires & Explosions	159
Total	**5692**

Source: US Department of Labor, Bureau of Labor Statistics, Census of Fatal Occupational Injuries, 2004 data http://www.bls.gov/iif/oshcfoi1.htm. Notes: Fatalities associated with events or exposures of bodily reaction and exertion (8) and other events or exposures (3) were excluded from the event categories. Government workers are distributed across the sectors according to the industry of the agency.

The services sector also had the highest overall frequency of nonfatal injuries (nearly 1 million injuries), as well as the highest number of cases requiring the injured worker to miss work (more than a quarter million–See Table 5). Manufacturing and wholesale and retail trade also had high numbers of nonfatal injuries, followed by construction and transportation, warehousing and utilities. Tables 6 and 7 summarize the 2004 data for fatal injuries; Tables 8 and 9 summarize the 2004 data for nonfatal injuries.

Table 5. Number of Nonfatal Injuries and illnesses by Industry Sector, 2004

NORA Industry Sector	Total Reportable Injuries/Illnesses	Total Cases with Days Away from Work
Services	971,800	283,380
Manufacturing	941,900	226,090
Wholesale and Retail Trade	867,600	259,900
Healthcare and Social Assistance	684,000	179,910
Construction	401,000	153,200
Transportation, Warehousing and Utilities	314,600	127,750
Agriculture, Forestry, and Fishing	54,700	19,750
Mining	21,600	9,350
Totals	**4,257,200**	**1,259,330**

Source: US Department of Labor, Bureau of Labor Statistics, Industry Illness and Injury Data, 2004 data (http://www.bls.gov/iif/oshsum.htm) Note: Cases with days away from work with an event of Other Events or Exposures were excluded (150). NORA Services sector estimate for nonfatal injuries and illnesses excludes public administration workers. All sector estimates exclude self-employed, household workers, workers on farms with <11 employees, and volunteers. Values may not match BLS News Release values.

The public health framework. Using a public health approach as a framework allows TI to structure research activities systematically and sequentially from data-driven priorities to identifying risk factors, developing prevention strategies, evaluating promising interventions, and facilitating the transfer and adoption of our science into the workplace. This allows the TI Program to identify, prioritize, and determine the appropriate research stage and activities needed to address new issues as they emerge. For instance, when the issue of child agricultural injuries emerged, it was clear that data on such injuries were insufficient to accurately characterize the child agricultural injury problem and determine and direct appropriate additional research activity. Therefore, surveillance capability had to be developed. If surveillance is adequate, but knowledge of causal and risk factors is lacking (as in problem areas such as violence and highway work zones), then causation research studies must be designed and conducted. If prevention options are known, but products or technologies are not available, then protective technology research and development efforts are needed (e.g., for tractor safety and fall protection). If effective prevention is known (safe lifting programs to prevent back injury), then interventions and programs, and business cases demonstrating their feasibility and cost effectiveness must be communicated. The process is an iterative one requiring continuous monitoring to ensure that strategies implemented actually reduce or eliminate the exposure or outcome as the intervention progresses and do not create unacceptable new risks. Components of the public health model have been incorporated into the "activities" component of the TI Research Program Logic Model (See Figure 5).

Table 6. Number of Fatal Occupational Injuries by Industry Sector and Event or Exposure, United States, 2004

NORA Sectors	Total	Transportation Incidents	Contact with Objects & Equipment	Falls	Assaults & Violent Acts	Exposure to Harmful Substances or Environment	Fires & Explosions
Agriculture, Forestry, and Fishing (11)	663	333	204	30	47	34	14
Mining (21)	152	61	56	13	*****	9	12
Construction (23)	1268	317	270	444	32	171	34
Manufacturing (31-33)	459	139	164	47	42	36	28
Wholesale and Retail Trade (42, 44-45)	576	223	57	50	203	22	20
Transportation, Warehousing, and Utilities (48-49, 22)	931	665	92	49	66	44	14
Services (51-56, 61, 71-72, 81, 92)	1518	650	157	170	374	127	34
Healthcare and Social Assistance (62)	131	70	3	10	30	16	*****
Total	5703	2460	1004	815	795	459	159

Source: BLS Census of Fatal Occupational Injuries (www.bls.gov/iif) Notes: Industry was unknown for 5 fatalities. Fatalities associated with events or exposures of bodily reaction and exertion (8) and other events or exposures (3) were excluded from the event categories. Government workers are distributed across the sectors according to the industry of the agency. Events are listed in rank order from left to right. Values may not match BLS News Release values.

Table 7. Rate of Fatal Occupational Injuries by Industry Sector and Event or Exposure, United States, 2004

NORA Sectors	Total	Transportation Incidents	Contact with Objects & Equipment	Falls	Assaults & Violent Acts	Exposure to Harmful Substances or Environment	Fires & Explosions
Agriculture, Forestry, and Fishing (11)	28.0	14.1	8.6	1.3	2.0	1.4	0.6
Mining (21)	23.4	9.4	8.6	2.0	*****	1.4	1.8
Construction (23)	11.8	2.9	2.5	4.1	0.3	1.6	0.3
Manufacturing (31-33)	2.6	0.8	0.9	0.3	0.2	0.2	0.2
Wholesale and Retail Trade (42, 44-45)	2.9	1.1	0.3	0.3	1.0	0.1	0.1
Transportation, Warehousing, and Utilities (48-49, 22)	12.8	9.2	1.3	0.7	0.9	0.6	0.2
Services (51-56, 61, 71-72, 81, 92)	2.5	1.1	0.3	0.3	0.6	0.2	0.1
Healthcare and Social Assistance (62)	0.9	0.5	0.0	0.1	0.2	0.1	*****
Total	4.3	1.8	0.8	0.6	0.6	0.3	0.1

Source: BLS Census of Fatal Occupational Injuries (www.bls.gov/iif) Notes: Rates are fatalities per 100,000 full-time equivalent workers. Population estimates are based on the Current Population Survey hours for the primary job worked (2000 hrs = 1 FTE) for workers 15 years of age and older. Fatalities and population estimates were not corrected for 12 fatalities to youth less than 16 years of age. Government workers are distributed across the sectors according to the industry of the agency. Events are listed in rank order from left to right. Values may not match BLS News Release values.

Table 8. Number of Nonfatal Occupational Injuries and Illnesses by NORA Industry Sector and Event or Exposure in Private Industry, United States, 2004

NORA Sectors	Total Reportable Cases	Cases with Days Away from Work: Total Cases with Days Away from Work	Contact with Objects & Equipment	Falls	Bodily Reaction & Exertion	Exposure to Harmful Substances or Environment	Transportation Incidents	Fires & Explosions	Assaults & Violent Acts	Nonclassifiable
Agriculture, Forestry, and Fishing (11)	54,700	19,750	7,080	4,410	5,190	650	890	60	960	500
Mining (21)	21,600	9,350	3,700	2,010	2,920	300	250	40	*****	130
Construction (23)	401,000	153,200	51,830	35,480	52,330	5,220	5,670	470	500	1,680
Manufacturing (31-33)	941,900	226,090	**80,620**	31,230	95,260	10,590	4,980	**750**	620	2,020
Wholesale and Retail Trade (42, 44-45)	867,600	259,900	72,940	49,840	**112,050**	7,480	12,220	370	2,360	**2,620**
Transportation, Warehousing, and Utilities (48-49, 22)	314,600	127,750	27,900	22,400	55,360	2,890	15,660	190	950	2,370
Services (51-56, 61, 71-72, 81)	**971,800**	**283,380**	67,870	**72,650**	97,580	**17,290**	**17,810**	480	7,170	2,460
Healthcare and Social Assistance (62)	684,000	179,910	23,220	37,590	91,070	8,400	5,380	50	**12,320**	1,880
Total	4,257,300	1,259,320	335,160	255,600	511,750	52,830	62,860	2,420	24,880	13,660

Source: BLS Survey of Occupational Injuries and Illnesses (www.bls.gov/iif) Notes: Cases with days away from work with an event of Other Events or Exposures were excluded (150). Rows and columns may not sum to totals because of rounding error. NORA Services sector estimate for nonfatal injuries and illnesses excludes public administration workers. All sector estimates exclude self-employed, household workers, workers on farms with <11 employees, and volunteers. Values may not match BLS News Release values.

Table 9. Rate of Nonfatal Occupational Injuries and Illnesses by NORA Industry Sector and Event or Exposure in Private Industry, United States, 2004

NORA Sectors	Total Reportable Cases (cases per 100 FTE)	Cases with Days Away from Work (cases per 10,000 FTE): Total Cases with Days Away from Work	Contact with Objects & Equipment	Falls	Bodily Reaction & Exertion	Exposure to Harmful Substances or Environment	Transportation Incidents	Fires & Explosions	Assaults & Violent Acts	Nonclassifiable
Agriculture, Forestry, and Fishing (11)	6.4	230.4	82.6	51.4	60.5	7.6	10.4	**0.7**	**11.2**	**5.8**
Mining (21)	3.8	163.2	64.6	35.1	51.0	5.2	4.4	**0.7**	*****	2.3
Construction (23)	6.4	243.7	**82.4**	**56.4**	83.2	**8.3**	9.0	**0.7**	0.8	2.7
Manufacturing (31-33)	6.6	158.6	56.6	21.9	66.8	7.4	3.5	0.5	0.4	1.4
Wholesale and Retail Trade (42, 44-45)	5.0	151.1	42.4	29.0	65.2	4.3	7.1	0.2	1.4	1.5
Transportation, Warehousing, and Utilities (48-49, 22)	**7.0**	**285.4**	62.3	50.0	**123.7**	6.5	**35.0**	0.4	2.1	5.3
Services (51-56, 61, 71-72, 81)	2.8	82.2	19.7	21.1	28.3	5.0	5.2	0.1	2.1	0.7
Healthcare and Social Assistance (62)	6.2	163.3	21.1	34.1	82.6	7.6	4.9	*****	**11.2**	1.7
Total	4.8	141.3	37.6	28.7	57.4	5.9	7.1	0.3	2.8	1.5

Source: BLS Survey of Occupational Injuries and Illnesses (www.bls.gov/iif) Notes: Cases with days away from work with an event of Other Events or Exposures were excluded (150). BLS does not report the FTE estimates used to calculate rates among private industries. To determine FTE for estimation of NORA industry sector rates the FTE estimates for individual industry sectors were back-calculated from the BLS number and rate data; then the FTE estimate used was the average of estimated values for Total DAFW, Contact with Objects, Falls, and Bodily Reaction categories. FTE in thousands were: Agriculture, Forestry, Fishing and Hunting 857; Mining 573; Construction 6,287; Manufacturing14,255; Wholesale and Retail Trade17,197; Transportation, Warehousing, and Utilities 4,476; Services 34,461; Healthcare and Social Assistance 11,019; and Total average FTE 89,119. All sector estimates exclude self-employed, household workers, workers on farms with <11 employees, volunteers, and government workers. Values may not match BLS News Release values.

The NORA Traumatic Injury (NORA-TI) Team Report. The National Occupational Research Agenda (NORA), unveiled by NIOSH in April 1996 on the occasion of the 25th Anniversary of the OSH Act of 1970, represented an “effort to guide and coordinate research nationally—not only for NIOSH, but for the entire occupational safety and health community.”[71] NORA, which was developed collaboratively by NIOSH and approximately 500 of its partners, focused upon 21 priority areas, including traumatic occupational injuries. In order to develop strategies for these 21 priority areas, partnership teams were formed, composed of NIOSH specialists and individuals representing multiple sectors—i.e., industry, labor, academia, and other government agencies—and multiple disciplines. For the NORA TI Team, members came from varied backgrounds and disciplines associated with traumatic injury research and practice, including public health, safety sciences, engineering, and communication. A major accomplishment of the NORA TI Team was the publication of “Traumatic Occupational Injury Research Needs and Priorities: A Report by the NORA Traumatic Injury Team.”[71]

The NORA-TI report describes a broad framework of the objectives and research needed to begin filling the gaps in knowledge and furthering progress toward safer workplaces and practices. In addition to wide peer-review, a draft of the document was presented at the NOIRS conference in Morgantown in October 1997 and at the Safe America Conference in Washington, D.C. in November 1997. Copies of the draft were made available for public review and comment at both of these national conferences. Revised per comments and input received, the document was published by NIOSH in 1998.

In the 1999 Institute of Medicine Report, “Reducing the Burden of Injury: Advancing Prevention and Treatment,”[74] the authoring committee recommended “…that NIOSH, working in collaboration with other Federal partners, implement the NORA research priorities for traumatic and other injury-related occupational injuries, and give higher priority to injury research.” The committee went on to say that “Traumatic injury research priorities recently developed by the multidisciplinary NORA team assigned to this topic also warrant special consideration by Congress.”[74]

This document not only serves as a driver of the NIOSH TI Program, but is also used by other organizations and academia to prioritize research in this area. For example, The University of Iowa School of Public Health requires that occupational injury epidemiology students, in selecting thesis and dissertation topics, be responsive to the priorities presented in this document.[75]

Research Project Planning and Resource Allocation

Traditionally, NIOSH research project planning has been conducted at the Division/Laboratory level based on an annual allocation ceiling determined by the NIOSH Office of the Director. With the advent of new Congressional funding for NORA, an additional project planning process was initiated at the Institute level to compete for NORA funds. NIOSH is in the process of transitioning the entire NIOSH research program into a sector-based, strategic goal-oriented planning process, as discussed previously. Currently there are two separate, complementary processes for research project planning and resource allocation: at the Division level and at the Institute level.

Because administration of mining TI research remains independent of non-mining TI research due to external factors, the following describes the planning process for non-mining TI research conducted in the Division of Safety Research. A few TI-related projects are also conducted by other NIOSH Divisions/Labs, and most employ a similar planning process.

At the research project level, planning is primarily a bottom-up approach with investigators proposing research projects within the context of the program drivers. Rather than allocating annual discretionary funding systematically by organizational unit (e.g., branch), the TI Program employs a process that aims to ensure that resources are focused on the greatest programmatic relevance and need, scientific quality, and expected impact of results. The vast majority of projects are designed to accomplish specific goals within finite time frames. The relatively few ongoing TI projects primarily address surveillance, field investigation programs, or Congressionally mandated projects. “Emerging issues” projects are also maintained to support pilot efforts or partnership opportunities that arise mid-planning cycle.

When projects end (due to completion or discontinuation), the funding returns to a pool for competition for new project concepts. Concepts are developed by staff, often by interdisciplinary, cross-branch teams, and presented to the entire staff. The DSR Leadership Team, with input from staff, rates and ranks the concepts based on the criteria of project need, soundness of approach/methods, and expected impact. The top-ranked concepts are then further developed for a second round of rating and ranking. The highest-ranked concepts are approved for implementation based on available funding. (The NORA proposal process and criteria were adapted from the TI Program process and criteria.) Research protocols are then developed for approved projects, reviewed by scientific peers, and modified based on this feedback. In addition, public meetings are held to seek stakeholder input and assess interest on most research project protocols. By including stakeholders, this review process also provides insight into the interest and potential impact of the research, and establishes and leverages relationships with partners who can provide guidance and assistance in ensuring marketability or adoption/use of results.

At the Institute level, there is an annual opportunity for NIOSH researchers to compete for project funding from a set-aside of intramural NORA funds. The process is similar to the competition for extramural R01 funding: submission of responsive letters of intent (LOIs) followed by full proposals which are externally peer-reviewed and scored. Funding decisions based largely on peer-review scores and available funding are made by the Director of NIOSH. While the Director may call for proposals in specific emphasis areas, proposals compete across program areas. Upon project completion, funds return to the NORA “pot” for renewed intramural competition and distribution across programs.

Extramural TI research is funded by NIOSH through several mechanisms. Investigators complete research proposals in response to the NIOSH general program announcement, in response to targeted RFAs developed by the TI Program and aimed at filling specific program gaps, and to a lesser extent, through cooperative agreements. The State FACE cooperative agreement is an example of a successful and interactive collaboration between TI staff and State Health and Labor Departments to conduct fatality investigations and prevention efforts using a systematic and cooperative approach.

Project assessment and adjustment, including refocusing and discontinuing projects when appropriate, is an ongoing process in the TI Program. Quarterly progress reports for each project are posted on a shared drive for information sharing, progress assessment, and input, and an annual review of programs and projects occurs at mid-year. This ongoing reassessment, including discontinuation of projects that lack anticipated progress or value, has been critical in assuring and maximizing the quality and relevance of the TI research.

Although project administration and management remains a Division-level responsibility, NIOSH is also implementing a governance structure for the NIOSH Program Portfolio that provides for Program and Division/Labs management in a matrix style approach. The goals of this approach are to continue to improve the internal management and coordination, and the coordination between intramural and extramural research and planning, and to increase the relevance and impact of the NIOSH programs.

External input and partnerships

While the TI Program strives to maintain data-driven research priorities, the program also responds to externally driven priorities such as Congressional initiatives and mandates. The TI Program currently has four research programs directed by Congressional initiatives: agricultural injuries among children, fire fighter safety, workplace violence, and workers in Alaska's high-risk industries. At the inception of each of these initiatives, we held stakeholder meetings to seek external input to guide the development of the research strategy. For two of these initiatives—children in agriculture and fire fighters—TI also held mid-course review meetings with stakeholders for input to assess and adjust program direction.

Recognizing the need for a national forum to facilitate information sharing and research collaboration among the nation's occupational injury researchers and practitioners, the TI Program organized and hosted the National Occupational Injury Research Symposia (NOIRS).[76] This forum, the first and only national meeting in the United States focusing on occupational injury research, facilitates discussion and input among researchers on works in progress, and builds research and prevention collaborations. The first NOIRS was held in October 1997 in Morgantown, West Virginia. NOIRS 2000 convened in Pittsburgh, Pennsylvania in October 2000. The third symposium (NOIRS 2003) was held in Pittsburgh, Pennsylvania on October 28 to 30, 2003. The fourth NOIRS is tentatively planned for October 2008.

External input and partnerships are important strategies for ensuring the relevance of both our research approach and our outcomes. Every research protocol in the TI Program undergoes external peer-review. Frequently this peer-review includes a public meeting announced in the Federal Register, and openly seeking input on the development of programs in new areas. TI staff members also serve on numerous standards-setting and professional association committees.

This connection with relevant stakeholders not only facilitates moving our research results towards workplace implementation, but also keeps us informed and aware of emerging safety issues and potential solutions.

Outputs and transfer

During the years 1996 through 2006, the TI Program has produced and disseminated 55 numbered NIOSH publications with more than 1.7 million copies distributed to date. This figure includes copies that have been proactively distributed by direct mail through the TI targeted dissemination approach as well as copies that have been distributed at various conferences and exhibits. However, a substantial proportion—42.5 percent of all copies distributed—have been sent out in response to customer requests. TI outputs have been reprinted, redistributed and incorporated into training courses, campaigns, and informational products by others. More information on TI outputs, the distribution of TI-related NIOSH publications, and the citations of TI peer-reviewed articles in other research publications is contained in Appendix 9.

The TI Program also ensures relevance through strategies to ensure widespread dissemination of our research. In 2003, TI launched the NIOSH "Traumatic Injury Topic Page," a Website containing all available TI Program information on traumatic injuries, including publications, data, FACE and fire fighter investigative reports, research summaries, information on NOIRS meetings, and relevant external occupational injury related links.[77] Immediately, the TI Topic Page became one of the most popular NIOSH Websites. Subtopic pages, including a page on Workplace Violence, the Fire Fighter Fatality Investigation and Prevention Program Website, and the FACE Website, ranked in the top pages in number of visits on the entire NIOSH Website. Specific subtopic pages were developed addressing Agricultural Safety (http://www.cdc.gov/niosh/injury/traumaagric.html), Child Agricultural Injury Prevention Initiative (http://www.cdc.gov/niosh/childag/default.html), Commercial Aviation (Alaska), Commercial Fishing (Alaska), Confined Spaces (http://www.cdc.gov/niosh/injury/traumaconf.html), Construction Safety (http://www.cdc.gov/niosh/injury/traumastruct.html), Electrical Safety (http://www.cdc.gov/niosh/injury/traumaelec.html), the Fatality Assessment and Control Evaluation (FACE) Program (http://www.cdc.gov/niosh/face/), Falls (http://www.cdc.gov/niosh/injury/traumafall.html), the Fire Fighter Fatality Investigation and Prevention Program (http://www.cdc.gov/niosh/fire/), Highway Work Zones (http://www.cdc.gov/niosh/injury/traumazone.html), Logging Safety (http://www.cdc.gov/niosh/injury/traumalog.html), Machine Safety (http://www.cdc.gov/niosh/injury/traumamc.html), Motor Vehicle (http://www.cdc.gov/niosh/injury/traumamv.html), and Occupational Violence (http://www.cdc.gov/niosh/injury/traumaviolence.html). This marked the first time all NIOSH TI information had been organized and presented on the Web in one site. The TI Topic Page can be accessed at: http://www.cdc.gov/niosh/injury/.

The TI Program also undertakes proactive strategies to transfer research results to the workplace or to the next step towards workplace implementation. For each research area, TI identifies at least one "recipient" of the findings. TI involves the recipient(s) from the conceptual phase of the research onward and attends to their input. This not only helps to ensure that the outputs will be relevant and acceptable, but also promotes shared ownership or buy-in by the recipients. At the conclusion of the research, TI facilitates the recipient in carrying out the next step in moving the research results towards workplace implementation.

Examples of the various types of recipients include:

- Translators of scientific information to worker-friendly guidance or training
- Materials manufacturers to develop and market safety technologies
- Regulators and employers to promulgate new safety policy
- Organizations to promote new health and safety practices
- Companies to implement new technologies, processes and practices to prevent injuries among their workforce

Emerging Issues

Maintaining optimal relevance and impact of any research program depends in part on the ability to detect and address current and emerging problems. The TI Program uses several strategies to identify and respond to emerging issues.

Surveillance data on fatal and nonfatal injuries are reviewed routinely. Annual trends of injuries and deaths provided primarily by BLS Surveillance Systems[40,41] drive the annual program planning. The TI also maintains real-time surveillance of injuries reported to a national sample of hospital emergency departments (NEISS)[73] and fatal injuries in selected States (FACE)[34] that allow more immediate detection of injury clusters or spikes. Moreover, the strong engagement with stakeholders and partners in the TI Program, as well as the National Occupational Injury Research Symposia, provide opportunities not only to learn of emerging issues, but to adapt partnership efforts to address them.

The TI Program drivers and planning process promote annual realignment of research priorities. The TI Program also maintains dedicated projects that are specifically designed to respond to emerging issues in the areas of surveillance, causality, and evaluation. Resources are allocated to these projects annually to fund pilot efforts in newly detected areas of concern or serendipitous partnership opportunities.

Finally, the FACE Program with its cooperative intramural and State-based components is designed to be flexible and adaptable to emerging hazards and changing priorities. For example, with the explosion of the telecommunication industry, we began to see a spike in deaths due to falls from towers during construction and maintenance. The FACE Program not only adapted to investigate these incidents, but also collaborated with industry to develop prevention efforts. When surveillance data showed high fatality rates among Hispanic workers, the FACE Program shifted priorities to begin investigating these incidents. Also, each State cooperating in the FACE Program has the flexibility to address high-risk issues specific to the State in addition to the current program investigation targets.

These strategies–attention to surveillance trends, the program planning process, connectivity with stakeholders, maintenance of projects designed to respond to emerging issues, and a flexible investigation program—allow the TI Program to adapt and respond to changes and emerging issues in workplace safety.

External Factors

Due to limited resources to address all work injuries in all sectors, it has been necessary to focus the TI Research Program towards worker groups with the greatest numbers and risk of serious injury or death. While the NIOSH TI Program has been largely data-driven, there have been some exceptions. Although the mining industry and motor-vehicle-related incidents are among the highest risk for occupational injury or death, the TI Program historically has not focused on this sector or cause of death. This conscious decision was based on the existence of other Federal agencies with responsibility and resources to conduct prevention research in these areas (USBM, DOT). Only recently has TI begun a concerted effort to address occupational motor-vehicle safety.

In addition, Congressionally mandated initiatives in several specific areas (i.e., children in agriculture, workers in Alaska, fire fighters, violence) ensured sustained research funding in these areas.

In 1997 the two research laboratories of the USBM (Pittsburgh and Spokane) were merged into NIOSH and NIOSH assumed responsibility for mining injury prevention research. There were a number of successful efforts to integrate research activities between the new mining laboratories and other Divisions. During the late 1990s, a special fund was set aside for collaborative projects between Divisions/Labs that focused on applying mining-related research to agriculture or construction industry sectors. The TI Program engaged in several interdivisional collaborations in response to this opportunity. Drawing from that experience, in 2001 a suite of research projects focusing on “closing the loop from science to prevention” was proposed by an interdivisional team including DSR, PRL, and SRL staff. This research program successfully competed for NORA funding and was conducted collaboratively from FY01 to FY06. Although these were successful collaborations and helped integrate the former USBM labs into NIOSH, the budget and function of these two laboratories have remained relatively independent of other NIOSH research divisions and programs, due largely to stakeholder interest and Congressional oversight.

Impact

It is a major challenge for TI to both directly impact prevention and to demonstrate a cause-effect relationship between TI work and injury metrics. However, from 1996 to 2005, the TI Program has contributed to a 39 percent decline in traumatic occupational fatalities among the U.S. workforce. While efforts of many external entities have also influenced the reduction in worker deaths, the TI contribution to this decrease is reinforced by decreases in specific goal areas where TI has concentrated efforts (e.g., homicides, workers in Alaska, back injuries in nursing homes, injuries to young workers). The following section (V) describes these efforts.

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V. Current TI Research Goals and Sub Goals

1. Reduce injuries and fatalities due to motor-vehicles

Introduction

Motor-vehicles are consistently the leading cause of traumatic occupational fatalities in the U.S., accounting for more than 29,000 deaths between 1992 and 2005—an average of 2,100 worker deaths each year—and more than 35 percent of all workplace fatalities.[1] About 65 percent of the victims were occupants (drivers and passengers) of vehicles on public roadways, 17 percent were occupants of vehicles off public roadways, and 18 percent were pedestrian workers. In addition to workers who are driving (or passengers in) motor-vehicles in traffic during work, pedestrian workers in construction work zones are at risk from both motor-vehicles and large construction vehicles.

Traditionally, many workers at risk of motor-vehicle-related injuries and fatalities have been considered homogeneous with the overall driving population in the U.S. in that they face the same risks, and are protected by the same laws, technologies, and other prevention approaches. When first considering TI research priorities nearly 40 years ago, NIOSH made the determination that research in the area of motor-vehicle risks and prevention was amply covered in the programs of other agencies and research institutions. Consequently, NIOSH excluded motor-vehicle-related safety research from its program.[2]

In the face of compelling data that demonstrated a lack of progress in reducing workplace crashes and fatalities, TI re-evaluated the situation in the mid- to late-1990s and elected to become involved in research and other activities aimed at reducing worker deaths and injuries from motor-vehicle incidents. TI also recognized that crash data systems that cover the general population did not adequately identify work relationship for crashes, and that no one was taking the lead in promoting needed enhancements to these data systems.

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Sub goal 1.1: Reduce occupational injuries and fatalities due to highway motor-vehicle crashes

Issue:
Two specific populations-at-risk are targets for TI efforts: professional truck drivers and workers who drive or ride in motor-vehicles during work-related travel but are not professional drivers.

Despite specific safety regulations designed to protect them, the injury and fatality risks for the nation's estimated 2.6 million truck drivers are among the highest of all occupations. From 1992 to 2002, the Census of Fatal Occupational Injuries recorded 8,864 truck driver fatalities, an annual average of 806, more than any other occupation.[1] Two-thirds of these were due to transportation incidents. The 2004 fatality rate for U.S. heavy and tractor-trailer truck drivers was 48.2 per 100,000 workers, over 10 times the national average of 4.4 deaths per 100,000 for all workers. In 2004, the Survey of Occupational Injuries and Illnesses estimated 63,570 nonfatal injuries among heavy and tractor-trailer truck drivers—the second highest number among all occupations. The most common events causing these nonfatal injuries were overexertion (23 percent), contact with object/equipment (19 percent), and transportation events (17 percent).[2]

Risk factors for truck drivers include:

- Operational characteristics of the trucking industry (e.g., long work hours and irregular schedules) which predispose truck drivers to fatigue and may lead to crashes
- Sleep disorders, such as obstructive sleep apnea, which have also been associated with motor-vehicle crashes among truck drivers
- Hourly pay schemes that may provide an incentive to exceed speed limits or drive too fast for conditions
- Use of prescription medications
- Non-use of safety belts
- Medical conditions
- Actions of other motorists who do not understand the operating capabilities of large trucks.

Numerous stakeholders agree that there is a need for additional occupational safety and health research focusing on truck drivers. In 2003, NIOSH, Wayne State University, the Owner-Operator Independent Drivers Association, the International Brotherhood of Teamsters, and the Alfred P. Sloan Foundation sponsored the Truck Driver Occupational Safety and Health Conference. Several presenters at this conference made specific recommendations for research targeting issues of long work hours and fatigue.[3] Similarly, participants in the 2005 International Truck & Bus Safety & Security Symposium and the National Occupational Research Agenda (NORA) town hall meeting for the Transportation, Warehousing, and Utilities industry sector (December 5, 2005), called for improvements in injury and illness data collection so that effective interventions to promote driver health and reduce injuries can be developed.[4]

Although about 40 percent of those who died in occupational crashes in the U.S. were employed as "professional" vehicle operators, e.g., truck or bus drivers, the remaining 60 percent had primary job duties other than driving. In contrast with truck and bus drivers, who are covered by comprehensive Federal regulations, other workers who drive on the job have only rarely been subjects of safety research and prevention efforts, and even today are not covered by any occupational safety and health regulations specific to driving. Responsibility for setting and enforcing vehicle safety policies falls to the employer, and small employers often lack the resources and know-how to implement effective programs.

Approach:
Since the inception of NIOSH in 1970, the Institute has been collecting, analyzing, and reporting upon surveillance data on occupational motor-vehicle injuries and fatalities. The development of the National Traumatic Occupational Fatalities (NTOF) Surveillance System in the 1980s provided the nation's first count of traumatic occupational fatalities, and confirmed that the leading cause was motor-vehicle incidents. That has not changed in the 26 years' worth of data collected both in NTOF and in the BLS Census for Fatal Occupational Injuries (CFOI).

The TI Program's overall approach has been to:

- Undertake a major research initiative in transportation safety, including research targeting truck drivers
- Identify opportunities to inform employers and other stakeholders of the risks associated with workplace driving for those who are not employed strictly as drivers
- Participate on the consensus standards committee that developed the first standard addressing safety for nonprofessional drivers
- Participate in global efforts to reduce motor-vehicle injuries and fatalities

Achieving a balance of activities that would address specific safety concerns for truck drivers along with those for other employee drivers has been a primary concern. Working with partners such as the American Society of Safety Engineers (ASSE) and the Network of Employers for Traffic Safety (NETS) has given TI Program staff the opportunity to learn about employer traffic safety concerns from a risk management perspective, to better understand the challenges of managing employee drivers, and to better serve the populations at risk and their representatives through research and outreach efforts.

Outputs and Transfer:
(For those outputs not specifically cited, see Appendix I: Supporting Evidence.)

In cooperation with numerous other stakeholders, TI Program staff contributed to the development of the American National Standards Institute (ANSI) standard Z15.1-2006, Safe Practices for Motor Vehicle Operations,[5] which received final approval from ANSI on February 15, 2006. The ANSI Z15.1 Standard is intended to further prevention of motor-vehicle crashes, which are the leading cause of workplace fatalities and a major contributor to workers' compensation and liability costs, lost productivity, and property loss. The standard, designed for use by any organization whose employees drive on the job, delineates minimum requirements for workplace traffic safety programs. The ASSE serves as secretariat of the Z15 Accredited Standards Committee, whose members represent more than 30 government agencies, insurance companies, employers, consulting groups, and trade associations. TI representatives have served on the ANSI Z-15 Committee from its inception in 2001. TI representatives contributed to all parts of the standard, and took the lead in drafting the portion of the standard that addresses crash data collection and incident analysis. In addition, the primary TI representative chaired the

subcommittee that resolved technical and editorial discrepancies across the sections of the standard and addressed the 100 pages of public comments received.
TI scientists are also represented on two Transportation Research Board (TRB) committees: Truck and Bus Safety (ANB70) and Vehicle User Characteristics (AND10). In this capacity, TI representatives contribute to committee-authored documents and strategic plans, review manuscripts to be presented at the TRB annual meeting, and participate in committee meetings and related conferences and workshops.

In response to a recommendation in the National Research Council monograph "Protecting Youth at Work,"[6] the U.S. Department of Labor (DOL) provided funds for TI Program staff to develop a report on the adequacy of Hazardous Orders (HOs) which define prohibited work activities for youth. The report made recommendations for existing HOs related to workplace driving by youth in agricultural and nonagricultural occupations.

Recent NIOSH-funded extramural grants have focused on preventing motor-vehicle-related injuries. One study found that extended-duration work shifts, which are currently sanctioned by the Accreditation Council for Graduate Medical Education, pose safety hazards for medical interns. These results have implications for medical residency programs, which routinely schedule physicians to work more than 24 consecutive hours.[7] Another study linked State workers' compensation to other data sources to better describe the burden and pattern of injuries among truck drivers. Findings from this study suggest that nationally available data on truck driver injuries underestimate seriously disabling injuries of the back, shoulder, and knees; and, that truck drivers are at greater risk of back and disc injuries than other occupational groups. These findings were reported at the 2006 National Occupational Research Agenda Symposium.[8, 9] A third study identified specific acoustic conditions that increase pedestrian workers' recognition of approaching motor-vehicles, and suggested that introducing temporary pavement treatments in work zones would produce tones that would increase worker safety. Study findings were published in the 2003 proceedings of the 9th International Conference on Auditory Display.[10]

TI staff prepared and disseminated a *Hazard Review* document that addressed issues such as identification of the worker groups at highest risk of crashes, the motor-vehicle safety regulatory climate, fleet safety recommendations for employers, distracted driving, use of cell phones while driving, and age-related driving issues.[11] Additionally, TI staff authored an MMWR article that was released in conjunction with World Health Day 2004.[12]

TI staff researched, wrote, and developed dissemination strategies for the transfer of other NIOSH publications addressing occupational motor-vehicle safety topics, including NIOSH Alerts on preventing worker deaths and injuries from traffic-related motor-vehicle crashes and refuse vehicles;[13,14] and reports identifying worker populations at risk of an occupational motor-vehicle-related injury or death, prevention strategies that employers can use to protect their workers, and specific risks faced by older drivers at work. More than 120,000 copies of these publications have been proactively distributed by the NIOSH Publications Office to targeted mailing lists and at conferences. Most have been reprinted several times.

NIOSH maintains comprehensive Web pages on motor-vehicle safety (www.cdc.gov/niosh/injury/traumamv.html) and on the NIOSH program for transportation, warehousing, and utilities (TWU) (www.cdc.gov/niosh/programs/twu).

Press releases were used to increase visibility of NIOSH or NIOSH-funded products related to vehicle safety. Much of the media response associated with the 2004 MMWR article (described below under Intermediate Outcomes) was fueled by the April 7, 2004 press release that accompanied it.[14] In the same way, the September 14, 2004 press release focused greater attention on NIOSH Director John Howard's appearance on a panel at the National Safety Congress that addressed the importance of safety belts in preventing worker injuries and fatalities.[15]

NIOSH co-sponsored the Truck Driver Occupational Safety and Health Conference held in Detroit, Michigan in April 2003. TI staff members gave presentations. The proceedings of the conference are nearing publication as a NIOSH document. NIOSH also co-sponsored the International Truck & Bus Safety and Security Symposium, held in Alexandria, Virginia on November 14-16, 2005.

Intermediate Outcomes:
Approval of the ANSI Z15.1 standard, Safe Practices for Motor Vehicle Operations, is a landmark achievement in worker protection.[5] This is the first occupational safety standard that offers comprehensive guidance to protect all workers who operate a motor-vehicle as part of their job. It fills a critical gap in guidance for organizations whose employee drivers are not covered by the Federal Motor Carrier Safety Regulations, which apply only to commercial drivers. ANSI Z15.1 will be particularly useful for small and medium-sized companies, which may not be aware of the need for a vehicle safety program or may lack the knowledge to implement a program.

The motor-vehicle *Hazard Review*[7] was featured in the February 2004 issue of the National Safety Council publication, *Safety + Health*.[16] It was also featured in the March 27, 2004 issue of the *Status Report,* published by the Insurance Institute for Highway Safety (IIHS).17 The June 2004 issue of *Safety + Health* featured an interview with the NIOSH Director, who responded to questions on occupational road safety. [18]

The MMWR article released around World Health Day 2004[12] generated media interest. The TI lead author was interviewed by the New York Times, CNN Radio, Reuters, and the Atlanta Journal-Constitution. The MMWR article was also featured in the June/July 2004 issue of Nation's Health, the newspaper-style publication of the American Public Health Association.[19] It was also featured in the Pittsburgh Post-Gazette and the Tulsa World.

Progress toward End Outcomes:
A final rule published by DOL in 2004 incorporated a NIOSH recommendation related to HO2 (Motor-Vehicle Occupations), and referred to NIOSH comments in the accompanying narrative.[20] DOL adopted the NIOSH recommendation that this HO be changed to comply with 1998 Congressional amendments to the Fair Labor Standards Act. The rule was changed to prohibit all workplace driving on public roadways by 16-year-old workers, and placed substantial restrictions on driving by 17-years-old workers. (See also Sub goal 8.1: Influence legislative changes to protect young workers.)

What's Next:
TI is collaborating with the Uniformed Services University of the Health Sciences to study the association between prescription medications and fatal motor-vehicle crashes among active duty military personnel. Other partners, including the National Highway Traffic Safety

Administration, are interested in results of the study. Another study is examining the influence of organizational and industry factors—such as scheduling practices, economic pressure, competition, and types of freight—on fatigue and safety in commercial truck drivers. TI is also a key participant in a national survey of long-haul truck drivers that will include modules on injury, health and lifestyle, fatigue, and sleep disorders. Another TI study involves collection of anthropometric and work-space data for a nationally representative sample of 500 U.S. truck drivers using traditional measurement methods and 3D scanning technology. Finally, TI is developing recommendations for improving the collection of crash data for State DOT employees, as well as vehicle safety recommendations for workers posted abroad.

In April 2006, a new TI-written RFA was issued for an extramural research grant program focusing on the safety and health of truck drivers.

External Factors:

Motor-vehicle incidents are the leading cause of workplace fatalities, but make up only about 3 percent of total U.S. traffic fatalities. Engaging the broader traffic safety community in prevention of occupational motor-vehicle crashes makes sense, given that many risk factors are shared. However, the toll of motor-vehicle crashes outside the workplace is so great that occupational safety issues are not a large part of the national traffic safety debate. Trucking, which becomes a public safety issue because of the large number of other motorists killed in crashes with trucks, is the exception.

NIOSH and the TI Program are relatively new players in the motor-vehicle safety arena. Until the late 1990s, TI allocated limited resources to data analysis and development of prevention strategies related to motor-vehicle crashes. In the late 1990s, TI staff began to develop a knowledge base in this area through data analysis, review of the literature, and contacts with stakeholders. In FY 2004 and again in FY 2007, TI competed successfully for internal funding for research related to motor-vehicle safety.

TI faces the continuing challenge of finding its niche within transportation safety research. The Transportation Research Board of the National Academies brings together thousands of researchers across all modes of transportation. There are numerous university-based transportation research centers that are well-respected and well-funded. For TI, the challenge is to develop research projects that address factors unique to occupational driving and to cultivate a strong stakeholder network that will ensure that research findings go directly to affected populations.

In the injury surveillance arena, TI clearly has a role to play in promoting better ascertainment of work relationship in existing crash data systems. The Fatality Analysis Reporting System does not identify as many work-related crashes as the Census of Fatal Occupational Injuries, and other general crash data systems do not capture work relationship at all. The lack of work relationship data in these systems impedes the identification of risk factors for occupational crashes.

OSHA has no regulations that cover workplace driving, and it has responded negatively to initiatives from research and interest groups in recent years urging it to develop regulations for safety belt use. OSHA's inaction sends the message to employers that motor-vehicle safety falls outside their responsibility. As a result, employers appear to accept to some degree that crashes are an inevitable consequence of doing business.

Large organizations that have the resources to collect and analyze crash data understand the enormous financial and human toll of motor-vehicle crashes and may take steps to prevent crashes. In the absence of regulations, many employers with fewer resources elect not to take action.

For the trucking industry in particular, economic realities and the operating environment work against implementation and acceptance of occupational safety and health initiatives. For example, truck drivers are exempt from overtime provisions of the Fair Labor Standards Act. Strong industry pressure and a regulatory framework that allows long hours of work make it politically untenable to argue for either overtime pay or shorter hours. Mileage-based compensation schemes create an incentive to drive beyond speed limits and beyond the number of hours of driving permitted under the regulations. Finally, the nature of truck drivers' work environment makes communicating health and safety information very difficult.

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Sub goal 1.2: Reduce occupational injuries and fatalities due to motor-vehicle incidents in highway and street construction work zones

Issue:
For the eight-year period between 1995 and 2002, 844 fatal occupational injuries[*] occurred at road construction sites. The majority of these fatalities, 693 cases (82 percent), were reported to be transportation incidents. Fatalities involving a worker being struck by a vehicle or mobile equipment accounted for 509 (73 percent) of the transportation incidents. Victims of these incidents were slightly more likely to be struck by dump trucks or construction machinery (32 percent) than by highway automobiles (28 percent).[1] The high percentage of transportation-related fatalities involving workers in work zones being struck by vehicles and equipment became a source of concern for governmental and private organizations.

Although these groups have taken steps to address the issue through regulation, awareness initiatives, and research, concern is that increases in road construction and structural changes in the industry may lead to increases in worker injuries and fatalities. This concern is underscored by two recent legislative actions, each of which includes safety-specific language: 1) the Safe, Accountable, Flexible, and Efficient Transportation Equity Act - A Legacy for Users, signed by President Bush in August 2005 and 2) the Federal Highway Administration Final Rule on Work Zone Safety and Mobility, with compliance required by October 2007.

Several factors are contributing to the issues faced by workers in highway and street work zones:

- Lack of knowledge on specific risk factors
- Lack of information on and evaluation of safety training programs designed for non-English speaking workers
- Insufficient adaptation of intervention technologies that are used in other industries
- Lack of scientific evaluation for existing and newly developed intervention approaches
- Inadequate guidelines, particularly for controlling vehicle and worker movements inside the work zone

Prompted by the data and stakeholder concern, TI is currently undertaking several efforts to address each of these factors to reduce motor-vehicle incidents in highway and street construction work zones.

Approach:
TI researchers analyzed existing data to determine the magnitude and circumstances of fatalities in the highway and street construction industry. The results prompted TI to initiate an effort to develop guidelines for addressing work zone safety, starting with a comprehensive review of the scientific literature, additional analysis of existing data from the BLS, and a review of relevant investigations conducted by the Fatality Assessment and Control Evaluation (FACE) Program. TI sponsored a 1998 workshop that focused on preventing injuries in work zones due to motor-vehicles and equipment. The workshop was attended by 54 individuals representing government, labor, industry, academia, and State Departments of Transportation. Information shared in the workshop sessions was the primary resource used to identify specific measures for preventing worker injuries from vehicles and equipment.

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[*] Fatality count is inclusive of all industries, not just those in the highway and street construction industry.

In 1999, the TI Program added highway and street construction work zone fatalities as a specific target for investigations by the FACE Program. Through investigative guidelines developed by TI researchers, details related to the circumstances surrounding these fatalities are captured. Since the addition of this target, TI researchers have conducted 13 highway and street construction FACE investigations, 12 of which were of transportation-related incidents.

In 2000, TI researchers, in cooperation with the Washington State Department of Transportation, began testing interventions that provide construction equipment operators with the ability to monitor the blind areas around the equipment they are operating. This type of intervention is often referred to as a proximity warning system (PWS). The objective of this effort was to determine which systems were most effective and reliable in monitoring blind areas, not for determining injury prevention efficacy.

TI researchers also tested the effectiveness and reliability of another PWS called the Hazardous Area Signaling and Ranging Device (HASARD) for possible deployment in the highway and street construction industry. The HASARD system, originally developed by TI researchers for underground mining equipment, uses a technology that alerts both the equipment operator and the pedestrian worker when the worker enters a hazardous area (blind area) around the equipment.

TI launched an effort in 2002 to rigorously evaluate selected prevention measures designed to protect workers from being struck by construction vehicles and equipment. The selected measures are implemented on active road construction sites with control and treatment data collected. Interventions being evaluated include several PWS devices and an administrative approach called an internal traffic control plan (ITCP). ITCPs are designed to assist in controlling construction vehicle and worker movements inside the work zone. The PWS devices and the ITCP are promising interventions that have not yet been proven effective for preventing fatalities and injuries associated with construction vehicles and equipment.

Researchers in the NIOSH Education and Information Division (EID) are currently evaluating the effectiveness of safety training programs designed for Spanish-speaking road construction workers. In this effort, researchers are collecting data from supervisors who typically have only a rudimentary knowledge of Spanish, yet are responsible for directing workers and providing safety training.

Outputs and transfer:
(For those outputs not specifically cited, see Appendix 1: Supporting Evidence.)

TI researchers authored a NIOSH document, "Building Safer Highway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Equipment,"[2] that was based on stakeholder input received during the 1998 TI-sponsored workshop. The document provides specific measures that contractors, contracting agencies, policy makers, manufactures, law enforcements, and the research community can use to reduce work-related injuries in highway work zones. This document has been disseminated through targeted mailings, conference and exhibition handouts, and downloads from the NIOSH Website. From four separate printings, approximately 21,000 copies have been distributed.

The 13 highway work zone FACE investigation reports are accessible at: http://www.cdc.gov/niosh/injury/traumazoneface.html. Eight of these reports involve a highway worker being struck by a motor-vehicle or equipment. Copies of the reports are also provided to the Occupational Safety and Health Administration (OSHA).

TI contractors authored five reports for use by TI researchers in developing the methodology to rigorously evaluate selected injury prevention measures for highway construction workers. The contractor reports provide information on blind area diagrams of specific equipment (areas around the equipment where the operator cannot see) and ITCP development for specific highway construction sites. Although originally developed solely for use by TI researchers, these documents are distributed externally upon request.

TI researchers have delivered 24 presentations at a wide variety of professional meetings to provide information about efforts to protect highway and street construction workers. Attendees were generally highway and street construction industry safety professionals and association members. Presentations usually focus on providing information about ongoing TI research relevant to the highway construction industry and soliciting participation in the TI research effort to evaluate injury prevention measures on active road construction sites.

Intermediate Outcomes:
The NIOSH document, "Building Safer Highway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Equipment,"[2] has been further distributed by OSHA offices in Washington D.C. and Puerto Rico, the Laborers' International Union of North America, the American Road and Transportation Builders Association (ARTBA), and the Washington State Department of Labor and Industries.

ARTBA and the National Safety Council (NSC) consulted with TI researchers in developing an OSHA 10-hour training course specifically for the road construction industry. Key measures from the NIOSH document were incorporated in the course training materials. This OSHA 10-hour course is provided to member construction companies for NSC and ARTBA, and is also a core component of the road construction safety training program for the Associated General Contractors of Vermont's Northeast Regional Safety Academy.

The Laborers' Health and Safety Fund of North America (LHSFNA) incorporated the Injury Prevention Measures and Glossary sections of the NIOSH document[2] in entirety in the Appendix and Glossary sections of their "Highway Workzone Safety Manual 2003."[3] Other organizations have used the document to:

- Provide risk management recommendations to clients (St. Paul and the CNA insurance companies)
- Support development of contract language to require contractors to use high-visibility clothing during disaster clean-up (Federal Emergency Management Agency)
- Guide strategic planning for transportation centers (Cleveland State University)
- Develop safety training videos (J. J. Keller and Associates)
- Incorporate injury prevention measures into a best practices guide (The Dallas Area Road Construction Work Zone Task Force)
- Develop safety training programs (Texas Engineering Extension Service, Laborers' Health and Safety Fund of North America, Washington State Department of Labor and Industries, and Wayne State University)

- Incorporate safety measures and FACE case examples into tool-box safety talks (highway and street construction companies)

In June 2000, the *Engineering News Record* published an article featuring the pending release of the NIOSH document.[4] The article noted that the document was much anticipated and included several of the injury prevention measures from the document.

The TI contractor reports on blind area diagrams and ITCP development were requested and used by the Washington State Department of Labor and Industries in developing recommendations for internal traffic control. PWS device manufacturers requested and used the blind area diagram contractor reports for product development and marketing. The blind area contractor reports have also been requested and used by individual construction companies for safety training. One of these companies used the reports for a company-wide safety stand down.[*]

In March 2004, The Bureau of National Affairs (BNA) published an article in its *Daily Report for Executives* that featured the ongoing TI research efforts to evaluate injury prevention measures on active road construction sites.[5] The article encouraged construction companies who were interested in participating to contact TI researchers. The article was written by a BNA reporter who attended a presentation by TI researchers at the 14th Annual Construction Safety Conference and Exposition.[6]

The National Asphalt Pavement Association (NAPA) commissioned an article for *Hot-Mix Asphalt Technology* to describe ongoing TI research efforts to evaluate injury prevention measures on active road construction sites. The article discussed the interventions being evaluated, data collection methods, and road construction site criteria.[7] The article also encouraged construction companies who were interested in participating to contact TI researchers.

What's Ahead:
The TI Program is continuing the effort to rigorously evaluate PWS and ITCP interventions on highway construction sites. Results of these studies will be published in peer-reviewed journals and disseminated to stakeholders in the highway and street construction industry in collaboration with partners including NAPA, ARTBA, NSC, and the Laborers' Health and Safety Fund of North America.

TI continues to include highway work zone fatalities as a target for FACE investigations to:

- Identify new risk factors and injury prevention strategies
- Identify, develop, adapt, and evaluate emerging technologies specifically related to PWS devices
- Influence the regulation activities of other governmental agencies such as OSHA by responding to proposed rulemaking and public comment notifications
- Respond to requests for information on highway and street construction worker safety
- Provide support to organizations advocating a safe work environment for these workers

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* A "safety stand down" is a suspension of company or organizational operations for the purpose of reviewing safety policies and procedures, and/or training employees.

- Communicate with EID on efforts to better understand and evaluate safety training programs designed for Spanish-speaking road construction workers

External Factors:
Several factors challenge TI research in highway and street work zone safety, including the following:

- Regulation for safe work practices in work zones falls under the jurisdiction of both the Federal Highway Administration and OSHA
- The industry is fractured by relatively small family businesses located in disparate localities
- The work environment is mobile with constantly changing variables (e.g., weather, construction phase)
- The industry base is changing with corporate consolidation, foreign investments, adoption of night work, and an increase in the number of non-English-speaking workers
- Field-based research is resource intensive requiring significant travel, personnel, and equipment expense

TI researchers have been relatively successful in meeting these challenges by partnering through alliance memberships that involve government, industry, and labor representation.

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2. Reduce injuries and fatalities due to falls from elevation

Introduction

One of the two leading causes of death and injury in the workplace (second only to motor-vehicle crashes), falls are responsible for disabling injuries to 313,000 American workers, and more than 700 occupational fatalities each year. Falls from elevations are a special concern. BLS (2004) data reveal that on average 651 American workers die and nearly 86,900 suffer an injury each year as a result of falls from elevation. The cost of a single fall-from-elevation injury usually starts at around $500,000 and easily reaches $1 million or more when third-party suits are involved in severe injury cases. The construction industry has the highest frequency of fall-from-elevation incidents, followed by the wholesale and retail trade, service, and transportation industries. Most often, construction workers fall from roofs, ladders, and scaffolds.

The first priority of the TI Falls from Elevations program is to seek engineering solutions to reduce fall hazards by conducting human factors and technology assessment studies.

Protective equipment provides the last line of defense for workers to prevent falls from elevations in cases in which work redesigns or engineering controls are inadequate or impractical. Occupational Safety and Health Administration (OSHA) regulations require that fall-arrest harnesses, guardrails, or safety nets be used as protective measures for tasks that are performed above six feet of height. Fall-arrest harnesses especially are used at various construction phases. Adequate fall-arrest-harness-sizing and design would reduce the risk of worker injury and thus is the second priority of the TI Falls from Elevations program.

Falls from telecommunication towers during either the construction or maintenance phase is an emerging issue that has required special attention, and thus is the third priority of the TI Falls from Elevations program.

Sub goal 2.1: Reduce worker falls from roofs

Issue:
In 2004, falls from roofs killed 178 workers and constituted the leading cause for work-related fatalities in the construction industry.[1] Falls from roofs are also a major cause of serious nonfatal injuries in the construction industry. In 2004, 2,220 workers were seriously injured after falling from roofs.[2] Research to understand human fall mechanisms and to identify preventive measures is critical to the reduction of fall-from-roof incidents.

The TI Program seeks to establish engineering solutions to control factors that contribute to falls from roofs and thus minimize the possibility of workers making unsafe choices or taking actions that could go beyond their capabilities. These solutions include new work strategies, improved tools, enhanced engineering products, and modified protective equipment. A comprehensive literature review by the TI Program team identified critical influential factors and major knowledge gaps in preventing falls from roofs.[3] The review assisted the TI Program in setting research priorities for this Sub goal area.

Approach:
TI Program work in this Sub goal area over the past decade includes:

1. Developing an adjustable roof guardrail assembly that can accommodate various roof pitches to protect workers from falling to lower levels during their roofing work
2. Validating virtual reality technologies for fall-from-roof prevention research
3. Identifying the effects of visual cues on balance control during roofing work
4. Developing improved footwear designs for work on roofs
5. Establishing sensory-enhancing technology to improve workers' balance on roofs
6. Developing safer scissor lifts and work practices to minimize fall-from-roof exposures and to enhance scissor lift safety

Outputs and transfers:
(For those outputs not specifically cited, see Appendix I: Supporting Evidence.)

Guardrail assembly. Temporary guardrails offer a solution for protecting workers from falling to the lower level during their roofing work. Most of the current guardrail systems are designed for use on low pitch roofs. The TI Program has developed a prototype adjustable roof guardrail assembly that can accommodate a higher roof pitch range (27^o to 63^o) increasingly being seen in new residential-building construction.[4] A utility patent application regarding the invention was filed in October 2005.[5] The TI Program held a public meeting in 2004 to transfer the invention into practice.

Virtual reality technology. The TI Program developed a surround-screen virtual reality (SSVR) system, the first SSVR system in the world designed for occupational fall prevention research. Validation studies have confirmed that the SSVR system is a valid tool for fall-from-roof prevention research.[6,7] The system is currently used to evaluate human performance at elevation, identify risk factors leading to fall incidents, and assess new fall prevention strategies.

Thousands of scientists, safety professionals, and construction trade representatives from around the world have visited the SSVR facility and consulted with TI staff on the application of this emerging and advanced technology to occupational safety research.

Visual cues' effect on balance control. TI Program publications in *Injury Prevention* and *Human Factors* journals have shown that at elevated environments, vertical visual anchors within 15 feet of a person's eyes can significantly reduce postural destabilization.[8,9] The findings have practical implications for improving workers' safety during roofing work. Temporarily, roof guardrails can serve not only as physical barriers to protect workers from falling, but also as visual anchors to reduce workers' postural instability at elevation.

Footwear for work at roof. The TI Program used virtual reality technology to evaluate the effects of different styles of footwear on workers' instability at elevation and has reported results to the safety scientific community.[10,11] Workers' balance on elevated and narrow surfaces was significantly improved with footwear styles that had high uppers and provided good motion control. Proper shoe selection and improvements in the design of specialized work footwear would enhance workers' stability at height.

Sensory-enhancing technology to improve workers' balance. TI Program researchers, in collaboration with researchers from Boston University, built and tested a prototype randomly vibrating ("smart") shoe insert to improve workers' balance at elevation. The smart-shoe insert increases the pressure-sensitivity under the feet by inducing below-sensory-threshold mechanical vibrations.

Safer scissor lifts and work practices. The TI Program has developed a preliminary computerized model that would be used to analyze the impact of the mechanical load of the lifts and operator's stability (e.g., side force and sway), on the scissor lift platform at different heights during various static and dynamic work conditions.

Progress toward Intermediate Outcomes:
All efforts under this Sub goal area are at the stage of transferring knowledge and technologies developed through research to research organizations and private-sector companies for further development and commercialization. The processes of transfer and commercialization can proceed for years before products are realized, marketed, and implemented in workplaces to reduce risk, thereby reducing injuries and fatalities. Although there are no end outcomes to report, there are promising intermediate steps to report.

Guardrail assembly. Four companies responded to a program announcement in the Federal Business Opportunities publication. TI sent the prototype guardrail assembly to all four companies. After reviewing the prototype, two companies—Garlock Equipment Company and Hug One, LLC—expressed interest in producing and marketing the invention. These companies are currently conducting product development and cost analyses, and evaluating potential agreements with the TI Program to carry forward this manufacturing and marketing venture. TI is intent on finalizing agreements with these manufacturing partners to commercialize the design.

Virtual reality technologies. Staff members from the Finnish Institute of Health and the Japan Occupational Health University have expressed interest in adopting the TI SSVR concept as a technological foundation on which to develop their fall prevention research laboratories.

TI Program researchers have used the technology to identify human fall mechanisms and evaluate engineering concepts for fall-from-roof prevention.

Safer scissor lifts and work practices. A letter of agreement (LOA) was signed in 2004 (running through 2007) between the TI Program and SkyJack, Inc., a leading scissor lift manufacturer. The LOA represents an agreement to jointly develop alternative aerial lift designs and safer work practices to reduce aerial lifts-related injuries and fatalities. The partner has provided two scissor lifts and related engineering support to the TI Program. Using volunteer participants, the TI research team is performing static and dynamic experiments on changes to center-of-mass of the scissor lift under various work scenarios. SkyJack is testing the computer simulation software developed by TI that analyzes lift performance under various work conditions to determine its applicability to design of new lifts.

Intermediate Outcomes:
The published literature review from this study[3] has been cited and used as course, research, and strategic planning materials by more than 50 entities.

What's Ahead:
Guardrail assembly. The TI Program expects to finalize and sign agreements in 2007 with two manufacturing partners with the intent to commercial (manufacture and market) the guardrail assembly design.

Virtual reality technology. A Web page regarding the TI SSVR facility and research activities will be established in 2007 to allow the international safety community to use the program as a validated method and advanced technological foundation to develop fall prevention research laboratories.

Visual cues on balance control. A lay-oriented practical work solution guide will be developed in 2007 to help workers and contractors understand the role of visual anchors during roofing work. This guidance will show how to set adequate temporary roof guardrails in order to maximize their function in protecting workers from falling, as well as in reducing postural instability during roofing work.

Footwear for work on roofs. A practical, lay-oriented guide will be developed in 2007 to help workers and contractors select adequate footwear for roofing work. Interactions with a leading work-shoe manufacturer (Iron Age Corp.) and the American Society of Testing Materials (ASTM) International Committee F13 (Safety and Traction for Footwear) will continue, with the goal of pursuing the best ways to transfer TI research results to the footwear design process.

Sensory-enhancing technology to improve workers' balance. The effect of this sensory-enhancing device on workers' postural stability will be evaluated in 2007 with motion analysis methods and in simulated construction environments using the SSVR system. At the end of the study, the research findings will be directly transferred to the Afferent Corporation, developers of the sensory-enhancing device (which was originally designed for medical applications), to facilitate its further development for application in the occupational safety field.

Safer scissor lifts and work practices. The TI Program will continue to perform static and dynamic experiments on the changes to center-of-mass of the scissor lift. Specifically, the program will conduct dynamic curb tests, depression tests, and driving and stopping (jerking) tests at a range of heights and with a range of loadings on the platform to validate computer simulation models. The study results will also provide critical information relating to scissor lifts to international standards committees for consideration in revising standards. These committees include the American National Standards Institute (ANSI) A92 Aerial Platforms Main Committee and various A92 sub-committees, the U.S. Technical Advisory Group to ISO Technical Committee 214 Elevating Work Platforms, and the Canadian Standards Association (CSA) B354 Elevating Work Platforms Technical Committee. Once successful tests are achieved, this joint TI-manufacturer research effort should ensure the commercialization and availability of new safety features on scissor lifts.

External Factors:
Multiple factors interactively affect the occurrence of falls from roofs. In the U.S., worker training on regulations (i.e., use of guardrails, safety nets, or fall-arrest systems) has for decades been the primary focus for preventing falls from roofs. However, many construction activities have been exempted from the regulatory requirements for practical reasons (i.e., technology, cost, and operation). In addition, research aimed at preventing falls has been hindered because of the difficulty in accessing work environments and worker activities at elevation (even with management and workforce cooperation), the dynamic nature in the construction industry, and even the potential injury risk to researchers. Also, testing new engineering solutions at elevated construction sites can expose workers to additional fall exposures and risks. Consequently, the fatalities and injuries associated with falls from roofs have remained high for decades.
The NIOSH TI Program for preventing falls from roofs was developed in the mid 1990s to address this major gap. It introduced bioscience research to better understand human fall mechanisms and develop innovative and cost-effective engineering solutions, such as new work strategies, improved tools, enhanced engineering products, and modified protective equipment. Recent advances in virtual reality, wireless sensing, and remote measurement technologies have enabled TI researchers to more effectively evaluate engineering interventions for fall protection.

The TI Program is transferring the new knowledge gained through research by developing low-cost engineering solutions to prevent falls from roofs. Industry cooperation in evaluating and implementing these solutions is an important component of the program. National success in reducing fall-from-roof fatalities and injuries in the next decade would be positively affected by:

1. Expansion of the national fall prevention program based on bioscience research and technology transfer with additional funding and human resources
2. Development of additional strong industry partners to commercialize new engineering solutions for fall prevention
3. Initiation of a national campaign to promote engineering innovations for fall prevention
4. Promulgation of a national safety standard that requires the implementation of effective new technologies to enhance worker safety during work on roofs

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Sub goal 2.2: Improve fall-arrest harnesses

Issue:
Fall-arrest harnesses provide the last line of defense to the 10.8 million construction workers in areas where fall hazards cannot be completely eliminated. Full-body harnesses replaced waist belts and chest-waist harnesses more than 10 years ago and are considered the standard body support component of a personal fall-arrest system in the United States and Canada.

Despite the important role played by harnesses as protective devices in construction and general industry, little has been published on proper fit and sizing and the physiological risk and traumatic exposure involved with falls from elevation that are arrested with harnesses. The anthropometric (human body measurement) data used in harness design are based on studies with military personnel in the 1970s and 1980s, and do not represent the current general U.S. worker population. Additionally, workforce demographics have changed, with more women and minorities employed in occupations that use harnesses. Resulting changes in the anthropometric characteristics of workers using harnesses mean that current sizing data is not only inadequate but also potentially dangerous.

Information is also lacking on how full-body fall harnesses fit workers when they are suspended after a fall. Research has shown that subjects experience respiratory distress within 5 to 30 minutes of suspension in a full-body harness. Updated information on human tolerance in suspended postures and on solutions to minimize suspension trauma is needed.

In short, the current limitations in harness design can result in non-use of harnesses, poor harness-user interfaces, improper size selection, or the failure to don harnesses properly, all of which can result in increased risk. The advanced technology and methods available through the TI Program makes it uniquely poised to redesign harnesses and sizing schemes to provide safer, more user-friendly, and ergonomically appropriate designs.

Approach:
The overall goals of this research effort are 1) the establishment of anthropometric guidelines for the design of improved full-body harnesses, and 2) the development of effective harness-sizing systems that will better accommodate the current population of U.S. workers.

The TI Program used an advanced scanning technology to perform whole-body 3D scans of workers in both standing and suspended conditions, the same conditions that workers would encounter during work and following a fall from height. The approach, which performed rapid 17-second whole-body scans, overcame a long-standing problem—human subjects in suspended conditions may go into respiratory distress in as little as five minutes, making tests with traditional, time-intensive anthropometric tools and methods unacceptable.

The TI Program then evaluated the range of body shapes accommodated by current sizing schemes and tested current "static fit" criteria for their usefulness in determining how well harnesses fit after a fall. Findings from these studies of workers in the construction trades showed that 24 to 40 percent of participants failed fit criteria for two types of harnesses, confirming the need for updated and accurate data on the interface between the human body and safety harnesses. Mathematical parameters were established to determine the points of contact between the human body in its various shapes and the safety harness, and to define optimal sizing schemes. Thigh strap angle and harness back D-ring location were identified as additional critical static-fit-test criteria to predict post-fall harness fit, which is important for future harness design.

The power of these studies was increased through the addition of data from an international study and attendant database of human shape. This anthropometric database of 2,340 subjects, known as CAESAR (Civilian American and European Surface Anthropometry Resource), was developed by a similar 3D scanning procedure by a consortium of industrial and government agencies, to provide an extensive database of the human form. Along with two harness manufacturers, the TI Program team has applied the mathematical parameters that were developed through the TI pilot studies to the CAESAR database to establish the adjustment range of each harness component. This is an important step to enable transfer of the scientific research results into industrial design practice. The NIOSH TI Program is one of the few international programs with the ability to perform this 3D digitization research and human-harness-interface modeling for harness design applications.

Further, a human physiology study was completed to determine the effects of an intervention to reduce physiologic stress to those in suspended conditions. A TI invention (a harness accessory) which automatically supports a wearer in a sitting position with the knees elevated at a position at or above the hips after a fall was found to increase suspension times for subjects. Mean suspension time was measured at 58 minutes (range 39 to 60 min) for the tests with the harness accessory, but only 29 minutes (range 5 to 56 minutes) for tests without the accessory.

Two major harness manufacturers (Mine Safety Appliances Co. and DBI-SALA Fall Protection Inc.) have actively participated in this research and are working with the TI research team to finalize the adjustment range of each harness component. These manufacturers have provided original static-test criteria, harness blueprints, and technical input for each study, and continued to provide feedback on proposed new sizing systems. They also are developing harness prototypes based on the proposed sizing systems and other TI Program study results reported above.

Outputs and Transfers:
(For those outputs not specifically cited, see Appendix I: Supporting Evidence.)

The research report on current harness-sizing issues and the effect of thigh strap angle and back D-ring location as additional harness static-fit-test criteria to enhance post-fall harness fit was published in the journal *Ergonomics* in 2003. The research received the prestigious International Ergonomics Association (IEA) Liberty Mutual Prize in Occupational Safety and Ergonomics in 2002. The information in the article is useful to construction employers and workers to ensure selection of the right size and proper donning of harnesses.

Findings from the human physiology study regarding the use of intervention technology to reduce suspension trauma potentials was presented at the American Industrial Hygiene Conference and Exposition in 2006. A provisional patent regarding the invention was filed in July 2006. The information will be shared with harness manufacturers along with the harness-sizing research results for the new generation harness design.

A provisional sizing scheme with an algorithm that describes the human torso shape-and-size distribution and a set of recommendations for producing vest-type harnesses has been accepted for publication by the *Human Factors* journal. A simplified version of the provisional sizing schedule was presented at the Ergonomics Society Conference and also published in Contemporary Ergonomics in 2005.

The draft report of a second provisional sizing scheme has also been shared with MSA and DBI-SALA.

Progress toward Intermediate Outcomes:
As mentioned, Mine Safety Appliances Co. (MSA) and DBI-SALA Fall Protection Inc. are currently developing prototype harnesses that incorporate the TI sizing scheme. Mine Safety Appliances Co. also has indicated interest in more extensive efforts to develop next-generation harness designs and prototypes using the criteria and schemes identified by the TI Program. MSA was strategically selected to participate in the TI pilot studies in year 2000, because company officials had previously expressed interest in revising fall protection designs using updated human form measurements. Both MSA and DBI-SALA also responded to a TI announcement in the Federal Business Opportunities in 2003 for partnership in harness-sizing studies and in transferring the knowledge to design and commercialization. Since the two manufacturers account for about 60 percent of the national market share of fall-arrest harnesses, the future adoption potential of the new harnesses and sizing systems in the construction trades is very high

What's Ahead:
NIOSH, two research contractors, and the two harness manufacturers are finalizing the adjustment range of each harness component. The final report was expected to be completed in December 2006. The two harness manufacturers and TI research team will complete prototypes of the new generation over-the-head harnesses in 2007. TI will use them to conduct studies to determine the validity and reliability of the second sizing system. Continued involvement with the manufacturing, standards, and user communities is anticipated. This will help ensure the diffusion of this technology throughout applicable industries. Additionally, dissemination of findings through peer-reviewed publications, conference presentations and proceedings, and focused fact sheets will remain a goal of research efforts. This project may also be extensible to other industries and internationally.

External Factors:
Support from stakeholders—including the Mine Safety Appliances Co., the American Society of Safety Engineers (ASSE), the International Safety Equipment Association (ISEA), the International Society of Fall Protection (ISFP) and California OSHA—has helped the TI Program obtain resources to advance scientific knowledge on formulating harness-sizing schemes and harness designs for various populations, including women and minorities, to assure the required level of protection, productivity, and comfort of harnesses to workers.

Active participation from the Mine Safety Appliances Co. (MSA) and DBI-SALA Fall Protection Inc. is facilitating the transfer of TI research to industry practice. Success in reducing fall-related injuries and fatalities on a national level, through the use of new generations of fall arrest harnesses, is expected. The following external factors would further enhance the outcome: 1) additional NIOSH funding and human resources to further the technology transfer for the subprogram, and 2) a national safety standard that requires the implementation of the updated anthropometric information in harness design to enhance worker safety during elevated work.

Sub goal 2.3: Reduce worker falls from telecommunication towers

Issue:
Between 1992 and 2005, 227 fatalities occurred that were associated with the construction or maintenance of telecommunication towers.[1] These included 178 deaths resulting from falls, 28 fatalities due to telecommunication tower collapses and 21 deaths from other causes which included, but were not limited to, electrocutions and struck-by incidents.[1] The leading causal factors involved in these fatalities were failure to use or the improper use of personal protective fall equipment, use of improper or inadequate hoisting equipment, lack of maintenance of hoisting equipment, lack of employer safety and health programs, and lack of structured training.[1]

Gross estimates of the risk for fatal injury for U.S. tower erectors suggest fatality rates from 10 to 100 times the average across all industries. While eight tower erectors lost their lives in 2005, 16 lost their lives in 2006. These numbers demonstrate that further work in evaluating this area of construction is necessary.

In 1996, in an effort to combat the high number of fatalities of their membership, and to gain consistent inspection procedures and regulation interpretations, NATE approached the U.S. Assistant Secretary of Labor. The Assistant Secretary instructed the National OSHA office to develop such procedures. As a result, the OSHA Telecommunication Tower Task Force was formed in April 1997. Members on the task force consisted of representatives from various government agencies, including two NIOSH representatives from the TI Program; and private industry groups, including NATE.

Approach:
TI reviewed Bureau of Labor Statistics and Occupational Safety and Health Administration (OSHA) data systems to identify and characterize fatal injuries incurred by workers constructing or maintaining telecommunication towers for the years 1992 through 2005.

TI researchers investigated 10 incidents involving 12 telecommunication tower-related fall fatalities from the years 1992 through 2001. Investigations of these fatal events revealed several important causal factors that are outlined in the **Issues** section above.

Outputs and Transfer:
TI participated in Telecommunication Task Force efforts and provided input to the preparation and dissemination of several important directives and publications. Specifically, TI has provided data analysis, investigative findings, and technical assistance to OSHA, NATE, and other organizations in the collaborative effort to address this emerging problem.

NIOSH researchers developed and disseminated the NIOSH Alert—"Preventing Injuries and Deaths from Falls During Construction and Maintenance of Telecommunication Towers," DHHS (NIOSH) Pub. No. 2001-1561—based upon data analysis and investigative findings. This Alert is now being reprinted in Spanish.

Additionally, [10] FACE reports were published from the TI telecommunication tower-related investigations and widely disseminated through NATE conferences and OSHA training classes.[2-11] These reports are available on the Web at: http://www.cdc.gov/niosh/face/default.html.

TI authored two articles entitled "NIOSH—A Resource for Occupational Health and Safety Support"[12] and "Falls- A Deadly Hazard for Tower Workers"[13] in the October 1998 and March 1999 issues of the NATE monthly publication *Tower Times.* NATE also provides a direct link to the NIOSH homepage and to relevant NIOSH publications in *Tower Times.* (http://www.natehome.com/TowerTimes/Index.cfm)

Intermediate Outcomes:
The Telecommunications Tower Task Force reviewed the leading identified causal factors and, to address these factors, developed and issued a compliance directive entitled "Interim Inspection Procedures During Communication Tower Construction Activities" (OSHA Compliance Directive CPL 02-01-029 - CPL 2-1.29).[14] This document contains the procedures to be used during the inspection of tower construction sites and the procedures to be followed during tower construction. Procedures for the hoisting of materials and employees, hoist selection and use, and fall protection for erectors were outlined. To address falls from these towers, which were the leading cause of fatalities, 100 percent fall protection is now required. This means that tower erectors have to use fall protection (being attached to the tower or a safe climbing device) from the time they leave the ground until they return to the ground. The 100 percent fall protection and personnel hoisting requirements contained in the initial and revised directive were supported by TI investigative findings and data input and, when used correctly, decrease worker exposure to fall hazards.

In March 2002, the compliance directive was revised to remove the restriction that employees' workstations had to be over 200 feet above ground before they could ride hoist lines to the workstations. An erector can now ride the hoist line to the workstation no matter what the height off the ground. The new directive was entitled "Interim Inspection Procedures during Communication Tower Construction Activities" (Compliance Directive CPL 02-01-036 - CPL 2-1.36).[15]

TI data analysis, information from fatality investigations, and recommendations were used in the development of the North Carolina Telecommunication Tower Standard,[16] the first in the nation. This standard outlines the proper safety and health procedures to be used during telecommunication tower construction and maintenance.

NATE has disseminated more than 8,000 copies of the NIOSH Alert to conference attendees at their annual conference and expositions.

Data, investigative findings from TI tower-related investigations, and TI technical input and assistance were used to develop:

- An OSHA safety checklist for telecommunication tower construction safety
- A three-day OSHA train-the-trainer program designed for OSHA compliance officers, contractors, tower erectors, tower owners, wireless service carriers, and tower component manufacturers
- The "Recommended Best Practices Site Safety Manual" produced by NATE at the request of the Advisory Committee on Construction Safety and Health
- A comprehensive NATE safety and health manual

TI researchers provided the Safety and Environmental Compliance Office of the Federal Aviation Administration (FAA) in Miami with information that led to the successful development of a scope of work involving the retrofitting of a damaged NDB antenna tower at Great Inagua, the Bahamas**.** This information included procedures to identify damaged tower components and procedures to replace these components without causing further damage to the tower or injury to workers. The FAA was also provided NATE and OSHA contacts who could supply additional information on accomplishing repair and replacement operations safely.

The president of wirelessestimator.com developed an article on the use of TI telecommunication tower-related reports as training aids for the wireless industry. Wirelessestimator.com is a free Internet service for the wireless industry. According to this site: "Tower construction industry leaders and safety professionals believe that FACE reports can be used effectively to create a greater awareness of how fatalities can easily arise and what preventative measures can be taken to keep them from occurring." The article that includes links to the reports can be found at: http://www.wirelessestimator.com/t_content.cfm?pagename=Fatalities. This Website also includes commentary on some of the FACE investigation reports from industry specialists.

TI researchers provided the Principal Specialist Inspector United Kingdom Health and Safety Executive Technology Division and the Specialist Team Leader United Kingdom Health and Safety Executive Technology Division with safety and health information developed jointly by TI, OSHA, and NATE pertaining to radio frequency (RF) radiation and working safely at heights. This information was provided through links to the TI and OSHA Websites.

What's Ahead:
In November 2006, OSHA and NATE formally entered into a nationwide partnership agreement. This agreement will require, at a minimum, that companies entering the partnership have a comprehensive safety and health program, have a competent person as defined by OSHA on each construction site, have all supervisory personnel complete an OSHA 30-hour tower safety course, and have all other workers on site complete an OSHA 10-hour safety course. Partner companies cannot have experienced a fatality within three years that resulted in a serious or willful violation. TI will continue to provide OSHA and NATE with updated statistics, investigative findings, suggested injury prevention measures, and technical assistance as needed.

External Factors:
While tower erector fatalities have not exhibited a steady downward trend, the lack of accurate data on the numbers of tower erectors currently building or performing maintenance services on telecommunication towers precludes the calculation of fatal fall rates. Rates (number of fatalities per number of workers per year) would provide better estimations of changes in risk over time.

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3. Reduce injuries and fatalities due to workplace violence

Issue:
Workplace violence (WPV) resulted in 564 homicides in 2005, 9.9 percent of the total number (5,702) of fatal occupational injuries.[1] Of these homicides, 182 occurred in retail establishments; 68 in food service and drinking places; 58 during State and local justice, public order, and safety activities; 41 in transportation; 11 in healthcare and social service settings; and three in education.[1] In 2005 there were also 14,560 occupational injuries involving lost work days in private industry due to assaults and violent acts by persons (9,850 were in educational and health services and 2,120 in transportation and utilities).[2] The societal cost of workplace homicide during 1992-2001 was estimated to be approximately $6.5 billion at a mean cost per homicide of $800,000.[3]

In FY 2002, Congress appropriated $2 million to the TI Program to "…develop an intramural and extramural prevention research program that will target all aspects of workplace violence and to coordinate its efforts with the Departments of Justice and Labor."[4] This allowed, for the first time, targeted extramural funding of research projects on workplace violence, including five grants that were funded in late FY 2002. The intramural research program has also been enhanced and includes a strong outreach component. Approximately 25 percent of the 2002 initiative funds have supported intramural WPV research, while the other 75 percent of the funds have gone for extramural WPV research activity.

Approach:
Historically, the Traumatic Injury (TI) workplace violence program has been focused on surveillance and reporting of WPV homicides and nonfatal injuries; causation, prevention, and prevention evaluation research in high-risk industries; and consensus building with national experts, stakeholders, and other Federal agencies for the development of strategic planning.

TI surveillance of work-related homicides and nonfatal WPV assaults has identified high-risk worker groups and monitored the effectiveness of prevention efforts. The TI National Traumatic Occupational Fatalities (NTOF) surveillance system enabled TI to report on the number and rates of WPV homicides (and other causes of death) in the 1980s and early 1990s when no other systems were available to provide an accurate count of workplace injury deaths.[5,6] More recently, TI has analyzed and disseminated occupational fatality data, including WPV statistics from the Bureau of Labor Statistics' Census of Fatal Occupational Injuries (CFOI) system.[1] In order to address the lack of statistics on the number and rate of nonfatal WPV injuries, TI developed and inserted modules of questions on WPV assaults, risk factors, and preventions into three national surveys during 2002-2006. These surveys are discussed in the Outputs and Transfer Section.

The TI intramural research approach is driven by surveillance data to focus on high-risk workers. During 1990 to 1998, the TI research focus was on identifying risk factors and identifying and evaluating prevention measures for workers with the highest risk of fatalities.

These included Type I violence* due to robbery of convenience stores and taxicab drivers. Since 2002, with the receipt of Congressional WPV initiative funds, the TI has expanded its research focus to include workers at high-risk of nonfatal WPV assaults in service industries (psychiatric hospitals workers and teachers) and on models for dissemination of known successful interventions into high-risk retail businesses (small grocery stores, gas stations, bakeries and donut shops, eating and drinking places, motel/hotels, and other high-risk retail businesses).

The TI extramural approach has focused research on all WPV types and has complemented the intramural effort. NIOSH funded 16 grants in WPV during 1996 to 2003. Response to the TI 2002 WPV RFA employing extramural WPV initiative funds was extraordinary and five research grants were funded in 2002, totaling $1.8 million. Of the 16 grants, five have focused on retail business workers, eight on healthcare and social service workers, one on police officers, one on long-haul truckers, and one on domestic violence in the workplace as research topics.

TI has sought to coordinate the development of a national agenda for WPV research agenda through periodic national conferences, workshops, and stakeholder meetings. TI has also sought to coordinate research collaboration between Federal agencies in accordance to stakeholder recommendations.

Outputs and Transfer:
(For those outputs not specifically cited, see Appendix I: Supporting Evidence.)

During 1991 to 1994, 11 papers were published that presented national surveillance data on the number of and risk factors for WPV homicides.[7-17] TI research has been widely quoted in the literature and cited in OSHA guidelines. These papers have been cited in 154 publications.

More recently, one paper was published on the cost of WPV fatalities[3] and one paper was been submitted for publication in 2006 on homicide trends from 1993 to 2002.[18] The homicide trends paper indicates that although WPV homicides are decreasing, public safety, retail workers, and taxicab drivers are still at high-risk of WPV homicides. These data will further shape future TI intramural and extramural research strategic goals.

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* Workplace violence has been categorized into four types for public health attention (Merchant and Lundell, 2001):

Type I is criminal intent in which perpetrator has no legitimate relationship to the business or its employees, and is usually committing a crime in conjunction with the violence. These crimes include robbery, shoplifting, and loitering. A large portion of Type I violence occurs in the late-night retail industry.

Type II is customer/client violence in which a perpetrator has a legitimate relationship with the business and becomes violent while being served by the business. This category includes customers, clients, patients, students, inmates, and other groups for which a business provides services. A large portion of Type II violence occurs in the healthcare industry, in settings such as nursing homes or psychiatric facilities where the victims are often patient care-givers. Police officers, prison staff, airline employees and teachers provide other examples of workers exposed to this violence.

Type III is worker-on-worker violence, in which the perpetrator is an employee or past employee of the business who attacks another employee.

Type IV is personal relationship violence in which the perpetrator does not have a relationship with the business but with the victim. A NIOSH study of the CFOI data on workplace homicides from 1993-2002, disclosed that Types I, II, III, and IV accounted for 82 percent, 3.8 percent, 8.2 percent, and 5.4 percent, respectively, of all (8,148) workplace homicides (Hendricks, Jenkins, and Anderson, in press 2006).

TI published a NIOSH Alert on occupational homicides in 1993[19] and a Current Intelligence Bulletin on WPV in1996.[20] Other publications provided additional reviews and recommendations.[21-26] These publications were groundbreaking reports—the first to highlight the problem in WPV on the national level.

TI disseminated its publications to other Federal agencies for use in development of WPV recommendations by these agencies. For example, TI made recommendations to OSHA, the Office of Personnel Management, and the FBI. See the Intermediate Outcomes section for more detail about outputs from these agencies.

Following the Alert and other NIOSH publications, TI responded to a large volume of media requests for WPV information. TI staff completed an on-air interview on "CBS Evening News" and contributed to CNN and national AP stories. ABC, NBC, CBS, and CNN radio provided coverage, along with the "Today Show" and "Good Morning America," and local media outlets. Over the past decade, other TI researchers have completed national television and radio interviews on the topic of WPV. TI has also responded to requests for print media interviews, often being called upon for expert input after specific incidents of workplace violence.

In addition to media interviews, In 2002 TI published a pamphlet on occupational hazards in hospitals [27] and in 2004 TI produced a DVD entitled "Violence on the Job"[28] to further disseminate its WPV recommendations.

During 1990 to 1998, TI conducted intramural research on robbery and robbery-related risk factors injury among late-night retail workers which confirmed the effectiveness of elements of Crime Prevention through Environmental Design (CPTED) programs to prevent robbery and associated injuries. This research confirmed recommendations in NIOSH Alerts and OSHA guidelines. Four papers [29-33] were published from four convenience stores studies and results were presented at three national conferences and meetings. The papers have been cited 25 times in other journal articles.

Because of the lack of detailed surveillance data on nonfatal workplace violence, NIOSH funded modules of questions to be inserted into three national surveys during 2002 to 2006. The purpose of these surveys was to evaluate workplace security operations, types and status of WPV programs and policies, employee training, and reporting procedures. These surveys include a special victims' survey of workplace risks conducted for TI in collaboration with the Bureau of the Census and the Bureau of Justice Statistics as part of its National Crime Victimization Survey (NCVS), a telephone interview survey of workers who were treated for work-related assault injuries in a sample of U.S. hospital emergency departments through the Consumer Product Safety Commission's National Electronic Injury Surveillance System (NEISS), and a survey of employers with regard to workplace violence policies, training, and related issues conducted in collaboration with the Bureau of Labor Statistics (BLS) during 2005 and 2006. Two papers, currently in draft form, report on data from the 2002 to 2006 NCVS and NEISS surveys.

Between 1990 and 2005, TI researchers made at least 51 presentations on workplace violence at various occupational safety and health, public health, and criminology scientific conferences. Thirty-six of these were invited presentations. In addition, 17 invited presentations were given at labor or industry forums specific to workplace violence. NIOSH expertise is recognized and sought not only by research colleagues but also by industry and labor representatives. In 2001, during a Congressional Briefing sponsored by Senator Harkin and Representative Leach, Jim

Merchant (University of Iowa) argued for increased Congressional funding and identified NIOSH as taking a leading role in the national WPV effort.[34]

In a 1996 “Occupational Medicine: State of the Art Reviews” volume, there was one NIOSH-authored article.[13] Eight of the other 13 articles in this volume specifically referenced NIOSH research and recommendations while one reported the findings from a NIOSH-funded study. In the 2003 “Clinics in Occupational and Environmental Medicine” special volume on workplace violence, there was one NIOSH-authored article;[25] six of the other 12 articles specifically referenced NIOSH, and two articles reported findings from NIOSH-funded studies.

With regard to extramural research outputs, NIOSH awarded 16 grants in workplace violence during September 1999 to September 2002. Nine grants involved research on workplace violence risk factors and seven involved evaluations of interventions. Of the 16 grantees, six who provided summaries of their outputs had 43 publications and 62 presentations. Outputs from an example of some of these extramural grants are highlighted below:

During 1999 to 2002, NIOSH funded UCLA to develop and evaluate the Workplace Violence Prevention Program (WVPP) in 314 Los Angeles retail establishments. This project demonstrated a reduction in all violent crimes of more than 30 percent and in robbery more than 50 percent in high compliance establishments compared to non-intervention comparison groups. UCLA published three publications from this NIOSH extramurally funded research and a fourth has been submitted for publication. UCLA’s WVPP was subsequently implemented by Santa Monica and Oxnard police departments which completed intervention projects in more than 60 retail establishments. There were nine publications from this study.

a. NIOSH funded an evaluation of the “OSHA Guidelines for the Prevention of Violence in Health Care and Social Service Settings.” Researchers from the University of Maryland and the New York State Public Employees Federation partnered to implement and evaluate the OSHA healthcare guidelines in mental healthcare facilities. Particular emphasis was placed on the elements regarding management commitment and employee involvement in the development and implementation of specific violence prevention strategies in these facilities. There were four publications from this study.

b. NIOSH funded UCLA to evaluate the California OSHA “Guidelines for Security and Safety of Health Care and Community Service Workers” and California Assembly Bill 508: the California Hospital Safety Act. The evaluation included both process and outcome components in approximately 200 hospitals in California and New Jersey. The process evaluation identified changes in safety protocols and procedures, equipment, and training, as well as environmental and work practice modifications made in response to these State initiatives. The process evaluation also gauged each hospital’s efforts to identify and respond to their individual risks through risk assessments and surveillance activities. The outcome evaluation examined changes in the incidence rate of assault events against employees before and after the initiatives. There were eight publications from this study.

In response to the Congressional funding initiative, TI created the Federal Interagency Task Force on Workplace Violence Research and Prevention with partners from the Departments of Labor and Justice and representatives from 20 Federal agencies. Details are provided in Appendix I: Supporting Evidence.

In 2003 TI hosted four stakeholder meetings in Washington, D.C. to gather input on how NIOSH could assist stakeholders in preventing WPV and to bring partners and stakeholders together to identify research gaps and direction for future research. Meetings were held on the topics of 1) healthcare, 2) domestic violence in the workplace, 3) retail, and 4) security/law enforcement. Attendees included municipal, State, and Federal government agencies, academia and professional associations, private industry and trade associations, security experts, and labor unions. A detailed description of the conferences, workshops, and meetings is included in the Appendix I: Supporting Evidence.

TI sponsored the national conference—Partnering in Workplace Violence Prevention: Translating Research to Practice— held in Baltimore, Maryland on November 17 to 19, 2004. A group of 182 representatives from a cross-sector of private industry, academics, trade associations, and Federal partners participated in this conference to make recommendations for a national WPV agenda. A conference summary document was published as a NIOSH numbered publication in September 2006.[35]

Intermediate Outcomes:
The contribution of TI surveillance and research likely contributed to an increase in research addressing WPV. The number WPV-related publications increased dramatically from 1970 to 2004 in the Medline database (see Figure 9 below).[36] Similar trends have been noted in the business, occupational safety and health, and legal literature. The dramatic upturn in interest in WPV, expressed in a high volume of published literature, occurred in the period from the late 1980s to the early 90s, coincident with TI surveillance findings and early reports in the literature indicating that homicide was a leading cause of traumatic occupational fatality.

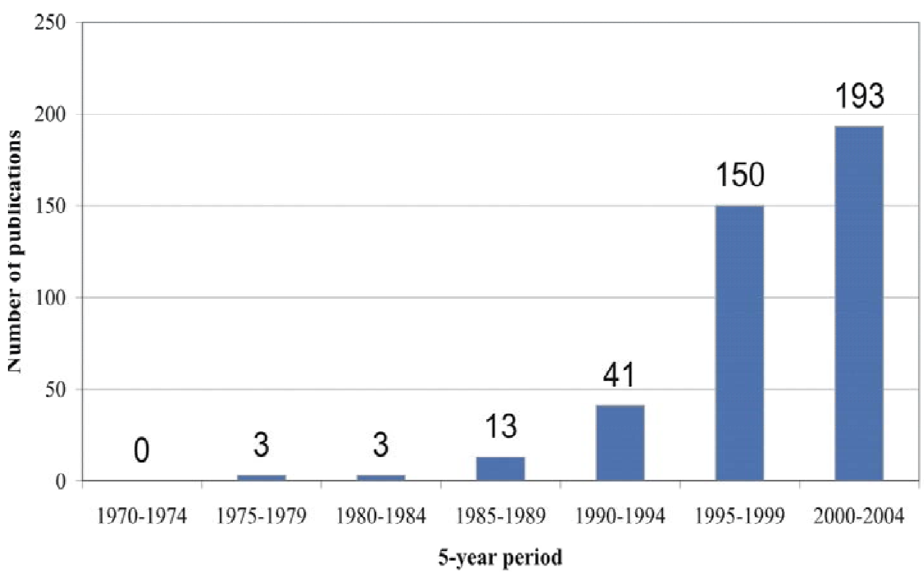

Figure 9: Medline entries for WPV for five-year periods from 1970 to 2004

In 1998, OSHA published its recommendations for WPV prevention programs in late-night retail establishments. 37 OSHA quoted TI surveillance and convenience store research.[5-7,29-33] The OSHA publication provided recommendations for management commitment and employee participation, worksite analysis of common retail robbery risk factors, security systems, prevention strategies (engineering controls/environmental designs, administrative and work practices, and post incident response), training of workers, and incident reporting and recordkeeping.

In 2000, OSHA published a fact sheet for recommendations for WPV in taxi and livery drivers.[38] OSHA quoted the NIOSH 1996 intelligence bulletin.[20] The fact sheet described the problem, risk factors, safety measures, employer responsibilities and rights.

In 2004, OSHA published guidelines for preventing WPV for healthcare and community service workers.[39] OSHA quoted NIOSH 1996 current intelligence bulletin and NIOSH recommendations for hospitals.[20, 27] The guideline provided recommendations for engineering controls and workplace adaptations, administrative and work practices, employer response, training, and recordkeeping and evaluation.

TI research and the OSHA recommendations[37-39] likely influenced many State and local workplace violence policies and regulations, although this has never been validated. TI assessed State-based approaches to WPV prevention and developed a compendium of State-based regulatory policies.[40] By October 2005, all but three States had developed workplace violence training materials, publications, or other guidance—10 had WPV policies, 15 had general WPV statutes, 11 had employers restraining order statutes, three had late-night retail statutes, and two had healthcare statutes.[40]

In 1998, The U.S. Office of Personnel Management (OPM) published a guide for agency planners in dealing with workplace violence.[41] NIOSH participated on the interagency workgroup which developed this guideline. The guide provided comprehensive approaches to analyzing and responding to threats or violent incidents in Federal workplaces.

The FBI published the proceedings of a 2002 symposium/workshop to address issues in response to workplace violence.[42] TI participated on the workgroup which developed these guidelines. The guidelines provided for threat assessment and management, crisis management and critical incident response, and legislative and research recommendations.

In 2005, the American Society for Industrial Security (ASIS) prepared guidelines for WPV prevention and response.[43] TI staff, at the request of the ASIS, participated on an expert panel to develop guidelines for WPV prevention and response in 2005. These guidelines were developed, submitted for public review and comment, and then published as consensus standards in late 2005.

During stakeholder meetings and conferences, partners and stakeholders provided recommendations on WPV research needs and roles for NIOSH, other Federal partners, State agencies, the private-sector, and other organizations.

Recommendations for future research from the 2004 conference[35] include:

1. Establish a national strategy/agenda
2. Conduct evaluation research
3. Develop consistent WPV definitions
4. Ensure consistent and universal reporting
5. Share data among partners
6. Conduct economics research

In addition to the NIOSH roles in conducting, collaborating in, and coordinating WPV research, these principal roles were suggested for NIOSH:

1. Developing and keeping a clearinghouse of information about WPV
2. Developing data gathering standards and a reporting system that capture all WPV events (verbal abuse and physical assaults)
3. Leading an effort to make WPV more visible

End Outcomes:
The number of workplace homicides decreased significantly from 1,074 in 1993 to 570 in 2004 (See Figure 10 below). The greatest decline in workplace homicides has been in the retail industry (from 525 in 1993 to 160 in 2004). Although progress has been made in reducing workplace violence, homicide is still a problem among police and security workers, late-night retail workers, and taxicab drivers. Additionally, workplace assaults leading to nonfatal injuries is a problem among police and security workers, late-night retail workers, taxicab drivers, bus drivers and other transportation workers, healthcare workers particularly in psychiatric facilities, and teachers.[2]

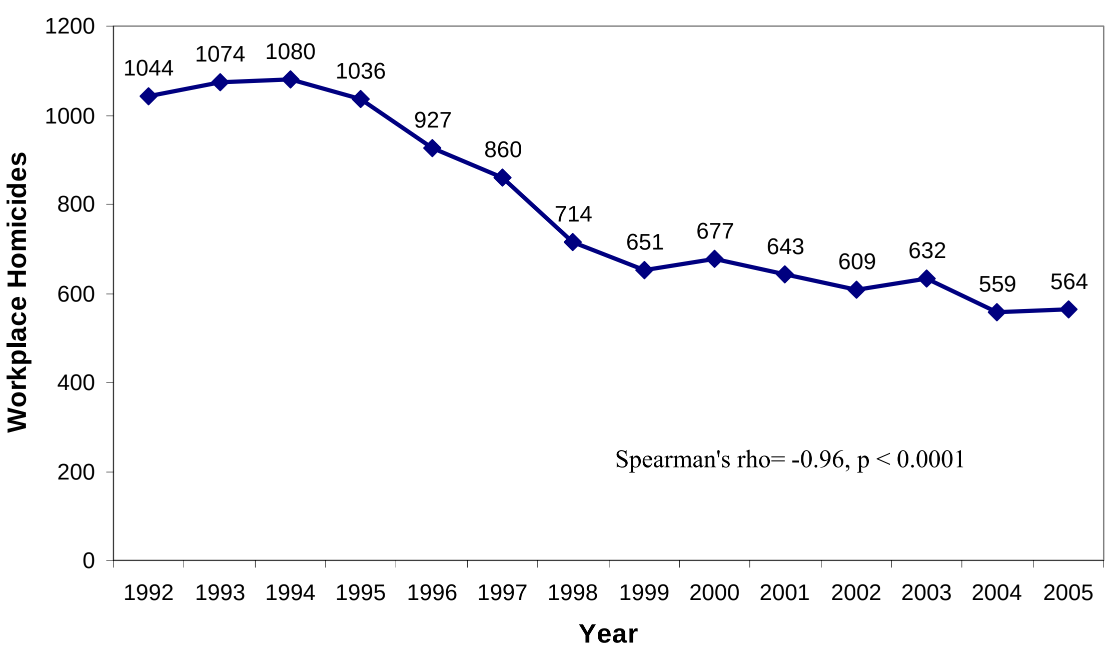

Figure 10. Number of Workplace Homicides in the U.S., 1992-2005
Source: BLS Census of Fatal Occupational Injuries (CFOI).[1]

TI surveillance data, research findings, coordination efforts, and extensive outputs and transfer activities have likely contributed to the decline in workplace homicides. However, many partners and stakeholders have also contributed. In addition to TI, a list of potential contributors to the reduced toll would have to include:

- Academic and industry security research in convenience stores, 1980 to 1998
- The National Association of Convenience Stores industry prevention guidelines
- The 1998 OSHA recommendations for robbery prevention in late-night retail establishments[37] and 2000 fact sheet on prevention measures for taxicab and livery drivers[38]
- State and local ordinances, polices, and training focusing on retail establishments and taxicab drivers
- Local community policing programs implementing CPTED elements in convenience stores, restaurants, banks, and shops
- Advocacy group pressure

What's Ahead:
The TI strategic plan aims to reduce WPV through evaluation and dissemination of effective interventions in high-risk industries and occupations. The TI Program plan will continue to focus on late-night retail clerks, healthcare and social service workers, teachers, and taxicab drivers, and other high-risk occupations. The TI WPV agenda will continue to build on previous research and achievements.

The TI Program will continue to collect, analyze, and disseminate national statistics on WPV homicides and nonfatal injuries. This will include analysis of BLS CFOI data, the National Electronic Injury Surveillance System (NEISS) emergency room data, BJS National Crime Victimization Survey data, and BLS Employer Survey data. TI will continue to monitor trends and impact of interventions. For example, TI will complete analyses and publications on the three national surveys to provide national statistics on nonfatal workplace violence. Additionally, these agencies will periodically be funded to continue to provide nonfatal WPV statistics.

NIOSH funded permanent changes to the NCVS to improve the quality and level of detail available to characterize workplace victimizations on an ongoing basis. For example, industry and occupation coding has been added to the NCVS for respondents who report experiencing workplace victimization. More detailed categories have also been added for variables describing the relationship of victims to offenders and the locations of work-related victimizations. These changes that were implemented in collaboration with the Bureau of Justice Statistics and the Bureau of the Census became effective in June 2001. These enhancements will allow continued monitoring of the nature and magnitude of workplace victimizations in addition to the in-depth, one-time surveys described above.

TI researchers have partnered with the former UCLA WVPP project research team to evaluate the administration of the WVPP using a community policing model. The goal of the TI approach is to facilitate development and to confirm the effectiveness of models which will increase enrollment and compliance of retail establishments to programs such as UCLA's WVPP. Community policing models which incorporate community organization involvement are to be evaluated. This project is now being developed for FY 2007 initiative funds.

Proposals for studies in general medical care and psychiatric care have been formulated. TI researchers have partnered with Veterans Home Administration (VHA) researchers to evaluate an intervention to reduce verbal threats and physical assaults to workers in VHA psychiatric hospitals. Pilot studies by the VHA have shown that WPV-focused twice-weekly community meetings between nurses and patients can reduce violent workplace events by as much as 50 percent. If future TI research in VHA hospitals supports the pilot findings, the intervention will be evaluated in private-sector psychiatric hospitals.

TI intramural researchers have also proposed to identify circumstances of WPV among teachers and other service workers, and to evaluate the effectiveness of current intervention programs.

TI will continue consistent with its Congressional mandate to work with other Federal agencies to conduct research to reduce workplace violence in the Federal sector. NIOSH will continue to sponsor workshops and conferences to promote and support WPV research and to help shape and achieve national strategic goals.

External Factors:
A variety of external factors have affected the evolution of the TI WPV program. For example, the distinction between public health and law enforcement objectives must be considered. Support from law enforcement agencies has provided some unique surveillance, risk factor, and intervention evaluation opportunities in convenience store robbery prevention research. On the other hand, lack of support from some law enforcement agencies has caused difficulties in the evaluation of State and local ordinances requiring taxicab or convenience store security measures.

Some businesses were unwilling to participate in WPV intervention evaluation studies for a variety of reasons, including distrust of researchers, inability to afford costly interventions, perceptions that their workers were not at sufficient risk to warrant the intervention, or concern with advocacy group and regulatory pressure for tighter security measures (such as multiple clerks on the third shift in convenience stores).

Resistance to the promulgation of Federal, State and local regulations for WPV prevention is a factor. For example, despite the evidence of effective intervention approaches, only three States have thus far adopted late-night retail (convenience store) ordinances.

Another factor impeding researchers is the difficulty they have in obtaining detailed nonfatal WPV injury surveillance data.

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4. Reduce injuries and fatalities due to machines

Introduction

Many workers operating or working around hazardous machinery or equipment are killed or injured. For the period 1980 to 1997, data from the National Traumatic Occupational Fatalities (NTOF) surveillance system documented that machinery was the third leading cause of death after motor-vehicles and homicides, accounting for approximately 13 percent of the total fatalities. Industry divisions with the highest number of fatal injuries due to machinery were: agriculture, mining, manufacturing, and construction.[1] More recent fatal and nonfatal occupational data confirm that machines are still a problem in the workplace. According to data from the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI) for 2005, on average, approximately 770 workers (14 percent) are fatally injured by some type of machine, plant and industrial powered vehicle, or tractor each year in the U.S. Tractors were the primary source of the largest number of such deaths (219), construction, logging, and mining machinery resulted in 199 deaths, forklifts in 94 deaths, and agriculture and garden machinery (excluding tractors) in 65 deaths.[2] Nonfatal injury and illness data from the 2005 BLS Survey of Occupational Injuries and Illnesses indicated that machines, plant and industrial powered vehicles, or tractors were the source of injury for 96,540 private-sector workers (eight percent) with lost-time injuries or illnesses.[3]

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Sub goal 4.1: Reduce injuries and deaths caused by tractor rollovers by increasing availability and use of effective roll-over-protective structures (ROPS)

Issue:

According to data from the BLS Census of Fatal Occupational Injuries, 1,894 agricultural workers died from tractor-related events between 1992 and 2000; 991of these deaths were due to tractor overturns.[1] The majority of these deaths involved farmers and farm workers over the age of 55 years. This same age group has also been found to have the highest fatality rates due to tractors. The use of roll-over-protective structures (ROPS) and seatbelts has been shown to be effective in preventing tractor overturn-related deaths and injuries.[2,3] TI Program data indicate that only 38 percent of tractors used on farms in the U.S. had a ROPS in 1993; this had increased to 50 percent in 2001.[1,4] The fatality rate for farm workers from tractor overturns has decreased only slightly since 1992.

Tractor data from the TI Program's Traumatic Injury Surveillance of Farmers (TISF) indicate that many tractors still in service were manufactured prior to the release of ROPS as an option on farm tractors in the mid- to late-1960s.[4,5] In addition, these non-ROPS tractors are primarily small to medium size "utility" tractors (tractors between 20 and 90 horsepower) used primarily on farms such as livestock operations (including dairies), field crop operations, and fruit and vegetable operations. Agricultural safety professionals have identified several barriers preventing farm operators from placing ROPS on tractors, including the cost and inconvenience of placing ROPS on older farm tractors. Additionally, for some agricultural operations, ROPS may interfere with tractor use in low-clearance areas.

The three types of farming where clearance is a major issue are livestock operations, dairy operations, and fruit/nut tree operations (because of the need to drive tractors into animal facilities or through rows of trees in an orchard). Based on 1993 tractor survey data, these farms accounted for about 2.7 million tractors, of which 67 percent did not have ROPS.[9] While it is not possible to say that all of these tractors do not have ROPS because of clearance issues, it does show that these farms had lower than average ROPS usage. TI is unaware of any data on whether farmers deferred buying new tractors because ROPS were standard on new tractors. While there are fold-down ROPS available for low clearance use on new tractors, they require the operator to manually put the folded ROPS into the upright position upon exiting a low clearance area.

Another issue that impacts ROPS design is the lack of updated anthropometry (human body measurement) data for agricultural populations that operate tractors. Inappropriate fit of people to workplace vehicles and equipment can directly or indirectly result in injury to workers. Individuals in the United States are becoming taller and heavier with time. Much of the available anthropometric data used in assessing the fit or design of machines in the workplace, including tractors, are outdated, two-dimensional, and do not typically include data on working women and minorities.

Approach:
Based on the tractor demographic data and the barriers to ROPS use identified by others, TI has undertaken an intramural program to increase the use of ROPS on farms in the United States. The program involves surveillance of ROPS use, evaluation of the cost-benefit of ROPS, and engineering research to develop ROPS designs that address common barriers.

In 1994, the TISF system was established as a means of collecting occupational injury data for farmers and farm workers across the United States. In addition to injury information, the TISF collected data on tractors used on U.S. farms and whether these tractors had a roll-over-protective structure (ROPS). TISF collected data on the tractor manufacturer, model, age, ROPS status, and the hours of use of each tractor on a farm. Farms averaged more than two tractors each with an average age of more than 20 years. More than 60 percent of U.S. farm tractors were without a ROPS. In addition to providing baseline tractor information for TI and others in the agricultural safety and health community, these TISF tractor data enabled TI researchers to estimate the most common tractor models used on farms that were without ROPS. The TI Program used these data to identify common older tractor models for assessing their structural integrity—particularly their ability to support ROPS structures during overturns—and for designing new ROPS for retrofitting them.

Although TISF was discontinued in 1997, surveillance of occupational injuries to farmers and farm workers was re-established through the Occupational Injury Surveillance of Production Agriculture (OISPA) project. As with the TISF before it, OISPA collected demographic and ROPS use information on farm tractors used on farms in the U.S. These data indicated that the use of ROPS had increased in the United States between 1993 and 2001, with nearly 50 percent of all tractors in use on farms having either a ROPS roll bar or a ROPS cab in 2001. Roll bar style ROPS showed the largest increase in use (75 percent). Historically, tractors have had a long useful lifetime and the average age increased somewhat over the eight years between surveys.

Figure 11: AutoROPS prototype test, 1999

The distribution of the most common tractors without ROPS changed little between the surveys, with the oldest tractors, the Farmall models, being slowly taken out of service.

Based on the tractor information collected through the TISF, a cost-effectiveness assessment of retrofitting tractors with ROPS was conducted.[4] The study concentrated exclusively on fatalities due to tractor overturns. The key findings from the study were that the immediate ROPS retrofitting of the most common farm tractor model in 1993 would save nearly 1,500 lives over 20 years at an estimated savings of $825,000 per life. The paper also found that a 1985 ASAE voluntary standard to place ROPS on all farm tractors manufactured after 1985 was having an impact on the use of ROPS. But the paper concluded that it would take 20 to 25 years for the standard to increase the use of ROPS on farms sufficient to cause a major reduction in tractor overturn deaths. A more complex economic analysis incorporated the cost of nonfatal injuries with the cost of fatal injuries associated with tractor overturns.[7,8] This analysis found that retrofitting tractors with ROPS would save approximately $490,000 per averted injury, and that the United States could save approximately $1.5 billion by retrofitting tractors with ROPS.

The TI engineering approach is focused on development of an auto-deploying ROPS (AutoROPS) for use in low clearance areas, and cost-effective ROPS designs (CROPS) for retrofit. While conducting this work, TI researchers began to have concerns about the anthropometric data used to define the ROPS protective zone for national consensus ROPS standards. This resulted in a separate research project to collect anthropometric data on a large sample of farm workers.

In 1993, the TI Program began development of AutoROPS, and in 1995 it began development of an AutoROPS overturn sensor. A ROPS was needed that could be lowered and latched for day-to-day use, but that could deploy during an overturn. Plus, an overturn sensor was required to monitor tractor operating conditions and provide a signal that would deploy the AutoROPS when needed. By 1999, TI had developed workable devices. The AutoROPS was tested at West

Virginia University and the sensor was tested in an intramural TI Program laboratory. However, to verify that the components would work together, TI conducted field tests. In the spring of 2000, the first AutoROPS overturn test was conducted at the NIOSH Pittsburgh Research Laboratory (PRL). It showed that the AutoROPS worked. Subsequent testing refined the AutoROPS structure and sensor designs.

In June, 2003, TI placed an announcement in the Federal Business Opportunities publication, soliciting equipment manufacturers for a partnership. TI subsequently entered into a partnership with SCAG Power Equipment. SCAG wanted TI to develop an AutoROPS for a line of zero turn lawn mowers.

TI secured a grant through the California State University—San Bernardino, Office of Technology Transfer and Commercialization (OTTC) to continue work with SCAG. (The OTTC mission is to promote the transition of new technologies to the marketplace.[10]) A new AutoROPS was developed with SCAG for its Turf Tiger zero-turn commercial mower. TI petitioned the American Society of Agricultural and Biological Engineers (ASABE) to begin work on a performance standard for the AutoROPS–ASABE-X599, Standardized Deployment Performance of an Automatic Telescoping ROPS for Agricultural Equipment. This standard was developed collaboratively by tractor manufacturers, ROPS manufacturers, academics, and government researchers. Once a standard is issued, manufacturers such as SCAG can begin producing the AutoROPS.

In 2000, a new NORA project continued the AutoROPS work. It included research for Cost-effective ROPS (CROPS) and composite ROPS. The CROPS research investigated the use of readily available commercial parts to construct a ROPS for different model tractors. Based on the estimates of common tractors in use without ROPS, the TI team chose 10 tractor models for CROPS designs. Initially, the researchers investigated different CROPS designs for a Ford 4600 model tractor (because TI already owned one). In 2002, the team successfully designed, built, and tested a CROPS design that passed the SAE-J2194 industry ROPS standard.

Having demonstrated that the CROPS could be a valid option for rollover protection, the team began work on five more CROPS designs. Through Federal Business Opportunities, TI solicited help from a ROPS manufacturer. A partnership with FEMCO resulted. FEMCO was responsible for manufacturing two of the five CROPS designs. Due to FEMCO’s production schedule, they have not yet produced any CROPS. The TI Program team completed the designs for all five tractor models. However, there were more models identified that required a CROPS design.

To address the gap in updated, reliable anthropometry data, the TI Program began collecting 3D body measurements of specific worker populations—including farmers and farm workers—using whole-body scanning technology. The use of 3D body form models allows designers and manufacturers to deliver more accurate, better fitting products through a substantial reduction in measurement error and a reduced reliance on body form assumptions.

A total of 100 agricultural workers were scanned using the 3D system.[11] The results showed that the vertical clearance for the current Society of Automotive Engineers ROPS standard is approximately 12 percent too short. In 2004, TI presented these data to the Society of Automotive Engineers J2194 Standard Committee for its consideration in updating the tractor cab dimension standard. To date there has been no revision to the SAE-J2194 Standard. If the standard is updated, it should have an impact on the design of the next-generation tractor cabs, affording better protection to the estimated six million tractor and farm machine operators in the U.S. Other uses of these data are also being explored.

Outputs and Transfer:
Tractor data from the TISF have been referenced in a minimum of 25 peer-reviewed journal articles based on a reference search for the manuscript "Roll-over protective structure use and the cost of retrofitting tractors in the United States, 1993" by Myers and Snyder [1995].

Economic analyses of ROPS retrofitting by NIOSH have been referenced in a minimum of 32 peer-reviewed journal articles based a search of the series of manuscripts published by Myers and Snyder, and Myers and Pana-Cryan.

TI has authored 15 peer-reviewed articles and 19 conference presentations on various topics including surveillance data on tractor-related injuries and fatalities, the anthropometry of the farm worker population, economic analyses related to tractor overturn deaths and ROPS, and engineering analyses of the performance and effectiveness of ROPS, AutoROPS, and CROPS. (See the Supporting Appendix section for a list of these outputs.)

Progress toward Intermediate Outcomes:
In 1985, ASAE adopted the voluntary standard S318.10, which recommended that all new farm tractors sold in the U.S. be fitted with a ROPS. TI estimates that more than 95 percent of all tractors used on farms manufactured after the adoption of this voluntary standard have a ROPS. The use of these newer ROPS–equipped tractors accounts for most of the 12 percent increase in ROPS use on farms.

A new standard for AutoROPS, ASABE-X599, Standardized Deployment Performance of an Automatic Telescoping ROPS for Agricultural Equipment, is in draft form and has undergone its first review by ASABE. This standard, once issued, will give the ROPS manufacturers required performance criteria to build and test the consumer availability of the AutoROPS.

Intermediate Outcomes:
Tractor data collected through the TISF survey were used by Colorado State University to help target engineering research evaluating the ability of pre-ROPS tractors to withstand the forces of a tractor overturn if a ROPS were designed and mounted on them. TISF tractor prevalence data were used to identify common tractors by manufacturer and model for ROPS retrofit evaluations (e.g., Ford 8-N). The TISF data were the only information source for prioritizing these research evaluations.

External Factors:
External factors affecting TI efforts include workers' lack of perceived need for ROPS or sense of urgency to obtain ROPS, and the attitudes and behaviors of manufacturers who are generally reluctant to assist in proving concepts or adopting new safety technology relevant to their products due to concerns about liability. Manufacturers, particularly those with a large share of the market, proceed slowly to finalize and prove new safety technology. Manufacturers are reluctant to implement new technology without a specific consensus standard addressing building and testing criteria. Voluntary standards from organizations like ASABE or SAE are critical to getting manufacturers to adopt new technology. Regulatory mandates for the use of ROPS have not occurred in the U.S., despite mandates in other nations, such as Sweden.

Small companies are often more willing than large "name brand" companies to partner with researchers and take risks in order to gain stature in the market. Therefore, a TI strategy was to work with small manufacturers. Another strategy was to engage with manufacturing partners (and relevant trade associations) early in the development process to seek their input and ensure their buy-in of the end product. Additionally, in the final stages of prototyping and testing, partnership agreements that share and formalize roles and responsibilities of both the government and the manufacturers help to avoid manufacturer efforts to forestall progress towards a proven safety technology. The importance of facilitating the development of product standards simultaneously with new technology was also an important lesson.

Also, the patent process is very time consuming and can significantly delay product adoption. TI is continuing to learn about the costs versus the benefits of patenting technology.

What's Ahead:

The TI Program continues to track the use of ROPS on farms through the OISPA project. Efforts to develop the X599 AutoROPS Performance Standard within ASABE are continuing,with the goal to have the standard published within the next two years. The CROPS project continues until the end of 2007. By then, TI expects to have reached an important intermediate outcome: a ROPS manufacturer offering CROPS as an alternative for consumers. The University of Kentucky is using OISPA tractor prevalence data from 2001 and 2004 for an economic analysis project of ROPS use on farms. The project includes analysis of tractor and ROPS use by hours worked, farming operation, and the need/feasibility of retrofitting ROPS to existing tractors. TI plans to complete five additional CROPS designs and is seeking a new partnership with a ROPS manufacturer for production and sale of CROPS.

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Sub goal 4.2: Reduce worker injuries and deaths caused by paper balers

Issue:
On average, approximately 800 workers in the U.S. are killed and 18,000 workers suffer amputations each year while using machinery. Between 1986 and 2002, 43 workers were killed operating recycling industry balers in the United States. Of these fatalities, 29 involved horizontal balers that were baling paper and cardboard.[1]

Machine-related deaths or injuries often occur when workers are servicing or maintaining machines. If machines are not properly de-energized and safeguarded during these tasks, hazardous energy can be released unexpectedly, causing injury to employees. Unexpected energy releases often occur when power is not turned off before workers begin servicing a machine, when power is unexpectedly turned on during the servicing process, or when stored energy is released (which can occur even when power is turned off). One-third of all hazardous-energy-release casualties occur while workers are cleaning or unjamming machines.[2] Balers, including paper and cardboard balers, often become jammed during regular operation, requiring the jammed material to be removed before operations can continue. Employees can mistakenly perceive the jammed machine to be safe since operation has stopped.

Current OSHA regulations are not specific for balers, but general regulations can be applied to situations encountered when using a baler. One important standard addresses the control of hazardous energy, also known as “lockout” or “lockout/tagout” (29 CFR 1910.147). The OSHA lockout standard requires that procedures be developed to place appropriate devices on the energy isolating mechanisms that either prevent (lock), or warn workers (tag) of the potential for unexpected energizing or release of energy.

Approach:
Although lockout/tagout procedures may reduce the risk of hazardous energy being released, they can be easily bypassed, ignored, or forgotten. A control system that automatically detects hazardous operating conditions and automatically responds to safeguard workers has been developed by TI researchers. This system, called JamAlert, detects a jam in a recycling baler by monitoring the strain that the shear bar experiences and the pressure at which the ram operates. If both of these values exceed a limit that is associated with jamming, the power to the baler is eliminated. A “captured key” method is used to ensure that the power cannot be returned to the machine until the employee is a safe distance away from the operating zone. This allows the jam to be cleared without the threat of an unexpected energy release.[3]

To develop this automatic protective device, TI researchers conducted laboratory tests to characterize the parameters of machinery jams and developed machine load (compression) signatures that occur during the compacting operation. A prototype device was designed and built that would respond to such parameters and shut off the power for safe clearing of the jam. The prototype was tested on a TI-owned and -operated baler under a variety of operational conditions, including those expected to produce a jam.

As part of the design effort, TI researchers worked closely with members of the ANSI Z245.5 Baler Safety Committee to ensure the prototype met or exceeded standards recommended by the committee. Also, equipment users, equipment builders, and safety device manufacturers have been consulted during the course of this research.

Outputs and Transfer:
The principal product of this research was the prototype protective device for baling equipment (JamAlert). An industry partner was recruited to carry forward field testing and commercialization. HJA International responded to this call and entered into a Cooperative Research and Development Agreement (CRADA) with TI. HJA has many years of experience in developing and marketing products for the recycling baler market.

TI researchers presented a paper at the 2005 American Society of Mechanical Engineers (ASME) International Mechanical Engineering Congress and Exposition concerning the laboratory testing that led to the JamAlert design recommendations.[3] An employee invention report and a U.S. patent application have been filed for the JamAlert.

The latest TI findings and program information on baler hazards was provided to the standards committee for the ANSI Z245.5 Standard on "Baling Equipment Safety" by the TI expert who served as a voting committee member.[3,4] Other members of the committee included safety experts from baler manufacturers, municipal waste authorities, and waste handling companies.

TI prepared and published a NIOSH Alert entitled "Preventing Deaths and Injuries While Compacting or Baling Refuse Material" (*NIOSH* Publication No. 2003-124).[5]

Intermediate Outcomes:
Findings from this research have been used by the ANSI Z245.5 standards committee in a revision of the Baling Equipment Safety standard. As an example, both the 1997 and 2002 revisions of the standard include a requirement for a key-lock on-off switch or similarly functioning security switch. This requirement resulted from a risk assessment conducted by TI researchers in 1995.[6] Users of the revised standard will be municipal and commercial recycling centers.

Baler manufacturers are already providing purchasers of new balers with safety equipment and safety instructions that meet the revised standard's requirements. Although ANSI standards are voluntary, OSHA routinely cites companies under the General Duty Clause, citing an ANSI standard as an indication that a hazard and the means for its control are generally known. As a result, all baler manufacturers should be meeting the ANSI Z245.5-2002 standard.

An earlier phase of this research involved a risk assessment study performed by TI that led to a decision by Congress (an amendment to the Fair Labor Standards Act) to permit workers under the age of 18-years-old to load, but not operate paper balers, particularly in grocery stores where cardboard boxes are baled for recycling.[6] The younger workers are permitted to perform baler loading specifically if the baler has safeguards that meet the ANSI Z245.5 standard.

What's Ahead:
The TI project team will continue supporting the work to be accomplished via the CRADA with HJA, International. TI researchers plan to coordinate design optimization and field testing of the JamAlert with HJA. Modifications may be needed to JamAlert to enhance its operation under routine use.

External Factors:
The primary external factor that has affected this project is convincing a company to invest its time and capital to manufacture the JamAlert device. Companies are not quick to invest money into something they did not design. With safety devices, another external factor is the issue of liability. Companies have to make sure that implementation of the device will not open them up to liability claims/lawsuits. When a company does show interest, it tends to move very slowly.

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Sub goal 4.3: Reduce injuries and deaths caused by machines through the conduct of fatality investigations and dissemination of prevention strategies

Issue:

A major difficulty in planning and prioritizing a research program to address machine safety is the large variety of machines, both fixed and mobile, used in a wide array of industrial settings. Occupational injury and fatality surveillance data do not usually have the degree of specificity required to accurately identify individual machines or types of machines involved in worker injuries and deaths, and enable an accurate comparison of risks among individual or types of machines. Even when surveillance enables researchers to identify machine-related injuries and deaths, rarely is enough information about the circumstances of the injury available to identify causal factors and potential prevention options.

One approach the TI Program uses to address the problem of machine-related fatalities is through the conduct of investigations through the Fatality Assessment and Control Evaluation (FACE) Program. Beginning in the mid 1990s, machine-related fatalities were selected as an investigation target area, although some machine-related fatalities had been investigated by TI staff prior to this time. Targeting machine-related occupational deaths for investigation has enabled TI staff to recognize and address machine hazards and to provide detailed case information and prevention recommendations to at-risk populations, regulators, machine manufacturers, and others whose actions and decisions impact workplace risk.

Approach:

The goal of the FACE Program is to prevent work-related fatalities and injuries by identifying work situations at high-risk of fatal injury and developing and disseminating prevention strategies to those who can intervene in the workplace.[1] FACE is voluntarily notified of selected occupational fatalities (currently machine-related, workers under 18 years of age, highway construction work zones, and Hispanic workers) by the Departments of Labor in the States of Maryland, North Carolina, South Carolina, Tennessee, and Virginia, Federal OSHA Area Offices in Ohio and Pennsylvania, and the Allegheny County Coroner's Office in Pittsburgh, Pennsylvania. All are in geographic proximity to the TI facilities in West Virginia to reduce travel expenses. FACE is also notified of work-related deaths of youth under 18 years of age across the nation by the Wage and Hour Division, U.S. Department of Labor. Additionally, through cooperative agreements, TI funds nine States to conduct fatality investigations in their respective States using the FACE methodology. The State-based FACE Program includes California, Iowa, Kentucky, Massachusetts, Michigan, New Jersey, New York, Oregon, and Washington.

Through on-site fatality investigations, TI staff members collect agent, host, and environment information from the pre-event, event, and post-event phases of the fatal incident via a case-series design to facilitate descriptive analysis of the incidents. These investigations are not conducted to find fault or place blame on employers or individual workers, but to better understand the chain of events and contributing factors that led to the fatal event and to develop recommendations for preventing similar deaths. The results of TI investigations are disseminated through narrative reports for each fatality, and all investigative reports are available through the NIOSH Website (http://www.cdc.gov/niosh/face/default.html).

Findings from FACE investigations are frequently combined with TI surveillance data to describe specific injury problems and develop prevention recommendations that are further disseminated through NIOSH-numbered publications such as Alerts, Workplace Solutions, and Hazard IDs. The results from the FACE Program have the unique capability to reach workers at risk through targeted dissemination of products to specific audiences that provide timely intervention strategies for reducing specific types of injury hazards.

Outputs and Transfer:
Since 1994, the outputs from these machine-related investigations have included 45 investigative summary reports and 10 NIOSH-numbered documents which address a variety of specific machine-related hazards, including:

- Crane tip-overs and contact with overhead power lines
- Compacting and baling refuse material
- Forklifts
- Skid-steer loaders
- Scalping from working with hay balers
- Rollover and struck-by hazards on ride-on rollers/compactors
- Hydraulic excavators and backhoe loaders
- Entanglement in wood chippers
- Explosion hazards from drilling into sealed frames on agricultural equipment

As part of the dissemination process, TI frequently targets specific audiences to receive information products based on the topic area. Prior to using this more targeted dissemination strategy (which TI began implementing in the 1980s) NIOSH-numbered documents were typically distributed to a general NIOSH mailing list of approximately 2,000 addressees. This approach was inadequate for transferring TI prevention strategies to the industries and workers who were at greatest risk from the identified hazards. During this time period, TI also began preparing documents with more focus on workers to facilitate implementation of the recommendations. This included a change in the physical appearance of the documents, such as a more eye-pleasing cover and improved document formatting for easier readability. Reader response cards included with each document provide feedback to the TI Program on how the information is used for injury prevention efforts in the workplace.

Below are examples of TI outputs from FACE investigations of machine-specific hazards.

During 2006, the Alert, "Preventing Worker Injuries and Deaths from Mobile Crane Tip-Over, Boom Collapse, and Uncontrolled Loads," was disseminated to a targeted mailing list of more than 8,600 specific businesses. These included:

- Heavy construction equipment rental (1,745 addresses)
- Steel erection (881 addresses)
- Telecommunications contractors (429 addresses)
- Masonry contractors (2,001 addresses)
- Demolition contractors (1,382 addresses)
- Machinery-movers and erectors (465 addresses)
- Utility contractors (1,119 addresses)

- Construction heavy projects (233 addresses)
- Other construction companies (387 addresses)

In 2004, based on the Alert, “Preventing Electrocutions of Crane Operators and Crew Members Working Near Overhead Power Lines,” TI mailed a packet of materials which included four crane-related FACE investigative reports and the recommendations summary page from the Alert to approximately 4,600 crane rental and crane service establishments across the nation. The information described crane-related injury risks and steps employers can take to prevent worker death and injury. Recipients were encouraged to use these materials for training purposes, toolbox talks, and as support for safety program development.

The TI Alert, “Preventing Deaths and Injuries While Compacting or Baling Refuse Material,” was distributed to paper baler manufacturers and trade associations. The Alert provides statistics on baler-related deaths, relevant machine and workplace standards, illustrative case examples, and concrete steps that employers and workers can take to work safely with these machines. A follow-up effort from FACE investigations of the serious hazards of working with paper balers led to an engineering research project by the TI Program which ultimately resulted in development of the JamAlert device described in Sub goal 4.2.

To address shared concerns about the incidence of young workers being fatally injured while operating forklifts, TI and the Department of Labor’s Wage and Hour Division (WHD) collaborated in December 2002 to send an information packet including three FACE reports and the summary sheet of recommendations from the TI Alert, “Preventing Injuries and Deaths of Workers Who Operate or Work Near Forklifts,” to more than 10,000 retail warehouses and storage facilities. This mailing also included a sticker that could be affixed to forklifts warning that no operators under 18 years of age were permitted.

During 2000 and 2001, TI received five reports of worker deaths associated with excavators or backhoe loaders. These incidents involved two fatal injury scenarios: being struck by the moving machine or by swinging booms and buckets, or being struck by quick-disconnect excavator buckets that unexpectedly detached from the excavator. In response to these incidents, TI developed a Workplace Solutions document entitled “Preventing Injuries and Deaths When Working with Hydraulic Excavators and Backhoe Loaders.” This publication is a non-technical and concise version of TI research targeted to the end user, e.g., safety and health practitioner, employer, supervisor, operator, foreman, worker or worker representative. The hazards and recommendations identified in this document also apply to other manufacturers and types of construction equipment. With the assistance of the Association of Equipment Manufacturers and its membership, TI disseminated more than 11,000 copies of this Workplace Solutions both nationally and internationally.

The Agricultural Health Nurse Program of New York State, funded by NIOSH, identified an incident that resulted in the scalping of a woman in New York when her hair became entangled in the rotating driveline of a hay baling machine. Subsequent investigation by TI staff identified four additional cases that had occurred, all females. The same model of hay baler was involved in all of these incidents. TI investigations indicated that when the women leaned under the driveline to adjust the tension on the hay bales, their hair became entangled in the driveline. The drivelines were covered by a U-shaped tunnel guard that left the bottom of the rotating driveline exposed. In response to these incidents, TI developed an Alert entitled “Preventing Scalping and Other

Severe Injuries from Farm Machinery." This publication was targeted to the end user, including farm operators, farm workers, county agricultural extension agents, equipment dealers and equipment manufacturers. Although only one model of machinery was involved in these incidents, the hazards and recommendations identified applied to many manufacturers and other types of agricultural equipment.

Through the NIOSH-funded Community Partners for Healthy Farming program in New York State, TI received two separate reports of farm workers who were injured while attempting to drill holes into sealed agricultural plow frames in order to mount a hitch or a "slow-moving vehicle" sign. These workers received serious skin burns and other injuries when the drill bits penetrated the frames releasing and igniting flammable gases. Subsequent TI investigations indicated that hydrogen and methane gas may be produced within sealed frames that are filled during manufacture with scrap metal for use as ballast. It was determined that the uncleaned, assorted, machine shop metal scrap ballast was reacting electrochemically with water and emulsion-type cutting oils to liberate flammable gases. As a result of these investigations, TI staff developed a Hazard ID Bulletin, "Ignition Hazard from Drilling into Sealed Frames of Agricultural Equipment," which summarized the hazards and steps to reduce injury. TI staff also developed and distributed a Technology News Bulletin entitled "The Explosion Hazard from Hydrogen Gas Generation Inside Sealed Frames."

Intermediate Outcomes:
To further broaden the reach and impact of TI prevention strategies, TI frequently collaborates with other public and private-sector partners. Additionally, the results and recommendations are frequently distributed by other organizations and groups which help to maximize the dissemination of this important prevention information. A number of examples follow.

Following the TI and Wage and Hour Division (WHD) distribution of prevention information related to forklifts in retail warehouses and storage facilities, TI, WHD, and OSHA collaborated in additional outreach efforts in January 2004 to distribute 5,000 copies of this same packet, along with an OSHA bulletin, to a broader mailing that included OSHA alliance partners such as members of the Industrial Truck Association (ITA). These packets contained a letter signed by John L. Henshaw, then Assistant Secretary of Labor, Tammy D. McCutchen, then Administrator of the Wage and Hour Division of the Employment Standards Division, and John Howard, M.D., Director of NIOSH. In addition, this package included both an English and Spanish version of the forklift sticker warning that no operators under 18 years of age were permitted.

As a result of the mailing of the packet pertaining to the Alert, "Preventing Electrocutions of Crane Operators and Crew Members Working Near Overhead Power Lines," a crane rental company requested additional copies of the package to include with each crane they rented. A construction contractor who received these materials requested multiple copies and praised the packet as the most useful safety tool he ever received from the government. In communication with TI, he wrote: "I had heard about the accidents, but didn't know the causes. I will circulate the publication among my employees who work with cranes. It will give us an opportunity to discuss crane safety using real life examples. I am sure my employees will find it as fascinating as I did."

After TI disseminated the Workplace Solutions, "Preventing Injuries and Deaths When Working with Hydraulic Excavators and Backhoe Loaders," the document received positive responses from the International Union of Operating Engineers and the Association of Equipment

Manufacturers. The Association of Equipment Manufacturers provided TI with an international mailing list with more than 200 entries for further dissemination. Additionally, several OSHA regional offices that were focusing on hazards associated with excavators and backhoes requested copies for further distribution.

With the assistance of the Association of Equipment Manufacturers and the National Asphalt Pavement Association, TI disseminated more than 20,000 copies of the Workplace Solutions, "Preventing Injuries When Working with Ride-On Roller/Compactors," both nationally and internationally.

Shortly after the Alert, "Preventing Scalping and Other Severe Injuries from Farm Machinery," was released, dissemination of the document to equipment dealers and county agricultural extension agents led to increased requests for a retrofit developed by the manufacturer that was already available. The retrofit enclosed the rotating drivelines and significantly reduced the hazard. Requests for the retrofit guard increased to the point that the manufacturer's inventory was exhausted and additional production was needed to fill orders.

Once the Hazard ID Bulletin, "Ignition Hazard from Drilling into Sealed Frames of Agricultural Equipment," was disseminated, the manufacturer ceased using the scrap for filling its equipment frames and began using clean stainless steel punch-out scrap. Additionally, while TI staff members were investigating this hazard, *Successful Farming* magazine ran a cover story detailing a project by the Future Farmers of America (FFA) in Kansas to replace slow-moving vehicle signs on all agricultural machinery in the State. The cover picture was of two youth drilling into a sealed frame. Following TI contact, the FFA issued a nationwide bulletin to all FFA chapters describing the hazard of drilling into sealed frames, and *Successful Farming* ran an article on the TI Hazard ID summarizing the hazard and steps to reduce injury. Penn State University also reprinted portions of the Hazard ID in its *Agricultural Safety and Health News*.[2] After the dissemination of the Hazard ID and the Technology News Bulletin highlighting the ignition hazard, TI received two calls that identified this hazard as being present in different types of machines and industries. While a mechanic was welding on a dragline at a surface mining operation in Australia, an ignition occurred whose source was identified as hydrogen. In another instance, while a weight pod on a mobile crane was being welded, a hydrogen ignition occurred. TI results had alerted others to similar hazards that were occurring on other types of equipment.

End Outcomes:
Work-related fatalities caused by machines, plant and industrial powered vehicles, or tractors have shown a steady decline since 1992. Based on available data from the BLS Census of Fatal Occupational Injuries, the number of deaths declined 16 percent and fatality rates per 100,000 workers declined 30 percent from 1992 through 2005.[3] While it is difficult to quantify the contributions of the TI Program to these reductions, the role of the program in providing practical recommendations for reducing worker risks has been recognized through feedback from external partners, stakeholders, and workers. For example, reader response cards from TI outputs have provided positive feedback that the information is being used for prevention and the format of the documents has been well-received by end users.

External Factors:
A number of the hazards identified by TI exist in machinery used by small companies that lack the expertise and resources to adequately abate the hazards, even when known prevention strategies are available. Additionally, due to limited resources, the TI Program is not able to

conduct follow-back with companies to determine if recommended interventions to reduce identified injury hazards have been implemented. As well, given the resource limitations, TI is limited in the number, type, and geographic location of investigations that can be conducted. To minimize this resource limitation, after notification of a machine-related fatality, TI staff determine whether or not the case will be investigated by focusing on cases where potential emerging hazards or new technologies were involved in the fatal event.

What's Ahead:

TI will continue including machine-related fatalities as an investigative target under the FACE Program. One of the strengths of this program is the ability to adapt the investigative process to emerging hazards. TI can refocus the FACE Program to investigate potential hazards from new trends and technologies as they are identified. This can lead to the development and dissemination of prevention strategies and products targeted to address these emerging hazards. To ensure these materials are most useful, TI will continue collaborating with industry, machine manufacturers, trade associations, Federal and State agencies, unions, and other entities to help ensure that accurate injury prevention information is made widely available as timely as possible.

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5. Reduce Acute Back Injury

Introduction

Back injuries account for nearly 20 percent of all injuries and illnesses in the workplace and cost the nation an estimated 50 billion dollars per year. Back injuries are the leading cause of disability in the United States for people younger than 45 years and are the most expensive healthcare problem for the 30- to 50-year-old age group.[1] Low back pain accounted for 23 percent ($8.8 billion) of total workers' compensation payments in 1995.[2] The Annual Survey of Occupational Injuries and Illnesses conducted by the Bureau of Labor Statistics indicates that in 1998 there were 279,507 back injuries due to overexertion that resulted in lost work days (89 percent in material-handling).

TI has focused back injury research and prevention efforts upon the problems of patient handling in the healthcare sector, particularly nursing homes, and materials handling across all sectors, particularly the evaluation of back belts.

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Sub goal 5.1: Reduce acute injuries caused by patient handling

Issue:
Frequent lifting and repositioning of patients is the leading source of injury for healthcare workers.[1] Direct and indirect costs associated with back injuries in the healthcare industry are estimated to be $20 billion annually.[2] Among female workers in the United States, nursing aides and orderlies suffer the highest prevalence (18.8 percent) and report the most annual cases (n=269,000) of work-related back pain.[3] In 2000, 10,983 Registered Nurses (RNs) suffered lost-time work injuries due to lifting patients. Twelve percent of nurses report that they left the nursing profession because of back pain.[4] Employment for nurses is projected to increase by 25 percent by 2012, creating an expected shortage in the nursing labor pool of 20 percent by 2015 and 30 percent by 2020.[5] The high injury rate coupled with a critical nursing shortage[6] raises serious concerns about the nursing workforce's capacity to care for our nation's expanding population.

Principal factors that contribute to back injury risks for caregivers (nursing aides, orderlies, nurses, therapists, and restorative aides) include:

- The size, weight, balance problems, and combativeness of patients
- The confined areas (bathrooms and rooms cluttered with furniture and medical equipment) and beds in the nursing home environment which prevent caregivers from assuming proper lifting postures
- Caregivers' inability to lift patients (the weight of any adult exceeds the lifting capacity of most caregivers, 90 percent of whom are female)
- The forward bending required for most patient lifting and moving tasks, which places the spine in its most vulnerable position

The problem of lifting patients is compounded by the increasing weight of patients to be lifted due to the obesity epidemic in the U.S. and the rapidly increasing number of older people who require assistance with their activities of daily living.[7] Further, equipment to assist healthcare workers in lifting obese and frail patients is not always available or adequate. Finally, the absence of evidence-based training curriculum for student nurses and caregivers means that outdated books and curriculum, which promote unsafe patient handling practices among newly trained student nurses, continue to be used. As a result, schools of nursing continue to teach, and nurses' licensure exams[8] continue to include, outdated and unsafe manual patient handling techniques.

Approach:
Over the past 20 years, TI researchers with backgrounds in epidemiology, biomechanics, and psychology have conducted a comprehensive and diverse research program to prevent injuries to caregivers associated with patient lifting.

From its inception in the mid 1980s, TI nursing back injury research has examined the incidence and prevalence of nursing injuries by job title, age, gender, work exposures, and other demographic characteristics to highlight the magnitude of the injury problem and to raise awareness of the hazards.[9-12] TI researchers (intramural and extramural) have conducted lab and field research to study the biomechanics of patient lifting, the impact of nursing work schedules, the adequacy of student nursing curriculum, and the effectiveness of 'best practices' safe patient lifting programs. TI intramural and extramural researchers have conducted task analyses to identify high-risk patient-handling tasks, lab studies to identify safer lifting methods through evaluation of patient lifting equipment, and intervention trials of "safe patient lifting programs" in nursing homes and hospitals.

For example, a NIOSH extramural research grant funded a landmark study that identified the most stressful patient handling tasks,[13] performed an ergonomic evaluation of these tasks,[14] conducted a laboratory study to select less stressful patient transferring tasks,[15] and conducted a field study that demonstrated the effectiveness of a safe patient lifting program that utilized mechanical lifting equipment.[16]

As a precursor to its own large-scale nursing home field study, TI conducted a biomechanical[17] and psychophysical evaluation.[18] Mechanical lifts were shown to reduce the compressive forces placed on the nursing assistants' backs by an estimated 60 percent, remove two-thirds of the lifting activities per transfer,[17] and increase residents' perceptions of comfort and security during transfers with mechanical lifts when compared to manual lifting.[18]

Because of the small sample size and 12-month follow-up period in the extramural field study,[16] TI researchers conducted a large intervention trial over a six-year period that demonstrated that a "best practices" safe patient lifting program can be highly effective in reducing resident handling injury incidence rates, workers' compensation costs, and lost workday injuries.[19] The initial investment of $158,556 for lifting equipment and worker training to establish the safe patient lifting program was recovered in fewer than three years based on post-intervention savings of $55,000 annually in workers' compensation costs. The "best practices" prevention program significantly reduced injuries for full-time and part-time nurses in all age groups, all lengths of employment, in all study sites.[7]

TI research, prevention and communication efforts have involved partners in industry, government, and academia, such as BJC Corporation, Johns Hopkins University, the Association of Schools of Public Health, the American Nursing Association, the Occupational Safety and Health Administration, and the Veterans Administration, among others. For example, TI researchers conducting the large-scale field study worked closely with BJC Health System, which provided the study population of 1,728 nursing staff at six nursing homes. TI worked with lifting equipment manufacturers—EZ Way, Inc. and Arjo, Inc.—by testing and evaluating their equipment in the laboratory, and using this equipment as a key component of the field study. These private-sector partners, along with Washington University and TI researchers, won the 2003 National Occupational Research Agenda Partnering Award for Worker Safety and Health.

Outputs and Transfer:
TI research results have been disseminated through peer-reviewed manuscripts, NIOSH numbered publications, NIOSH laymen's documents, and nursing student textbooks. TI has promoted more widespread implementation of safe patient lifting programs in the United States by developing business cases and providing research evidence to support safe patient lifting legislation. TI research results have been further disseminated by the American Nurses Association (ANA) and the Veteran's Health Administration.

Key findings from TI intramural and extramural research were published in a NIOSH numbered publication and disseminated by direct mail to 17,000 nursing homes in the United States. This guide—"Safe Lifting and Movement of Nursing Home Residents"[7]—presents a business case to nursing home owners, administrators, nurse managers, safety and health professionals and workers who are interested in establishing a safe patient lifting program. The guide offers evidence that safe patient lifting programs can protect workers from injury, reduce workers' compensation costs, and improve the quality of care delivered to patients.[7]

In 1987, TI published (in partnership with the Association of Schools of Public Health and the Johns Hopkins University Injury Prevention Center) an annotated bibliography on nursing back injury research to raise awareness of the problem and to provide researchers and healthcare organizations the latest evidence-based research information on safe patient lifting programs.[21]

TI researchers wrote two chapters in the book, "Safe Patient Handling and Movement – A Practical Guide for Health Care Professionals"[22, 23] that present best practices for safe patient lifting. This book was written as a resource for hospital and nursing home administrators, nurse managers, caregivers, risk managers, and those involved in procurement of patient handling technology.

TI research staff participated on a Department of Labor, Occupational Safety and Health Administration (OSHA) committee to synthesize the evidence supporting safe patient lifting programs from 1998-2002. In 2003, OSHA published "Guidelines for Nursing Homes: Ergonomics for the Prevention of Musculoskeletal Disorders" (OSHA 3182).[24] This guidance can be accessed at: www.osha.gov/ergonomics/guidelines/nursinghome.

TI scientists are working with the National Council Licensure Examination (NCLEX) Board[8] to update the curriculum on safe patient lifting to include the latest research findings from TI and others in nursing licensure exams. The Safe Patient Handling and Movement (SPH&M) training presentation[19] can be downloaded at the NIOSH Website and the algorithms[20] can be downloaded at the VA Patient Safety Center Website.

Intermediate Outcomes:
TI researchers were asked to provide testimony at legislative hearings in two States, but had to decline since government scientists are prohibited from such activities. TI did provide copies of relevant peer-reviewed articles and laymen's publications on safe patient handling to Congressional staff members working on the legislation. Bill Borwegen (Safety and Health Director for the Service Employees International Union) actively participated in each of the State hearings, and personally communicated to TI researchers that without the TI research evidence, the State legislation would likely not have passed. TI research on safe patient lifting has been used in support of the passage of the following safe patient handling legislation in the United States:

1. Texas Senate Bill 1525 was signed into law on June 17, 2005.[26] Texas is the first State in the nation to mandate that hospitals and nursing homes implement policy for safe patient handling and movement programs, restricting "to the extent feasible with existing equipment and aids, of manual patient handling or movement of all or most of a patient's weight except in emergency, life-threatening, or otherwise exceptional circumstances."

2. Washington House Bill 1672 was signed into law on March 22, 2006.[27] Washington State mandates that hospitals provide lift equipment as part of their policy for safe patient handling, with the hospital's choice of three options for implementation of equipment, and with financial assistance by tax credits for the cost of lifting equipment and reduced

workers' compensation premiums for hospitals implementing safe patient handling programs.

3. Hawaii House Concurrent Resolution No. 16, 4-24-06.[28] Safeguards are to be instituted in healthcare facilities to minimize the occurrence of musculoskeletal injuries suffered by nurses; also calls for the Legislature of Hawaii to support policies in American Nurses Association "Handle with Care" Campaign.

4. Rhode Island House 7386 and Senate 2760, 7-7-06 passed in June 2006.[29] This legislation states that hospitals and nursing facilities need to "Implement a safe patient handling policy for all shifts and units of the facility that will eliminate manual lifting, transferring, and repositioning of patients, except in emergency, life-threatening, or otherwise exceptional circumstances."

5. Ohio House Bill 67 was signed into law on March 21, 2005.[30] Section 4121.48 creates a bureau of workers' compensation long-term care loan fund "to make loans without interest to…nursing homes…to purchase, improve, install, or erect sit-to-stand floor lifts, ceiling lifts, other lifts, and fast electric beds, and to pay for the education and training of personnel, in order to implement a facility policy of no manual lifting of residents by employees."

6. New York companion Bills A07641 and S04929 were introduced in April 2005, and signed into law on October 18, 2005. [30] These bills call for creation of a two-year study to establish safe-patient-handling programs and collect data on the incidence of nursing staff and patient injury with patient handling, manual versus lift equipment. Results will be used to describe best practices for improving health and safety of healthcare workers and patients during patient handling.

American Nurses Association's (ANA) Handle with Care Program.[25] The ANA used TI research findings in its "Handle with Care" Program. The "Handle with Care" Program is an industry-wide effort designed to prevent back and other musculoskeletal injuries among the nation's nurses. The campaign is helping reshape nursing education and Federal and State ergonomics policy by highlighting safe patient lifting research (by TI and others) that shows technology-oriented safe patient handling benefits both patients and the nursing workforce.

TI outputs, which have contributed to the passage of safe patient lifting laws in six States, have also informed proposed legislation in six additional States, as well as a Federal Bill that is being considered by Congress.

Progress toward End Outcomes:
Data from the U.S. Department of Labor, Bureau of Labor Statistics (BLS) indicate that the incidence rate for sprains and strains involving days away from work in nursing homes steadily decreased by 67 percent (from 482.7 to 159.7 per 10,000 workers) between 1992 and 2005 (see Figure 11), approximately five years after the TI comprehensive research program on safe patient lifting was implemented. Similarly, the incidence rate for sprains and strains in hospitals decreased 52 percent (from 222.4 to 106.1 per 10,000 workers) between 1992 and 2005.

The BLS data identified lifting healthcare patients as the leading source of injury. The BLS data depicted in Figure 12 show that from 1992 to 2005, there has been a 70 percent reduction (from 397.8 injuries to 121.2 injuries per 10,000 workers) in injury rates in nursing homes where healthcare patients were listed as the source of injury. Similarly, a 52 percent reduction in lost workday injuries (from 110.8 to 53.5 per 10,000 workers) occurred between 1992 and 2005 in hospitals where healthcare patients were listed as the source of the injury (Figure 13).

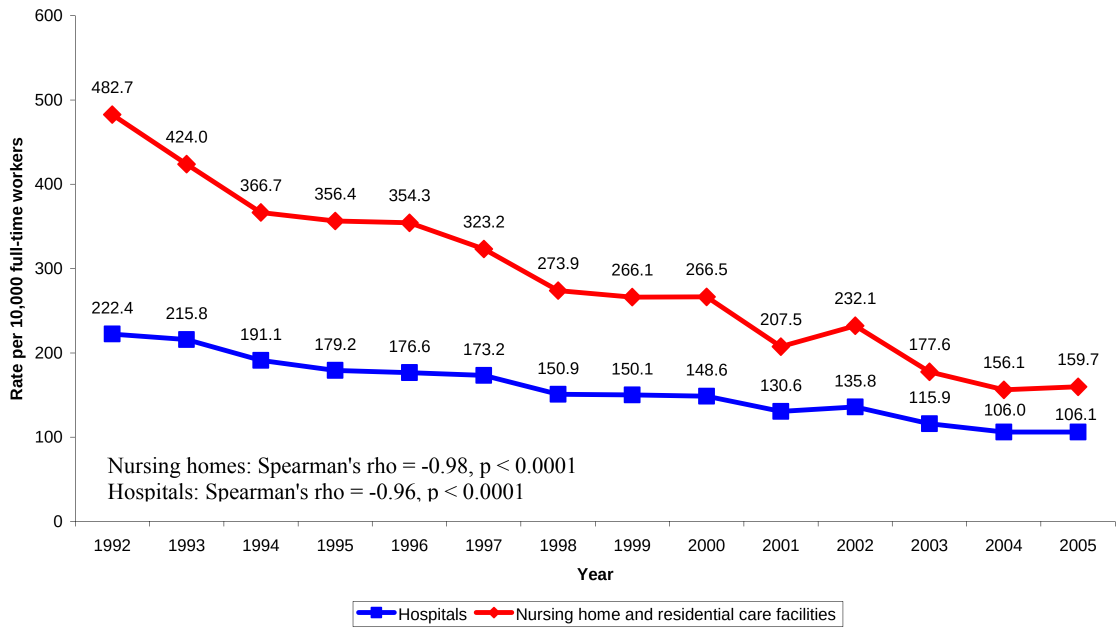

Figure 12. Rates of Sprains, Strains and Tears Involving Days Away from Work In Hospitals and Nursing Homes, 1990-2005

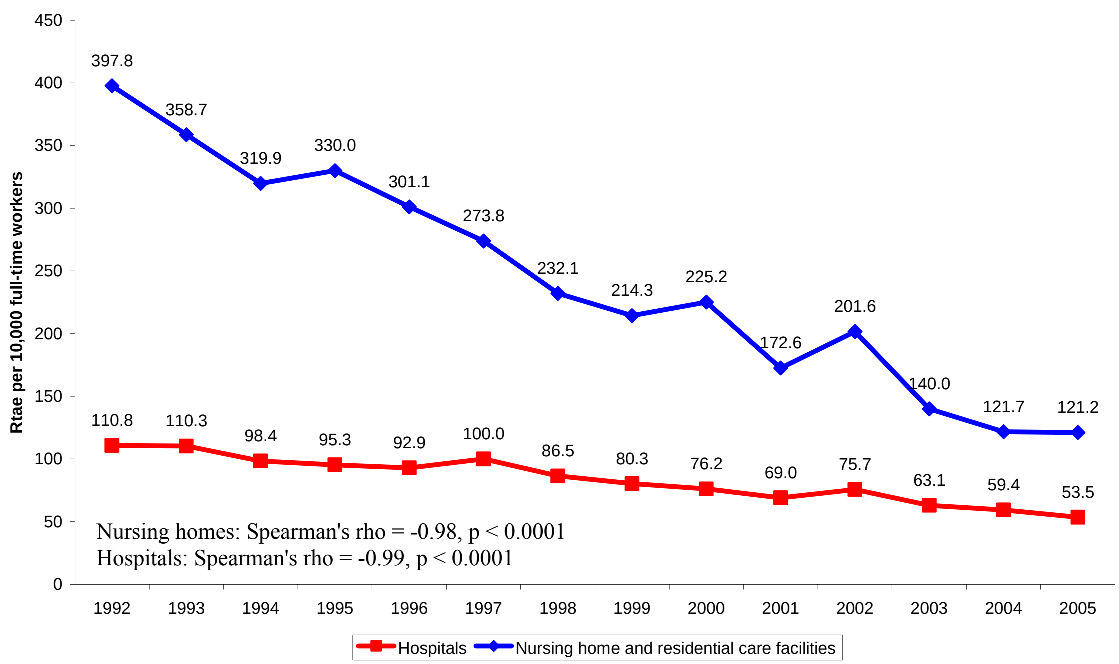

Figure 13. Rates of Nonfatal Injuries and illnesses Involving Days Away from Work in Hospitals and Nursing Homes, Health Care Patients as Source, 1992-2005

What's Ahead:
Translating TI research findings into practice is currently in progress on several fronts. The reductions in injuries and costs shown in the field research is promising, and can likely be replicated in nursing homes across the U.S. if similar safe patient lifting programs are adopted. Although TI has conducted extensive safe patient lifting research in nursing homes, the next phase of research will address acute care hospitals and home healthcare workers. TI recently funded an extramural research grant to conduct an intervention trial of a "best practices" safe patient lifting program institution-wide in a large tertiary acute care hospital over a 12-year period (1997-2008). TI is contributing, in partnership with the ANA and the VA, to the restructuring of nursing student curriculum to include evidence-based research. New student training curriculum, including a textbook and curriculum module, was developed in 2004 and evaluated in 26 schools of nursing. Data analysis is not complete. In support of this effort, patient lifting equipment manufacturers donated or loaned patient lifting equipment to the participating schools of nursing.

TI will continue intramural research to develop and evaluate methods to safely lift and move patients in home healthcare environments, and will continue to co-sponsor the Safe Patient Handling and Movement Conference that is attended by an estimated 800 healthcare professionals each year. TI staff members have participated in this conference since its inception seven years ago and will continue to present the latest TI research findings to this large audience of healthcare professionals.

TI researchers, in partnership with the ANA, are conducting research to determine if work schedules (long hours and shift work) are likely to play an important role in the development of safety and health problems for nurses.

External Factors:
Several external factors have affected the progress and the impact of this research. At a time when NIOSH TI researchers were seeking industry partners to conduct intervention trials, the industry was immersed in worker safety litigation regarding patient lifting. Soaring injury rates in nursing homes had led OSHA to target worker safety problems in nursing homes. However, an extensive legal battle led to a ruling in favor of Beverly Enterprises (the largest nursing home chain in the U.S.) against OSHA. The presiding Occupational Administrative Law Judge stated that epidemiological data did not exist to support OSHA allegations that patient lifting was associated with acute back injuries among caregivers. Nursing homes were not inclined to participate in NIOSH research that could ultimately lead to industry regulation. Battles between unions and nursing homes over safe patient lifting issues also created difficulties for NIOSH researchers seeking study partners. NIOSH TI researchers also had two potential study populations erode due to corporate mergers that resulted in the key study contacts losing their jobs.

At the end of the Clinton Administration in 2000, OSHA passed legislation creating ergonomic standards affecting more than 100 million workers. This legislation was promptly overturned in 2001 when the Presidential administration changed hands. This reversal was followed by a moratorium in all "ergonomics" enforcement activities by OSHA.

The first mechanical patient lifts, introduced in the 1940s, were prone to tip over and be uncomfortable for patients, and were resisted by caregivers and patients. It wasn't until the late1990s that dramatic design improvements led to widespread availability and usage of mechanical lifts.

U.S. nursing schools still teach body mechanics to show nurses how to use their physical strength to “properly lift” patients. Each year, nursing students are graduating without being trained on how to use mechanical lifts to safely lift patients.

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Sub goal 5.2: Evaluate interventions used to prevent acute injuries caused by material handling

Issue:
Employers have attempted prevention of back injuries by providing, or requiring employees to wear, industrial back belts. In 1995, approximately four million back belts were purchased. Based on a review of the literature, a NIOSH working group found insufficient scientific evidence to support the use of back belts. The studies reviewed at that time had conflicting results, were often restricted in scope, and most suffered from serious design flaws. This finding was reported in two 1994 NIOSH publications entitled Workplace Use of Back Belts (NIOSH Publication Number 94-122)1 and "Back Belts - Do They Prevent Injury?" (NIOSH Publication Number 94-127).[2]

Following the NIOSH review in 1994, two additional major studies were completed, again with conflicting results and some important limitations.[3,4] To increase the science on the effectiveness of back belts, TI undertook a large study in collaboration with Wal-Mart. The report on the NIOSH-Wal-Mart study appeared in December, 2000 in the Journal of the American Medical Association.

Approach:
The aim of this TI research effort was to evaluate stretchable industrial-type back supporting belts in preventing initial and recurrent low back injuries in retail store employees.

To examine the effect of back belt use on back injuries in the workplace, a large, prospective cohort study was conducted among material handlers in a retail setting. The main study was conducted in workers with the highest lifting exposures from 160 Wal-Mart stores distributed across 30 States which ranged geographically from New Hampshire to Michigan in the North and from Florida to Texas in the South. Between April 1996 and April 1998, 50 new stores and 110 newly expanded stores (combination supermarket and merchandise) were enrolled in the study on the day they first opened for customer sales. Controlling for multiple individual risk factors, this study found that elastic support back belt use was not associated with reduced incidence of back injury claims or low back pain. Neither frequent back belt use nor a store policy that required belt use was associated with reduced incidence of back injury claims or low back pain. With the finding that back belts were not effective, TI reaffirmed the finding that back belts could not be recommended for general use as protective technology in the workplace.[5]

Two laboratory evaluations examined the physiological and human motion effects of the same belt used in the prospective cohort study. A laboratory evaluation of the physiological effects of belt use found a significant reduction in mean oxygen consumption, but no significant effect on heart rate, blood pressure, or breathing rate.[6] An evaluation of the effects of the elastic back belt on human body motion during box-lifting tasks found that use of the belt significantly reduced the distance of forward spine bending and the velocities of forward-and-backward-spine-bending among subjects in the laboratory setting.[7] Unlike the epidemiologic study, these laboratory evaluations did not examine the association between back belt use and the outcomes of back injury or back pain.

A number of partners were involved in this project including Wal-Mart Corporation (provided employees time to participate in the telephone surveys and provided data on injury reports and payroll), Battelle Corporation (conducted the telephone surveys and data management under contract), University of Massachusetts at Lowell (conducted a direct observation task analysis in a limited number of workplaces), and University of Pittsburgh (consultant on design and analysis).

Outputs and Transfer:
The principal outputs of this study were the peer-reviewed journal articles that appeared in JAMA, Applied Ergonomics, and Spine in 2000 and 2001.[5-7]

A Website summarizes current knowledge about industrial back belts: http://www.cdc.gov/niosh/topics/ergonomics/#back.

Intermediate Outcomes:
This study found that an existing injury intervention in widespread use by industry was not effective in preventing back injury or pain. Such a finding would not be expected to directly result in a reduction of injury. However, subsequent to publishing the study results, a number of large retail establishments have ceased requiring their employees to wear back belts, and have shifted their safety resources towards more promising intervention strategies.

Wal-Mart no longer requires back belts to be worn by associates in their retail establishments, although they will provide them upon request. They have implemented other back injury prevention strategies such as reorganized stocking and display of heavy items and redesigned checkout stations to eliminate cashiers lifting of bagged merchandise. Home Depot no longer requires or even provides back belts upon request, despite having participated in a study prior to the NIOSH study that suggested a protective effect of back belts. Lowes has also eliminated their policy of requiring employees to wear back belts. There is anecdotal evidence that cost savings from employer-provided back belts are being redirected to pursue other injury prevention efforts.

External Factors:
In the past, some employers have provided back belts to employees and in some cases required employees to wear them in the attempt to prevent back injuries. It is known that approximately four million industrial back belts were purchased in 1995. Data, however, on back belt sales has not been available to assess sales trends as a proxy for back belt use in the workplace. Other data that might provide insight into the impact of the TI findings—such as any measure that could document a shift by employers away from back belts to other back injury prevention efforts (e.g. engineering controls to reduce lifting hazards)—have likewise not been available.
Other issues that have affected the trends in overexertion back injuries include the transient nature of the population of material handling workers. There is evidence that the risk of back injury is high among newly hired employees and employees with the least amount of work experience.[8] Employment trends with respect to these issues may account for some of the decreasing trend in back injuries.

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6. Reduce injuries and fatalities among workers in Alaska

Introduction

In the late 1980s, TI identified Alaska as the highest-risk State for worker fatalities. For the decade from 1980 through 1989, the traumatic occupational fatality rate in Alaska was nearly 35/100,000—almost five times the U.S. average of 7.0 deaths per 100,000 workers per year.[1] The TI Program established the Alaska Field Station in Anchorage in 1991 with a goal of reducing this high rate of traumatic occupational fatalities.

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Sub goal 6.1: Reduce injuries and fatalities in commercial fishing

Issue:
During the five-year period from 1990 through 1994, 118 Alaskan commercial fishermen died from trauma, a rate of 140 deaths per 100,000 workers per year.[1] Commercial fishermen in Alaska face extreme environmental risk factors, including cold weather, cold water (the coldest in the U.S.), and the remote location of many fishing grounds (and the consequent lack of nearby rescue teams and emergency response systems). As TI began to examine work-related fatalities in Alaska in 1991, early surveillance data showed that commercial fishing fatalities were primarily due to vessels sinking and crew members falling overboard.[1]

From 1991 through 1998, severe nonfatal injuries occurred in the Alaskan commercial fishing industry at a rate of 410 injuries per 100,000 fishermen.[2] Unlike fatal injuries, most severe nonfatal injuries among these workers occur on deck during the deployment and retrieval of fishing gear (67 percent). Not only is the deck of a fishing vessel an unstable work platform that is constantly moving, it is often congested with machinery and fishing equipment, which accounts for 40 percent of all nonfatal injuries. Much of the machinery and equipment used on commercial fishing vessels is rudimentary with inadequate guarding. Machinery-related injuries result from cables, chains, lines, winches, hydraulic “pot launchers” and other deck equipment. Workers getting caught in winches represent 35 percent of all of these severe machine-related injuries. [2]

When the TI was established in 1991, several barriers hampered researchers in their efforts to effectively address the problem of traumatic occupational injuries and fatalities among Alaskan workers. First, one of the essential prerequisites of an effective public health approach to prevention was missing—a comprehensive, effective occupational injury and fatality surveillance system. Further, no system was available to accurately count or estimate the number of workers at risk in the commercial fishing sector. This lack of denominator data prohibited the calculation and comparison of injury and fatality rates. Effective surveillance, including the ability to calculate rates, is needed to accurately identify and compare injury and fatality risks, to direct research and prevention efforts, to track changes, and to evaluate the results of interventions, programs, and policy changes. Also, effective partnerships between TI and other agencies with worker safety mandates and interests, including both governmental and private-sector organizations, had not been established. Finally, policies affecting the industry, including regulatory actions such as the Commercial Fishing Industry Vessel Safety Act of 1988 (CFIVSA),[3] had not been evaluated. Other regulatory constraints, such as the fishery management requirements in the Magnuson-Stevens Fishery Conservation and Management Act,[4] inadvertently created a negative impact on the safety of fisheries.*

* Fishery management provides a compelling illustration of how policies can adversely affect safety in an industry. To prevent the depletion of fish stocks as the competition for these stocks increases, each fishery (defined by species, time, and place) has its own management plan. The challenge is to keep fisheries at sustainable levels while preserving the economy of the fishing communities that depend on this resource. Fishery management plans can limit the number of participants; limit the type or amount of gear that can be carried; put geographic restrictions on fishing areas; limit the number of minutes, hours, or days fleets can fish; or place limits on the total eight of the catch across the fleet without the use of major time constraints. Fishery management regulations that result in short seasons sometimes cause fishermen to pursue fish in waters for which their vessels were not designed, or change to new, unfamiliar fishing gear, thereby increasing risks.

TI was well equipped to overcome each of these barriers through staff expertise in public health surveillance, case investigation, epidemiologic research, intervention evaluation, communications, and coordination with partners.

Approach:

The TI Program set a goal in 1994 to decrease the commercial fishing fatalities and fatality rate in Alaska by 50 percent by the year 2005 by establishing comprehensive occupational fatality and injury surveillance; coordinating the efforts of a variety of agencies and organizations; conducting collaborative research, evaluation, and prevention efforts; and communicating risk and prevention information.

TI designed and implemented a comprehensive surveillance system for occupational fatalities, the Alaska Occupational Injury Surveillance System (AOISS).[5] This was largely done by establishing data-sharing agreements with agencies such as the U.S. Coast Guard (USCG) and the Division of Alaska State Troopers, and through direct TI site investigations of fishing fatalities and interviews of survivors. In addition, the AOISS collects information from National Transportation Safety Board (NTSB) investigative reports, death certificates, medical examiner reports, and news media reports. Further, TI established a relationship with the State of Alaska to enable the development and use of Alaska Trauma Registry (ATR) data for surveillance of serious hospitalized injuries. TI now uses information from both AOISS and the ATR to identify and assess the hazards of commercial fishing and to track progress in attaining program goals. Through its surveillance efforts, TI has identified high-risk incidents such as vessel sinkings, falls overboard, and deck injuries; high-risk groups based on type of fishing (e.g., crab fishing); and high-risk gear used in fishing (e.g., deck winches).

To enable calculation of rates of fatalities and injuries in commercial fishing, TI designed a way to determine denominator data by estimating the number of full-time equivalent fishermen for each fishery and for the entire workforce. The fishery-specific rates allow TI to identify the most hazardous fisheries in Alaska and thereby focus prevention efforts, whereas the overall rates enable comparisons with fatality and injury rates faced by Alaskan workers in other sectors. These comparisons are used to monitor progress and assess and determine program direction and priorities.

TI scientists formed and facilitated an Interagency Working Group (IAWG) for the Prevention of Occupational Injuries. Members of this working group include experts from many organizations including:

- State agencies such as the Alaska Department of Health and Social Services (AKDHSS) and the Alaska Department of Labor
- Federal agencies such as OSHA, the U.S. Coast Guard (USCG), and the Federal Aviation Administration (FAA)
- Local entities such as the Municipality of Anchorage (MOA)
- Industry associations such as the Alaska Marine Safety Education Association (AMSEA) and the North Pacific Fishing Vessel Owners Association (NPFVOA
- The University of Alaska Anchorage (UAA).

The IAWG first met at the Alaska Governor's Safety and Health Conference in March 1991, where one of the first subgroups formed focused on commercial fishing safety issues.

Other subgroups have been formed to address deaths and injuries in the aviation and construction industries. The group includes agencies with jurisdiction and oversight of the highest-risk industry sectors in Alaska. The IAWG has served an important role in Alaska by collectively providing a broader understanding of occupational injuries in the State, and enabling rapid response to emerging occupational injury problems. It has also facilitated many of the efforts of TI, including the development of improved industry fatality and injury surveillance.

In addition to playing a central role in defining, describing, and disseminating commercial fishing risks through surveillance, TI has collaborated in research efforts to investigate injury causation and prevention, and evaluated major intervention strategies and programs. In 2000, TI initiated a study aimed at finding and disseminating practical solutions to fatal and nonfatal injuries that occur on fishing vessel decks. In collaboration with the North Pacific Fishing Vessel Owners Association (NPFVOA), TI conducted focus groups with crab fishermen to discuss deck safety problems and toured vessels to view problems and discuss potential modifications. After initial work that concentrated upon crab fishing vessels, researchers turned their attention to other types of fishing vessels.

A series of industry meetings revealed that fishermen were concerned about deck winches, which pose risk of entanglement. To address this hazard, engineers at the NIOSH Spokane Research Laboratory (SRL) designed an emergency stop (e-stop) system* that allows a fisherman to quickly stop a winch, even when entangled. A fishing vessel owner and captain in Seattle, Washington partnered with TI on the design and installation of the e-stop system, and successfully tested the system during the 2005-6 Alaska salmon seasons. Crew members praised the device as a significant safety and productivity improvement and they continue to use the system. TI researchers also collaborated with researchers from the Harvard School of Public Health in a study aimed at characterizing and reducing falls overboard from lobster vessels.

In the winter of 2005, the USCG requested TI's assistance by evaluating the USCG Dockside Pre-season Boarding Program. TI demonstrated that from the implementation of the USCG program in October 1999 until 2005, there had been only three fatalities (two fell overboard, one crushed) in the crab fishery that had averaged seven deaths per year in the prior five years.

Individual Fishing Quotas (IFQs), which were implemented as an element of fishery management for the halibut/sablefish fisheries in January 1995, set an allowable catch limit for vessel owners and a time frame (April to September) in which they had to catch their limit. In 1997, the Ocean Studies Board of the National Research Council asked TI to provide testimony regarding the safety implications of IFQs on the halibut/sablefish fishery. TI analyzed USCG data and showed that no fatalities had occurred since implementation of the IFQs, and that search and rescue missions had declined significantly.

Using AOISS, AFS conducted the first major assessment of commercial fishing fatalities since the passage of the Commercial Fishing Industry Vessel Safety Act of 1988 (CFIVSA).[3] NIOSH

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*The emergency-stop (e-stop) system allows the winch to be quickly stopped by a worker, even if the worker is caught in the winch. The system can be retrofitted to any winch and consists of a sturdy pushbutton mounted on the winch housing, electronic controls, and a hydraulic valve interfaced into the existing hydraulic controls. A fisherman who becomes entangled can push the electronic button located on the winch. This in turn actuates a solenoid valve that stops the flow of hydraulic oil powering the winch, and the rotation stops. This allows the fisherman to be freed from the entanglement.

found that although there had been a decline in the fatality rate among commercial fishermen, there had not been a decline in the numbers of vessels sinking. NIOSH recommended augmenting the CFIVSA approach, which emphasized the use and availability of safety equipment during and after a disaster at sea, by focusing upon preventing these disasters in the first place.

TI has worked with partners to organize conferences and workshops on commercial fishing safety. Of particular importance have been two Fishing Industry Safety and Health (FISH) Workshops, the first conducted in 1992 (Anchorage), and the second in 1997 (Seattle). In October 2000, the first International Fishing Safety and Health (IFISH) Workshop was conducted at Woods Hole, Massachusetts, followed by IFISH II in 2003 (Sitka, Alaska) and IFISH III in 2006 (Chennai, India). These conferences have brought together researchers, industry representatives, government administrators and policymakers, safety practitioners, and others together from around the U.S. and the world to raise awareness, build coalitions, develop strategies, share research and policy information, and establish a forum for all the representatives and organizations that have a stake in commercial fishing safety.

The CFIVSA regulations include a requirement that fishermen participate in monthly emergency drills and that these drills be conducted by a Certified Drill Conductor.[3] In the early 1990's, AMSEA received its first NIOSH Training Program Grant (TPG) to help train fishermen to become qualified Drill Conductors for these required monthly drills. AMSEA and the TI have collaborated on many other projects on fishing vessel safety since the early 1990s, including conducting a dive safety workshop and preparing a deck-safety pamphlet. Since 1992, AMSEA has held more than 1,000 classes and trained more than 15,000 fishermen.

Outputs and Transfer:
TI has published scientific articles, NIOSH documents, MMWR articles, and industry trade articles describing injury and fatality risks and recommending strategies to prevent injuries and deaths among Alaskan commercial fishermen. In addition, TI has sponsored and published proceedings from domestic and international scientific conferences focusing on fishing vessel safety. The following information highlights the most important outputs and transfers to date:

Using results of data analyses conducted in support of the TI evaluation of the CFIVSA, TI prepared and published the NIOSH Current Intelligence Bulletin (CIB) "Commercial fishing fatalities in Alaska: risk factors and prevention strategies" (DHHS (NIOSH) Publication No. 97-163).[6] This CIB outlines risk factors and prevention strategies for commercial fishing deaths in Alaska, including a discussion of management regimes and the safety roles of the USCG in implementing CFIVSA. Recommendations call for more attention to improvement of vessel stability and hull integrity, licensing and training of skippers, training of crewmembers, avoidance of harsh sea and weather conditions, prevention of falls overboard, human factors associated with injuries, and deck safety.

Modifications identified in the study of deck safety on crab fishing boats as good solutions were published with illustrations and general installation instructions in the "Deck Safety Handbook for Crab Fishermen."[7] These potential solutions to deck safety problems included the installation of "pot guides" that decrease the swinging motion of full crab pots as they are being lifted from the water to the deck. Other proposed solutions included improved lighting and closed-circuit TVs to enable crew members and the skipper to see one another more easily. In addition to the Handbook, a 1/10-scale deck safety model was built for use at industry trade shows during discussions of deck safety to illustrate the hazards and solutions presented in the deck safety booklet. More than 4,000 copies of the “Deck Safety Handbook” have been distributed to fishermen in the Northwest and a copy is posted on several safety Websites as a resource.

The previously mentioned emergency stop (e-stop) system—that allows a fisherman to quickly stop a winch, even when entangled—was demonstrated at Pacific Marine Expo in Seattle, the largest commercial fishing trade show in the U.S. Many vessel owners and operators requested information on how to obtain the device.

The findings from the TI-Harvard collaboration were compiled and published by Harvard in an industry-specific publication—“Lobstering Safety Secrets Revealed”[8]—and distributed to commercial lobsterman in Maine. This collaborative research also resulted in a NIOSH Workplace Solutions document entitled “Dangers of Entanglement During Lobstering,” DHHS (NIOSH) Publication No. 2005–137, August 2005.[9] These documents report that lobster fishing is a hazardous occupation that has resulted in drowning from entanglement in trap lines and being pulled overboard. A survey of 103 lobstermen developed recommended work practices and controls to reduce entanglement, escape entanglement, and provide opportunities to reboard the vessel.

Proceedings documents were published for the two FISH conferences, and the first two of three IFISH conferences.[10-13]

Intermediate Outcomes:
The USCG in Alaska designed and implemented a Dockside Pre-season Boarding Program. USCG personnel had participated in the Vessel Loss Prevention Working Group at the November 1997 FISH Workshop in Seattle, and took the lead in designing a plan to prevent vessels from sinking. USCG vessel safety examiners developed the “at-the-dock” boarding program to identify and correct safety hazards known to exist in the Bering Sea crab fisheries. These fisheries were chosen based on NIOSH findings identifying the crab fishery with the highest fatality rate of any fishery in Alaska. Bering Sea crab fishing requires the use of crab “pots” that are 600- to 800-pound steel cages to catch crabs on the ocean floor. A vessel improperly loaded with crab pots may become dangerously unstable and capsize. This Dockside Pre-season Boarding Program examines a large number of vessels within the fleet prior to the opening of the crab fishery. The examiners review vessel stability information with vessel masters, and check life-saving equipment required by the CFIVSA. If the vessel is not loaded properly or if there is a lack of life-saving equipment, a Captain of the Port Order is issued and the vessel is not able to leave port until the discrepancy is corrected.

In addition, TI publications that documented the safety record of the Bering Sea crab fishery fleet (and which showed that this is a dangerous fishery) were used as foundational evidence for a recently implemented quota-based management system.

In 1998, the U.S. Coast Guard (USCG) convened a task force and used the NIOSH Current Intelligence Bulletin (CIB)[6] to develop a national plan for fishing vessel safety. In the final report called “Living to Fish, Dying to Fish,”[14] the USCG adopted eight of the 11 recommendations from the CIB to improve fishing vessel safety for the U.S.

The TI Current Intelligence Bulletin has been used by many organizations as a resource to discuss the dangers of the commercial fishing industry including the Alaska Department of Fish and Game,[15] the Alaska Fishing Job Clearinghouse,[16] CareMarx consumer health,[17] The University of Vermont,[18] WorkSafe BC in British Columbia,[19] and Trident Marine Association.[20]

End Outcomes:
Since 1990, deaths of commercial fishermen in Alaska have declined by 74 percent, and the annual fatality rate has declined by 51 percent (see Figure 14 below).

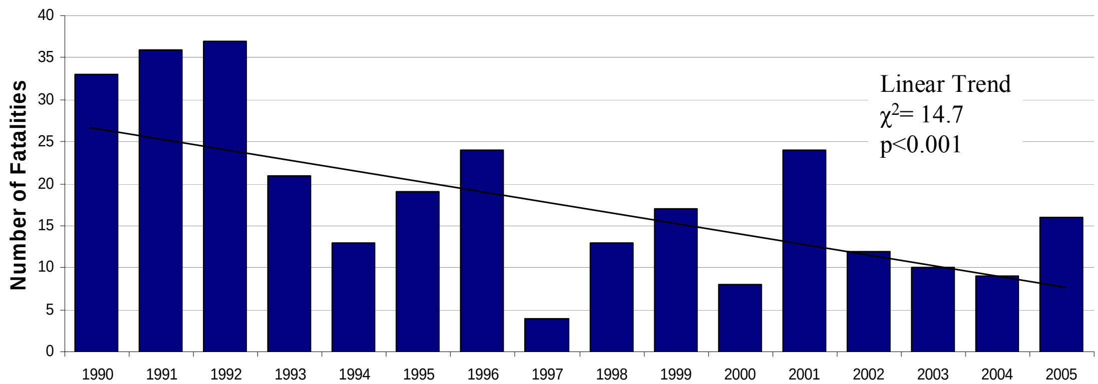


Figure 14. Commercial Fishing Fatalities in Alaska by Year, 1990-2005 (n=296)

In particular, fatalities declined among crab fishermen. Comparing fatality rates for the decade of the 1990s versus the rates since 2000, the rate has dropped by more than 50 percent among crab fishermen. (Note in Figures 15 and 16 below the difference in pre-2000 and post-2000 data. The USCG began the vessel-stability checks as part of its Pre-season Boarding Program in October 1999.)

The principal TI contributions to the reduction in crab fishery fatalities, and commercial fishing fatalities overall, have been in the areas of surveillance, coordination and collaboration, and evaluation research. For example, TI conducted the early assessment of the decline in commercial fishing fatalities after the implementation of the Commercial Fishing Industry Vessel Safety Act, and found that although fatalities had decreased, vessel sinking events had not. In addition, by identifying the fishery in which each fatal event occurred, TI showed that the crab fishery in the Bering Sea was the most hazardous fishery in the State, and that the principal problem was the loss of fishing vessels. Bringing partners together at the FISH II Workshop in Seattle in 1997, TI organized the working group to prevent vessels from sinking. This resulted directly in the 1999 USCG Dockside Pre-season Boarding Program, a program strongly supported by the crab industry. The overall reduction in fatalities in commercial fishing has been largely driven by the reduction in fatalities in the crab fishery.

Although TI had previously demonstrated that fatalities had been reduced in the crab fishery after implementation of the USCG Dockside Pre-season Boarding Program, in January 2005 another fall-overboard fatality occurred, and the fishing vessel “Big Valley” sank, resulting in five fatalities.

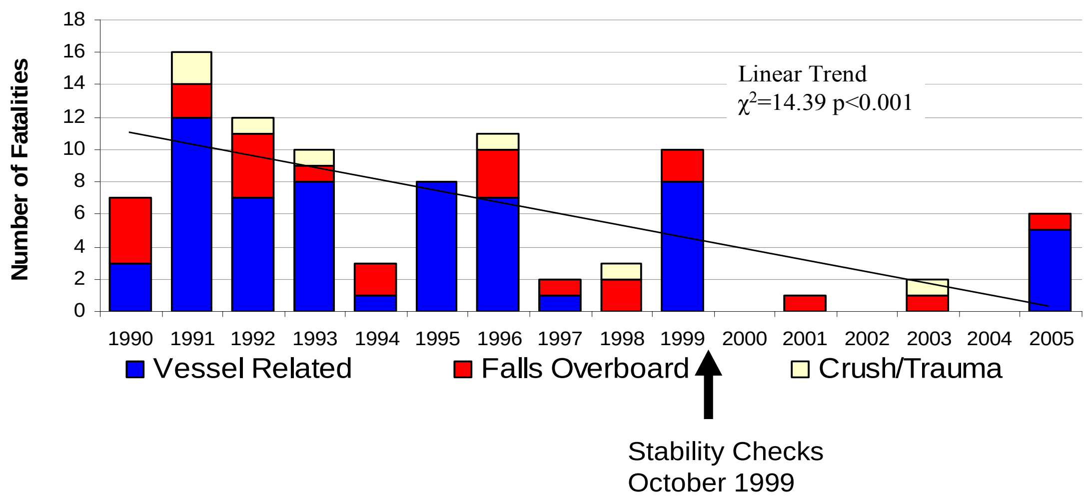
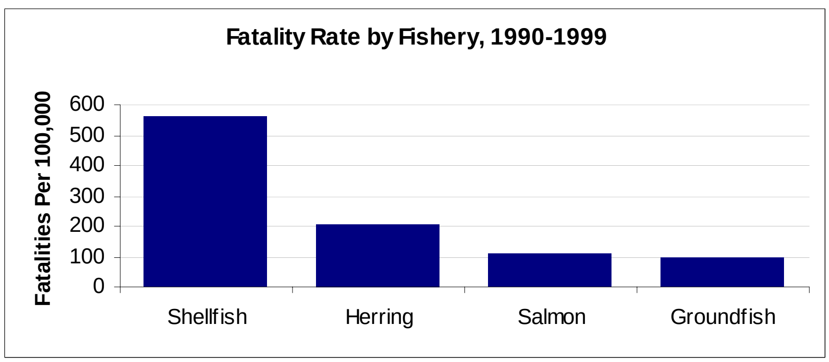


Figure 15. Commercial Crab Fishing Fatalities in Alaska by Year and Cause, 1991-2005 (n=91)



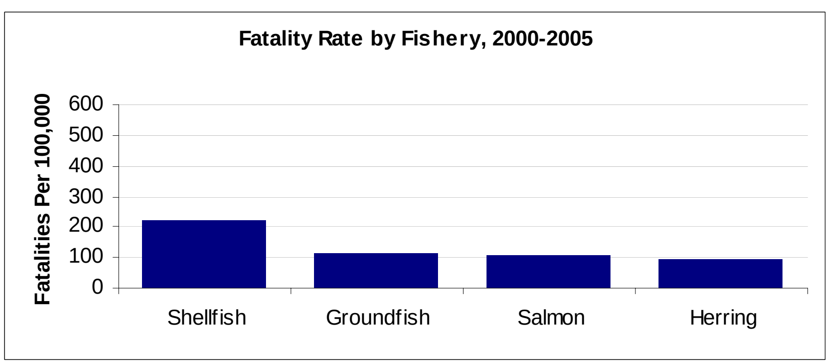


Figure 16. Comparison of Fatality Rates by Fishery in Alaska, 1990-1999 (top graph) and 2000-2005 (bottom graph)

External Factors:
Although collaborative research and communication efforts have developed and disseminated recommendations and promising interventions, the USCG, the agency with the regulatory authority for the safety of the fleet, has not yet addressed nonfatal injuries.

What's Ahead:
TI is producing a video on deck safety, developing a commercially available retrofit kit for the e-stop (in collaboration with the original switch manufacturer), and preparing a control technology publication aimed at increasing the distribution and impact of the e-stop.

TI has recommended that all current and proposed management regimes be examined for safety concerns.[6] Despite the assertion by fishery managers, industry leaders, and academicians that vessels operating in a quota-based fishery are generally safer, no systematic assessment to examine corresponding improvements in measures of safety has been conducted. TI scientists successfully competed for a grant in 2005 from the North Pacific Research Board to evaluate the impact of the changes in fishing management regimes on safety in the halibut/sablefish fleet and the Bering Sea Aleutian Island pollock fleet.

The NIOSH Alaska Field Station is expanding on the successful work in Alaska to include other commercial fishing regions of the country during FY07. This research program will apply classic epidemiologic and engineering analysis methods in order to better understand and prevent commercial fishing fatality and injury events in all geographic areas which comprise the U.S. coastline.

TI researchers will continue analysis of falls overboard to:

- Understand root causes and possible interventions
- Seek to develop improvements to deck designs or fishing equipment
- Evaluate commercially available crew overboard alarms, and tracking and rescue devices
- Design new, innovative crew overboard interventions that can prevent such incidents
- Continue development of e-stop and guarding technologies
- Consider new ways to detect, monitor, control, and prevent dangerous, uncontrolled downflooding that can sink an otherwise intact, seaworthy vessel.

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Sub goal 6.2: Reduce injuries and fatalities in helicopter logging operations

Issue:
Because of the unique capabilities of helicopters, their use in hauling logs and recently felled trees (also known as “helicopter logging,” helicopter long-line logging,” or “heli-logging”) has steadily increased worldwide since the late 1980s. Unfortunately, helicopter logging in some areas, such as Southeast Alaska, has been an extremely high-risk operation. A series of crashes in Alaska during 1992 and 1993 brought these operations to the attention of TI. Amid the rapid growth of this new industry in Alaska—between January 1, 1992 and June 30, 1993—six (16 percent) of the 25 helicopters flying in logging operations crashed, killing nine workers (including four pilots) and severely injuring 10 workers.1 National Transportation Safety Board (NTSB) investigations revealed that all crashes involved improper operation and/or maintenance practices.

Approach:
This first major focused prevention effort of the TI Program at the Alaska Field Station came early after the establishment of the State-wide occupational surveillance system—the Alaska Occupational Injury Surveillance System (AOISS)—in 1992. After the occurrence of two serious helicopter logging crashes during one week in May 1993, and the recognition that these crashes were only the latest in a series of crashes dating back to 1992, TI began a series of urgent consultations, and organized an emergency meeting of the Alaska Interagency Working Group (IAWG) for Prevention of Occupational Injuries. Representatives from the various governmental agencies participated in this meeting on July 8, 1993. Each agency either had jurisdictional responsibilities or shared an interest in preventing helicopter logging crashes. In addition to TI, participating agencies included the Federal Aviation Administration (FAA), the National Transportation Safety Board (NTSB), the U.S. Forest Service, the U.S. Coast Guard (USCG), OSHA, and the Alaska Departments of Labor (AKDOL) and Health and Social Services (AKDHSS).

At this meeting (which was chaired by TI leadership), participants discussed prevention measures and identified a list of recommendations for the prevention of logging helicopter crashes. Included were recommendations for heli-logging companies to provide specific long-line logging operations training for both pilots and ground crews, to adopt limits on crew flight time and duty periods, to follow manufacturer recommendations for more frequent maintenance, and to use multi-engine helicopters for long-line logging. They also called for the development of industry-wide standards and procedures. Additional recommendations included the need for more vigorous oversight and development of rigorous voluntary industry standards for equipment, maintenance, and training.

Prompted to action by the emergency meeting, by the end of July 1993, the jurisdictional agencies (FAA and AKDOL) had visited and inspected all helicopter logging sites and ramps in the State, and shut down or curtailed a number of these operations for irregularities.

Subsequently, TI co-sponsored three Helicopter Logging Safety Workshops in Ketchikan, Alaska in March 1995, February 1996, and March 1997 in order to increase safety awareness, build coalitions, share information and experiences, and encourage action to prevent injury in the helicopter logging industry. Attendees and participants at the workshops consisted of more than

150 representative participants from government agencies, industry (including 27 companies that conduct helicopter logging operations), academia, and insurance organizations. At the workshops additional preventive measures were developed and refined and provided to the industry as recommended safety countermeasures.

Outputs and Transfer:
The IAWG disseminated the initial prevention recommendations that were produced from discussions at the emergency July 1993 meeting. These recommendations were published in a CDC MMWR article1 and discussed in subsequent meetings with the State and Federal participating agencies, and with the helicopter logging companies. This resulted in a joint enforcement effort by FAA, USFS, and AKDOL. Within two weeks these agencies shut down the least desirable operations in Southeast Alaska. The IAWG disseminated additional prevention recommendations that emerged from discussions at the three heli-logging workshops conducted each year from 1995 to 1997. These recommendations were then adopted by the Helicopter Association International (HAI) Helicopter Logging Committee as HAI standards. Helicopter hull manufacturers and re-insurer companies then adopted these standards for all helicopter logging operations.

Three publications ultimately resulted from TI helicopter logging safety research, including a 1994 MMWR article,[1] a 1997 chapter in the book “Safety and Health in Agriculture, Forestry, and Fisheries,”[2] and a 1998 NIOSH report entitled “Helicopter Logging Safety.”[3]

Also, proceedings of the first Helicopter Logging Safety Workshop in 1995 were published and disseminated to all participants.[4]

Intermediate Outcomes:
In July 1993, TI convened and led the collaborative efforts of the Alaska Interagency Working Group for the Prevention of Occupational Injuries. These efforts directly resulted in six tangible intermediate outcomes for preventing helicopter logging crashes and fatalities:

The U.S. Forest Service and the AKDOL shared information on the timber sale locations and the ramp (maintenance) and hangar locations for helicopter logging operations with the FAA. The three agencies collaborated in making site visits to each location to enforce FAA and AKDOL regulations pertaining to helicopter logging.

1. These joint site inspections in Southeast Alaska during the late summer of 1993 noted serious violations involving operations of the two helicopter logging companies that had experienced the fatal helicopter crashes during 1992-1993. Because of the serious nature of these violations, FAA and AKDOL closed down these helicopter logging operations immediately.

2. The Helicopter Logging Safety Committee was formed under the auspices of the Helicopter Association International (HAI) in June 1996. The mission statement of the committee is “...to help promote the safe use of helicopters in all aspects of the helicopter logging industry.” The committee has established its own “Helicopter Logging Guidelines,” which address four issues: 1) general helicopter safety for forestry operations, 2) integration of ground and flight activities, 3) helicopter specific planning, and 4) a pre-accident plan (HAI, 1997). More detailed accounts of these data, events, and interventions have been published in the above three documents.

3. The Helicopter Logging Safety Committee of HAI disseminated these guidelines to all helicopter logging companies, and all 27 major helicopter logging companies agreed to adopt them as a part of their operational procedures at the 1997 HAI Conference in Portland, Oregon. As noted by the Draft HAI Helicopter Logging Safety Manual (contained in NIOSH Publication Number 98-147, "Helicopter Logging Safety" on pages 238-254),[2] these companies agreed that implementing the guidelines would help reduce fatal crashes in the helicopter logging industry worldwide.

4. The insurance industry played a major role in helicopter logging safety by substantially discounting helicopter insurance costs for helicopter logging operators adhering to standards developed by the Helicopter Logging Safety Committee.

The partnership developed among government agencies, HAI, and insurance underwriters has demonstrated the value of joint efforts to address specific occupational safety problems to workers in Alaska.

End Outcomes:
Since the emergency IAWG meeting in July 1993, the subsequent site visits by AKHSS, AKDOL and FAA later the same month, the immediate shutdowns of helicopter logging operations that were in violation of helicopter logging regulations, and the dissemination of the IAWG recommendations all of which occurred during July 1993 (following the emergency IAWG session called by TI), there were no further helicopter logging crashes or fatalities in Alaska until July 1996, when a single helicopter crash occurred with one fatality. Since 1996, there have not been any additional helicopter logging crashes (through December 2006), despite large-scale helicopter logging in Alaska from 1994 through 1999 (see Figure 17).

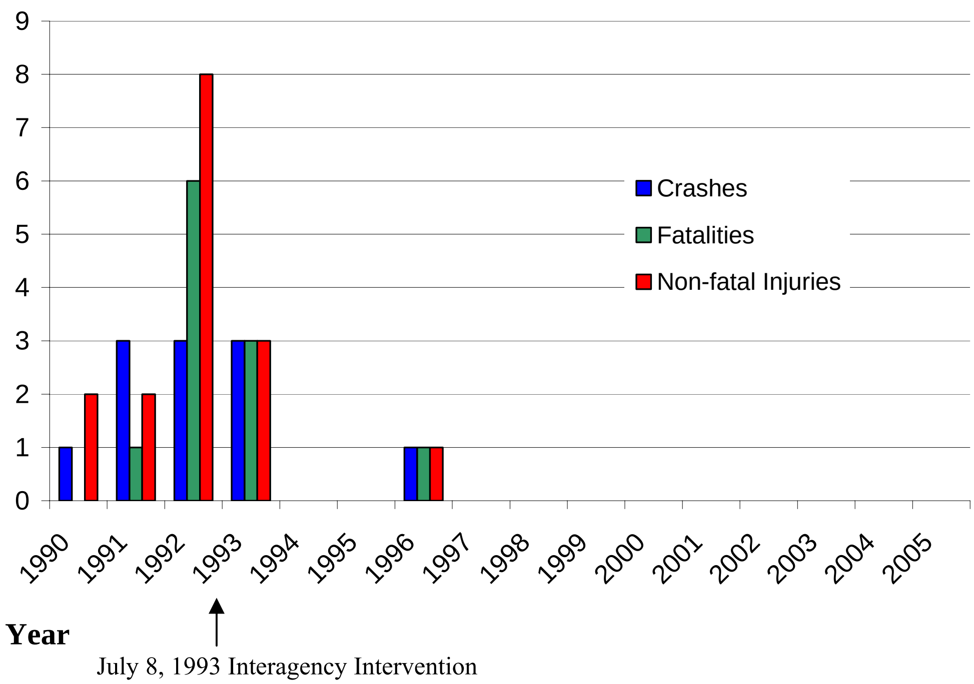

Figure 17. Crashes, Fatalities, and Nonfatal Injuries in Alaskan Helicopter Logging Operations, 1990-2005 Source: AOISS (2005 data provisional)

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Sub goal 6.3: Reduce injuries and fatalities in Alaska aviation

Issue:

Among U.S. States, Alaska is uniquely dependent upon air transportation. Commuter and air taxi operators serve as the main link connecting more than 250 villages—which are located off the road system—with regional hubs. These operators provide a critical service by transporting people, cargo, and mail. This critical mode of transportation has also proven dangerous. Of the 401 people who died in aviation crashes in Alaska during 1990-1999, 157 (39 percent) were on-the-job at the time of their death. The majority of these workers (106) were commercial pilots. This is equivalent to a rate of 420 deaths per 100,000 pilots per year, approximately 100 times the mortality rate for all U.S. workers and nearly five times the rate for all U.S. pilots (88/100,000).[1]

There are several reasons why this mode of transportation has been so dangerous in Alaska. The State has a challenging terrain for air travel, including 17 of the 20 highest peaks in the United States and more than 47,000 miles of coastline. The weather can change quickly, and most of the State is covered with snow and ice for half of the year. Only 60 percent of Alaska had radar coverage over 10,000 feet above mean sea level in the 1990s, and of the more than 200 airports with International Air Transport Association codes in 1998, well over 50 percent were unpaved and did not have instrument approach procedures published.

The leading cause of commercial aviation crashes worldwide is controlled flight into terrain (CFIT) accounting for 24 percent of all fatal commercial airline crashes.[2] CFIT is a causal category of unintentional crashes where a pilot unknowingly flies an airworthy aircraft into terrain (e.g., a mountainside, flat ground, or water), usually due to loss of situational awareness. CFIT crashes accounted for an average of five fatal occupational crashes per year in Alaska from 1990 to 1999.

Approach:

When TI opened the Alaska Field Station in 1991, several industries in Alaska had a history of high fatality rates. Commercial aviation was one of these industries, with the fatalities occurring in air taxi and commuter operations that deliver people and goods across the State to small villages. NIOSH TI activities in Alaska are based on the public health model. Using this model, NIOSH staff began to study the problem scientifically, focus on the worst problems, build consensus for change, and then evaluate interventions for success.

Early work focused on studying the risk factors for pilot fatalities, identifying the most common fatal events, and establishing key partners for ongoing collaboration. Activities included scientific study and publication of research articles and sharing of information with aviation regulatory agencies.

In 2000, TI, the Federal Aviation Administration, the National Transportation Safety Board, and the National Weather Service collaborated to improve air safety through the Alaska Interagency Aviation Safety Initiative. This collaboration was supported by Congressional funding (Public Law 106-69). The TI Aviation Safety in Alaska Project was designed as part of this Initiative to reduce the number of work-related aircraft crash fatalities in Alaska. The concept is that TI, in cooperation with other regulatory and industry groups, can contribute to a 50 percent reduction in occupational aircraft crash injuries and fatalities in Alaska by the end of 2009. The Initiative is part of the process of focusing on the worst problems and building consensus for change.

TI staff have conducted many activities aimed at transferring scientific research findings to the target audience. These include public workshops for aviation passengers; funding, co-organizing and speaking at aviation safety seminars for pilots and industry; and organizing and speaking at scientific aviation panel discussions.

In an attempt to reduce the number of aviation-related occupational fatalities in Alaska, TI offered two free Aviation Passenger Safety Seminars associated with the 2000 and 2001 Alaska Governor's Safety and Health Conferences. The first Seminar, in March of 2000, was well attended (~100 people). TI staff presented updates on aviation safety including information about what passengers can do prior to take-off and while in-flight to make their flight safer, and during and after a crash to increase their chances of survival. Additionally, seminar attendees learned about available training that can teach them the basics of flying and landing a small aircraft should the pilot suddenly become incapacitated, and information regarding how to incorporate safety measures into a company's contract with an air carrier to transport its employees. Finally, information on preventing passengers from pressuring pilots to fly into bad weather was discussed. The success of this seminar led to the second seminar the following year. The March 2001 seminar was smaller and more focused, with an attendance of approximately 40 people.

TI has been a leader in presenting aviation safety information to pilots and industry. In 2003-2006, NIOSH sponsored, co-organized, and presented at the annual Aviation Safety Alliance meeting in Anchorage, Alaska. This event is part of the annual Alaska Air Carrier's Association meeting which has an attendance of approximately 250 people each year.

TI has also provided information for safety organizations and regulatory agencies to develop their safety programs. TI designed and funded a survey of Alaska air taxi and commuter operations to study pilot and company practices and attitudes in order to develop intervention strategies that would reduce aviation fatalities. An analysis of the results was conducted to examine the practices and attitudes of Alaskan commuter and air taxi operators and their pilots as they relate to company fatal accident rates. Pilots of operators with high fatal accident rates differed from those working for the other operators, both in experience and working conditions. The combination of pilot inexperience and longer work hours and work weeks may contribute to Alaska's high aviation crash rate.[3]

As part of the public health model activity of evaluating interventions, TI helped design and fund an independent evaluation of the Aviation Initiative. While many of the interventions have only been in place for a few years, there has been a decline both in the number and rate of fatal aviation accidents in Alaska since the start of the Initiative.

Outputs and Transfer:
(For those outputs not specifically cited, see Appendix I: Supporting Evidence.)

Outputs of the Aviation project include public presentations, research articles, and less formal transfers involving industry conferences, data summaries, and Alaska media coverage.

Aviation Safety Alliance Meeting. NIOSH has used this forum to present updated information on safety and scientific findings presented in industry-appropriate terminology. NIOSH has also sponsored the Aviation Safety Seminar at the public Alaska Aviation Show, which has a weekend attendance of over 19,000 people.

Aerospace Medical Association Annual Meeting. As part of the Aerospace Medical Association Annual Meeting in Anchorage Alaska in 2004, TI organized a panel discussion of safety experts including TI safety scientists and safety professionals from the Medallion Foundation and the National Weather Service. The Aerospace Medical Association is the largest professional organization in the fields of aviation, space, and environmental medicine.

Research articles. NIOSH researchers have published articles on the epidemiology of work-related aviation fatalities, CFIT among commuter and air taxi operators, attitudes and practices of high-risk versus low-risk air carriers, and safety practices and attitudes of Alaska air carrier operators and pilots in the scientific journal of aerospace research—Aviation, Space and Environmental Medicine. Other descriptive epidemiologic studies have been published on factors associated with pilot fatalities in Alaska, human error as a cause of occupant mortality in air taxi and commuter crashes, and deaths of scientific workers and licensed professionals in Alaska. TI researchers have written and published two NIOSH documents, one presenting results of analysis of survey data entitled "Survey and Analysis of Air Transportation Safety among Air Carrier Operators and Pilots in Alaska," which are available both in hard copy and on the Web. Research on aviation safety by TI staff has also been published in Morbidity and Mortality Weekly Report (MMWR) and the American Journal of Epidemiology. This last journal has a general epidemiology focus, and a journal impact factor of 4.9 (ISI index, 2004) which indicates that it is a leading journal for the field. Also, five abstracts of presentations given at national and international conferences have been published in journals or proceedings, including one in the American Journal of Epidemiology.

Copies of these research articles have been distributed at industry meetings, to Federal agencies, and to pilots and operators through aviation organizations such as the Alaska Air Carrier's Association. The research itself has been used to create presentations such as those listed in the previous section, and to create data summaries and displays presented at industry conferences.

During 1990 to 2004, at least 25 percent of the 352 fatal accidents involving commuter/air taxi aircraft in the U.S. were survivable (there were 87 cases where at least one person lived).[4] TI staff researched and published results about several critical risk factors for pilot fatalities in Alaska including post-crash fire, shoulder restraint use, instrumental meteorological conditions (poor visibility), and distance from airport. Recommendations from this research included the use of shoulder restraints, fire resistant clothing to enable pilots to escape post-crash fire, and training in case of unexpected instrument meteorological conditions.

TI staff members regularly create displays presenting up-to-date safety information for pilots and industry at regional industry meetings, including the Alaska Airmen's Association annual meeting, and the well attended Alaska Air Trade Show. TI staff members participate in local safety committees as part of these organizations and regularly pass on aviation safety research information through these committees, making safety information available to pilots and operators.

During the last 15 years, TI has worked with the local media to make safety information publicly available. The largest paper in the State, the Anchorage Daily News, has featured four articles of more than 600 words about TI work on safety in the Alaskan aviation industry. These articles include quotes from nonprofit safety groups, industry, and regulators who joined with TI to form a team working on aviation safety issues.

A Website dedicated to aviation safety in Alaska is available on the NIOSH Website TI Topic Page (http://www.cdc.gov/niosh/injury/traumaaviation.html). This page contains recent statistics on aviation crashes and fatalities as well as links to published aviation research by TI staff.

Intermediate Outcomes:
FAA Circle of Safety Program. The information presented by TI staff at the two passenger safety seminars associated with the Alaska Governor's Conferences in 2000 and 2001 was used by the FAA in designing and creating the Circle of Safety consumer education program.*

FAA Pilot Training. A summary of the information presented in the two passenger safety seminars and CFIT research findings and recommendations from TI staff were combined into an informational handout for pilots. These handouts have been used by the FAA in its training at an Alaskan flight standards district office.

Educational PSAs and Video. The Alaska Airmen's Association and the FAA have used TI findings and recommendations in public service announcements and in a crash survival training video.[5]

Pilot and Operator Survey Results Used by FAA and Medallion Foundation (for Intervention Evaluation and Pilot Training). TI published the results of the surveys of air taxi and commuter pilots and operators, and in the process made several recommendations including allowing adequate rest periods for pilots, increasing regional training, and providing supervision for less experienced pilots. These results have been used by the FAA, Flight Standards Division in reviewing intervention programs, and by the nonprofit Medallion Foundation to focus their training for pilots.

End Outcomes:
Through concerted efforts by TI; other Federal agencies such as NTSB, NWS, and FAA; nongovernmental organizations; and industry, aviation fatalities in Alaska have decreased (See Figure 18 below). Comparing the 1990s to the years since the start of the initiative (2000 to 2005), the number of occupational fatalities in aviation crashes has decreased by 44 percent and the pilot fatality rate has decreased by 53 percent (NIOSH Alaska Occupational Injury Surveillance System). A recent evaluation of the effects of the Alaska Interagency Aviation Safety Initiative found that fatal accident rates have declined since the start of the Initiative and are likely the result of the combined efforts to create a "culture of safety."[6]

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[*] FAA Circle of Safety Program: http://www.alaska.faa.gov/flt_std/index.cfm?template=circle_of_safety

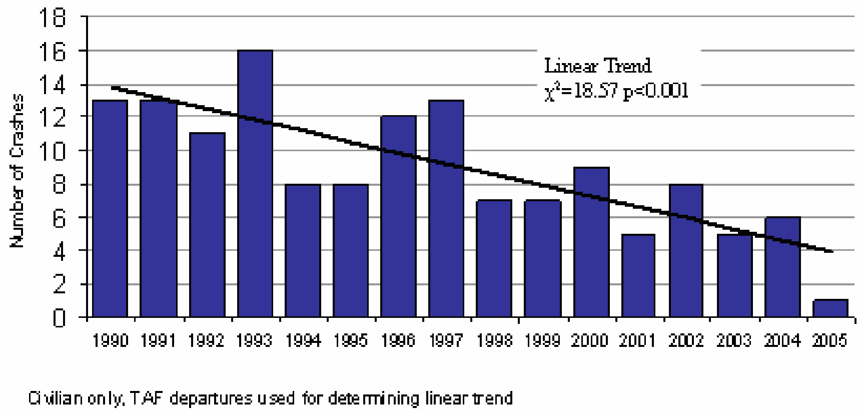

Figure 18. Fatal Occupational Aviation Crashes in Alaska, 1990-2005 (n=142)
Source: AOISS

Since the start of the initiative in 2000, the average number of fatal occupational crashes per year decreased by 45 percent (11 per year during 1990-1999 to six per year during 2000-2005). The average number of fatal occupational accidents due to CFIT declined by 60 percent from five per year during 1990-1999 to two per year during 2000-2005. The Aviation Safety in Alaska Project has worked to reduce the number of work-related aircraft crash injuries in Alaska by studying the problem scientifically, focusing on the worst problems, building consensus for change, and evaluating interventions for success. This strategy has proven effective.

The project has created outputs including scientific articles, public presentations, and direct transfer of information to the aviation community through displays and brochures at industry conferences. The evidence is clear that this information has been used. Research about pilot safety and controlled flight into terrain risk factors have been integrated into public service announcements by the FAA, and put into practice through an increase in weather cameras by the National Weather Service. The ideas and concepts about weather awareness and corporate safety policies presented in the passenger awareness seminars by TI staff were adopted by the FAA into the Circle of Safety Program. TI research is also used in the Circle of Safety Aviation Coordinator Handbook to recommend policies for companies which use air taxi and commuter operators in Alaska. Pilot and operator survey results were used by the Medallion Foundation to improve its training.

What’s Ahead:
NIOSH researchers are reviewing CFIT crashes in Alaska to examine how recent improvements in safety are related to the decline in crashes. The improvements seen in the Alaska aviation industry may provide useful insight into how to decrease crashes in other parts of the country with a history of air taxi and commuter crashes involving controlled flight into terrain, such as New Mexico and Colorado.

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7. Reduce Injuries and Fatalities to Emergency Responders

Police officers, fire fighters, emergency medical technicians (EMTs), public health professionals, and other emergency response professionals are typically the first workers to arrive at the scene of personal, community, and national crises, and are therefore often called “first responders.” The United States currently depends on approximately 1.1 million fire fighters—three out of four are volunteers—to protect its citizens and property from losses caused by fire. Estimates of EMS workers—both professional and volunteer—range from 750,000 to 900,000.[1, 2] Approximately 850,000 police and detectives were employed in the U.S. in 2004.[3] In recent large-scale disasters, both natural disasters and terrorist attacks, workers other than traditional emergency responders played important roles in response, rescue and recovery operations—for example, utility workers and construction laborers, and equipment operators.

Workers responding to emergency situations face unique and sometimes unknown risks, and must often rely upon personal protective equipment, well practiced standard operating procedures and protocols, effective communications, and especially one another, to protect themselves.

The TI Program’s involvement in fire fighter safety, principally carried out in the Fire Fighter Fatality Investigation and Prevention Program (FFFIPP), was directed by Congress at the request of the fire fighter community. The special hazards faced by EMTs who must ride in the patient compartments of ambulances and care for emergency patients was largely identified through investigations of ambulance crashes through FFFIPP. TI also conducted a study of safety management at large-scale disaster sites in the aftermath of 9/11 attacks on the World Trade Centers and the Pentagon. These TI efforts are described below.

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Sub goal 7.1: Reduce injuries and fatalities to fire fighters

Issue:
According to the National Fire Protection Association (NFPA), data from recent years indicate that approximately 54 fire fighters die each year from fatal traumatic injuries and another 48 die from cardiovascular-related disease (CVD) in the line-of-duty.[1] Approximately 95,000 fire fighters are injured at work each year.

In fiscal year 1998, Congress recognized the need for further efforts to address the continuing national problem of occupational fire fighter fatalities, and appropriated funds to NIOSH for a fire fighter safety initiative.

Approach:
As a result, NIOSH developed the TI Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) and hired new and trained existing staff to conduct on-site investigations of fire fighter line-of-duty deaths.

When notified of a traumatic line-of-duty fire fighter death, TI investigators interview fire department personnel, take photographs and measurements at the site, and review all applicable records (e.g., standard operating procedures and guidelines, dispatch records, training records, medical records, and coroner/medical examiner reports). In cases in which the performance of self-contained breathing apparatus (SCBA) may have been a factor, personnel in the National Personal Protective Technology Laboratory (NPPTL) are asked to evaluate SCBA performance. Since 1998, NPPTL has evaluated 53 SCBAs which were involved in 37 fatalities. In select cases, TI seeks expert evaluation of other types of fire service equipment that may have malfunctioned, including oxygen regulators, diving suits and other equipment related to underwater incidents, and personal alert safety system (PASS) devices. TI has also supported the National Institute of Standards Technology (NIST) in its development of computerized fire simulation models for some investigations. These computerized models are useful tools in efforts to explain or verify fire behavior and conditions, or test and reinforce the validity of recommendations.

A report is completed for each investigation summarizing the sequence of events that led to the fire fighter death or injury and making recommendations for preventing future deaths and injuries under similar circumstances. The investigations do not seek to place blame on fire departments or individual fire fighters or officers; rather, the goal is to identify steps that could be taken for prevention in the future. No identifiers are included in the report, because inclusion of such information might discourage the willing participation of fire departments and personnel in TI investigations. All finalized reports can be viewed at: http://www.cdc.gov/niosh/fire/.

Since the inception of the FFFIPP in 1998 through July 2006, TI investigators have conducted 366 investigations of incidents that resulted in 409 fire fighter deaths (both trauma and CVD) in 48 States. TI investigated 44 percent of all fire fighter line-of-duty deaths for the period 1998 to 2004 (excluding fire fighter deaths associated with the 2001 World Trade Center attacks). Traumatic injury incidents accounted for 187 of the investigations (81 structure fires, 65 motor-vehicle-related, 15 training, nine wildland fires, six explosions, and 11 other incidents—e.g., helicopter crash, falls, homicide, drowning, struck-by, etc.).

Cardiovascular incidents accounted for the other 179 investigations. Additionally, TI investigated nine nonfatal injury incidents that resulted in 19 injuries.

TI has often worked collaboratively with other agencies and fire service organizations to leverage resources when addressing fire fighter safety issues of common interest. For example, in 1998, the IAFF requested that TI investigate a number of flash fires in regulators used to control the flow of oxygen in oxygen resuscitation systems. Such fires had resulted in burn injuries to fire fighters and emergency medical technicians. TI worked collaboratively with the Food and Drug Administration (FDA)—FDA regulates these devices—and with the National Aeronautics and Space Administration (NASA) due to its expertise in oxygen safety. Investigations revealed that aluminum in the regulator was a contributing factor to the flash fire incidents, and that there were a number of safe handling techniques which fire fighters and emergency medical technicians could use to reduce the risk of regulator flash fires. Most of the reported flash fire incidents involved a single manufacturer who voluntarily recalled regulators and offered trade-ins with non-aluminum regulators.

In the early 2000s, after identifying the collision hazard caused by the need for fire/emergency apparatus to cross railroad tracks during emergency response, TI contacted the Federal Railroad Administration (FRA) and Operation Lifesaver (a nongovernmental program dedicated to eliminating injuries from train collisions). The TI consulted with the FRA during investigations of incidents where trains collided with fire apparatus at railroad crossings, and ultimately collaborated with FRA and Operation Lifesaver on a safety publication.

TI partnered with the International Association of Fire Chiefs (IAFC) in a June 2005 and 2006 “stand down” for safety. The purpose of this initiative was to encourage fire departments to set aside time specifically for safety and health training to raise awareness within the fire service community. The IAFC recommended the use of TI fatality investigation reports for the training.

The TI has conducted outreach efforts to the fire service which include the formation of partnerships with fire service and other Federal agencies to increase the use of the TI reports, findings, and prevention recommendations. The TI staff members also provide information and participate on committees developing standards and tools for fire fighter safety.

TI recently entered into a memorandum of understanding (MOU) with the USFA to identify collaborative efforts to improve safety and health conditions for fire fighters throughout the United States. The primary focus of the memorandum involves fostering the use of TI products and recommendations in USFA fire fighter training materials and programs. The TI also recently entered into a letter of agreement with the State of Pennsylvania, Office of the Fire Commissioner to identify collaborative efforts to improve safety and health conditions for fire fighters throughout the State of Pennsylvania. The primary focus of the agreement involves the use of TI products and recommendations in Pennsylvania State fire fighter training materials and programs.

The TI held a fire service stakeholders meeting in March 2006 in Washington, D.C. to request stakeholder input on possible ways to improve the program and enhance impact on fire fighter safety and health. TI has compiled and considered all comments received at the meeting and through the NIOSH docket, and used them in writing a draft summary document outlining the immediate next-steps of the program. This summary will be posted to the NIOSH Website in 2007.

Several intramural research projects have been initiated based on the findings of the FFFIPP. Research topics include fire fighter personal protective equipment (PPE) such as boots, gloves, and apparel (bunker gear and driving and physiological factors of PPE). TI investigations of fire fighters/emergency medical service workers fatally injured in the patient compartments during ambulance crashes helped to show that occupants in the patient compartment of an ambulance are inadequately protected. This led to the research effort reported in this evidence package in *Sub goal 7.2:* Improve protection for ambulance workers in patient compartments.

A proposal was submitted recently through the TI that would include an anthropometry survey of career and voluntary fire service personnel, and the collection of a minimum set of body size and shape measurements to validate the appropriateness and the accuracy of the range of sizing dimensions described in SAE, ASTM, FAMA and NFPA sizing schemes mandated for use in fire vehicle and fire fighter PPE/apparel design.

In November 2005, TI was granted approval by the Office of Management and Budget to proceed with an evaluation of the TI Fire Fighter Fatality Investigation and Prevention Program. The study, largely funded by CDC, was conducted in conjunction with RTI International (a nonprofit research organization). The evaluation included a survey of a stratified random sample of 3,000 fire departments across the U.S. in the spring of 2006, and a number of focus groups consisting of front-line fire fighters. The evaluation study has been completed, and TI has received a DRAFT report of the findings from RTI. When finalized, this evaluation report will document the extent to which the program's reports, recommendations, and other products are being utilized by the fire service for training, policies, practices, and other prevention efforts. The evaluation will provide additional insight into the impact of the TI Program and help to identify enhancements that might further the program's impact.

Outputs and Transfer:
(For those outputs not specifically cited, see Appendix I: Supporting Evidence)

In April 2005, the TI notified the NFPA by letter of several fatality investigations in which PASS devices were not heard by fire fighters working near fallen fire fighters or by rapid intervention teams searching for the fire fighters. The PASS alarms had been certified as compliant to NFPA 1982, 1998 Edition, and involved both stand-alone PASS and SCBA-integrated PASS. The TI identified potential reasons why the PASS devices may not have performed as designed, and recommended that the NFPA committee revising NFPA 1982 Standard on Personal Alert Safety Systems (PASS) consider modifications in testing and performance criteria. TI staff members from NPPTL who participate on this committee provided technical support to address these issues in the revision. TI also contacted other organizations representing fire fighters and rescue workers, such as the IAFF, to tell them that exposure to high temperature environments may cause the loudness of Standard on Personal Alert Safety Systems (PASS) alarm signals to be reduced, causing the alarm signal to become indistinguishable from background noise at the incident scene.

Each finalized report from fire fighter fatality investigations includes prevention recommendations. When multiple TI investigations identified common safety and health concerns, the TI developed educational documents (including four Alerts, two Workplace Solutions, four Hazard IDs, and one fact sheet), as well as journal articles, that summarize hazards and recommend prevention measures. Examples of hazards addressed by the educational documents include preventing injuries and deaths of fire fighters due to truss system failures, live-fire training in acquired structures, training dives (SCUBA), electrical hazards, tanker truck rollovers, working along roadways, structural collapse, propane tank fires, motor-vehicle related crashes, general prevention of injuries and deaths of fire fighters, and exploding flashlights. Fire fighter safety and health issues addressed in TI-authored journal articles include flashing of oxygen regulators and risk factors for injury in structure fires.

A primary venue for transfer of TI fire fighter-related outputs is the TI-FFFIPP Website (355,429 hits in FY 2004, and 444,147 visits in FY 2005), which is available at: www.cdc.gov/niosh/fire/. The Website contains links to all investigative reports and TI publications. The Web page provides a section where users can subscribe and be automatically notified (currently 1,707 subscribers) when a new product is available.

TI has partnered with a number of fire service trade journals including *Firehouse*, *Fire Rescue*, *Fire Chief*, *NFPA Journal*, *Responder Safety*, and *Responder Magazine* to transfer investigative findings and recommendations to their readers. The total monthly combined circulation for the six magazines is approximately 300,000, reaching a potential audience of more than 1,400,000 fire service professionals per month.

TI conducts periodic mass-mailings to all 30,000+ fire departments in the United States. The mass mailings are typically done once per year and usually contain a packet of five to six reports addressing a variety of situations in which fire fighters have died in the line-of-duty, or a single report thought to be of particular importance for the fire service as a whole.

TI also disseminates findings and products at meetings and conferences. TI staff members have given 61 oral presentations at national and international fire service conferences in order to provide an overview of the TI Program, report on current findings, and share information on specific cases. In addition, TI regularly sets up informational booths with products for distribution at many of the fire service conferences. TI personnel have presented investigation findings at public health, occupational medicine, and safety conferences (e.g., annual meetings of the American Public Health Association, American Occupational Health Conference, National Safety Congress, American Society of Safety Engineers, and the NIOSH National Occupational Injury Research Symposia). Examples of specific traumatic injury topics presented at these meetings include safety hazards with oxygen systems, motor-vehicle incidents, structural fire incidents, and ambulance safety.

TI recommendations have also been disseminated to manufacturers to enhance safety aspects of fire service equipment, municipalities to address organization and coordination of fire services as well as safety requirements related to buildings and structures, standard-setting bodies to modify or develop new standards, and research organizations to enhance and develop technologies to improve fire fighter safety.

The TI collaboration with the FRA and Operation Lifesaver on the issue of collisions between trains and emergency vehicles at railroad crossings resulted in a joint publication entitled “Your Safety- 1st--- Railroad Crossing Safety for Emergency Responders” (NIOSH Pub. No. 2003-121).

As an outgrowth of their collaboration on the issue of flash fires in oxygen regulators, TI and FDA developed a joint public health advisory that was widely distributed to the fire service (http://www.fda.gov/cdrh/oxyreg.html), and a training video on safe handling of oxygen systems. The release of the advisory led to this issue being highlighted on the FDA's Patient Safety News satellite broadcast (http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/psn/index.cfm).

TI personnel have been actively involved in various National Fire Protection Association (NFPA) and ASTM standards which support fire fighter health and safety. On October 31, 2005 NFPA and NIOSH entered into an MOU that focuses on emergency responder safety and protective clothing and equipment. The goal of the collaboration is to provide the research and technology so that NIOSH regulations and NFPA standards can give leadership for protective clothing and equipment to aid the protection of emergency responders. In December 2005, NIOSH and ASTM International signed an MOU to support the ASTM International Committee F23 on Protective Clothing and other standards developing committees related to protective clothing. The agreement highlights the role of the NIOSH to support standards development work related to personal protective clothing and equipment. The purpose of the MOU is to facilitate cooperation between NIOSH and ASTM International involving the determination of performance requirements and cooperation in the development of test methods, product specifications, practices, guides, classifications and terminology related to worker and emergency responder protective clothing and equipment. In support of these MOUs, TI personnel actively attend the various ASTM and NFPA committee meetings as voting members.

TI staff participate on several safety-related NFPA technical committees, including

- NFPA 1500: Standard on Fire Department Occupational Safety and Health Programs[2]
- NFPA 1981: Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services[3]
- NFPA 1982: Standard on personal alert safety systems (PASS),[4] and
- NFPA 1989: Standard on Breathing Air Quality for Fire and Emergency Services Respiratory Protection.[5]

TI personnel have also actively participated on the IAFC Safety and Survival Section Executive Board since 2006.

In 2005, NIOSH was asked to participate in Project HEROES (Homeland Emergency Response Operational Equipment Systems). Project HEROES is funded by the Technical Support Working Group (TSWG) and managed by the International Association of Firefighters (IAFF). The goal of the project is to develop a prototype PPE ensemble for fire fighters that provides improved protection against chemical and biological agents. The NIOSH role on the team is to conduct physiological/ergonomic testing of the ensemble, select test methods, and interface with the NFPA and ASTM. Key design features include a moisture/chemical/biological barrier that provides the same level of breathability as current moisture barriers; seals at the wrist, ankle and collar areas; and an innovative system for capturing the SCBA exhalation to provide positive pressure against exterior penetration, and an upper torso cooling system. NIOSH developed an ergonomic and physiological testing protocol to compare the new prototype versus a standard ensemble. The protocol was successfully peer-reviewed and approved by the NIOSH human subject review board. Subjects have been recruited and testing is underway. An ASTM working group was formed to develop a standard test practice based on the physiological testing portion of the NIOSH protocol (ASTM F23 Work Item WK8818 Standard Practice for the Physiological Evaluation of Protective Clothing). As part of the Project HEROES team, NIOSH provided comments to the NFPA technical committees working on revisions to the NFPA 1971 (structural fire fighter ensembles)[6] and NFPA 1994 (CBRN ensembles)[7] standards. NIOSH chaired the task group that wrote the CBRN option for the NFPA 1971 standard and was instrumental in ensuring the CBRN option was included in the revised edition. The 2007 Editions of NFPA 1971 and 1994 became effective in August 2006.

Intermediate Outcomes:
The NFPA 1982 PASS standard was recently revised and issued (effective December 20, 2006).[8] TI provided information from its investigations of four fire fighter fatalities that occurred from 2001 to 2004 in which PASS alarms were not heard or were barely audible. The PASS alarms had been certified as compliant to NFPA 1982, 1998 Edition, and involved both stand-alone PASS and SCBA-integrated PASS. TI communicated this information to NFPA by direct participation in Technical Committee meetings, and by an April 2006 letter which outlined TI technical findings and recommendations, as well as a request that this information be considered in a revision of the 1982 standard.

Both the NFPA and the International Association of Fire Fighters recently posted notices regarding PASS devices on their Websites warning fire fighters that PASS devices may not function as intended under high temperature conditions based on issues raised by the

TI investigations and initial testing by the National Institute for Standards Technology.
An encouraging preliminary finding from the evaluation of the FFFIPP is that TI recommendations have been used by approximately 11,000 fire departments to update the content of their training programs on personal protective equipment (PPE), self-contained breathing apparatus (SCBA), personal alert safety system (PASS) devices, incident command (IC), traffic hazards, radio communications and other topics.

Prior to the evaluation, TI had received anecdotal feedback on a variety of ways in which the fire service, public safety departments, and universities have been using TI fatality investigation reports to improve fire fighter safety. For example, several fire departments across the country reported using TI fatality investigation reports in their fire fighter safety training (as the evaluation study found). These fire departments include Baltimore City, Maryland; Howell Township, New Jersey; Mentor, Ohio; and, Portland, Oregon. State fire training academies, including those in Pennsylvania, West Virginia, and Tennessee, also consider findings and recommendations when reviewing and developing new curriculum. For example, in Pennsylvania, the training academy instructed 1,200 local instructors to incorporate training on “accountability” into their classes based on a series of TI investigations making recommendations for improving accountability on the fire scene. TI is also aware of fatality investigative reports being used as case studies in university fire safety curriculums, including courses at West Virginia University and Northern Virginia Community College.

Findings from TI fatality investigations have been referenced or used to develop State legislation aimed at improving fire fighter safety and health. For example, the TI investigation of the 2001 death of a fire fighter in New York (FFFIPP report number 2001-F38) was cited in the justification for a 2003 New York law called Bradley’s Law. Bradley’s Law prohibits the use of people to play the role of victims in live-fire training. In addition to the NFPA 1982 PASS standard, TI findings and recommendations have been used in the development and revision of other current NFPA consensus standards. Mr. Richard Duffy, the Secretary of the Technical Committee that developed NFPA 17109 and 1720,10 reported that NIOSH fatality investigation reports were used extensively in the development of NFPA 1710, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments. This standard recommends staffing based on the types of emergency response fire departments are likely to encounter. Many provisions of this standard are also included in a counterpart for volunteer departments, NFPA 1720. TI findings were shared with each of these committees in both electronic and hard-copy form.

The TI partnership with fire service trade journals including *Firehouse*, *Fire Rescue*, *Fire Chief*, *NFPA Journal*, *Responder Safety*, *Responder Magazin*e, and *Wildland Fire* journal resulted in the reprinting of more than 70 fire fighter fatality report summaries in the past 18 months.

Starting in 1999, the NIOSH Chemical, Biological, Radiological and Nuclear (CBRN) respirator standards program began work on a series of new equipment standards for fire fighters and first responders. In 2001, NIOSH published the CBRN Standard for Open-Circuit Self-Contained Breathing Apparatus (SCBA). This standard establishes performance and design requirements to certify SCBA for use in CBRN exposures for use by emergency responders. In 2002, NIOSH published the Standard for CBRN full facepiece Air Purifying Respirator (APR). The purpose of this standard is to specify minimum requirements to determine the effectiveness of full facepiece APR, commonly referred to as gas masks, used during entry into CBRN atmospheres not immediately dangerous to life or health (IDLH). In 2003, NIOSH published the CBRN Air-Purifying Escape Respirator and CBRN Self-Contained Escape Respirator. The purpose of this standard is to specify minimum requirements to determine the effectiveness of escape respirators that address CBRN materials identified as inhalation hazards from possible terrorist events for use by the general working population. In 2004, the U.S. Department of Homeland Security's (DHS) Science and Technology division adopted these standards to protect emergency responders against CBRN threats. The NFPA also adopted the NIOSH respirator standards into private-sector consensus standards (NFPA 1500, 1991,[11] 1994, and 1981). DHS requires that all respirators purchased through its grant program be NIOSH CBRN certified. Through September 2006, NIOSH certified 79 CBRN-approved respirators (67 for SCBA, nine for APR, and three for escape).

External Factors:

The number of fire fighter deaths has not exhibited a steady downward trend. Several external factors impede the widespread implementation of TI recommendations, including what has been identified as the “culture” of the fire service. Simply put, this “culture” or occupational behavior involves a willingness to assume a high level of risk for minimal or no return or gain. Local government budget shortages also have a negative impact, as TI recommendations are frequently costly to implement. Further, TI recommendations are all voluntary, not mandatory, and the TI Program has no authority to create regulations or to enforce them. Other concerns of fire service administrators are that implementation of certain TI recommendations might decrease the recruitment and retention of volunteer fire fighters, or might infringe upon labor agreements. In addition, the lack of accurate data on the number of active fire fighters (career and volunteer) and number of hours of exposure precludes the statistically sound calculation of accurate fatality rates, which would provide the TI better estimates of changes in risk over time.

Lastly, other causes of death, such as aircraft crashes and homicide, are outside the scope and influence of TI research and outreach.

What's Ahead:
The NORA program is currently funding a pilot TI project to evaluate and compare the effects of wearing bunker boots/bunker pants with wearing a station uniform in manipulating the accelerator and brake pedals of a mock-up emergency apparatus cab, and to determine if future research is needed in this area. This pilot project was proposed based on hypotheses that bulky turnout gear may negatively impact the ability of drivers to operate fire apparatus, contributing up to 25 percent of all fire fighter deaths. It is hypothesized that heavier, bulkier, more restrictive apparel (bunker pants/boots) will increase braking reaction time, therefore increasing fire apparatus stopping distances, possibly leading to a crash. This project is ongoing.

Through its personal protective technology program, NIOSH also funds research that can be considered part of the TI Program. Some examples include NIOSH work on Project HEROES, fire fighter cooling garments, and EMS protective clothing.

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Sub goal 7.2: Improve protection for ambulance workers in patient compartments

Issue:
Emergency medical service (EMS) workers in ambulance patient compartments are at risk of vehicle crash-related injury. Protection from crash-related injury for patient compartment occupants is provided by lap belts, which do not allow EMS workers the needed mobility to access the patient or EMS equipment at all times. Consequently, EMS workers tend not to use the lap belts at all. This places them at risk for serious injury or death during vehicle crashes. Secondary to the lack of occupant restraint use, EMS equipment is commonly carried unsecured in ambulance patient compartments posing additional risk for injury when crash forces cause them to become projectiles.

Current Federal standards do not address either occupant safety or crashworthy equipment mounting for ambulance compartments. In fact, some States specifically exempt EMS workers in patient compartments from using occupant restraints. Previous intervention efforts have focused on crash avoidance through development of safe operating procedures and vehicle operator training. These approaches have no doubt yielded positive results, however little or no effort has been focused on injury intervention if crash avoidance fails.

Researchers have estimated that the injury rate for EMS is 12.7 per 100,000 workers.[1] This issue also affects fire fighters since 45 percent of all EMS is fire department-based.[2] While there have been significant advances in the protective technology for automobiles and aircraft, similar research and development addressing the patient compartment of an ambulance is lacking.[3]

Approach:
TI has focused efforts on quantifying the scope of the problem, identifying injury mechanisms and work procedures that expose EMS workers to risk of crash-related injury, and identifying engineering solutions that would allow EMS workers the mobility required to care for patients, while protecting them from injury due to ambulance crashes.

TI implemented two projects to address the issue. Beginning in 2001, TI formed a project team comprised of public and private-sector partners to implement the Evaluation of Emergency Service Vehicle Occupant Safety Project. Under TI leadership, this project team identified circumstances and injury risks for EMS workers during ambulance crashes, evaluated engineering interventions, and began technology transfer to TI customers. The team included 15 public and private-sector partners. Together, these partners pooled staff, facility, and financial resources to implement a comprehensive project that evaluated the crash performance of four mobile occupant restraint systems.[*]

In 2004, TI began implementation of a phase two effort, the Ambulance Crash Survivability Improvement Project. Under this project, scheduled to end in the fall of 2007, TI is working with 11 public and private-sector partners to describe the scope of nonfatal injury risk for EMS, identify human factors-related obstacles to occupant restraint use in patient compartments,

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[*] Mobile occupant restraints employ worker-worn harnesses that are tethered to the structure of the patient compartment. The tethers are stored on retractor reels which unwind as the occupant moves away from the seat and wind up as the occupant moves back into the seat. In the event of a crash, the retractor reels automatically lock, providing restraint against crash forces. This arrangement allows EMS workers the mobility needed to access patients while simultaneously providing crash protection.

develop test recommendations for crashworthy EMS equipment storage and mounts, and provide selection criteria for energy absorbing foam padding. (For a list of all TI partners who participated in these two projects, and a short description of the role each played, see Appendix I: Supporting Evidence.)

To describe the scope of the problem, TI conducted analysis of the National Highway Traffic Administration (NHTSA) Fatality Analysis Reporting System (FARS) database. Published results of this analysis identified 300 fatal ambulance crashes resulting in the death of 27 EMS workers occurring between the years 1991 to 2000. While conducting this analysis, TI identified a lack of public health surveillance data that could be used to quantify nonfatal EMS crash-related injuries.[4]

TI and American Medical Response (AMR), a large EMS service provider in 36 States, are jointly analyzing AMR's employee injury and compensation database in an attempt to quantify the scope of nonfatal EMS crash-related injury. TI and AMR expect to publish the results of this ongoing effort in 2007.

TI and various partners engaged in several approaches to the study of the circumstances and characteristics of ambulance patient compartments in simulated and actual ambulance crash scenarios. To describe circumstances present in the patient compartment work environment that could lead to increased risk of crash-related injuries, TI and partners are analyzing results of a survey of emergency medical technicians (EMTs). The survey data have confirmed anecdotal data indicating user acceptance of potential interventions.

TI conducted investigations of five fatal ambulance crashes and developed reports that document crash-related injury risk and incident circumstances, and provide recommendations for preventing future similar occurrences. These reports are available to the public and other researchers at the FACE Program Website at: http://www.cdc.gov/niosh/face/ and at the Fire Fighter Fatality Investigation and Prevention Program Website at: http://www.cdc.gov/niosh/fire/.

TI also funded and participated in six ambulance crash reconstructions. The reconstruction reports documented environmental circumstances, operator actions, vehicle crash mechanisms, and occupant injury mechanisms. Five of these reports are available to other researchers at http://www-nass.nhtsa.dot.gov, while the other report is not yet in the pubic domain.

After identifying occupant restraint systems that offered potential to provide mobility as well as crash protection for EMS workers, TI and partners then evaluated the systems through computer modeling and dynamic testing. Dynamic tests were conducted using both a system that simulated ambulance crashes (with a sled, simulated patient compartment, and instrumented crash test dummies) and four actual ambulances also equipped with instrumented crash test dummies. Twenty-nine tests were conducting using the sled, in which the instruments collected kinematic (high-speed video), force, moment, and acceleration data. In addition to these data, four full-scale ambulance crash tests enabled collection of data that described crash pulses for the vehicles. Previous to these tests, vehicle crash pulses (acceleration vs. time trace) specific to ambulances were generally not available to public or private-sector entities. The only similar data that the TI project team could access were from 1990 Canadian tests that had not been publicly disseminated.

TI is currently working to finalize the test reports and data analysis. In the meantime, TI engineers presented post-test briefings to each partner. TI engineers provided each partner participating in the crash tests with appropriate data packages for use in further development of systems and refinement of ambulance designs. Public sector partners received copies of all test data, while each private-sector partner received a similar data package containing only the test data for their restraint system. These data packages can be used to support continued development of the systems at each partner's discretion. TI has presented preliminary analytical results at EMS conferences and meetings.

TI has also conducted, and used a contractor to conduct, engineering evaluations of the performance of energy absorbing foams. The evaluations involve computer modeling and impact testing at 10, 15, 20, and 30 mph using simulated human head forms to gather data describing the performance of selected foams. Energy absorbing foams have application for padding of bulkhead and other surfaces within the ambulance patient compartment that can be sources of struck-by injury for EMS during a crash. Data from this effort will be used to support recommendations to the EMS industry, ambulance manufacturers, and standard-setting bodies. These test data will yield a comprehensive data set to support recommendations for foam selection criteria.

TI has used a contractor to conduct evaluations of the crashworthiness of EMS equipment commonly carried in ambulance patient compartments. To date, contract engineers have identified the physical characteristics of common EMS equipment and are working toward development of test procedures that can be used to quantify crash performance of the mounting systems.

TI hired a contractor to construct an ambulance to meet the GSA Federal Specification for the Star of Life Ambulance—KKK-1822E (June 1, 2002). The patient compartment of this vehicle was specially configured to allow mounting of two types of mobile restraint systems. Upon receipt, TI outfitted the vehicle with video cameras and monitors to collect vehicle operating data. The vehicle is used as a Mobile Emergency Medical Service (EMS) Work Environment Laboratory to study the efficacy of patient compartment design changes and occupant restraint use through human subject testing. Then TI, along with EMS and manufacturing partners, conducted human subject testing to identify obstacles to occupant restraint use in the patient compartments. Eight Paramedic and EMT Basic volunteers from the EMS performed simulated patient care tasks in an ambulance patient compartment while using the lap belts and a high mobility restraint system. On a pilot test basis, TI researchers collected heart rate, video footage, and reach measurement data from each subject using each restraint system. The data are currently being analyzed in preparation for a larger study to be conducted in spring 2007.

Outputs and Transfer:
(For those outputs not specifically cited, see Appendix I: Supporting Evidence.)

In February 2004, a TI engineer presented "A Review of NIOSH Research to Support Ambulance Worker Safety," to the National Truck Equipment Association's (NTEA) Ambulance Manufacturers Division (AMD) winter business meeting in Tampa, Florida. NTEA/AMD is a trade association involving truck chassis and ambulance manufacturers, component and supply manufacturers, and those involved in buying and selling ambulances. The winter business meeting had about 50 high-level attendees including corporate principals, engineering managers, sales managers and ambulance service managers. The group works with GSA to maintain the

Star of Life Ambulance Specification, GSA KKK-1822E. An open dialogue with this group is a major key to effectively transferring new research findings and technologies into industry practice.

In September 2005, a TI engineer met with the Chief and the EMS Supervisor of the Winter Park Florida Fire Department. At the time, the department was developing specifications for procurement of new ambulances and was working with one of the TI research partners, a safety products manufacturer. During the meeting, the TI engineer provided a briefing on the TI sled and vehicle crash test results to the fire department representatives, including preliminary test results and video footage of the tests.

In November 2004 and May 2006, TI staff participated in the American Ambulance Association's Mobile Medical Transport Safety Symposium. TI presented a project brief to the attendees. Attendance was by invitation and included 25 persons involved in EMS safety research representing government, academia, EMS service providers, and equipment manufacturers.

During June 2006, a TI engineer met with representatives of vehicle and equipment manufacturers to provide a project briefing that included preliminary results of the dynamic ambulance and occupant restraint tests.

TI has presented research findings at 12 international, national, and regional conferences and meetings. TI has published two journal articles reporting on research findings. Additionally, a TI presentation has been included in published conference proceedings.

National Highway Traffic Safety Administration crash reconstruction reports funded by TI documenting environmental and vehicular circumstances and the injury mechanisms for patient compartment occupants present during an ambulance crash are available to the public at http://www-nass.nhtsa.dot.gov.

Intermediate Outcomes:
As a result of the TI projects, one of the TI manufacturing partners—Schroth Safety Products—is actively marketing restraints to ambulance manufacturers and has developed collaborations with several ambulance manufacturers, and a seat manufacturer to incorporate Schroth restraints into new ambulances.

American Medical Response (AMR) and American Emergency Vehicles' (AEV) concept ambulance incorporates restraint systems influenced by TI sled and crash test results. AMR, in cooperation with AEV, has incorporated the Schroth restraints, as tested by the TI project, into one concept vehicle. This vehicle incorporates several innovations intended to increase patient compartment safety, including improved occupant restraints. The vehicle is being used as a demonstrator at various EMS conferences throughout 2005 and 2006, gauging AMR employee acceptance of its features.

As a result of TI collaboration with EVS Ltd, the company has developed first-generation seats that replace the standard three-point lap and shoulder belt with mobile occupant restraints manufactured by Schroth Safety Products or Allied Services Systems.

EVS is currently working to refine its seat design to better utilize the capabilities of the restraints and has embarked on its own testing program to explore the crash performance of mobile restraints in side-facing and swiveling seats intended as upgrades to ambulance patient compartments.

After being briefed on the TI project In the fall of 2005, the Winter Park Fire Department of Winter Park, Florida, in the spring of 2006, took delivery of two new ambulances that had design changes incorporated in the patient compartment based in part on TI sled and crash test results.[5] The department, in cooperation with the ambulance manufacturer, developed patient compartments that minimize the need for emergency medical technicians (EMTs) to move around the patient compartment. Of note, the Winter Park Fire Department eliminated the CPR seat location and adjacent equipment cabinet based on information contained in TI crash test videos. The new ambulances also incorporate an improved five-point occupant restraint manufactured by Schroth Safety Products. Use of the Schroth five-point restraint resulted from the Schroth marketing campaign to ambulance manufacturers. TI is currently working with the department to evaluate the ergonomics and user acceptance of the new design.

GSA and the Ambulance Manufacturers Division (AMD) of the National Truck Equipment Association have used NIOSH project results and TI-supplied anthropometric data to support development of revision F to the KKK 1822 Specification for the Star-of-Life Ambulance. This specification, which has been adopted by 34 State EMS departments, is the principal driver of U.S. ambulance design. Nearly every U.S. ambulance and EMS equipment manufacturer is a member of AMD. The KKK 1822 F specification—which includes specifications for increased head clearance above seats, based in part on NIOSH project results—is currently undergoing industry and public comment. Revision F is scheduled for full implementation during the third quarter (April through July) of FY 2007.

As a result of presenting preliminary results at the 2005 NFPA World Safety Conference and Exposition, TI received a request from the International Association of Fire Fighters (IAFF) for copies of crash test videos. The videos were incorporated into an emergency vehicle operators training DVD and course curriculum developed by IAFF for its membership. Other professional and volunteer EMS services and fire departments have also requested TI crash test footage to support their local training programs. All of these requests resulted from TI presentations at EMS conferences and meetings.

What's Ahead:
TI is currently working with its contractor ARCCA Inc. to finalize and publish the data analysis and test reports for the sled and crash testing. Upon publication the data will be available for use by other researchers, ambulance manufacturers, standard-setting bodies, EMS services, and fire departments to support improvements in ambulance design that will lead to a safer EMS work environment. TI and ARCCA Inc. are also developing a series of papers for peer-review publication that will provide a comprehensive discussion of crashworthiness issues related to the ambulance patient compartment.

TI will develop and transfer additional recommendations to the General Services Administration and the Ambulance Manufacturers Division of the National Truck Equipment Association to support revision of KKK 1822 Specifications for the Star-of-Life Ambulance.

These recommendations will include test procedures to improve the crashworthiness of EMS equipment and mounting systems, selection criteria for energy absorbing foam padding, and recommendations for occupant protection systems.

TI and AMR will publish results of their joint analysis of AMR employee injury and compensation data. The results should help to provide a clearer picture of the scope of nonfatal injury for EMS workers in ambulance patient compartments.

TI's collaboration with the Winter Park Florida Fire Department to evaluate the effectiveness of the newly designed ambulance patient compartment is expected to provide information that can be used to guide similar developments by other researchers, ambulance manufacturers, and EMS providers.

The TI human factors evaluation results will be shared with the restraint manufacturers to support restraint system refinement, and with the EMS industry to promote acceptance of improved restraint systems and patient compartment redesigns.

External Factors:
In 2004, the year for which the most current data are available, the general motoring public experienced 33,134 motor-vehicle crash-related fatalities.[6] During the period 1991 to 2002, 27 EMS workers lost their lives in ambulance crashes.[5] Because of this disparity, the bulk of NHTSA resources are focused on an overall reduction in motor-vehicle crashes and on vehicle crashworthiness issues affecting the general public rather than EMS workers. Federal Motor Vehicle Safety Standards (FMVSS) promulgated by NHTSA do not apply to vehicle manufacturers producing fewer than 5,000 vehicles annually. No single ambulance manufacturer in the U.S. produces 5,000 vehicles annually; in fact, the total production from all U.S. ambulance manufacturers is about 5,500 vehicles per year. Thus, ambulance manufacturers are not required to address crashworthiness issues in the patient compartment. The only applicable Federal standard is the non-mandatory GSA KKK-1822E Specifications for the Star-of-Life Ambulance. While this purchase specification has significant impact on ambulance patient compartment design, it contains minimal crashworthiness standards. Therefore, if TI research results are to be implemented, ambulance manufacturers must be convinced to adopt them. TI staffers have had numerous personal contacts with manufacturers' representatives and have presented preliminary results before manufacturer organizations, such as NTEA's AMD. Although ambulance manufacturers are individually supportive of improving the safety of their vehicles, TI believes that lack of uniformly applied Federal crashworthiness regulations and specifications significantly impedes improvements in ambulance crashworthiness.

TI financial and staff resources available to address the problem are limited. TI initially perceived this to be a negative influence for which TI was required to compensate by developing partnerships with private and public sector entities that could provide the additional financial and staff resources to the effort. These partnerships have had a positive effect on the research serving to broaden its impact and facilitate the introduction of TI research products into the workplace. Lack of resources also forced TI and its partners to narrow the research scope to issues that could be solved within a short time and to focus on developing research products that provide a foundation for others to expand upon without TI assistance. Nevertheless, lack of staff and funding resources remains an impediment to continued ambulance safety research, and many ambulance crashworthiness issues will remain unanswered by TI research efforts.

National level ambulance crash injury and EMS population data, currently lacking, are needed to drive research and policy decisions. The FARS database from NHTSA provides national level information regarding fatalities due to ambulance crashes, but similar data to adequately assess the scope of nonfatal injury are not available at the national level. Such data reside within the custody of private and public entities at State and local level. These databases are not uniform regarding reporting protocol and are not generally available to Federal researchers. While some researchers and EMS advocates believe that the injury problem is substantial because of the large numbers of crashes occurring, there is no national level validation of the numbers of injuries to EMS resulting from these crashes. Because volunteers make up a large portion of the EMS community, understanding of injury rates is further hampered by lack of accurate population data.

Knowledge of the vehicle acceleration vs. time trace (or vehicle crash pulse) generated during a crash is basic to development of engineering interventions to prevent injury. The crash pulse provides a basis for conducting computer modeling and dynamic testing. The pulse also indicates the magnitude of the crash forces against which occupants must be protected and the level of structural strength required for vehicle chassis. Because of the historical emphasis on motor-vehicle crash safety for the general population, vehicle crash pulse data are available for automobiles and light trucks. However, similar ambulance crash pulse data are generally lacking. Few tests have been conducted that would provide ambulance crash pulse data, and they are not current because of the age of the vehicles tested as well as by the test methodology. Further, to TI's knowledge the most recent tests were not fully instrumented and the resulting crash pulses have not been made publicly available. TI had to obtain these data from their own crash tests, which consumed a large amount of resources that could have been focused on intervention development. The testing resulted in a set of vehicle crash pulses obtained from uniform testing that will reside in the public domain and will be available to other researchers.

To evaluate potential interventions, TI and its partners conducted a series of tests using crash test dummies. Vehicle manufacturers and Federal regulators use data from crash test dummies that predict the likelihood of crash-related injury to humans as a basis for standards and intervention development. This is done by comparing the crash test dummy data to injury assessment reference values (IARV) derived from human cadaver testing. However, most human cadaver testing has been related to front- or rear-facing seated occupants. There are few IARVs for side-facing occupant seats and IARVs for standing occupants is nonexistent. This is especially true for criteria addressing the potential for neck injury in humans. Ambulance patient compartments contain four side-facing seats, and EMS workers may need to leave their seats to provide patient care. Likewise, at the time TI conducted its testing, crash test dummies which could measure lateral neck loads and moments were not available. TI attempted to overcome this limitation by using the most advanced crash test dummies available and by comparative evaluations of test data. However, the lack of appropriate IARVs and test equipment poses a limitation to the full application of the study results that may not be overcome until further research is conducted on the relationship between crash test dummy response and the potential for human injury.

Public criticism from other researchers has posed a minor obstacle for the TI project staff. There is some debate regarding the appropriateness of TI involvement in vehicle crashworthiness. TI believes that this is due in part to the personal agendas of a minority of researchers, the perception that the mandated NIOSH mission and the public health methodology should be focused solely on epidemiologic studies of work-related injury, and that vehicle crashworthiness studies and development of engineering interventions should be left to the automotive industry.

This obstacle is further compounded because the TI research has not yet achieved an endpoint and final project results have not been published. TI's strategy for dealing with this criticism has been to partner with external researchers and engineers who possess vehicle occupant survivability expertise and credentials and to present preliminary data to EMS providers, ambulance manufacturers, and Federal agencies with responsibility for EMS. Based upon the amount of requests for information and invitations to present at conferences received from the EMS community, TI views this as a minor impediment that will be overcome upon publication of the study's final results.

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Sub goal 7.3: Improve protection for emergency workers responding to large-scale disasters and terrorist attacks

Issue:
In 1990, TI investigated a series of electrocutions that occurred in Puerto Rico during recovery efforts in the aftermath of Hurricane Hugo. Several of the cases involved utility crews working on power lines thought to be de-energized that were actually “live” due to the presence of feedback electrical current produced by portable generators. Since then, information about the hazard of feedback electrical current, along with information on other disaster response hazards, has been included in fact sheets and on CDC and NIOSH disaster-response Websites. The availability of this disaster-specific safety information has been especially promoted and communicated at times when workers have been actively involved in response and recovery operations in large-scale disasters. In addition to information on electrical safety and generators, TI has contributed information to CDC and NIOSH fact sheets and disaster response Websites on topics such as entry to confined spaces, carbon monoxide poisoning, and chainsaw injuries.

The terrorist attacks of September 11, 2001 resulted not only in the deaths of thousands of World Trade Center (WTC) workers, but also in the deaths of hundreds more fire fighters, police, EMS, and other first responders at the WTC site who were killed performing their jobs trying to rescue people, control fires, etc. Over the course of the lengthy rescue and recovery efforts, more responders were injured, exposed to serious hazards (including respiratory insults that resulted in permanent disability for many), and subjected to physical and emotional stresses associated with their activities.

Several major safety issues emerged in the aftermath of the terrorist attacks of 9/11—including, the need for improved personal protective equipment (PPE) and related technologies and strategies for emergency responders, the need for rapid development and dissemination of information on specific safety topics as the need arises, the need for improved surveillance of responder injuries during rescue and recovery operations, and the need for overall improvements in safety management during response to large-scale disasters and terrorist attacks.

Approach:
In mid-September 2001, TI was asked to prepare eye safety information for rescue and recovery workers at the WTC site. TI staff—in collaboration with Prevent Blindness America, the International Safety Equipment Association, and a well-known ophthalmologist specializing in eye safety—prepared a tri-fold information brochure that describes common eye injury hazards, various eye protection options for recovery workers, first aid for eye injuries, and a four-point eye safety plan. The brochure was distributed at the WTC site through the Disaster Medical Assistance Teams (DMATs). TI also posted the information on the NIOSH Website (http://www.cdc.gov/niosh/eyesafe.html). An updated eye safety publication is currently being prepared for printing.

In recent years DSR staff has provided injury surveillance assistance to national and international rescue and recovery operations resulting from natural and human-caused disasters. Active surveillance of emergency responder injuries is an important component of ensuring their safety that often receives little attention compared to the injuries and illnesses of the primary disaster victims. During the rescue and recovery operations at the WTC, TI staff facilitated dissemination of rescue worker injury and illness data, obtained from DMATs, to other NIOSH divisions for analysis. Additionally, TI staff designed data collection tools for capturing responder injuries and illnesses as a part of a disaster response worker registry. TI staff also provided modular surveillance data collection tools that could be used or adapted to monitor injuries and illnesses of rescue and mortuary workers following the December 2004 tsunami in Southeast Asia and for evacuation shelter workers following Hurricane Katrina in September 2005 (http://www.cdc.gov/niosh/topics/flood/pdfs/KatrinaShelterWorkerSurveillance.pdf).

TI staff has worked in the field with the CDC team supporting the New Orleans and Louisiana State Public Health Departments after Hurricane Katrina and during Hurricane Rita to provide assistance with injury and illness surveillance of residents and response workers; and to identify hazards and provide safety recommendations for people within the disaster zones. An important component of the latter effort was developing targeted and effective health communication messages for a diverse population. Being present in the field played a key role in understanding and responding to the local needs.

In 2001 the NIOSH National Personal Protective Technology Laboratory (NPPTL) contracted with the RAND Corporation to develop a national program of collaboration, research, service, and communications directed at providing personal protective technologies to fire fighters, emergency medical service personnel, and specialized teams responding to and mitigating emergencies. RAND conducted a series of workshops and meetings in support of this contract and authored several widely read reports.[1-5]

Under this contract, the TI Program engaged RAND in a collaborative study of occupational safety and health management practices associated with major disaster response. Researchers from RAND and TI gathered input directly by means of individual and group interviews of workers and managers involved in response and recovery activities during the 9/11 terrorist attacks in New York City and Arlington, Virginia; the Anthrax investigation in Boca Raton, Florida and New York City; the Northridge, California earthquake; and Hurricane Andrew in Central Florida.

A workshop conducted in Arlington, Virginia on February 27, 2003 assembled more than 100 responders and experts in emergency response and occupational safety and health to obtain expert comment and opinion on

- Integration of safety management into incident command and incident management systems
- Preparation for disaster response through training and multi-organizational planning
- Hazard assessment and monitoring, healthcare and surveillance targeting emergency workers
- Numerous related issues

Additional information was obtained from literature related to disaster response and safety management.

Outputs and Transfer:
In 1994, TI published a Fact Sheet on the hazards of flood cleanup work. This publication is available on the NIOSH Website at: http://www.cdc.gov/niosh/flood.html.

The eye safety brochure developed by TI was distributed at the WTC site through the Disaster Medical Assistance Teams (DMATs). TI also posted the information on the NIOSH Website at http://www.cdc.gov/niosh/eyesafe.html. An updated eye safety publication is currently being prepared for printing.

CDC and NIOSH have both developed extensive Web-based resources devoted to disaster response worker safety. TI has contributed extensively to these sites, which can be accessed at: http://www.bt.cdc.gov/disasters/ and http://www.cdc.gov/niosh/topics/, respectively.

In May 2003, during the course of the study, two briefings were conducted to share preliminary results of the TI/RAND Disaster Safety Management Study. One briefing was provided for agencies of the Department of Homeland Security (DHS) and Department of Defense (DoD), including:

- Federal Emergency Management Administration (FEMA)
- United States Coast Guard (USCG)
- U.S. Army Corps of Engineers

The other briefing was provided to the task force engaged in revising the National Response Plan (NRP) and developing the National Incident Management System (NIMS).

To formally report the findings from the study, RAND and TI co-authored the report: "Protecting Emergency Responders, Volume 3: Safety Management in Disaster and Terrorism Response," which was released in June 2004.[4] This report was the third in the series of NIOSH-RAND reports on protecting emergency responders. The 2004 report was officially launched by press releases from NIOSH and RAND on June 14, 2004, and was presented at a Congressional Briefing held June 16, 2004 in Washington, D.C.

The report was disseminated by direct mailings to:

1. More than 3,500 local (municipal and county) and State emergency management and public safety officials
2. Federal agencies with NRP roles and responsibilities, particularly DHS and the NRP/NIMS Task Force to consider for integration into national disaster response planning efforts
3. Public health agencies
4. State OSHA programs and
5. Academic institutions (38) with emergency management degree programs
6. National and international emergency managers' associations, and
7. Response organizations and associations and unions that represent them

In all, 5,032 copies of the report were directly mailed to targeted mailing lists. The reports that were directly mailed included a cover letter from Dr. John Howard, NIOSH Director, and a reader response card soliciting feedback on the quality and utility of the publication. An additional 11,057 copies have been mailed in response to customer requests that came in by phone, fax, mail, email, and through the NIOSH Website. NIOSH distributed another 834 copies at conferences, trade shows and exhibits, and 39 copies were requested by visitors to the NIOSH Publications Office. Of the 19,500 copies of the report that were printed, a total of 16,923 copies have been distributed.

In addition, Web versions of the report were made available on both the NIOSH (http://www.cdc.gov/niosh/docs/2004-144/) and RAND (http://www.rand.org/pubs/monographs/MG170/) Websites.

RAND and TI staff members presented results of the NIOSH-RAND study and details of the dissemination strategy to the National Advisory Committee on Occupational Safety & Health (NACOSH) meeting on August 18, 2004.

TI Staff briefed the Federal Interagency Committee on Emergency Medical Services (FICEMS) on September 2, 2004 at the National Emergency Training Center (NETC) in Emmitsburg, Maryland. FICEMS also provided a mailing list targeting agencies and organizations with emergency medical services (EMS) responsibilities. TI staff also briefed a meeting of the Occupational Safety and Health State Plan Association in 2004.

Intermediate Outcomes:
To obtain a glimpse of users' response to, and the utility of, the NIOSH-RAND report on disaster safety management, reader response cards were included with the documents mailed directly to emergency management agencies. Two hundred sixteen of the recipients of the report filled out the reader response card and mailed it back to NIOSH. Findings included:

- 94 percent (203 of 216) of those who returned response cards are using the report to inform planning (81 percent), change plans (39 percent), change training (39 percent), implement specific recommendations (five percent), or "other" uses, such as share with colleagues (seven percent).
- Most of those who returned reader response cards were Emergency Directors/Administrators for local (county and municipal) agencies.

As previously mentioned, the NIOSH-RAND report recommendations were presented to the national task force commissioned to update the National Response Plan and to develop the National Incident Management System at briefings in May of 2003. The report recommendations received positive feedback. The NIMS, which was released in March 2004, three months before the RAND-TI report was published, provides the best "current" practices in incident management and provides for the development of the NIMS Integration Center established to facilitate "additional development and refinement." The role of the Safety Officer, as described in the NIMS, echoes some of the primary concerns expressed by the TI-RAND report, particularly the need to coordinate safety among the multiple agencies and organizations that come together in response to a major disaster or terrorist incident. According to the NIMS, the responsibilities of the Safety Officer include the "ongoing assessment of hazardous environments, the coordination of multiagency safety efforts, and implementation of measures to promote emergency responder safety." The NIMS goes on to say that the Safety Officer "must also ensure the coordination of safety management and functions and issues across jurisdictions, across functional agencies, and with private-sector and nongovernmental organizations."

NIMS can be accessed on the Web at: (http://www.fema.gov/pdf/emergency/nims/nims_doc_full.pdf). NRP, released in January 2005, is an all-discipline, all-hazards plan that provides a single, comprehensive framework for incident management. The NRP can be accessed on the Web at: (http://www.dhs.gov/interweb/assetlibrary/NRP_FullText.pdf). It coordinates Federal support to State, local, and tribal incident managers. The Worker Safety and Health Support Annex of the NRP outlines the Federal safety and health management role, and was developed by OSHA in collaboration with NIOSH.

Although neither the NIMS nor the NRP (released in 2005) references the RAND-TI report, it is likely that the briefing on the study in May 2003 and ultimately the published report were considered among many other inputs to the Task force's deliberations. The RAND-TI recommendations largely reflected the thinking of the emergency response community.

The AIHA based a 2005 White Paper "Role of the Industrial Hygienist in Emergency Preparedness & Response" on recommendations from the NIOSH-RAND report. The text of the White Paper can be obtained at: (http://www.aiha.org/1documents/GovernmentAffairs/EPRWhitePaper_Final.pdf) (Last viewed on October 31, 2006).

What's Ahead:
The report on Disaster Safety Management,[4] along with a proposal for facilitating the implementation of report recommendations in the nation's municipal, county, and State emergency management offices, has been conveyed to the Department of Homeland Security. No further work on this project is planned.

The NIOSH Emergency Preparedness and Response Program continues to work with OSHA in carrying out responsibilities for Worker Safety and Health Support during large scale disasters. TI will continue to be responsive in rapidly preparing and disseminating worker safety information following disasters.

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8. Reduce injuries and fatalities to working youth

Introduction

Approximately 2.3 million youth aged 16 to 17 years worked in the US in 2005.[1] Official employment statistics are not available for youth younger than 15 years of age who are also known to work, especially in agricultural settings. Although work can have positive benefits for youth, there are also safety risks, with 54 deaths of youth younger than 18 years of age in 2005,[2] and an estimated 54,800 emergency department treated injuries in 2003.[3] Youth occupational injury death rates are comparable to those of young adult and middle-aged workers (18 to 54 years of age).[4, 5] The comparability of these rates is cause for concern. Rates of nonfatal injuries treated in emergency departments generally decrease with age, with the rates for youth 15 to 17 years of age exceeded only by the rates for workers 18 to 19 years of age.[6]

Youth have unique risks for work injuries based on their biologic, psychosocial, and economic characteristics. A number of specific factors contribute to the high incidence and rates of young worker injuries, including:

- inadequate abatement of recognized hazards in youth workplaces
- absence of meaningful training for youth on the hazards in the work environment inexperience of youth
- physical, cognitive, and emotional characteristics related to youth development
- lack of appropriate supervision
- inappropriate work assignments that are illegal or otherwise exceed the capabilities of working youth.[7]

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Sub goal 8.1: Influence legislative changes to protect young workers

Issue:
Child labor laws are designed to ensure the health and educational welfare of children and would be expected to afford additional protection to youths compared to adults. These laws place limits on the types of work that youth can do, including prohibiting youth from conducting work considered to be especially hazardous. The U.S. Secretary of Labor has authority to prohibit work considered especially hazardous for youth under the Fair Labor Standards Act (FLSA). These regulatory prohibitions are termed "Hazardous Orders" (HOs) and have been largely unchanged for decades despite changes in how work is conducted and increased knowledge about occupational safety and health.

A number factors contribute to outdated child labor laws, including: previous minimal attention to youth less than 18 years of age by occupational safety researchers, an absence of linkages between occupational safety researchers and child labor regulators, and the political context in which legislation and regulations are promulgated. The TI Program undertook specific efforts to increase awareness of the importance and need for updating child labor laws.

Approach:
TI researchers collected and analyzed data to describe the magnitude and circumstances of young worker injuries. TI researchers also provided technical assistance to State-based young worker injury and illness surveillance systems in Massachusetts (Teens at Work Project) and Wisconsin under cooperative agreements.

TI researchers actively participated and later assumed leadership of the NIOSH Child Labor Working Team, established in 1994 by the Acting NIOSH Director. The Team included representatives of other Federal agencies, including the U.S. Department of Labor, Employment and Standards Administration, Wage and Hour Division (ESA/WHD), which has responsibility for promulgating and enforcing child labor laws. TI researchers established effective working relationships with ESA/WHD representatives, providing technical assistance in injury statistics, conducting special analyses on request, and sharing relevant TI research and recommendations.

TI researchers played a key role in NIOSH co-sponsoring a National Research Council (NRC) study on the health and safety implications of child labor, which was initiated by the NIOSH Director. TI researchers provided support in seeking co-sponsors (including several represented on the NIOSH Child Labor Working Team), provided background materials for the committee, and responded to committee inquiries.

In response to research recommendations in the 1998 NRC study report, "Protecting Youth at Work,"[1] and specific comments about the value of Fatality Assessment and Control Evaluation (FACE) investigations in "providing contextual information that is unavailable in other systems and can be vital to prevention efforts," the TI Program added youth less than 18 years of age as a specific target for fatality investigations by the FACE Program in 1999. TI researchers developed investigative guidelines and provided technical support and assistance to States with NIOSH cooperative agreements to conduct FACE Programs. Since 1999 when the TI Program added youth as a specific target for fatality investigations, TI researchers have conducted 29 FACE investigations of young worker deaths, and States with FACE cooperative agreements have conducted 42 young worker fatality investigations.

These investigations frequently identified that work tasks which are not currently prohibited by existing child labor laws have resulted in fatal injuries to young workers.

Also in response to recommendations in the NRC report, "Protecting Youth at Work,"[1] the TI Program and ESA entered into an interagency agreement in which ESA provided the TI Program with funds to 1) review the adequacy of existing child labor laws that prohibit youth from work identified as especially hazardous (HOs), and 2) develop and oversee an extramural research program on young worker safety and health risks in the construction industry. Established relationships with ESA/WHD were instrumental in the development of the interagency agreement.

TI researchers led the review of the adequacy of existing child labor laws, analyzing multiple data sets, reviewing FACE reports, and reviewing hundreds of articles in the scientific literature. TI researchers developed a request for applications (RFA) for research that would provide empirical data that could guide efforts to prevent deaths and injuries of youth less than 18 years of age working in construction, with a focus on data required to determine if changes were needed in existing child labor laws. This RFA resulted in two NIOSH cooperative agreements addressing youth construction injuries and prevention, and funding for a grant investigating hearing loss in newly hired construction workers.

TI researchers also developed RFAs for childhood agricultural injury research. These RFAs resulted in 24 grants characterizing the incidence and risks for childhood agricultural injury, and a grant specifically looking at the potential impact on childhood agricultural injuries of removing the farm family exemption from Federal child labor laws.

Outputs and Transfer:
(For outputs not specifically cited, see Appendix I: Supporting Evidence)

TI researchers have provided ESA/WHD with science-based recommendations for revisions to Federal child labor laws by submitting NIOSH comments in response to public comment periods on proposed rule changes, and a comprehensive 2002 NIOSH report developed through the TI/ESA interagency agreement. The 2002 report recommended revisions to 21 hazardous orders and 17 new hazardous orders. TI provided these recommendations directly to ESA/WHD. The 2002 comprehensive report was posted on the NIOSH Website and provided to requestors such as the Child Labor Coalition and International Labour Organization. TI researchers also participated in stakeholder meetings organized by ESA/WHD to seek input on the scope and prioritization of NIOSH recommendations.

The Teens at Work project contributed to the development of a Massachusetts Young Worker Initiative, a community led coalition of stakeholders that developed a State blueprint for action to protect working teens.[8] This State blueprint cited statistics from the Teens at Work project and included recommendations for revisions to Massachusetts State child labor laws.

Since 1988, TI researchers have published 20 articles in the peer-reviewed literature and Morbidity and Mortality Weekly Report (MMWR)[*] identifying the magnitude and patterns of young worker injuries and deaths.

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[*] Centers for Disease Control Publication with wide dissemination to the medical and public health fields and the media.

Fifteen of these articles were published in 1996 or later. These articles identified young worker deaths and injuries not addressed by current child labor laws.

External researchers who conducted young worker injury and illness research through cooperative agreements and grants have communicated findings in at least 25 articles in the peer-reviewed literature. These reports helped identify the magnitude and patterns of young worker injuries and illnesses, and identified the need for revisions to child labor laws and increased enforcement of existing child labor laws.

TI researchers authored 11 NIOSH documents since 1995 featuring data on young worker injuries. Seven of these documents included data collected by TI researchers which were not previously available from any existing data system, to quantify the magnitude and patterns of work injuries of youth who live and work on farms.[2] TI researchers constructed targeted mailing lists to ensure that these NIOSH publications were distributed to relevant researchers, safety practitioners, and safety groups. TI researchers enlisted the support of partners including the Child Labor Coalition, Interstate Labor Standards Association, and OSHA to distribute copies of two of these publications which were NIOSH Alerts broadly addressing young worker safety. The TI Program maintains a NIOSH Website that compiles, organizes, and contains links to all NIOSH products on young workers. This Website may be accessed at www.cdc.gov/niosh/topics/youth/.

The TI Program posts FACE reports on the NIOSH Website, with a specific link for young worker fatality investigations, and provides copies to ESA/WHD and the Occupational Safety and Health Administration (OSHA). These reports may be accessed at: http://www.cdc.gov/niosh/injury/traumayouthface.html. State FACE Programs disseminate reports within their own States, and frequently provide copies to State child labor regulatory agencies.

The NRC study on the health and safety implications of child labor culminated in a 1998 publication "Protecting Youth at Work."[1] This publication included the following recommendation: "The U.S. Department of Labor should undertake periodic reviews of its hazardous orders in order to eliminate outdated orders, strengthen inadequate orders, and develop additional orders to address new and emerging technologies and working conditions. Changes to the hazardous orders should be based on periodic reviews by the National Institute for Occupational Safety and Health of current workplace hazards and the adequacy of existing hazardous orders to address them." NRC Committee members held briefings with sponsoring organizations, including NIOSH and ESA/WHD, and also presented findings and recommendations at conferences, such as the annual meeting of the American Public Health Association. This specific recommendation was the impetus for the TI/ESA interagency agreement discussed in the "Approach" section.

Intermediate Outcomes:

New Federal child labor regulations went into effect on February 14, 2005.[3] Research and recommendations from the TI Program were cited among the justifications for the rule changes. These changes have the potential to reduce young worker deaths and injuries associated with working on roofs, compactors and balers, driving, and the manufacture of explosives. ESA/WHD reports that they continue to consider NIOSH recommendations for child labor law changes and will be proposing additional rule changes in the future.

The 2002 NIOSH report recommending changes to Federal child labor laws has been used by others advocating for changes in child labor regulations. The Child Labor Coalition made numerous references to the report in a June 28, 2006 letter to Secretary of Labor Elaine Chao requesting action on child labor regulations for agriculture.[4] In the current and previous Congressional sessions, Representative Lantos introduced the Youth Worker Protection Act (H.R. 2870), which, among other provisions, would require the Department of Labor to implement changes to child labor laws recommended by NIOSH.[5] The Child Labor Coalition has cited the report in a document it produced questioning if the United States is in compliance with International Labour Organization (ILO) Convention 182 (Convention Concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labor), particularly as concerns children working in agriculture.[6] This is now being considered by the ILO Conference Standards Committee which has requested that the U.S. Government report on measures taken or envisaged to address these concerns.[7] In March 2003, the Young Worker Health and Safety Network, a subcommittee of the Occupational Safety and Health Section of the American Public Health Association, provided ESA/WHD with a recommended prioritization of NIOSH recommendations. A peer-reviewed journal article summarizing these recommendations was subsequently published.[8] And, in 2003, the Farmworker Justice Fund referenced the NIOSH recommendations in a press release calling for the Department of Labor to revise HOs in agricultural occupations.[9]

On January 3, 2005, a new child labor law became effective in Oregon prohibiting youth less than 18 years of age from working in occupations involving the use of explosives. This new rule was based on recommendations in an Oregon FACE investigation “Youth camp counselor killed when cannon burst into pieces” (OR2003-20-01).

A bill to strengthen child labor laws was introduced into the Massachusetts legislature in July 2006, and recently signed into law. News coverage of this proposed legislation cited TI statistics and statistics from the Massachusetts Teens At Work project.[10]

NIOSH Alerts on young worker safety have been repeatedly reprinted based on requests for more copies, and statistics on young worker deaths and injuries included in NIOSH publications are routinely cited in the press and by groups advocating for child labor law changes. Findings from NIOSH-funded extramural research have also been cited in the press. Recent examples include press coverage of results from the Wisconsin young worker injury surveillance project and young worker construction safety research funded through the TI/ESA cooperative agreement.[11-14]

TI-authored peer-reviewed journal articles and NIOSH publications that identify the incidence and circumstances of young worker injuries have been cited more than 250 times in the scientific literature. (Citation frequency is provided in Appendix I: Supporting Evidence for selected publications).

What’s Ahead:
The TI Program is not currently actively engaged in efforts to encourage legislative or regulatory change to improve young worker safety. The 2002 NIOSH report recommending changes to Federal child labor laws was comprehensive and should serve as a resource for years to come. Because recent FACE investigations of young worker deaths are less frequently identifying new prevention strategies, including recommendations for new or revised child labor laws, the TI Program is considering scaling back or removing youth as a target for FACE investigations. The

TI Program will develop a report summarizing findings from FACE investigations of youth, with an emphasis on gaps identified in existing child labor laws. The TI Program will seek input from stakeholders on the scope and format of this document to ensure it meets their needs and to garner support for their use and dissemination of the report.

The TI Program will continue to analyze existing data on young worker injuries and deaths, and report on data trends. TI researchers will continue to provide technical support to the ESA/WHD, including responding to requests for technical information and sharing new scientific findings from NIOSH cooperative agreements and grants. The TI Program will lead the development of NIOSH comments on future proposed rulemaking by the Department of Labor.

External Factors:
The TI/ESA interagency agreement for the TI Program to develop recommendations for changes to Hazardous Orders was initiated in 1998. As work progressed and the report neared completion, there were changes in the leadership at ESA. New leadership had no investment in the TI recommendations, and reacted somewhat defensively to the efforts of NIOSH and other stakeholders to promote it as an important tool for guiding future rulemaking. As well, in general, regulatory actions have slowed and become increasingly difficult to initiate, with recent increased requirements for regulatory agencies to evaluate the economic impact of new regulations. It is possible that the increased complexity of the rulemaking process has contributed to inaction by DOL/ESA.

Statutory provisions of the Fair Labor Standards Act (FLSA) limit the potential impact of regulatory changes. Large numbers of working youth are not covered by the FLSA, including youth who work on their parents' farms, and youth 16- and 17- years of age who work on any farm.

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Sub goal 8.2: Reduce child agricultural injuries

Issue:
Official employment statistics identify an estimated annual average of 50,000 youth aged 16 to 17 years who worked in agriculture and related industries in 2005, with an estimated annual average of 6,000 youth working as unpaid family workers.[1] Official employment statistics are not available for youth younger than 15 years of age, and therefore provide a very different picture of the size of the youth working population in agriculture than data collected in periodic surveys of farm operators by the TI program. A TI survey of farm operators estimated 790,000 youth younger than 18 years of age who worked on U.S. farms at some point during 2004 (not averaged across the year), with 591,000 of these youth living in the farm household and 199,000 hired youth who did not live in the farm household.[2]

Although work can have positive benefits for youth, there are considerable safety risks in the agriculture setting. There were 125 deaths of youth less than 18 years of age working in the agriculture, forestry, and fishing industry sector between 1998 and 2002, accounting for 41 percent of all young worker deaths during this period.[3] Almost 60 percent of these deaths occurred among youth who worked on the family farm, and almost two-thirds of the deaths occurred to workers less than 16 years of age. Using official employment statistics from the Bureau of Labor Statistics (BLS) to calculate rates, young worker fatality rates in the agricultural production sector are highest for 15-year-olds (18.5 deaths per 100,000 full-time equivalent workers for the years 1992 to 2002), and rates for youth working in agricultural production are more than 3.5 times greater than rates for youth working in other industries.[4] An estimated 5,700 youth sustained nonfatal work injuries on farms in 2004, at a rate of 7.3 work injuries per 1,000 youth working on farms.[2]

In addition to factors that contribute to youth work injuries generally (e.g., inadequate training and supervision, and factors related to physical and psychosocial development), several factors are unique to agricultural production which contribute to the high incidence and rates of young worker injuries in agriculture. These include:

- Elevated injury risks for agriculture compared to other work settings
- The involvement of younger youth in work (e.g., children less than 14 years of age)
- Work by youth that would typically be performed by adults in other work settings (e.g., operation of heavy machinery such as tractors)
- Common use of older equipment without safety features
- Virtual irrelevance of occupational safety and health regulations
- Limited child labor laws that do not cover youth 16 and 17 years of age, and exempt children working on their family's farm (these provisions are different from child labor laws in nonagricultural occupations)
- Social norms and unsafe traditional practices in agricultural communities, and
- Economic pressures and challenges in small farm operations.[5-7]

The TI Program undertook a comprehensive effort to fill surveillance gaps, identify risk factors, evaluate interventions, and communicate findings and injury prevention recommendations to stakeholders.[8]

Approach:
TI researchers actively participated on the National Committee for Childhood Agricultural Injury Prevention (NCCAIP) that developed a national action plan to prevent childhood agricultural injuries.[5] The National Farm Medicine Center (NFMC) led the development of the national action plan with funding support from NIOSH and the Maternal and Child Health Bureau (MCHB) of the Health Resources and Services Administration. The 42-member multidisciplinary NCCAIP included researchers, farmers, agricultural groups, safety and health professionals, and government officials (including two from the TI Program). Over a 16-month period, the NCCAIP developed the national action plan using a consensus process and actively seeking review and input from stakeholders. The national action plan identified 13 objectives and 43 recommended action steps to maximize the safety and health of children and adolescents exposed to agricultural hazards. The national action plan called for leadership, surveillance, research, education, and public policy, and specifically called for NIOSH to serve as the lead Federal agency in preventing childhood agricultural injury.

In Fiscal Year 1997, NIOSH received a $5 million Congressional appropriation to lead a national childhood agricultural injury prevention initiative.* TI researchers drafted an implementation plan that built on previous TI research and recommended action steps in the NCCAIP national action plan, and held a public meeting in February 1997 to seek stakeholder input.[8] Based on input received at this meeting, TI researchers revised the implementation plan and conducted a separate peer-review process in October 1997 to receive expert input on TI plans for routine and ongoing surveillance of childhood agricultural injuries. The TI surveillance plan was modified based on this expert input to use a combination of surveillance methods to ensure adequate data collection for different youth populations of concern, including minority and Hispanic working youth.

In September 1999, the TI Program held a midcourse review of the childhood agricultural injury prevention initiative, summarizing progress and seeking input on proposed future directions.[9] The TI Program made revisions to the initiative based on input, including developing a Website to better communicate information from the initiative (www.cdc.gov/niosh/niosh/childag/). TI researchers also helped plan and participated in the 2001 Summit on Childhood Agricultural Injury Prevention, led by the National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS) with funding by NIOSH, to assess progress and update the 1996 national action plan.[6] Nearly 100 individuals representing farmers and farm organizations, researchers, safety and health professionals, and governmental agencies participated in the development of the updated action plan. The updated action plan included three broad goals and 12 recommendations, including a recommendation to maintain Federal funding for childhood agricultural injury prevention initiatives, including funding a Federal interagency working group and a National Children's Center to provide leadership and coordination between the public and private-sector.[6]

The TI- developed childhood agricultural injury prevention initiative includes intramural surveillance and coordination efforts (approximately 25 percent of appropriation), and a large extramural research and outreach program (approximately 75 percent of appropriation). TI researchers periodically analyze data from the Census of Fatal Occupational Injuries and National Electronic Injury Surveillance System to describe the magnitude, patterns, and trends in

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* The childhood agricultural injury prevention initiative includes efforts addressing non occupational injuries. Efforts described here focus on occupational injuries.

occupational injuries of youth in agriculture. TI researchers piloted new methods and survey mechanisms to fill gaps in young worker agricultural injury surveillance, and considered new methods undertaken by extramural researchers. The TI Program subsequently established periodic surveys of farm operators in collaboration with the National Agricultural Statistics Service (NASS) of the U.S. Department of Agriculture (USDA), and in collaboration with the U.S. Department of Labor (DOL), incorporated childhood agricultural injury questions into field-based surveys of seasonal and migrant farm workers as part of the National Agricultural Workers Survey.

TI researchers developed a series of Requests for Applications (RFAs). These RFAs resulted in cooperative agreements to fund the National Children's Center for Rural and Agriculture Safety and Health (NCCRAHS), and 50 research grants since 1997 to characterize young worker agricultural injuries, risk factors, outcomes, and to develop and evaluate interventions. The NCCRAHS, which also receives funding from MCHB, leads and organizes groups to develop consensus recommendations, and conducts research and outreach to facilitate the use of state-of-the-art information and consensus guidelines by program planners, agribusiness, educators, safety and health professionals and advocates, farm media, farmers, and farm families. TI researchers provide technical assistance and work collaboratively with NCCRAHS, and between 1999 and 2004, convened annual meetings of research grant recipients to provide a forum for sharing findings and discussing common problems and solutions in conducting childhood agricultural injury research.

The TI Program formed a Federal Interagency Working Group on Preventing Childhood Agricultural Injuries in 1997, and reorganized the group in 2004. The group currently includes 11 agencies that have an interest, mission, or mandate in childhood agricultural injury prevention, including MCHB, the national FFA Advisor and Office of Migrant Education in the U.S. Department of Education, the Occupational Safety and Health Administration (OSHA) and the Employment Standards Administration (ESA) in the DOL, the Cooperative State, Research, Education, and Extension Service of the USDA, and, the National Institute of Child Health and Human Development in the National Institutes of Health. A TI researcher chairs the working group and convenes bi-annual meetings of the group to share information on ongoing activities, and to facilitate new findings and products on young agricultural worker safety being incorporated into safety efforts.

Since 1999 when the TI Program added youth as a specific target for fatality investigations, TI researchers have conducted three FACE investigations of young worker deaths in agriculture, and States with FACE cooperative agreements have conducted 17 young agricultural worker fatality investigations. These investigations frequently identified inadequate training, inadequate supervision, a mismatch between equipment and physical characteristics of youth, the use of equipment without safety features, and work assignments that were prohibited by child labor laws (or would be without the family farm exemption).

As previously discussed in Sub goal 8.1, TI researchers led the review of the adequacy of existing child labor laws, analyzing multiple data sets, reviewing FACE reports, and reviewing hundreds of articles in the scientific literature. TI researchers had previously led the development in 1994 of NIOSH comments to DOL on an advanced notice of proposed rulemaking on child labor laws, which included numerous recommendations specific to agriculture.

Outputs and Transfer:
(For outputs not specifically cited, see Appendix I: Supporting Evidence.)

In finalizing the 1996 national action plan, NCCAIP committee members briefed stakeholders on the plan and sought commitments to move forward on NCCAIP recommendations. Nearly 80 organizations were identified as providing support to the 1996 national action plan, including professional groups such as the American Academy of Pediatrics, trade groups such as the American Farm Bureau Federation, farm worker groups such as the Association of Farmworker Opportunity Programs, manufacturers such as Deere & Company, research centers such as the University of Minnesota Agricultural Engineering Department, and governmental agencies, such as MCHB.[5]

Since 1988, TI researchers have published 28 articles in the peer-reviewed literature and Morbidity and Mortality Weekly Report (MMWR)[*] addressing the incidence, risks and prevention of young worker injuries in agriculture. Twenty-three of these articles were published in 1996 or later. Findings were presented at professional and scientific conferences, including annual meetings of the National Institute for Farm Safety, Agricultural Safety and Health in a New Century, National Occupational Injury Research Symposiums, Annual Childhood Injury Prevention Conferences, and the North American Guidelines for Children in Agriculture Symposium.

TI researchers contributed to nine NIOSH and three USDA documents since 1995 featuring young agricultural worker injury data and prevention recommendations. All of these documents are included on a NIOSH "Childhood Agricultural Injury Prevention Initiative" Website (http://www.cdc.gov/niosh/childag/). TI researchers constructed targeted mailing lists to ensure that these publications were distributed to relevant researchers, safety practitioners, safety groups, and stakeholders. For example, the TI Program has worked with NASS to provide NIOSH pamphlets to 100,000 farm operators participating in the NIOSH/NASS farm operator surveys. The pamphlets summarize data collected in the surveys on common causes of childhood farm injury and recommend steps that farmers can take to foster safe farm environments for youth. Finally, TI researchers share findings and outputs with the NCCRAHS and at bi-annual meetings of the Federal Interagency Working Group on Preventing Childhood Agricultural Injuries.

The TI-supported NCCRAHS has published consensus-based action plans and guidelines. These outputs have been directly disseminated to stakeholders. Information on these outputs is presented at professional conferences and farm organization events, and provided to the farm media. NCCRAHS researchers have also published research in the peer-reviewed literature. NCCRAHS communicates information about major childhood agricultural safety programs through a quarterly newsletter, Nurture, which is distributed in print copy to about 2,000 recipients and posted on the Internet. NCCRAHS maintains a general Website that provides an overview of NCCRAHS activities and offers downloadable reports and resources such as fact sheets: http://www.marshfieldclinic.org/nfmc/pages/default.aspx?page=nccrahs welcome. NCCRAHS maintains another Website devoted to the National Agricultural Guidelines for

[*] Centers for Disease Control Publication with wide dissemination to the medical and public health fields and the media.

Children's Agricultural Tasks, which were developed under the leadership of NCCRAHS, using a consensus-based process: www.nagcat.org.

The NRC report, "Protecting Youth at Work,"[10] discussed in Sub goal 8.1 included recommendations that child labor laws in agriculture be changed to be consistent with child labor laws in nonagricultural settings, encompassing 16- and 17-year-olds and removing the family farm exemption. NRC committee members held briefings with sponsoring organizations, including ESA/WHD, and presented findings and recommendations at conferences and published them in the public health literature.[11, 12]

TI researchers provided ESA/WHD with science-based recommendations for revisions to Federal child labor laws by submitting NIOSH comments in response to public comment periods on proposed rule changes, and a comprehensive 2002 NIOSH report developed through the TI/ESA interagency agreement described in the "Approach" section in Sub goal 8.1. In 1994, NIOSH comments on proposed rulemaking recommended that DOL raise the minimum age for hazardous work in agriculture from 16 to 18 and remove the family farm exemption. The 2002 report recommended revisions to eight of the 11 HOs in agriculture, retention of the remaining three HOs, and a new HO in agriculture and nonagricultural industries that would prohibit youth from work requiring respirators. TI researchers also participated in stakeholder meetings organized by ESA/WHD to seek input on the scope and prioritization of NIOSH recommendations, including a meeting centered on the NIOSH recommendations specific to agriculture. The NCCRAHS provided DOL with written comments on the NIOSH recommendations specific to agriculture.

External researchers who conducted young worker agricultural injury research through cooperative agreements and grants have communicated findings in at least 31 articles in the peer-reviewed literature. These reports helped identify the magnitude and patterns of young agricultural worker injuries, and made recommendations for prevention measures.

Intermediate Outcomes:
TI surveillance efforts have provided previously unavailable data on the number of youth working in agriculture, and the numbers and patterns of injury.[13] NCCRAHS, Farm Safety for Just Kids, the National Safe Kids Campaign, USDA and others have used these data to guide their prevention efforts, and the media now routinely use these data in news stories. An example is a recent USDA news release announcing more than $400,000 in grants to train young people who work on farms about safety rules, noting a TI Program statistic from 2001 that more than a third of all agricultural injuries of youth were associated with work.[14] TI estimates of youth farm injuries were also cited in proposed Congressional legislation, which has not been acted upon. The Children's Act for Responsible Employment of 2005 (CARE Act of 2005, HR 3482), submitted in the House of Representatives by Representative Roybal-Allard in July 2005, proposed changes to child labor laws in agriculture, and identified the TI Program youth farm injury data collected through farm operator surveys as one source of data that would be used to develop an annual report on occupational injuries to youth working on farms in the U.S.

As discussed in Sub goal 8.1, the 2002 NIOSH report recommending changes to Federal child labor laws has been used by others advocating for changes in child labor regulations in the agriculture industry, including the Child Labor Coalition, Young Worker Health and Safety Network, and the Farm Workers Justice Fund.

TI-authored peer-reviewed journal articles and NIOSH publications that identify the incidence and circumstances of young agricultural worker injuries have been cited more than 260 times in the scientific literature (Citation frequency is provided in Appendix I: Supporting Evidence for selected publications).

End Outcomes:
Data on nonfatal agricultural work-related injuries of youth are available from the TI/NASS surveys of farm operators for the years 1998, 2001, and 2004.[2] These data suggest a steady decline in the number of work-related injuries among youth less than 18 years of age from an estimated 11,970 injuries in 1998 to an estimated 7,490 injuries in 2001, and an estimated 5,740 injuries in 2004. This represents a greater than 50 percent decrease in the number of agricultural work-related injuries in a seven-year period. These data also suggest a decrease in the rate of nonfatal agricultural work-related injuries among youth, though the decline is not as large as suggested by the numbers of injuries, since the number of youth working in agriculture has declined over the last seven years. Rates of nonfatal agricultural work-related injuries among youth declined from 10.5 injuries/1,000 working youth in 1998 to 8.8 in 2001, and to 7.3 in 2004, a 30 percent decline.

What's Ahead:
The TI Program will continue to collect and analyze data on young worker injuries and deaths in agriculture, report on data trends, provide leadership in childhood agricultural injury prevention, and seek to address recommendations in the 2001 updated national action plan. The TI Program is planning a public meeting and symposium to assess progress and new emphasis areas in FY 2008.

External Factors:
A number of external factors impede progress in reducing young worker injuries and deaths in agriculture, including:

- Social norms and unsafe traditional practices in agriculture
- Economic pressures of small farm operations
- Decreasing private-sector investments in childhood agricultural injury prevention outdated child labor laws
- Exclusions of 16- and 17-year-olds working in agriculture from Federal child labor laws
- The family farm exemption in Federal child labor laws
- Limited enforcement of child labor laws at the Federal and State level
- Absence of OSHA standards or enforcement in agriculture.

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Sub goal 8.3: Foster the development and widespread use of safety materials and intervention strategies to protect young workers

Issue:
The risk of fatal and nonfatal occupational injuries to the nation's youth is not fully understood nor appreciated by employers, parents, the youth themselves, nor the general public. A general lack of awareness exists of the hazards of working environments in which young workers are employed, the factors that contribute to higher risk for youth, the types of work and specific tasks that are illegal or exceed the capability of working youth, and the prevention options for protecting young workers. The TI Program undertook specific efforts to increase awareness of the need to improve the safety and well-being of working youth, and to develop and evaluate intervention strategies and materials that could be widely used. This section focuses on these efforts in nonagricultural workplaces.

Approach:
TI led the efforts of the NIOSH Child Labor Working Team, which identified research needs, including intervention research to identify effective prevention strategies, and refinement and expansion of community-level interventions. TI researchers developed a Request for Applications (RFA) for community-based demonstration projects and a subsequent RFA for an extension of the community-based approach to regions and States. The first RFA resulted in three cooperative agreements for community-based demonstration projects in Los Angeles, California, Oakland, California, and, Brockton, Massachusetts. The subsequent RFA resulted in two cooperative agreements. The first extended the work of the Los Angeles, California community-based project to a larger area within Los Angeles. The second used a State-team approach in Northeastern States. TI researchers provided technical assistance to the grantees in the execution of these projects, and modified materials developed by these cooperative agreement programs for national use (See Appendix I: Supporting Evidence for information on these cooperative agreements and products modified for national use). For example, TI researchers modified curricula developed by the community-based demonstration projects and worked with State educational agencies to pilot test this core curricula. The curricula were found to be effective in teaching students basic information to keep them safe and healthy on the job.

TI researchers established working relationships with partners in the public and private-sector. Relationships with Federal partners were facilitated by TI leadership of the Child Labor Working Team, and later TI participation on the Federal Network for Young Worker Safety and Health (FedNet) led by the Occupational Safety and Health Administration (OSHA) (http://www.cdc.gov/niosh/fedNet/). The NIOSH Child Labor Working Team, active from 1994 to 2000, included six representatives from other Federal agencies, including the Wage and Hour Division of the Department of Labor responsible for child labor laws, and the School-to-Work Office in the Departments of Education and Labor responsible for implementing the School-to-Work Opportunities Act. The FedNet, organized in 2003, includes 11 Federal agencies who work collaboratively to reduce injuries and illnesses among young workers up to 24 years of age. TI researchers provide these other Federal agencies with technical expertise on young worker injury statistics and research findings, seek input on TI products, and collaborate in outreach efforts.

TI researchers established relationships with private groups actively involved in educational efforts to reduce the incidence of young worker injuries, including the Child Labor Coalition, vocational and technical education groups, and the Young Worker Safety and Health Network, a subcommittee of the Occupational Safety and Health Section of the American Public Health Association. TI researchers provide technical assistance in interpreting young worker injury statistics and research findings, and seek input from these groups on TI products and activities, and their assistance in disseminating TI findings and products.

Outputs and Transfer:
(For outputs not specifically cited, see Appendix I: Supporting Evidence.)

Since 1988, TI researchers have published 15 articles in the peer-reviewed literature and Morbidity and Mortality Weekly Report (MMWR)[*] identifying the magnitude and patterns of young worker injuries and/or prevention strategies Ten of these articles were published in 1996 or later. These articles identified workplaces with the greatest numbers and rates of young worker injuries, common hazards and events resulting in young worker injury, inadequate youth safety and health training, inadequate supervision of young workers, inappropriate youth work assignments, and promising prevention strategies.

TI researchers contributed to 13 NIOSH documents since 1995 featuring young worker injury data and prevention recommendations. All of these documents are included on a NIOSH Young Worker Safety and Health Website (www.cdc.gov/niosh/topics/youth/.) TI researchers constructed targeted mailing lists to ensure that these NIOSH publications were distributed to relevant researchers, safety practitioners, safety groups and stakeholders. For example, over several years, TI researchers mailed a fact sheet, brochure and poster to more than 25,000 high schools in the United States, requesting that information be posted on school bulletin boards and distributed to parents, teachers and students.[2] Additionally, the TI Program participated in collaborative educational outreach efforts with the Wage and Hour Division and OSHA. TI researchers provided materials for inclusion in Department of Labor "Work Safe this Summer Campaigns" in the 1990s, collaborated on joint mailings of materials related to forklift safety and youth work in construction, and collaborated on Internet guidance on safe work for youth.[3-5]

As noted in Sub goal 8.1, the TI Program provides copies of FACE reports to WHD and the Occupational Safety and Health Administration (OSHA) and State FACE Programs disseminate reports and associated prevention materials within their own States. One specific example is widespread distribution by the Massachusetts FACE Program and partners of safety information on young workers and forklifts, including a sticker developed by the Massachusetts FACE Program that could be affixed to forklifts noting that they should not be operated by workers less than 18 years of age.

External researchers who conducted young worker injury and illness research through cooperative agreements and grants have communicated findings in at least 23 articles in the peer-reviewed literature. These reports helped identify the magnitude and patterns of young worker injuries and illnesses, and made recommendations for prevention measures by regulators, employers, parents, educators and youth.

The extramural community-based demonstration projects developed numerous young worker safety and health educational materials. These included stand-alone curricula, educational activities for integration into existing high school curricula (e.g. science, English, history), and

[*] Centers for Disease Control Publication with wide dissemination to the medical and public health fields and the media.

educational materials targeted to parents, employers, healthcare providers, and youth. These materials are highlighted in a NIOSH publication, "Promoting Safe Work for Young Workers: A Community-based Approach." The projects worked with community, State and Federal level groups to transfer findings and products to regulators, employers, parents, educators, and youth.

The TI-supported Massachusetts young worker injury surveillance project described in Sub goal 8.1, Teens at Work, revised and updated materials developed in the Protecting Young Workers in Brockton community-based demonstration project, and uses them in surveillance-driven outreach efforts. Outreach includes train-the-trainer workshops on curricula developed in the community-based demonstration project for vocational and general education teachers, OSHA compliance assistance specialists, and peer leaders. Since 2004, the Massachusetts Teens at Work project has coordinated the Massachusetts Interagency Work Group on Youth Employment, a group of State and Federal agencies that meets quarterly to coordinate government activities to protect young workers in Massachusetts. The Teens at Work project also contributed to the development of a Massachusetts Young Worker Initiative, a community led coalition of stakeholders that has developed a State blueprint for action to protect working teens.[8]

Intermediate Outcomes:

Young worker safety efforts initiated under the TI-supported community-based demonstration projects have continued on, in large part, without subsequent NIOSH funding. At least three State-based teams initiated in association with TI-supported community-based demonstration projects have continued. The Outputs and Transfer section includes information on the Massachusetts team. In 2000, the California legislature established the California Resource Network for Young Worker Safety and Health based on a consensus recommendation from a State group including representatives from both TI-supported California-based demonstration projects.[15] A recent newsletter reporting that the Connecticut Department of Health is undertaking a focused intervention and training program for young restaurant workers based on surveillance findings noted continued collaborative work by the Connecticut Young Worker Safety Team.[16] This team was established through the Northeast Young Resource Center Cooperative Agreement. Additionally, the work of investigators with the Oakland, California community-based demonstration project and Northeast Young Worker Resource Center has been extended through the Young Worker Safety Resource Center funded by OSHA (http://socrates.berkeley.edu/percent7Esafejobs/nation/index.html#contactinfo). This center, a project of the Education Development Center and University of California, Berkeley Labor Occupational Health Program, provides services that can help State and local agencies and organizations protect young workers.

In response to targeted follow-up by the Massachusetts Teens at Work surveillance project, a national retail bakery chain undertook specific safety efforts that likely had an impact beyond the Massachusetts borders. The Massachusetts Teens at Work surveillance project pinpointed hot coffee/slurry from coffee brew baskets as a common source of injury for teens in Massachusetts, and presented these findings to owners, managers, and corporate staff of this national retail bakery chain. In 2001, corporate headquarters, which specified the equipment to be used in franchise stores, required owners purchasing new equipment to install brew baskets with shields to prevent spillage. A retrofit kit was also designed and available to owners not purchasing new equipment. Most recently, this national chain has reported new efforts to implement requirements that supervisors be on-site when teens are working.

NIOSH Alerts on young worker safety have been repeatedly reprinted based on requests for more copies (See the Supporting Evidence section for numbers of copies distributed), and statistics on young worker deaths and injuries included in NIOSH publications are routinely cited in the press. Findings from NIOSH funded extramural research have also been cited in the press. Recent examples include press coverage of results from the Wisconsin young worker injury surveillance project and young worker construction safety research conducted by Runyan, et al.[9-12]

The TI Program has received information on how some recipients of TI young worker safety and health products have used these materials. For example, following mailings of materials to high school principals, thousands of additional copies were requested, and some principals reported inserting copies in high school report cards and signed work permits, and incorporating the information into school-based occupational safety and health training.[13] Following a joint TI/Wage and Hour Division mailing of packets on forklift safety and young workers to more than 10,000 retail warehouses and storage facilities in December 2002, recipients requested an additional 2,000 information packets and 7,000 stickers. (This sticker was a modification of the sticker developed by the Massachusetts FACE Program discussed in the Outputs and Transfer section above.) Requests for these stickers continue. In September 2005, the Wage and Hour Division received a request for 300 stickers from the Crown Equipment Corporation, a forklift manufacturer. This firm noted that customers wanted the stickers affixed to forklifts that they sold.[14]

Statistics, findings, and prevention recommendations from TI products are routinely cited in safety efforts and programs of others. An exhaustive search has not been conducted, but some illustrative examples follow. In 2001, the American Public Health Association (APHA) issued policy statement 2001-9, Protection of Child and Adolescent Workers, that referenced NIOSH research and included a specific recommendation for the incorporation of comprehensive health and safety training modules in school curricula.[17] In a recent announcement by the Michigan Occupational Safety and Health Administration (MIOSHA) of a multi-year campaign focusing on youth worker safety and health, the MIOSHA acting director cited statistics reported in TI publications and made the following statement: “So when we saw these statistics we thought we should step up efforts to get information out to young people as they start their working careers.”[18] MIOSHA program materials make specific references to NIOSH statistics and the Michigan FACE Program, and include references to case studies developed through the TI-supported community-based demonstration projects.[19]

TI-authored peer-reviewed journal articles that identify the incidence and circumstances of young worker injuries have been cited more than 200 times in the scientific literature. (Citation frequency is provided in Appendix I: Supporting Evidence for selected publications.)

What’s Ahead:

The TI Program is currently customizing the pilot-tested curricula to reflect differences in State child labor laws. The TI Program will work with partners (e.g., career clusters programs, American Society for Safety Engineering, and vocational technical education groups) to broadly distribute the curricula. The curricula will also be included on a World Health Organization Website for use by other countries. The TI Program will continue to analyze existing data on young worker injuries and deaths, and report on data trends.

External Factors:
Although there are numerous intermediate outcomes from TI Program efforts to improve young worker safety, surveillance data are not demonstrating convincing reductions in rates of injury and death, with the exception of nonfatal work injuries in the agricultural industry. Although the rates of emergency department-treated injuries decreased between 1998 and 2003, especially for males, these declines were not statistically significant.[20] Fatality rates from 2000 to 2004 appeared generally to be lower than rates in the 1990s, yet recently released data from the BLS show a fatality rate increase. The rate for young worker injury deaths in 2005 was 3.2 per 100,000 full-time equivalents.[21] This rate is only modestly lower than the cumulative rate for 1992 to 2000 of 3.5 deaths per 100,000 full-time equivalents.

Among the external factors impeding progress in reducing young worker injuries are the following:

- Lack of resources for focused and widespread intervention efforts beyond the agriculture sector
- Outdated child labor laws
- Exclusions of family farm youth from child labor laws
- Limited enforcement of child labor laws at the Federal and State level, and
- An absence of specific OSHA standards that address hazards resulting in large numbers of nonfatal youth work injuries (e.g., lacerations, sprains and strains, and burns).

Although results from the TI pilot tests of core curricula are promising, there will be hurdles in trying to get new curricula adopted into schools that already have full slates and increasing pressures to demonstrate improvements in test scores, which do not include testing on occupational safety and health.

References:

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4. OSHA [2004b]. Federal agencies launch effort to help teen workers stay safe and healthy on the job this summer. Washington, DC: OSHA Trade Release, May 18, 2004.

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15. California Department of Industrial Relations [2006]. DIR Young Workers Website, http://www.dir.ca.gov/youngworker/youngworkernetwork.html. Accessed October 18, 2006.

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VI. TI Strategic Goals for the Future

Beginning in 2005, NIOSH developed and implemented a matrix management structure to coordinate cross-Institute programmatic activities. The NIOSH Program Portfolio consists of eight (8) NORA Sector Programs that represent industrial sectors; fifteen (15) Cross-Sector Programs organized around adverse health outcomes, statutory programs, and global efforts; and seven (7) Coordinated Emphasis Areas that support the Sector and Cross-Sector Programs (see Table 1, page 16).

The Traumatic Injury (TI) Research Program is one of the Cross-Sector Programs within the matrix structure. A NIOSH TI steering committee was formed to develop strategic goals and outcome measures for NIOSH TI research. This committee, with input from research staff across the Institute, recently developed the following interim research goals. The strategic plan for TI research is evolving as the TI steering committee considers input from external partners. We look forward to feedback and input from the National Academies' review in this planning process to help us maximize the relevance, quality and impact of the NIOSH TI Program.

NIOSH Traumatic Injury Research Program Interim Goals

Strategic Goal 1: Reduce Fall Injuries in the Workplace

1.1: Reduce fall-related fatalities and injuries in the construction industry

Intermediate Goal 1.1.1: Analyze existing data sets, including injury investigation reports, to identify the detailed sources and causes of fall-to-lower-level fatalities and injuries in the construction industry.

Intermediate Goal 1.1.2: Identify and summarize the existing measures, best practices, and intervention evaluations for preventing falls-to-lower-level in the construction industry for each injury source (i.e., roof, scaffold, and ladder) and priority task (i.e., roofing, masonry, painting and paper hanging, and carpentry).

Intermediate Goal 1.1.3: Identify and characterize falls from elevation among Hispanic construction workers.

Intermediate Goal 1.1.4: Evaluate the effectiveness of fall prevention technologies, programs, and communication materials in the construction industry.

Intermediate Goal 1.1.5: Transfer current knowledge and best practices on fall prevention and protection to construction special trade contractors, general building contractors, and Hispanic construction workers including current standards, PPE technologies, and available technologies and methodologies in other fields that can be utilized in the construction applications.

Intermediate Goal 1.1.6: Provide the scientific basis for and facilitate the development of public health campaigns on fall prevention in the construction industry.

1.2: Reduce fall-related injuries in the health services industry

Intermediate Goal 1.2.1: Characterize and track fall-related injuries in the health services industry, including determination of fall sources and causes.

Intermediate Goal 1.2.2: Identify and summarize preventive measures and products, current guidelines, best practices, and intervention evaluations for slip, trip, and falls (STF) applicable to the health services industry.

Intermediate Goal 1.2.3: Evaluate the effectiveness of fall prevention technologies, programs, and communication materials in the health service industry.

Intermediate Goal 1.2.4: Summarize and transfer current knowledge on effective interventions and best practices for fall prevention and protection to nursing care facilities and hospitals as well as family service and residential care institutes.

Intermediate Goal 1.2.5: Provide the scientific basis for and facilitate the development of public health campaigns on fall prevention in the health services industry.

1.3: Reduce fall-related injuries in the wholesale and retail trade industry

Intermediate Goal 1.3.1: Analyze existing data resources to determine the major sub-sectors in the retail and wholesale trade that have the highest fall-related injuries and fatalities and identify their sources and causes of fall injuries.

Intermediate Goal 1.3.2: Identify and summarize existing protective measures, best practices, and intervention evaluations for preventing falls in the high-risk sub-sectors of the retail and wholesale trade industry.

Intermediate Goal 1.3.3: Evaluate the effectiveness of fall prevention technologies, programs, and communication materials in the wholesale and trade industries.

Intermediate Goal 1.3.4: Summarize and transfer current knowledge on fall prevention and protection to retail merchandise stores that have the highest risk of fall-related injuries and fatalities (grocery stores and wholesale stores for vehicles, furniture, and construction materials suppliers).

Intermediate Goal 1.3.5: Provide the scientific basis for and facilitate the development of public health campaigns on fall prevention in the trade industry.

1.4: Reduce fall-related injuries through research on biosciences underlying human fall initiation, fall dynamics, fall termination, and control measures.

Intermediate Goal 1.4.1: Identify, analyze and summarize the existing gaps in fall-prevention and fall-protection research and technology.

Intermediate Goal 1.4.2: Develop innovative fall-prevention strategies that mitigate fall initiation hazards, especially during roofing, framing, scaffolding, and ladder-using jobs.

Intermediate Goal 1.4.3: Develop new and improved fall-protection systems and devices to reduce the forces to the human body during fall arrest and fall termination.

Intermediate Goal 1.4.4: Develop scientifically comprehensive yet easy-to-use digital models of human fall dynamics, including the phases of fall initiation and fall termination, for use in efficient evaluation of new fall prevention and protection methods and strategies, and in fall incidents investigation (reconstruction), and workers' hazard recognition training.

Strategic Goal 2: Reduce occupational injuries and deaths due to motor-vehicles

2.1: Reduce motor-vehicle-related incidents in the TWU industry Sector. [TWU Strategic Goal 7]

Intermediate Goal 2.1.1: Characterize and track injuries among truck drivers. [TWU Strategic Goal 1]

Intermediate Goal 2.1.2: Identify risk factors associated with occupational motor-vehicle crashes. [TWU Strategic Goal 7.2]

Intermediate Goal 2.1.3: Reduce motor-vehicle-related injuries and deaths due to fatigue, distraction, and sleep disturbance. [TWU Strategic Goal 4]

Intermediate Goal 2.1.4: Evaluate the effectiveness of technologies and other means of reducing the incidence of motor-vehicle-related injuries. [TWU Strategic Goal 7]

2.2: Reduce fatal and serious nonfatal injuries to workers in roadway construction work zones

Intermediate Goal 2.2.1: Quantify worker exposure to being run over by construction vehicles and equipment operating inside roadway construction work zones. [Construction Intermediate Goal 2.1]

Intermediate Goal 2.2.2: Evaluate the potential for proximity warning system (PWS) use on road construction equipment to reduce worker exposure to being run over. Assess existing systems and explore development of new improved PWS technology. [Construction Intermediate Goal 2.2]

Intermediate Goal 2.2.3: Evaluate the potential for Internal Traffic Control Plans (ITCPs) to reduce worker exposure to being run over by construction equipment. [Construction Intermediate Goal 2.3]

Intermediate Goal 2.2.4: Improve availability and use of operator visibility limit information for road construction vehicles and equipment. [Construction Intermediate Goal 2.4]

Intermediate Goal 2.2.5: Evaluate worker injury risks associated with the expanded use of night work in the road construction industry. [Construction Intermediate Goal 2.5]

Intermediate Goal 2.2.6: Provide the scientific basis for campaigns to promote widespread usage of effective prevention measures in the road construction industry. [Construction Intermediate Goal 2.6]

2.3: Reduce injuries and fatalities from motor-vehicle incidents, including being struck by vehicles, among public safety and emergency response workers. [Services Intermediate Goal 1]

Intermediate Goal 2.3.1: Identify and evaluate the leading risk factors for motor-vehicle incidents among public safety and emergency response workers, including being struck by vehicles, and provide effective recommendations to reduce the number of fatalities and days- away-from-work incidents. [Services Intermediate Goal 1]

Intermediate Goal 2.3.2: Identify and evaluate the effectiveness of interventions such as driver training in reducing motor-vehicle-related injuries and deaths among public safety and emergency response workers, including volunteer response workers such as volunteer fire fighters. [Services Intermediate Goal 1]

Intermediate Goal 2.3.3: Develop and promulgate information on appropriate body restraints for fire fighters and emergency medical service when operating or riding in emergency response vehicles. [Services Intermediate Goal 1]

2.4: Reduce occupational road traffic injuries worldwide. [TWU Strategic Goal

Intermediate Goal 2.4.1: Identify risk factors for occupational road traffic injuries outside the U.S.

Intermediate Goal 2.4.2: Develop road safety materials targeted to employees posted overseas.

Strategic Goal 3: Reduce occupational injuries and deaths due to workplace violence

3.1: Reduce workplace violence in the transportation, warehouse, and utilities industries.

Intermediate Goal 3.1.1: Develop and assess models that increase participation and compliance to effective interventions that reduce violence among high-risk taxicab driver populations.

3.1.1.1: Conduct research studies to demonstrate the effectiveness of model programs that increase compliance of high-risk taxicab drivers to adopt effective interventions that reduce violence risk.

3.1.1.2: Develop partnerships with community organizations, police departments and their associations, and taxicab associations, and implement a model program in at least one community to increase the number of taxicabs compliant with effective interventions.

3.2: Reduce workplace violence among high-risk wholesale and retail trade workers including grocery stores, gasoline stations, convenience stores, bakeries, and liquor stores.

Intermediate Goal 3.2.1: Increase the reliability and availability of surveillance data sets for workplace violence in high-risk wholesale and retail trade industries and occupations.

Intermediate Goal 3.2.2: Identify factors that increase risk of workplace violence among wholesale and retail workers who are employed in high-risk wholesale and retail establishments.

Intermediate Goal 3.2.3: Implement effective interventions that reduce violence among high-risk populations of workers in the high-risk wholesale and retail trade sector.

3.2.3.1: Identify management practices that minimize the risks of workplace violence in high-risk wholesale and retail establishments.

3.2.3.2: Complete an assessment of intervention methods to reduce the incidence and severity of violent incidents.

3.2.3.3: Identify and evaluate successful community policing program models which increases participation and compliance to implementing NIOSH and OSHA guidelines for prevention of robbery and robbery-related assault in late-night retail businesses.

Intermediate Goal 3.2.4: Improve transfer, diffusion, and adoption of effective workplace violence interventions in high robbery-risk wholesale and retail trade sector businesses.

3.2.4.1: Utilize partnerships with employers, labor unions, trade associations, police departments and their associations, and government agencies to increase the knowledge of workplace violence risks and potential strategies and interventions that limit risks in high-risk wholesale and retail trade businesses.

3.2.4.2: Develop and implement communication plans for effective workplace violence intervention strategies that are demonstrated to have reached target audiences in the wholesale and retail trade sector.

3.2.4.3: Utilize partnerships with employers, trade associations, government agencies, police departments and their associations, and crime prevention organizations to increase WPV prevention knowledge among police departments and implement a successful community policing program which increases business compliance to interventions and reduces robbery-related assaults in three communities.

Intermediate Goal 3.2.5: Use reliable economic models to accurately assess the costs of fatal and nonfatal injuries from workplace violence and the potential savings from reducing incidence and severity of workplace violence events.

3.2.5.1: Complete an assessment of reduction in costs due to implementation of a successful community policing program in one community.

3.2.5.2: Disseminate return on investment and cost data to community partners to promote compliance to NIOSH and OSHA guidelines for retail workplace violence prevention.

3.3: Identify risk factors and effective interventions to prevent workplace violence among high-risk services, healthcare, and social service sector workers such as eating and drinking establishment workers; hotels/motel workers; automotive repair mechanics; teachers; nurses and nursing assistants in general medical, home healthcare, nursing homes, and psychiatric hospitals; social service workers in job training, residential care, and day care industries; private security workers; and public safety and correctional workers in emergency response tasks (e.g., medical services, police calls, and correctional officer activities).

Intermediate Goal 3.3.1: Conduct studies to identify factors associated with trauma from workplace violence among high-risk services sector workers.

3.3.1.1: Conduct etiologic research studies to identify the conditions that lead to physical or psychological trauma from workplace violence among high-risk services sector workers.

3.3.1.2: Identify work organization strategies that minimize the risks of psychological trauma due to harassment, intimidation, bullying, and sabotage.

3.3.1.3: Evaluate the factors associated with fatal and nonfatal workplace violence incidents among youth worker populations in high-risk services sector industries.

Intermediate Goal 3.3.2: Conduct studies to increase the reliability and availability of surveillance data sets for workplace violence in high-risk service sector industries and occupations.

3.3.2.1: Identify a prioritized list of essential information for efficient population-based surveillance of verbal aggression and physical trauma from workplace violence in high-risk industries and occupations, and in priority populations (similar to the data collected through the National Crime Victimization Survey for physical trauma).

3.3.2.2: Develop at least one effective partnership with employers, unions, government, or non-governmental organizations to collect ongoing surveillance information about verbal aggression and physical trauma from workplace violence.

3.3.2.3: Interpret surveillance information to help identify and eliminate workplace conditions that lead to physical trauma from workplace violence and disseminate the results.

3.3.2.4: Distribute and publicize surveillance data sets that include parameters on workplace violence for widespread use by extramural investigators.

Intermediate Goal 3.3.3: Develop effective interventions that reduce violence among high-risk populations of workers in the services sector.

3.3.3.1: Validate at least three intervention methods to reduce the incidence and severity of violence in high-risk service sector industries.

3.3.3.2: Develop at least three partnerships with employers or trade associations in high-risk service sector industries to implement interventions in WPV programs and evaluate compliance to effective intervention strategies that have been demonstrated to reduce workplace violence.

Intermediate Goal 3.3.4: Improve transfer, diffusion, and adoption of effective workplace violence interventions in high-risk service sector industries, particularly for small businesses.

3.3.4.1: Utilize partnerships with employers, labor unions, trade associations, and government agencies in the service sector to increase the knowledge of workplace violence risks and potential strategies to limit risks.

3.3.4.2: Develop and implement communication plans for effective workplace violence intervention strategies that are demonstrated to have reached target audiences in the range of small to large employers.

Intermediate Goal 3.3.5: Use reliable economic models to accurately assess the costs of fatal and nonfatal injuries from workplace violence and the potential savings from reducing incidence and severity of workplace violence events among service sector workers.

3.3.5.1: Disseminate return on investment and cost data to community partners to promote compliance to NIOSH and OSHA guidelines for retail workplace violence prevention.

Strategic Goal 4: Reduce occupational injuries and deaths due to machines and industrial vehicles.

4.1: **Reduce occupational injuries and deaths due to machines and industrial vehicles in the Agriculture, Forestry and Fishing Industry, with an emphasis on tractor-related injuries and deaths.**

Intermediate Goal 4.1.1: Complete testing and market development of the NIOSH AutoROPS for zero-turn riding mowers for adoption by manufacturers.

Intermediate Goal 4.1.2: Complete testing and market development of the NIOSH AutoROPS for medium horsepower tractors for adoption by manufacturers.

Intermediate Goal 4.1.3: Complete testing and market development of the NIOSH cost-effective rollover protective structures (CROPs) for retrofitting older tractors without ROPS for adoption by manufacturers.

Intermediate Goal 4.1.4: Characterize and track injuries and fatalities from machinery and industrial vehicles in commercial fishing.

Intermediate Goal 4.1.5: Identify and prioritize risk factors associated with machinery and industrial vehicles in commercial fishing.

Intermediate Goal 4.1.6: Reduce the incidence of on-deck machinery entanglements on commercial fishing vessels through continued development of emergency-stop (e-stop) and other machine guarding technologies.

Intermediate Goal 4.1.7: Characterize and track injuries and fatalities from machinery and industrial vehicles in logging.

Intermediate Goal 4.1.8: Identify and prioritize risk factors associated with machinery and industrial vehicles in logging.

Intermediate Goal 4.1.9: Identify work situations at high-risk for machine-related fatal injury and develop prevention strategies for those who can intervene in the workplace by conducting Fatality Assessment and Control Evaluation (FACE) investigations of targeted occupational fatality incidents.

4.2: Reduce occupational injuries and deaths due to machines and industrial vehicles in the Construction Industry.

Intermediate Goal 4.2.1: Quantify worker exposure to being run over by construction vehicles and equipment operating inside roadway construction work zones. [Construction Intermediate Goal 2.1]

Intermediate Goal 4.2.2: Evaluate the potential for proximity warning system (PWS) on road construction equipment to reduce worker exposures to being run over. Assess existing systems and explore development of new improved PWS technology. [Construction Intermediate Goal 2.2]

Intermediate Goal 4.2.3: Evaluate the potential for internal traffic control plans (ITCPs) to reduce worker exposure to being run over by construction equipment. [Construction Intermediate Goal 2.3]

Intermediate Goal 4.2.4: Improve availability and use of operator visibility limit information for road construction equipment. [Construction Intermediate Goal 2.4]

Intermediate Goal 4.2.5: Evaluate worker injury risks associated with the expanded use of night work in the road construction industry. [Construction Intermediate Goal 2.5]

Intermediate Goal 4.2.6: Provide the scientific basis for campaigns to promote widespread usage of effective prevention measures in the road construction industry.

Intermediate Goal 4.2.7: Validate a computer simulation model to analyze the impact of dynamic loading of scissor lifts for evaluating fall, collapse, and tip-over incidents for use in improving equipment design and developing effective safety devices for adoption by equipment manufacturers.

Intermediate Goal 4.2.8: Identify work situations at high-risk for machine-related fatal injury and develop prevention strategies for those who can intervene in the workplace by conducting Fatality Assessment and Control Evaluation (FACE) investigations of targeted occupational fatality incidents.

4.3: Reduce occupational injuries and deaths due to machines and industrial vehicles in the Manufacturing Industry.

Intermediate Goal 4.3.1: Characterize and track injuries and fatalities from machinery and industrial vehicles.

Intermediate Goal 4.3.2: Identify and prioritize risk factors associated with machinery and industrial vehicles.

Intermediate Goal 4.3.3: Identify work situations at high-risk for machine-related fatal injury and develop prevention strategies for those who can intervene in the workplace by conducting Fatality Assessment and Control Evaluation (FACE) investigations of targeted occupational fatality incidents.

Intermediate Goal 4.3.4: Evaluate the effectiveness of technologies and other means of reducing the incidence of injuries and fatalities from high-risk machinery and industrial vehicles.

Intermediate Goal 4.3.5: Complete the testing and market development of the NIOSH JamAlert for passively controlling hazardous energy during un-jamming tasks on industrial balers for adoption by manufacturers.

Intermediate Goal 4.3.6: Complete the NIOSH evaluation of the ANSI B11 TR3 machine risk reduction methodology and provide recommendations to OSHA on the adoption of new ANSI and ISO methods for machine risk reduction.

Intermediate Goal 4.3.7: Complete testing and market development of the NIOSH radio frequency (HASARD) device for passively controlling hazardous energy from worker proximity to conveyors for adoption by manufacturers.

4.4: Reduce occupational injuries and deaths due to machines and industrial vehicles in the Mining Industry.

> **Intermediate Goal 4.4.1**: Develop interventions for preventing injuries related to machine safety and powered haulage equipment. [Mining Intermediate Goal 4.2]

> **Intermediate Goal 4.4.2:** Investigate wearable sensor technologies for empowering the miner to take proactive steps in decreasing his/her exposure to work-related injuries. [Mining Intermediate Goal 4.3]

> **Intermediate Goal 4.4.3**: Develop interventions, best practices, and strategies for improving miners' training with respect to hazard recognition, risk factor awareness, and emergency response. [Mining Intermediate Goal 4.5]

Strategic Goal 5: Reduce occupational injuries and deaths among high-risk and vulnerable worker groups.

5.1: Reduce occupational injuries and deaths among youth workers.

> **Intermediate Goal 5.1.1**: Track trends in youth worker injuries and deaths.

> **Intermediate Goal 5.1.2:** Partner with educational groups to increase youth education on occupational safety.

> **Intermediate Goal 5.1.3**: Provide empirical data to guide the development and enforcement of child labor laws.

> **Intermediate Goal 5.1.4**: Partner with governmental agencies, child safety advocates, safety groups, trade associations, and others to communicate young worker safety information.

5.2: Reduce occupational injuries and deaths among older workers.

> **Intermediate Goal 5.2.1**: Characterize and track trends in older worker injuries and deaths.

> **Intermediate Goal 5.2.2:** Identify risk factors for injury and death among older workers.

> **Intermediate Goal 5.2.3**: Evaluate intervention strategies to prevent older worker injuries and deaths.

> **Intermediate Goal 5.2.4**: Partner with governmental agencies, senior citizen organizations, and others to communicate older worker safety information.

5.3: Reduce occupational injuries and deaths among high-risk ethnic and minority workers.

Intermediate Goal 5.3.1: Characterize and track trends in injuries and death among ethnic and minority workers.

Intermediate Goal 5.3.2: Identify risk factors for injury and death among high-risk ethnic and minority workers.

Intermediate Goal 5.3.3: Partner with governmental agencies, safety groups, environmental justice organizations, social organizations, and others to develop and evaluate effective culturally-sensitive prevention strategies.

Intermediate Goal 5.3.4: Partner with governmental agencies, safety groups, environmental justice organizations, social organizations, and others to communicate safety information to employers and high-risk ethnic and minority workers.

5.4: Reduce occupational injuries and deaths among immigrant workers.

Intermediate Goal 5.4.1: Characterize and track trends in injuries and death among immigrant workers.

Intermediate Goal 5.4.2: Identify risk factors associated with injury and death among immigrant workers.

Intermediate Goal 5.4.3: Partner with governmental agencies, safety professionals, immigrant organizations, and international agencies to communicate safety information to employers and immigrant workers.

Appendix 1: Supporting Evidence for the TI Goals/Sub goals

This Appendix contains lists of publications, presentations, conferences and workshops, partners and stakeholders, and miscellaneous other evidence that supports the Research Goal/Sub-goal write-ups in Section V of the TI Program Evidence Package.

For journal articles, the number of times the article has been cited in other literature is included in parentheses at the end of the citation where this information is known. For NIOSH publications, the number of total copies distributed, and the number of those that were requested (i.e., by mail, by phone, by fax, and by Web) are included in parentheses at the end of the citation. For a few of the publications, the number of copies requested is not known, so just the total distribution figure is given.

1. Reduce injuries and fatalities due to motor-vehicles

Sub goal 1.1: Reduce occupational injuries and fatalities due to **highway motor vehicle crashes**

Supporting Evidence:

Journal Articles

Ore T, Fosbroke DE [1997]. Motor vehicle fatalities in the United States construction industry. *Accident Analysis and Prevention 29*(5):613-626. (9 citations)

Pratt S [2004]. Work-related roadway crashes - United States, 1992-2002. *Morbidity and Mortality Weekly Report 53*(12):260-264.

NIOSH Publications

NIOSH [1997]. *NIOSH Alert: Preventing worker injuries and deaths from moving refuse collection vehicles*. Cincinnati, Ohio: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 97-110. (20,292 distributed; 8,143 requested)

NIOSH [1998]. NIOSH Alert: Preventing worker injuries and deaths from traffic-related motor vehicle crashes. Cincinnati, Ohio: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 98-142. (128,500 *distributed*; 20,355 *requested*)

NIOSH [2000]. Comments of the National Institute for Occupational Safety and Health on the Department of Labor Notice of Proposed Rulemaking and Request for Comments on Child Labor Regulations, Orders and Statements of Interpretation; Child Labor Violations – Civil Money Penalties, 29 CFR Parts 570 and 579. January 28, 2000.

NIOSH [2004]. Work-related roadway crashes: prevention strategies for employers. By Pratt SG, Le H, Marsh SM. Cincinnati, Ohio: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Pub. No. 2004-136. *(12,114 distributed; 9,848 requested)*

NIOSH [2004]. Work-related roadway crashes: who's at risk? By Marsh SM, Pratt SG. Cincinnati, Ohio: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, 2004. DHHS (NIOSH) Pub. No. 2004-137. *(10,245 distributed; 8,330 requested)*

Pratt SG [2003]. Work-related roadway crashes: challenges and opportunities for prevention (NIOSH Hazard Review). Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Pub. No. 2003-119. *(7,549 distributed; 4,778 requested)*

Pratt SG, Marsh SM, DeGuzman G [2005]. Older drivers in the workplace: crash prevention for employers and workers. NIOSH fact sheet. DHHS (NIOSH) Pub. No. 2005-159. *(5,496 distributed; 1,007 requested)*

Conference Papers and Presentations

Pratt S [2004a]. Occupational roadway fatalities in the USA: Differences by vehicle registration and vehicle type [Abstract] In: 7th World Conference on Injury Prevention and Safety Promotion, June 6-9, 2004, Vienna, Austria: Kuratorium fur Schutz und Sicherheit/Institut Sic her Leben , NN: 20024699.

Oleinick A, Gandra CR, Simon C, Werner RA [2006]. Nature of injury data in the BLS annual survey seriously underestimate the medical burden of work injuries. NORA Symposium 2006: Research Makes a Difference, April 18-26, 2006, Washington, DC.

Oleinick A, Werner RA, Blower DF, Gandra C, Simon CD [2006]. The utility of linked and transformed workers' compensation data to study work injuries by occupation among employees of Ohio for-hire carriers, 1997-1999. NORA Symposium 2006: Research Makes a Difference, April 18-26, 2006, Washington, DC.

Neuhoff JG, Preston JG [2003]. A spatial auditory display for the prevention of pedestrian-motor vehicle collisions. Proceedings of the 9th International Conference on Auditory Display, Boston, MA.

Husting EL [2006]. Health and wellness: future truck and bus safety research opportunities. In: Future truck and bus safety research opportunities [Conference Proceedings 38]. Washington, DC: Transportation Research Board, p. 48-54.

NIOSH Updates

NIOSH Update: Medical Interns' Risk for Car Crashes Linked With Extended Shifts in NIOSH-Funded Study - January 13, 2005

NIOSH Update: Requiring Safety Belt Use is Key Employer Policy for Preventing Job Vehicle Deaths, NIOSH Says - September 14, 2004

NIOSH Update: NIOSH Recommends Ways to Prevent Fatalities from Work-Related Roadway Crashes - April 7, 2004

NIOSH, OSHA, Roadway Work Zone Safety and Health Coalition Ally to Improve Roadway Work Zone Safety — November 26, 2003

Ways to Prevent Job-Related Roadway Deaths, Critical Research Areas Identified by NIOSH — November 6, 2003

NIOSH Report Highlights Motor Vehicle Crash Risk for Workers, Recommends Practical Preventive Measures — July 27, 1998

Fatality Investigation Reports

NIOSH [1991]. County garbage collector dies after falling from back end of moving garbage truck. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) Report No. 91-09.

NIOSH [1992]. Trash collector dies after being crushed by collection truck—Virginia. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) Report No. 92–31.

NIOSH [1994]. Tree trimmer foreman dies after being struck by a pickup truck. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) Report No. 94-07.

NIOSH [1994]. Sanitation worker run over after falling from trash collection vehicle—Virginia. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) Report No. 94–11.

NIOSH [1995]. Sanitation worker run over at solid waste transfer station—Virginia. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) Report No. 95-11.

NIOSH [1998]. Temporary laborer crushed by dump truck at landfill -- South Carolina. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) Report No. 98-10

Other Publications

Castillo DN, Pratt SG, Mardis AL, Hendricks KJ [2002]. National Institute for Occupational Safety and Health (NIOSH) recommendations to the U.S. Department of Labor for changes to Hazardous Orders. Report to the U.S. Department of Labor, Employment Standards Administration, Wage and Hour Division.

Chen G, Jenkins EL, Husting L [2004]. A comparison of crash patterns in heavy trucks with and without collision warning system technology. In Safety Performance and Accident Free Driving. SAE Special Publication. Warrendale, PA: SAE Inc. ISBN 0-7680-1533-2. 31-36. [Reprinted in SAE 2004 Transactions of Journal of Commercial Vehicles 2004; *113*(2): 360-365.]

Husting EL, Biddle E [2005]. Truck safety in the age of information. In: Trucking in the age of information. Burlington, VT: Ashgate Publishing Company, p. 247-268.

NIOSH [2000]. Comments of the National Institute for Occupational Safety and Health on the Federal Motor Carrier Safety Administration Proposed Revision of the Hours of Service Rules for Commercial Carriers, 49 CFR Part 395, Docket No. FMCSA 97-2350. December 14, 2000.

NIOSH [2005]. Comments of the National Institute for Occupational Safety and Health on the Federal Motor Carrier Safety Administration Notice of Proposed Rulemaking on the Hours of Service of Drivers, 49 CFR Parts 385, 390, and 395, Docket No. FMCSA 2004-19608. Cincinnati, OH: National Institute for Occupational Safety and Health. March 2005.

Reports from TI Supported Extramural Research

Barger LK, Cade BE, Ayas NT, Cronin JW, Rosner B, Speizer FE, Czeisler CD [2005]. Extended work shifts and the risk of motor vehicle crashes among interns. *New England Journal of Medicine 352*:125-134

Sub goal 1.2: Reduce occupational injuries and fatalities due to motor vehicle incidents in highway and street construction **work zones**

Supporting Evidence:

Journal Articles

Ruff TM [2005]. Evaluation of a radar-based proximity warning system for off-highway dump trucks. *Accident Analysis and Prevention 38*: 92-98.

NIOSH Publications

Pratt SG, Fosbroke DE, Marsh SM [2001]. Building safer highway work zones: measures to prevent worker injuries from vehicles and equipment. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-128. *(21,563 distributed; 16,810 requested)*
(This publication authored by TI researchers resulted from a 1998 TI program sponsored workshop that focused on preventing vehicle- and equipment-related worker injuries in highway work zones.)

Ruff TM [2003]. Evaluating systems to monitor blind areas behind trucks used in road construction and maintenance – phase I. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2003-113.

Conference Papers and Presentations

Fosbroke DE, Beaupre J, Hammer R [2006]. Designing internal traffic control plans. Invited presentation at the Plants, People, and Paving Training Conference, World of Asphalt, Orlando FL, March 15.

Fosbroke DE [2006]. Evaluation of injury prevention measures inside roadway work zones: 2006 update. Invited presentation at the 51st Annual National Asphalt Pavement Association Meeting, Hollywood, FL, January 22.

Fosbroke DE [2004]. NIOSH Reports! Studies on heavy equipment blind spots and internal traffic control. Presentation at the Third International Roadway Construction Safety and Health Conference, Baltimore, MD, November 4.

Marsh SM [2004]. Evaluating roadway construction work zone interventions. Presented at the 37th Annual Meeting of the North American Association of Transportation Safety and Health Officials, Indianapolis, IN, August 4.

Beaupre J, Hause M, Hammer R [2004]. Preventing workers from being struck by roadway construction equipment. Presented at the 14th Annual Construction Safety Conference and Exposition, Rosemont, IL, February 10.

Ruff TG, Fosbroke DE [2003]. NIOSH testing of proximity warning devices on road construction equipment. Invited presentation at the 2003 Mid-West Work Zone Safety Conference, Springfield, IL, December 3.

Hause MG [2003]. Defining hazard areas around construction equipment. Presented at the National Occupational Injury Research Symposium, Pittsburgh, PA, October 28-30.

Hendricks SA [2003]. Tracking worker and equipment positions with GPS receivers. Presented at the National Occupational Injury Research Symposium, Pittsburgh, PA, October 28-30.

Pratt SG, Fosbroke DE [2002]. Building safer highway work zones. Presented at the Ninth Occupational Safety and Health Conference: Knowledge and Education: Milestones in Accident Prevention, Dorado, Puerto Rico, December 11.

Pratt SG [2002]. Roadway worker deaths during night operations: what do the data show? Presented at the Second International Roadway Work Zone Safety Conference, Lake Buena Vista, FL, December 5.

Pratt SG, Fosbroke DE [2002]. Preventing worker deaths and injuries in roadway construction: a synthesis of industry practice, injury surveillance data, and current research. Presented at the Sixth World Injury Conference, Montreal, Quebec, May 13.

Fosbroke DE [2001]. Working safely around traffic vehicles and construction equipment. Presented at the International Union of Operating Engineers Annual Training Conference, Lake Buena Vista, FL, November 12.

Fatality Investigation Reports

NIOSH [2004]. Hispanic laborer on roadway construction work site run over and killed by a backing flat bed dump truck - North Carolina. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2004-11.

NIOSH [2004]. Hispanic flagger dies after being run over by a dump truck - North Carolina. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2004-10.

NIOSH [2002]. Construction laborer dies after being run over and crushed by a grader at a road construction site - North Carolina. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2002-03.

NIOSH [2002]. Roadway construction worker dies from crushing injuries when backed over by a dump truck - Virginia. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2002-06.

NIOSH [2001]. State Department of Transportation worker (laborer) dies after being struck by motor vehicle - North Carolina. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2001-01.

NIOSH [2001]. State Department of Transportation highway maintenance worker dies after being struck by a car while installing reflectors on a guardrail. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2001-02.

NIOSH [2001]. Seventeen-year-old part-time road construction laborer dies after being run over by a water truck - Indiana. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2001-10.

NIOSH [2000]. Flagger struck from behind and killed by a truck intruding into a highway construction work zone - Wisconsin. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2000-02.

Other Publications

NIOSH [2003]. Comments of the National Institute for Occupational Safety and Health on the Federal Highway Administration Proposed Rule on Work Zone Safety and Mobility, 23 CFR Part 630, FHWA Docket No. FHWA-2001-11130. September 2003.

NIOSH [2002]. Comments of the National Institute for Occupational Safety and Health on the Department of Transportation Notice of Proposed Amendments to the Manual on Uniform Traffic Control Devices (MUTCD); Request for Comments. 23 CFR Part 655, FHWA Docket No. FHWA-2001-11159. August 2002.

Contractor Reports

Caterpillar [2004]. Construction vehicle and equipment blind area diagrams, final report – contract modification. Prepared under NIOSH Contract No. 200-2002-00563. Peoria, IL: Caterpillar, Inc.

C.L. Williams Consulting, Inc. [2004]. Internal traffic control plans, sites 1 and 2: internal traffic control plans for Portland cement concrete paving operation.

Prepared under NIOSH Contract No. 200-2002-00596, Modification No. 1. Lakeside, AZ: C.L. Williams Consulting, Inc.

Caterpillar [2003]. Construction vehicle and equipment blind area diagrams, final report. Prepared under NIOSH Contract No. 200-2002-00563. Peoria, IL: Caterpillar, Inc.

C.L. Williams Consulting, Inc. [2003]. Revised internal traffic control plans, sites 1 and 2: internal traffic control plans for asphalt paving operations on freeway segments. Prepared under NIOSH Contract No. 200-2002-00596. Lakeside, AZ: C.L. Williams Consulting, Inc.

C.L. Williams Consulting, Inc. [2003]. Internal traffic control plan draft development guide: internal traffic control plans for asphalt paving operations on freeway segments. Prepared under NIOSH Contract No. 200-2002-00596. Lakeside, AZ: C.L. Williams Consulting, Inc.

Roadway Work Zone Safety and Health Coalition Alliance [2005]. Internal traffic control plans. Prepared under CDC Contract No. 212-2003-M-02677. Washington DC: Laborers' Health and Safety Fund of North America.

2. Reduce injuries and fatalities due to falls from elevations

Sub goal 2.1: Reduce worker ***falls from roofs***

Supporting Evidence:

Journal Articles

Simeonov P, Hsiao H , Powers J, Ammons D, Amendola A, Kau T, Cantis D [2006]. Footwear effects on walking balance at elevation. (submitted to the *Ergonomics* journal)

Conference Papers and Presentations

Hsiao H [2005]. Falls Prevention (keynote speech), Slip, Trip, and Fall Symposium, the Ergonomics Society annual conference (UK), 2005.

Hsiao H, Dotson BW [2000]. Safe work at elevation through virtual reality simulation. NOIRS 2000--Abstracts of the National Occupational Injury Research Symposium 2000, Pittsburgh, PA, October 17-19, 200, Pittsburgh, PA: National Institute for Occupational Safety and Health, 60-61.

Pan C, Hoskin A, Lin M, Castillo D, McCann M, Fearn K [2005]. Incidents Due to Aerial Work Platforms. Proceedings of XVIIth World Congress on Safety and Health at Work, Orlando, FL, 2005.

Simeonov P, Hsiao H, Dotson B, Ammons D [2002]. Comparing standing balance at real and virtual elevated environments, *Proceedings of the Human Factors and Ergonomics Society 46th Annual Meeting 2002,* Sep-Oct, 2169-2173.

Sub goal 2.2: Improve ***fall-arrest harnesses***

Supporting Evidence:

Journal Articles

Hsiao H, Bradtmiller B, Whitestone J [2003]. Sizing and Fit of Fall-Protection Harnesses. *Ergonomics 46*(12): 1233-1258. *(1 Citation)*

Hsiao H, Long D, Snyder K [2002]. Anthropometric Differences among Occupational Groups. *Ergonomics 45*(2): 136-152.

Hsiao H, Whitestone J, and Kau T [2006]. Evaluation of Fall-Arrest Harness Sizing Scheme. *Human Factors 48*. [in press]

Conference Papers and Presentations

Hsiao H, Whisler R, Kau T, Zwiener J, Guan J, and Spahr J [2005]. Constructing New Harness Fit Charts using 3D Anthropometric Information. *Contemporary Ergonomics 3*:7, April 4 – 7, 2005, Hertfordshire, England.

Hsiao H [2004]. Anthropometric Procedures for Design Decisions: From Flat Map to 3D Scanning. *Contemporary Ergonomics*, proceedings of the Ergonomics Society Conference in April 2004. Boca Raton, FL: CRC Press, pages 144-148.

Friess M, Rohlf FJ, Hsiao H [2004]. Quantitative assessment of human body shape using Fourier analysis, in proceedings of SPIE—The International Society for Optical Engineering Conference, January 18-22, 2004, San Jose, California.

Bradtmiller B, Whitestone J, Feldstein J, Hsiao H, Snyder K [2000]. Improving Fall Protection Harness Safety: Contributions of 3-D Scanning. in Scanning 2000—Numerisation 3D, 5th ed. Proceedings of the Industrial Congress on 3D Digitizing, Paris, France, May 24-25, 2000. Dinard Cedex, France: Harbour, pp. 117-128.

Turner N, Weaver D, Whisler R, Zwiener J, Wassell J [2006]. Suspension tolerance in men and women wearing safety harnesses, presented at the American Industrial Hygiene Conference and Exposition, Chicago, IL, 2006. (Abstract No. 144)

Patents
Provisional patent application was filed on July 14, 2006 for a harness accessory which automatically supports a wearer in a sitting position with the knees elevated at a position at or above the hips after a fall (CDC Ref. No. I-002-06).

Sub goal 2.3: Reduce worker falls from **telecommunication towers**

Supporting Evidence:

NIOSH Publications

NIOSH [2001]. NIOSH Alert: Preventing injuries and deaths from falls during construction and maintenance of telecommunication towers. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-156. *(25,444 distributed; 24,765 requested)*

Fatality Investigation Reports

NIOSH [1992]. FACE 92-05: Painter dies after 80-foot fall from electrical transmission tower in Indiana. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH [1997]. FACE 97-10: Tower erector/inspector dies after falling 200 feet from a telecommunication tower to the ground-North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH [1998]. FACE 98-05: Tower worker dies after falling 130 feet from hoist cable to ground-Pennsylvania. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH [1998]. FACE 98-07: Tower erector dies after falling 125 feet from cellular phone tower-South Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH [1998]. FACE 98-20: Tower erector dies after falling 200 feet from telecommunication tower-North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH [1998]. FACE 98-21: Tower painter dies and a second painter injured after falling 900 feet while inside a man basket-South Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service,

Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH [1998]. 98MO161: Tower construction worker dies following 940-foot fall from television tower. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH [1999]. FACE 99-01: Tower hand dies after 230-foot fall from communication tower-North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH [1999]. 99MO138: Tower construction worker dies following 40-foot fall from cellular tower. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH [2000]. FACE2000-07: Three tower painters die after falling 1,200 feet when riding the hoist line-North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NCDOL (State of North Carolina Department of Labor) (2005). Title 13 of the North Carolina Administrative Code State Specific Rule 07F.0600 (13 NCAC 07F.0600) *Communications Towers*, effective February 1, 2005.

3. Reduce injuries and fatalities due to workplace violence

Supporting Evidence:

Journal Articles

Hendricks S, Jenkins EL, Anderson KR. Trends in workplace homicides in the U.S. 1993-2002: a decade of decline. *American Journal of Industrial Medicine*, Submitted for publication, May, 2006.

Hartley D, Biddle EA, Jenkins EL [2005]. Societal cost of workplace homicides in the United States, 1992-2001. *American Journal of Industrial Medicine 47*: 518-527.

Anderson KR, Tyler MP, Jenkins EL [2004]. Preventing workplace violence. *Journal of Employee Assistance 34*(4): 8-11.

Peek-Asa C, Jenkins EL [2003]. Workplace violence: how do we improve approaches to prevention? *Clinics in Occupational and Environmental Medicine 3*(4): 659-672.

Faulkner KA, Landsittel DP, Hendricks SA [2001]. Robbery characteristics and employee injuries in convenience stores. *American Journal of Industrial Medicine 40*(6):703-709, Dec. *(2 Citations)*

Hendricks SA, Landsittel DP, Amandus HE, Malcan J, Bell J [1999]. A matched case-control study of convenience store robbery risk factors. *Journal of Occupational and Environmental Medicine 41*(11):995-1004. *(9 Citations)*

Amandus HE, Hendricks SA, Zahm D, et. al. [1997]. Convenience store robberies in selected metropolitan areas – Risk factors for employee injury. *Journal of Occupational and Environmental Medicine 39*(5):442-447, May. *(9 Citations)*

Jenkins EL [1996]. Homicide Against Women in the Workplace. *Journal of the American Medical Women's Association 51*(3):118-122.

Amandus HE, Zahm D, Friedmann R, et al. [1996]. Employee injuries and convenience store robberies in selected metropolitan areas. *Journal of Occupational and Environmental Medicine 38*(7):714-720. *(5 Citations).*

Amandus HE, Hunter RD, Hendricks JES [1995]. Reevaluation of the effectiveness of environmental designs to reduce robbery risk in Florida convenience stores. *Journal of Occupational and Environmental Medicine 37*(6): 711-717.

Castillo DN, EL Jenkins [1994]. Industries and Occupations at High Risk for Work-Related Homicide. *Journal of Occupational Medicine 36*(2):125-132.

Goodman RA, Jenkins EL, Mercy JA [1994]. Workplace-Related Homicide Among Health Care Workers in the United States, 1980 Through 1990. Journal of the American Medical Association *272*:1686-1688.

Jenkins EL [1994]. Occupational Injury Deaths Among Females: The U.S. Experience for the Decade 1980-1989. *Annals of Epidemiology 4*:146-151.

Jenkins EL [1996]. Workplace Homicide: Industries and Occupations at High Risk. *Occupational Medicine: State of the Art Reviews 11*(2):219-225. *(12 Citations)*

Centers for Disease Control and Prevention (CDC) [1994]. Occupational Injury Deaths of Postal Workers—United States, 1980-1989. *Morbidity and Mortality Weekly Report 43*(32):593-595.

Jenkins EL, Layne LA, Kisner SM [1992]. Homicide in the Workplace: The U.S. Experience, 1980-1988. *AAOHN Journal 40*(5): 215-218.

Bell CA [1991]. Female Homicides in United States Workplaces, 1980-1985. *American Journal of Public Health 81*(6):729-732.

NIOSH Publications

NIOSH [2006]. Workplace Violence Prevention Strategies and Research Needs: Report from the Conference Partnering in Workplace Violence Prevention: Translating Research to Practice, November 17–19, 2004, Baltimore, Maryland. NIOSH Publication No. 2006-144. Cincinnati, OH: National Institute for Occupational Safety and Health, 38 pp. *(2,967 distributed; 1,405 requested)*

NIOSH [2004]. Violence on the Job (DVD). Washington, DC: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 2004-100d. *(32,101 distributed; 20,038 requested)*

NIOSH [2002]. Violence: Occupational Hazards in Hospitals. Washington, DC: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 2002-101. *(41,273 distributed; 35,563 requested)*

Jenkins EL [1996]. Current Intelligence Bulletin 57, Violence in the Workplace: Risk Factors and Prevention Strategies. DHHS (NIOSH) Publication No. 96-100. *(83,242 distributed; 36,264 requested)*

NIOSH [1993]. Alert: Request for Assistance in Preventing Homicide in the Workplace. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 93-109.

NIOSH [1993]. Fatal Injuries to Workers in the United States, 1980-1989: A Decade of Surveillance, DHHS (NIOSH) Publication No. 93-108. Cincinnati, OH: National Institute for Occupational Safety and Health, 27 pp. (August 1993).

Bell CA, Jenkins EL [1992]. Homicide in U.S. Workplaces: A Strategy for Prevention and Research. DHHS (NIOSH) Publication No. 92-103. Cincinnati: National Institute for Occupational Safety and Health.
(This publication summarizes discussions from a NIOSH sponsored workshop on occupational homicide held in Washington, DC on July 23-24, 1990. A panel of 14 experts from government agencies, academia, private industry, and trade associations participated by discussing limitations of available data, important research issues, areas where further research is needed, and evaluation of known prevention strategies.)

Other Publications

Quick JC, Piotrkowski C, Jenkins EL, Brooks YB [2003]. Four Dimensions of Healthy Work: Stress, Work-Family Relations, Violence Prevention, and Relationships at Work. [Book Chapter] In: *Psychology Builds A Healthy World: Opportunities for Research and Practice*, 233-273.

Jenkins EL [2002]. Existing evidence of the prevalence of violence in health services within different geographical, social, and economic settings. In: *Workplace violence in the health sector: State of the Art*. Edited by Cary L. Cooper and Naomi G. Swanson. International Labor Organization.

Fisher BS, Jenkins EL, Williams N [1998]. The Extent and Nature of Homicide and Non-fatal Workplace Violence in the United States: Implications for Prevention and Security in *Crime at Work: Increasing the Risk for Offenders, Volume II.* Edited by Martin Gill. Perpetuity Press, Leicester, UK.

Jenkins EL [1998]. Prevention Strategies and Research Needs in Violence in the Workplace: Preventing, Assessing, and Managing Threats at Work. Edited by Carol W. Wilkinson. Rockville, MD: Government Institutes.

Jenkins EL [1998]. Violence in the Workplace: Scope of the Problem and Risk Factors in Violence in the Workplace: Preventing, Assessing, and Managing Threats at Work. Edited by Carol W. Wilkinson. Rockville, MD: Government Institutes.

Workshops, Conferences, and Meetings

Federal Interagency Task Force: NIOSH coordinated and hosted meetings of a task force of 20 federal agencies which met 4 times during 2002-2005*(Jan. 2003, Sept. 2003, Apr. 2004 and Nov. 2005).* Provides an opportunity for all of the agencies that are doing work or who have an interest in workplace violence research to share information and identify opportunities for collaborative efforts. The purpose of the meetings was to determine WPV problems in federal agencies, what types of programs and research was being done, and areas for collaboration. Out of these meetings, NIOSH developed partnerships with DOL/BLS, DOJ/BJS, CPSC/NEISS, VHA and NIJ. NIOSH provided funds to BLS, BJS, and NIJ for survey of employers (BLS), victims of crimes (BJS NCVS), and emergency room visits for WPV (CPSC NEISS survey). Surveys were completed during 2002-2005 and results are presently being analyzed and reports prepared. BLS has already released statistics to the media for the employer survey.

NIOSH-VHA Partnership. NIOSH has partnered with VHA to evaluate interventions in VHA hospitals. The VHA provided funds to NIOSH to complete a pilot study of 5 hospital WPV intervention programs. NIOSH and VHA are jointly funding an evaluation study of an intervention to prevent patient violence towards staff in psychiatric hospitals.

NIJ Task Force. TI staff members have participated on a NIJ task force on an evaluation of the effects of Tasers used by police to subdue perpetrators.

University of Iowa Workshop on Workplace Violence Intervention Research. TI sponsored and participated in this workshop that was held in Washington, DC on April 5-7, 2000. A panel of 37 invited participants representing private industry, organized labor, municipal, state, and federal governments, and academia met to examine issues related to all four types of violence in the workplace and to develop recommended research strategies to address this public health problem. In addition to the conference summary report *(Workplace Violence: A Report to the Nation),* published by the University of Iowa in February 2001, peer-reviewed papers from this conference were published in the American Journal (Am. J. Med., 2001:20(2)).

1994 NIOSH Conference on Silent Epidemics in the Workplace.
Workplace violence was one of four occupational safety and health topics targeted for interdisciplinary discussion and prevention effort in this 1994 Workshop.

The 1995 National Violence Prevention Conference
TI organized the workplace violence track, one of four primary tracks within the conference. The sessions brought together academic and government researchers; industry and labor representatives; and Federal, State, and local government policy makers to identify the state of WPV knowledge and remaining research and prevention gaps.

2003 TI Workplace Violence Prevention Stakeholder Meetings

> *Healthcare industry – May 2003.* A diverse group of 38 attendees representing trade associations, federal partners, state agencies, and labor unions participated in discussions concerning strategies for prevention of violence against healthcare workers. Presentations were designed to inform participants about the TI and OSHA efforts in prevention of violence directed towards healthcare workers. After these brief presentations, each person in attendance was given some time to describe their organizations' efforts, successes, and trials in preventing workplace violence directed towards healthcare workers. Attendees were asked to describe ways that TI could assist them in preventing workplace violence. A recommendation from this group was that TI organize and sponsor a conference designed to share the "best practices" of workplace violence prevention in the healthcare setting.
>
> *Domestic Violence in the Workplace – June 2003.* A diverse group of 38 attendees representing trade associations, federal partners, state agencies, and labor unions participated in discussions concerning strategies for prevention of domestic violence incidents in the workplace. Presentations were designed to inform participants about the TI, CDC, and FBI efforts in prevention of domestic violence in the workplace. After these brief

presentations, each person in attendance was given some time to describe their organizations' efforts, successes, and trials in preventing domestic violence in the workplace. Attendees were asked to describe ways that TI could assist them in preventing workplace violence. A recommendation from this group was that TI organize and sponsor more meetings that address the issue of preventing domestic violence in the workplace.

Retail Industry – August 2003. Seventeen people representing a cross-sector of private industry, trade associations, federal partners interested in preventing retail industry violence participated. Presentations were designed to inform participants about the TI and OSHA efforts in prevention of violence directed towards retail workers. After these brief presentations, each person in attendance was given some time to describe their organizations' efforts, successes, and trials in preventing workplace violence directed towards retail workers. Attendees were asked to describe ways that TI could assist them in preventing workplace violence. A recommendation from this group was that TI research why the presence of certain risk factors makes an establishment an attractive target to someone intent on committing a crime

Security/Law Enforcement – November 2003
A diverse group of 25 attendees representing trade associations, federal partners, state agencies, and labor unions participated in discussions concerning strategies for prevention of violence against security and law enforcement officers. Presentations were designed to inform participants about the TI and OSHA efforts in prevention of violence directed towards security workers. After these brief presentations, each person in attendance was given some time to describe their organizations' efforts, successes, and trials in preventing workplace violence directed towards security workers. Attendees were asked to describe ways that TI could assist them in preventing workplace violence. A recommendation from this group was that TI evaluate the use of community policing as a method of preventing violence against security personnel.

4. Reduce injuries and fatalities due to machines

Sub goal 4.1: Reduce injuries and deaths caused by tractor rollovers by increasing availability and use of effective ***roll-over-protective structures (ROPS)***

Supporting Evidence:

Journal Articles

Hsiao H, Whitestone J, Bradtmiller B, Zwiener J, Whistler R, Kau T, Gross M, Lafferty C [2005]. Anthropometry criteria for the design of tractor cabs and protection frames. *Ergonomics 48*(4):323-353.

Etherton JR, McKenzie Jr EA, Lutz TJ, Cantis DM, Kau TY [2004]. An Initial Farmer Evaluation of a NIOSH AutoROPS Prototype. International Journal of Industrial *Ergonomics* 34:155-165

Etherton JR, Cutlip RG, Harris JR, Ronaghi M, Means KH, Howard S. [2002]. Dynamic performance of the mechanism of an automatically deployable ROPS. *Journal of Agricultural Safety and Health 8*(1):113-118.

Etherton JR, Cutlip RG, Harris JR, Ronaghi M, Means KH, Gillispie A. [2002]. Static load test performance of a telescoping structure for an automatically deployable ROPS. *Journal of Agricultural Safety and Health 8*(1):119-126.

Hsiao H, Long D, Snyder K. [2002]. Anthropometric differences among occupational groups. *Ergonomics 45*(2):136-152.

Pana-Cryan R, Myers ML [2002]. Cost effectiveness of Roll-Over Protective Structures. *American Journal of Industrial Medicine 42*(S2):68-71.

Powers JR, Harris JR, Etherton JR, Snyder KA, Ronaghi M, Newbraugh BH. [2001]. Performance of an automatically deploying ROPS on ASAE Tests. *Journal of Agricultural Safety and Health 7*(1):51-61.

Powers JR, Harris JR, Etherton JR, Ronaghi M, Snyder KA, Lutz TJ, Newbraugh BH. [2001]. Preventing tractor rollover fatalities: performance of the NIOSH AutoROPS. *Injury Prevention 7*(Suppl. I):54-58.

Myers ML. [2000]. Prevention effectiveness of Roll-Over Protective Structures-Part I: strategy evolution. *Journal of Agricultural Safety and Health 6*(1):29-40.

Myers ML, Pana-Cryan R. [2000]. Prevention effectiveness of Roll-Over Protective Structures-Part II: decision analysis. *Journal of Agricultural Safety and Health 6*(1):41-55.

Pana-Cryan, Myers ML. [2000]. Prevention effectiveness of Roll-Over Protective Structures-Part III: economic analysis. *Journal of Agricultural Safety and Health 6*(1):57-70.

Harris JR, Ronaghi M, Snyder KA. [1998]. Analyzing tractor rollovers using finite element modeling. *Analysis Solutions 2*(4):24-25.

Myers JR, Snyder KA, Hard DL, Casini VJ, Cianfrocco R, Fields J, Morton L. [1998]. Statistical and epidemiology of tractor fatalities-a historical perspective. *Journal of Agricultural Safety and Health 4*(2):95-108.

Myers ML. [1998]. NIOSH perspective on tractor-related hazards. *Journal of Agricultural Safety and Health 4*(4):205-230.

Conference Papers and Presentations

McKenzie EA Jr, Etherton JR, Harris JR, Cantis DM, Lutz TJ [2005]. NIOSH AutoROPS Research to Practice: Zero Turn Commercial Mowers, in the Proceedings of 2005 American Society of Mechanical Engineers, Congress and Exposition, Orlando, FL, November 11, 2005.

Ronaghi M, Abukhadra SM, McKenzie EA Jr, Etherton JR, Means KH [2005]. Finite Element Modeling of a Fiber Reinforced Plastics Composite Materials in Automatically Deployable Rollover Protective Structure**,** in the Proceedings of 2005 American Society of Mechanical Engineers, Congress and Exposition, Orlando, Florida, November 8, 2005.

Lutz TJ, McKenzie EA Jr [2005]. Remote Control on a Zero-turn Commercial Lawn Mower To Conduct SAE J2194 Rollover Test, in the Proceedings of the 2005 American Society of Agricultural Engineers Annual International Meeting, Tampa, FL, July 17-20, 2005.

Harris JR, Cantis DM, McKenzie EA Jr, Etherton JR, Ronaghi M, Commercialization of cost-effective rollover protective structures (CROPS): research-in-progress, in the Proceedings of the National Institute for Farm Safety (NIFS) Annual Conference*,* Wintergreen, Virginia, June 26-30, 2005.

Guan J, Hsiao H, Zwiener J, Current RS, Newbraugh BH, Powers JR, Spahr J [2005]. Injury Potential to a Seat-Belted Operator During a Rear and Side Overturn of a ROPS Equipped Farm Tractor, in the Proceedings of the National Institute for Farm Safety Conference, Wintergreen, VA, June 28, 2005, Abstract, p.81.

Etherton JR, McKenzie EA, Powers JR [2004]. Commercializing an Automatically Deployable Rollover Protective Structure (AutoROPS) for a Zero-Turn Riding Mower: Initial Product Safety Assessment Criteria, in the Proceedings of the ASME International Mechanical Engineering Congress and Exposition, Anaheim, California, November 13-19, 2004.

Harris JR, Etherton JR, Cantis DM, McKenzie EA Jr, Ronaghi M [2004]. Tractor Overturns and ROPS Performance - Is the SAE Standard Tough Enough. National Symposium on Agricultural Safety and Health, Keystone Resort, Colorado, June 20-24, 2004.

Harris JR, McKenzie EA Jr, Cantis DM, Etherton JR, Ronaghi M [2004]. Technology transfer – Putting cost-effective rollover protective structures in the field**,** National Symposium on Agricultural Safety and Health, Keystone Resort, Colorado, June 20-24, 2004.

Guan J, Hsiao H, Current RS, Powers JR, Ammons DE [2003]. Traumatic Injury Potential to Seat Belted Operator During a Rearward Overturn of a ROPS Equipped Farm Tractor, NORA Meeting, Arlington, Virginia, June 23-24, Abstract, p.51.

McKenzie EA Jr, Etherton JR, Harris JR, Cantis DM, Lutz TJ [2003]. NIOSH AutoROPS 3rd Generation Static Testing and Human Interaction Element, in the Proceedings of the 2003 American Society of Mechanical Engineers Congress and Exposition, Washington, DC, November 15-21, 2003.

McKenzie EA Jr, Etherton JR [2002]. NIOSH AutoROPS Latch and Release Mechanism: Second Generation, in the Proceedings of the 2002 American Society of Mechanical Engineers Congress and Exposition, New Orleans, Louisiana, November 17-22, 2002.

Harris JR, McKenzie EA Jr, Etherton JR Cantis DM, Designing Cost-effective Rollover Protective Structures (CROPS) at NIOSH, in the Proceedings of the National Institute for Farm Safety (NIFS) Annual Conference, Ponte Verda, Florida, June 23-27, 2002.

McKenzie EA Jr, Etherton JR [2002]. Novel Latch and Release Mechanism for an Automatically Deployable ROPS**,** Agricultural Equipment Technology Conference, Kansas City, MO, February 20-23, 2002.

McKenzie EA Jr, Powers JR, Harris JR, Ronaghi M, Etherton JR, Current RS, Cantis DM, Newbraugh BH, Lutz TJ [2001]. Continuing Developments at NIOSH on ROPS for Agricultural Tractors, in the Proceedings of the National Institute for Farm Safety Annual Conference, Pittsburgh, Pennsylvania, June 24-27, 2001.

Powers JR, Harris JR, Snyder KA, Ronaghi M, Etherton JR, Newbraugh BH [2000]. Performance of the NIOSH AutoROPS, National Occupational Injury Research Symposium (NOIRS) 2000, Pittsburgh, Pennsylvania, October 17-19, 2000, Abstract, p.12.

Ronaghi M, Harris JR, Powers JR, Snyder KA [2000]. Dynamic Nonlinear Analysis of Tractor Rollovers, in the Proceedings of the 9th International ANSYS Conference and Exhibition, Pittsburgh, Pennsylvania, August 28-30, 2000.

Powers JR, Harris JR, Etherton JR, Snyder KA, Ronaghi M, Newbraugh BH [2000]. Performance of a New ROPS on ASAE Tests, in the Proceedings of the 93rd Annual International Meeting of ASAE, Paper No. 007005, Milwaukee, Wisconsin, July 9-12, 2000.

Harris JR, Mucino V, Etherton JR, Snyder KA, Means KH, Computer simulation of ROPS testing in ASAE S519, National Occupational Injury Research

Symposium (NOIRS) 1997, Morgantown, West Virginia, October 15-17, 1997, Abstract, p.46.

Other Publications

Myers JR [2003]. Tractor occupational safety and health update, in Record of Tractor- Related Injury and Death Meeting. Pittsburgh, PA, February 13-14, 2003, pp. 5-23. Morgantown, WV: NIOSH.

Sub goal 4.2: Reduce worker injuries and deaths caused by ***paper balers***

Supporting Evidence:

Journal Articles

Moore P, Burkhart J [2001]. Baler and compactor-related deaths in the workplace--United States, 1992-2000, *Morbidity and Mortality Weekly Report 50*(16):309-313.

NIOSH Publications

NIOSH [1997]. Control of scrap paper baler crushing hazards. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, NIOSH Publication No. 97-113. *(26,416 distributed; 2,717 requested)*

Sub goal 4.3: Reduce injuries and deaths caused by machines through the conduct of **fatality investigations** and **dissemination of prevention strategies**

Supporting Evidence:

NIOSH Publications

NIOSH [2006] Preventing Workers Injuries and Deaths from Mobile Crane Tip-Over, Boom Collapse, and Uncontrolled Hoisted Loads. Cincinnati, Ohio: Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2006-142. *(10,680 distributed; 624 requested)*

NIOSH [2003] Preventing Deaths and Injuries While Compacting or Baling Refuse Material. Cincinnati, Ohio: Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2003-124. *(6,930 distributed; 5,391 requested)*

NIOSH [2001]. Preventing Injuries and Deaths of Workers Who Operate or Work Near Forklifts. Cincinnati, Ohio: Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-109. *(32,442 distributed)*

NIOSH [1998]. Preventing Injuries and Deaths from Skid-Steer Loaders. Cincinnati, Ohio: Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 1998-117. *(20,413 distributed; 7,595 requested)*

NIOSH [1995]. Preventing Electrocutions of Crane Operators and Crew Members Working Near Overhead Power Lines. Cincinnati, Ohio: Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 1995-108.

NIOSH [1994]. Preventing Scalping and Other Severe Injuries from Farm Machinery. Cincinnati, Ohio: Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 1994-105.

NIOSH [2005]. Preventing Injuries When Working With Ride-On Rollers/Compactors. Cincinnati, Ohio: Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005-101. *(27,781 distributed)*

NIOSH [2004]. Preventing Injuries When Working With Hydraulic Excavators and Backhoe Loaders. Cincinnati, Ohio: Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004–107. *(17,233 distributed; 7,865 requested)*

NIOSH [1999]. Injury Associated with Working Near or Operating Wood Chippers. Cincinnati, Ohio: Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 99-145. *(32,757 distributed; 5,613 requested)*

NIOSH [1998]. Ignition Hazard From Drilling Into Sealed Frames of Agricultural Equipment. Cincinnati, Ohio: Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 98-146. *(23,079 distributed; 11,730 requested)*

NIOSH Technology News Bulletin No. 473. The Explosion Hazard from Hydrogen Gas Generation Inside Sealed Frames.

Fatality Investigation Reports (included in first TI crane mailing)

Iowa FACE [2003]. FACE IA 03-101: Workers Dies When Tower Crane and Water Tank Crash to the Ground-Iowa. Morgantown, WV: U.S. Department of

Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH [2000]. FACE 2000-12: Carpenter Dies After Being Struck by Uncontrolled Concrete Bucket When Crane Tips Over-Ohio Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH [1999]. FACE 1999-11: Three Ironworkers Die After Heavy-Lift Crane Tips Over-Wisconsin. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH [1997]. FACE 97-03: Mechanic Fatally Injured During Dismantling of Crane Boom at Scrap Metal Yard-Pennsylvania. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

Fatality Investigation Reports (included in forklift mailing)

Indiana FACE [2003]. 96IN06601: Yard Worker Dies After Forklift Dropped a Unit of Wafer Board on Him While3 He Was Stacking and Straightening Lumber-Indiana. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH [2000]. FACE 2000-09: Sixteen-Year-Old Laborer At a Building Supply Center Crushed by Forklift that Tipped Over-Ohio. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH [2000]. FACE 2000-22: Seventeen-Year-Old Laborer at Salvage Lumber Operation Crushed by Forklift That Tipped Over-New York. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

NIOSH Machine-related Fatality Investigation Reports (since 1994)

94-06	Extrusion Machine Operator Dies of Head Injuries Received When His Head Became Caught in Extrusion Machine Rollers—South Carolina
94-20	Cleanup Person at Veneer Factory Killed When Cutoff Saw Inadvertently Activated–Virginia
95-01	Ironworker Foreman Dies After Falling 24 Feet From A Forklift—Tennessee
95-02	Mill Operator Dies From Injuries Received After His Upper Torso Was Caught Between Lamination Rollers–Tennessee
95-10	Tree Trimmer Dies After Being Run Over by Aerial Bucket Truck—Virginia
95-11	Sanitation Worker Run Over at Solid Waste Transfer Station–Virginia
95-12	Laborer Fatally Injured While Cleaning Concrete Mixer – Tennessee
95-13	Shift Supervisor Dies From Injuries Received After His Arms Were Caught Between Two Paper Machine Rollers–Tennessee
95-14	Machine Operator Fatally Injured When Struck by the Elevator of a Concrete Block Cuber Machine–Tennessee
95-20	Assistant Manager Dies After 15-Foot Fall From Forklift-Suspended Pallet--South Carolina
96-02	Sanitation Worker Dies After Being Caught In Chiller At Poultry Processing Plant–South Carolina
96-03	Trash Collector Dies After Being Caught In Compactor of Refuse Vehicle--North Carolina
96-04	Press Operator Dies After Forklift Rams Scrap Bin–North Carolina
96-11	Welder Dies After Being Struck By A Three-Ton Steel Roof Truss–South Carolina
96-18	Supervisor Dies As A Result Of Injuries Sustained In Fall with Powered Vertical Lift Aerial Platform–Virginia
96-23	Recycling Center Laborer Crushed In Baling Machine–Tennessee
96-24	Steel Rack Installer Dies After Being Struck By 3,000 Pound Bundle of Rack End Pieces–South Carolina
97-01	Company President Killed When Forklift Overturns–North Carolina
97-07	Order Picker Dies After Falling From a Lift Truck-Suspended Pallet--North Carolina
97-12	Tree Trimmer Dies After 40-Foot Fall in Aerial Bucket--Virginia
97-14	Maintenance Worker Dies After Overhead Crane Collides With Aerial Platform At Construction Equipment Plant - North Carolina

97-15	Laborer Dies After Falling Into Baler at Paper Products Plant–South Carolina
97-17	Maintenance Electrician Dies From Crush Injuries When Caught Between Nip Barrier and Upper Frame of Paper Rewinder–Virginia
97-19	Electric Line Technician Dies After Falling From Forklift–North Carolina
97-20	Laborer Dies When Caught Between Boom Linkage Of Skid-Steer Loading Machine–North Carolina
98-10	Temporary Laborer Crushed by Dump Truck at Landfill -- South Carolina
98-14	Machine Operator Dies After Being Crushed by 9,700-Pound Coil Cart–Pennsylvania
2000-01	Worker Dies From Crushing Injuries After Falling Into a Baling Machine–North Carolina
2000-12	Carpenter Dies After Being Struck by Uncontrolled Concrete Bucket When Crane Tips Over - Ohio
2000-15	A Plant Production Supervisor Dies After Being Crushed Between the Boom Arm and Front Chassis of a Skid-Steer Loader–North Carolina
2000-19	Sixteen-Year-Old Produce-Market Worker Dies From Crushing Injuries After Being Caught in a Vertical Downstroke Baler–New York
2000-22	Seventeen-Year-Old Laborer at Salvage Lumber Operation Crushed by Forklift That Tipped Over–New York
2001-03	38-year-old Stevedore Fatally Injured After Being Struck by the Boom of the Mobile Crane on Site
2002-02	Seventeen-Year-Old Warehouse Laborer Dies After the Forklift He Was Operating Tipped Over and Crushed Him—Arizona
2002-04	Plumber Dies After Being Crushed Between a Tandem Scissors Lift Platform and the I-Beam Frame of a Mobile Home—Tennessee
2002-05	Maintenance Mechanic Dies After Being Trapped in the Pneumatic Door of a Vacuum Cooler - South Carolina
2002-09	Hispanic Forklift Operator Dies After Being Caught Between Mast and Cage of Forklift - North Carolina
2003-13	18-year-old Dies After Being Entangled in a Portable Mortar Mixer–South Carolina
2004-01	Hispanic Laborer Dies After Being Crushed Between the Frame of a Skid Steer Loader and the Scraper Attachment on the Loader Lift Arms–Ohio
2004-03	Seventeen-Year-Old High School Student Working as a Warehouse Laborer in Work-Based Learning Program Dies After Forklift Tips Over

	and Crushes Him–Tennessee
2005-05	Hispanic Youth Dies in Densifier at a Plastics Recycling Plant–Tennessee
2005-09	Worker Killed While Operating a Rock Driller—Tennessee
2006-01	Hispanic Construction Workers Dies After Being Struck By Crane Boom Being Disassembled—North Carolina
2006-02	Sawmill Worker Killed in Debarker--South Carolina
2006-05	Bulldozer Operator Dies From Burns After a Hydraulic Line Bursts--Tennessee

5. Reduce acute back injury

Sub goal 5.1: Reduce acute injuries caused by **patient handling**

Supporting Evidence:

Journal Articles

Nelson AL, Collins, JW, Knibbe H, Cookson K, deCastro AB, Whipple KL, Hudson A [In press]. Myths and Facts about policies for safe patient handling. *Nursing Management.*

Nelson AL, Collins JW, Siddharthan K, Matz M, and Waters T [In press] Link between safe handling and patient outcomes in long-term care. *Rehabilitation Nursing*.

Waters T, Collins JW, Galinsky T, Caruso C [2006]. NIOSH research efforts to prevent musculoskeletal disorders in the healthcare industry, *Orthopaedic Nursing 25*(6): 1-11.

Collins JW, Wolf L, Bell J, Evanoff B [2004]. An evaluation of a "best practices" musculoskeletal injury prevention program in nursing homes, *Injury Prevention* (10):206-211. *(10 Citations)*

Zhuang Z, Stobbe TJ, Collins JW, Hsiao H, Hobbs G [2000]. Psychophysical assessment of assistive devices for transferring patients/residents. *Applied Ergonomics 31*:35-44. *(10 Citations)*

Zhuang Z, Stobbe TJ, Hsiao H, Collins JW, Hobbs G [1999]. Biomechanical evaluation of assistive devices for transferring residents. *Applied Ergonomics* 30:285-94.

Zhuang Z, Stobbe TJ, Hsiao H, Collins JW, Hobbs GR [1999]. Biomechanical evaluation of assistive devices for transferring residents. *Applied Ergonomics 30*(4):285-294. *(17 Citations)*

Collins JW, Owen BD [1996]. NIOSH research initiatives to prevent back injuries to nursing assistants, aides and orderlies in nursing homes. *American Journal of Industrial Medicine 29*(4):421-424. *(17 Citations)*

Hersey JC, Collins JW, Gerson R, et al. [1996]. Methodologic issues in intervention research—health care. *American Journal of Industrial Medicine 29*(4):412-417, Apr. *(2 Citations)*

Jensen RC [1987]. Disabling back injuries among nursing personnel: Research needs and justification. *Research in Nursing and Health*, 10(1):29-38.

NIOSH Publications

Collins JW, Nelson A, and Sublet [2006]. Safe lifting and movement of nursing home residents, DHHS (NIOSH) Publication No. 2006-117. Cincinnati, OH: National Institute for Occupational Safety and Health. *(22,950 distributed; 8,361 requested)*

Conference Papers and Presentations

Collins, JW [May 2005]. Briefing on Capital Hill on Safe Patient Lifting. Seventy-three people attended the Congressional briefing on Pathways to Safety and Quality in Nursing. Of the total, 42 attendees were congressional staff—38 from the House of Representatives and four from the Senate.

Collins, JW [March and November, 2003, 2004, 2005, & 2006]. Evaluation of a Best Practices Back Injury Prevention Program in Nursing Homes. Graduate course lecture, Johns Hopkins University, School of Public Health.

Collins JW [2002-2007], Graduate student lecture on safe patient lifting among health care workers. West Virginia University, School of Medicine. March 2002-2007

Collins JW [2006]. NIOSH and International Research on Safe Patient Lifting Programs. 2006 Safe Patient Handling & Movement Conference. February 2006.

Collins JW [2002-2005]. Presentations on NIOSH's latest research were presented each year at the Annual Safe Patient Handling and Movement Conference. Conference is co-sponsored by NIOSH and the Veteran's Health Administration. March 2002-2005.

Collins JW [2004]. NIOSH Research to Prevent Injuries in Health Care Workers. USPHS Professional Conference. May 2004.

Collins JW [2002]. Evaluation of a Best Practices Back Injury Prevention Program in Nursing Homes. Best Practices in Occupational Safety and Health, Education, Training, and Communication: Ideas that Sizzle Conference, Baltimore, Maryland. October 2002

Collins JW [2001]. Intervention Program for Transferring Residents in Nursing Homes. 2001 National Occupational Research Agenda Symposium, Washington, DC, June 26-27, 2001.

Collins JW [2000]. Improved Methods for Lifting and Transferring Residents in Nursing Homes. Public Health Professional Conference sponsored by the Commissioned Officers Association of USPHS, Scottsdale, Arizona, June 7-10, 2000.

Collins JW [1999]. NIOSH Research Initiatives to Prevent Back Injuries Among Nursing Personnel. Nursing Council Workshop sponsored by the Service Employees International Union, Pittsburgh, Pennsylvania. December 1999.

Collins JW [1993]. NIOSH Research Initiatives to Reduce Back Injuries Among Nursing Personnel. Federation of Nurses and Health Professionals Annual Meeting, Washington D.C. March 1993.

Jensen RC [1985]. *Events that trigger disabling back pain among nurses*, in Proceedings of the Human Factors Society 29th Annual Meeting, Human Factors Society, Santa Monica, California, 799-801.

Jensen RC [1986]. *Work-related back injuries among nursing personnel in New York.* In Proceedings of the Human Factors Society 30th Annual Meeting. Human Factors Society, Santa Monica, California, 244-248.

Jensen RC [1986]. *Disabling back pain among nursing personnel in North Carolina*. *Living with Change and Choice in Health*. 337-340.

Reports from TI Supported Extramural Research (not an exhaustive list):

Owen BD, Garg A [1989]. Patient handling tasks perceived to be the most stressful by nursing assistants. In: Mital, A. [Eds.), Trends in Ergonomics/Human Factors IV. North-Holland, Amsterdam, pp. 831-838.

Garg A, Owen BD, Beller D, Banaag J [1991]. A biomechanical and ergonomic evaluation of patient transferring tasks: bed to wheelchair and wheelchair to bed. *Ergonomics 34*:289-312.

Garg A, Owen B, Carlson B [1992]. An ergonomic evaluation of nursing assistants' job in a nursing home. *Ergonomics 35*:979-95.

Garg A, Owen B [1992]. Reducing back stress to nursing personnel: an ergonomic intervention in a nursing home. *Ergonomics 35*:1353-75.

Other Publications

Collins JW, Menzel NN [2006]. Chapter 1: Scope of the problem – Moving and handling patients: A core function of Nurses. In *Safe Patient Handling and Movement - A practical guide for health care providers.* Audrey Nelson, ed., Springer Publishing Company, Inc. pp. 3-26.

Collins JW [2006]. Chapter 10 – Safe Lifting Policies. In *Safe Patient Handling and Movement - A practical guide for health care providers.* Audrey Nelson, ed., Springer Publishing Company, Inc. pp. 151-9, and 214-5.

The Safe Patient Handling and Movement (SPH&M) training presentation. Available online at: http://www.cdc.gov/niosh/review/public/safe-patient/introduction.html. Last accessed: February 21, 2007.

Jensen RC, Myers AH, Nestor D, Rattiner J [1987]. Low Back Injuries among Nursing Personnel: An Annotated Bibliography. Published by Johns Hopkins University Injury Prevention Center, Baltimore, MD.

Sub goal 5.2: Reduce acute injuries caused by **material handling**

Supporting Evidence:

Journal Articles

Giorcelli R, Hughes R, Myers J [2004]. Accuracy of a System for Measuring Three Dimensional Torso Kinematics during Manual Materials Handling, *Journal of Applied Biomechanics 20*(2):185-194.

Johnston JM, Landsittel DP, Nelson NA, Gardner LI, Wassell JT [2003]. Stressful psychosocial work environment increases risk for back pain among retail material handlers, *American Journal of Industrial Medicine 43*(2):179-187. *(4 Citations)*

Bobick TG, Belard J-L, Hsiao H, Wassell JT [2001]. Physiological effects of back belt wearing during asymmetric lifting, *Applied Ergonomics 32*(2001):541-547. *(3 Citations)*

Giorcelli RJ, Hughes RE, Wassell JT, Hsiao H [2001]. The effect of wearing a back belt on spine kinematics during asymmetric lifting of large and small boxes, *Spine 26*(16):1794-1798. *(4 Citations)*

Wassell JT, Gardner LI, Landsittel DP [2001]. A Study of Back Belts to Prevent Back Pain and Injury, *Injury Insights Newsletter*, June 2001 (June):1-2.

Wassell JT, Gardner LI, Landsittel DP, Johnston JJ, Johnston JM [2000]. A prospective study of back belts for prevention of back pain and injury, *Journal of the American Medical Association 284*(21):2727-2732. *(20 Citations)* *[This article won the Alice Hamilton Award for Excellence in Occupational Safety and Health, April 25, 2001, and was nominated for both the 2001 Charles C. Shepard Science Award for excellence in science at CDC and ATSDR and the CDC/ATSDR Statistical Science Award. The study had extensive press coverage through an Associated Press article that appeared in about 400 newspapers nationally and a video news release. In addition, CBS Evening News' covered the back belt study on Dec. 5 2000 including an interview with Acting NIOSH Director, Dr. Larry Fine.]*

Landsittel DP, Gardner LI, Arena VC [1998]. Identifying populations at high risk for occupational back injury with neural networks, *Human and Ecological Risk Assessment 4*(6):1337-1352.

Gardner LI, Landsittel DP, Nelson NA [1999]. Risk factors for back injury in 31,076 retail merchandise store workers, *American Journal of Epidemiology 150*(8):825-833. *(10 Citations)*

Wassell JT, Gardner LI, Landsittel [2001]. Does back belt use prevent on-the-job back pain and injury? Injury Insights *2001*(June/July):1.

Wassell JT, Landsittel DP, Gardner LI, Johnston JM [2001]. Do Back Belts Prevent Back Injury? In reply to letters to the editor. *Journal of the American Medical Association 285*(9):1152.

Wassell JT [2003]. Studies on Back Belts in the Workplace, Salud (i) (SIIC) (i)Ciencia-Voice of the Sociedad Iberoamericana de Informacion Cientifica (SIIC), March 3, 2003.

Zhuang Z, Stobbe TJ, Hsiao H, Collins JW, Hobbs GR [1999]. Biomechanical evaluation of assistive devices for transferring residents. *Applied Ergonomics 30*(4):285-294. *(17 Citations)*

Gardner LI, Sweeney MH, Waters TR, Fine LJ [1997]. Distinguishing back-belt effects from other factors in reduction of back injuries (letter to editor). *International Journal of Occupational and Environmental Health 3*(3):236-239. *(3 Citations)*

Conference Papers and Presentations

Wassell JT [2006]. A Prospective Study of Back Belts for Prevention of Back Pain and Injury (and a review of more recent related studies on back belts). Invited Seminar Presentation, Occupational Medicine Grand Rounds, West Virginia University, Morgantown, WV, August 15, 2006.

Wassell JT. [2004]. The National Institute for Occupational Safety and Health Back Belt Study: A Prospective Study of Back Belts for Prevention of Back Pain

and Injury. Invited Seminar Presentation. Texas Medical Association, Austin, TX. May 15, 2004.

Wassell JT, Hendricks SA [2003]. Intensity and Binomial Risk Models for Injury Count Data. and. Oral Presentation at the 2003 CDC/ATSDR Symposium on Statistical Methods, Atlanta, GA, January 29, 2003.

Wassell JT [2002]. Causal Analysis of Back Belts to Prevent Low Back Pain. Oral Presentation at the 2002 meeting of the American Statistical Association, New York City, New York, August 14, 2002.

Wassell JT [2002]. Causal Analysis of Back Belts to Prevent Low Back Pain. 2002 *Proceedings of the American Statistical Association, Section on Statistics in Epidemiology* [CD-ROM], Alexandria, VA: American Statistical Association.

Wassell JT [2001] .A Prospective Study of Back Belts for Prevention of Back Pain and Injury. Invited Seminar Presentation. Agency for Health Care Quality Research, Rockville, MD, October 5, 2001.

Wassell JT [2001]. A Prospective Study of Back Belts for Prevention of Back Pain and Injury in Material Handlers. Invited Seminar Presentation. Rice University, Department of Statistics, Houston, TX, April 23, 2001.

Wassell JT [2001]. A Prospective Study of Back Belts for Prevention of Back Pain and Injury in Material Handlers. Invited Seminar Presentation. Department of Occupational and Environmental Health, The University of Iowa, Iowa City, Iowa, March 6, 2001.

Wassell JT, Gardner LI, Landsittel DP, Johnston JJ, Johnston JM [2001]. A Prospective Study of Back Belts for Prevention of Back Pain and Injury. Poster presentation at the National Occupational Research Agenda (NORA) Symposium, June 27, 2001, Washington, D.C.

Wassell JT [2000]. A Prospective Study of Back Belts for Prevention of Back Pain and Injury in Material Handlers. Presentation of Study Results to Dr. Jeff Koplan, Director, Centers for Disease Control and Prevention (NIOSH Program Review). NIOSH, Pittsburgh Research Laboratory, Bruceton, PA, March 16, 2000.

Wassell JT [2000]. A Prospective Study of Back Belts for Prevention of Back Pain and Injury in Material Handlers. Three Invited Presentations: *Interim* Analysis Results on December 17, 1997 and *Final* Study Results on February 3, 2000 and December 21, 2000; Presentations to Risk Control and Loss Prevention Directors and Management Staff at Wal-Mart Headquarters, Bentonville, AR.

Wassell JT [1999]. A Longitudinal Study of Injuries in Retail Workers. Invited Presentation. National Safety Council, New Orleans, LA, October 18, 1999.

Gardner LI, Wassell JT, Johnston JJ, Johnston JM, Landsittel DP [1999]. A Longitudinal Study of Back Belt Efficacy in Retail Workers. Presented at the 1999 American Public Health Association Meeting, Chicago, IL, November 9, 1999.

Hsiao H, Giorcelli R, Bobick T, Belard J-L, Hughes R, Wassell, J. [1999]. Laboratory Study of Back Support Belts: Biomechanical and Physiological Evaluation. Presented at the 1999 American Public Health Association Meeting, Chicago, IL, November 9, 1999.

Gardner LI, Collins JW, Johnston JJ, Wassell JT [1997]. Efficacy of Back Belts for Prevention of Back Injuries in Material Handling Workers. Presented at the 4th Annual Conference for Managing Ergonomics in the 1990s, Cincinnati, Ohio, June 17-20, 1997. *Proceedings of Managing Ergonomics in the 1990's: A Discussion of Science and Policy Issues.* Published on the Internet at: http://www.ergoweb.com/resources/reference/manergo/gardner.cfm

Gardner LI, Collins JW, Johnston JJ, Wassell JT [1997]. Efficacy of back belts for prevention of back injuries in material handling workers. Presented and published in the proceedings of the 4th Annual Conference for Managing Ergonomics in the 1990's: A Discussion of Science and Policy Issues, Cincinnati, OH, June 17-20, 1997.

6. Reduce injuries and fatalities among workers in Alaska

Sub goal 6.1: Reduce injuries and fatalities in ***commercial fishing***

Supporting Evidence:

Journal Articles

Lincoln JM, Perkins R, Melton F, Conway GA [1996]. Drowning in Alaskan waters. *Public Health Reports 111*(6):531-535. *(5 Citations)*

Conway GA, Lincoln JM [1996]. Preventing deaths in Alaska's fishing industry (Editorial). *Public Health Reports 110*(6):700. *(4 Citations)*

Lincoln JM, Conway GA [1999]. Preventing commercial fishing deaths in Alaska. *Occupational and Environmental Medicine 56*(10):691-695.

Conference Papers and Presentations

Conway GA, Lincoln JM, Jorgensen , Klatt ML, Manwaring JC [1998]. Preventing drownings in Alaska's commercial fishing industry. Proceedings of the

Tenth International Congress on Circumpolar Health, Anchorage, AK, September, 1998.

Husberg BJ, Lincoln JM, Conway GA [2001]. On-Deck Dangers in the Alaskan Commercial Fishing Industry, Marine Safety Council, Proceedings 58(2): pp. 23-24.

Husberg BJ [2002]. Surveillance for Nonfatal Work-Related Injuries in the Alaska Fishing Industry. In: Proceedings of the International Fishing Industry Safety and Health Conference, Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 2003-102.

Lincoln JM, Husberg BJ, Conway GA [2002]. Improving Safety in the Alaskan Commercial Fishing Industry. In: Proceedings of the International Fishing Industry Safety and Health Conference, Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2003-102.

Husberg BJ, Lincoln JM [2003]. Making Alaska's Fishing Industry Safer: applied Epidemiology and Engineering [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

NIOSH Publications

NIOSH [2003]. Proceedings of the International Fishing Industry Safety and Health Conference, 2002 Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2003-102.

NIOSH [2005]. Dangers of Entanglement during Lobstering. [Workplace Solutions] By: Backus A; Smith T; Brochu P Lincoln J, Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005-137.

Workshops, Conferences, and Meetings

FISH (1992). Objectives of the first commercial fishing conference organized and co-sponsored by TI-AFS—the first Fishing Industry Safety and Health (FISH) Workshop held in Anchorage in 1992—were to raise consciousness, build coalitions, disseminate information, and encourage action to prevent injury and disease in fishing. There were 77 people in attendance from Alaska and the U.S. west coast. All papers presented at the conference were included in a proceedings volume and disseminated.

FISH II (1997). AFS sponsored and organized a second workshop—Fishing Industry Safety and Health II (FISH II)—in Seattle in 1997. By identifying the most hazardous areas requiring immediate attention, findings published in the CIB provided the scientific basis for the workshop. The primary workshop goal was to describe current circumstances and plan the next steps to ensure that fishermen have relatively safe workplaces. Working groups discussed prevention of vessel-related fatalities, man overboard fatalities, diving fatalities, and non-fatal work-related injuries in the industry. Each of these working groups developed recommendations that were published in the conference proceedings, which includes 28 of the 40 presentations given at the Workshop.[7] The range of subjects was broad, from risk factor analyses to intervention approaches, some rooted in practicalities and success, some more theoretical.

IFISH (2000). In 2000, TI-AFS and the Harvard University School of Public Health (SPH) partnered to organize the First International Fishing Industry Safety and Health (IFISH) Workshop in Woods Hole, Massachusetts. This October 2000 conference, designed to discuss issues in fishing safety on an international scale, was attended by more than 100 fishermen and safety professionals from 13 different countries. Topics covered included a summary of worldwide problems and challenges in the industry, innovative approaches to investigating and preventing fishing vessel casualties, risk perception, intervention programs, surveillance, and unique approaches to safety training.

IFISH II (2003). NIOSH partnered with AMSEA to convene and facilitate the IFISH II conference in Sitka, Alaska in September 2003. There were 135 registrants from 18 nations. Forty speakers addressed topics ranging from deck safety needs for crabbers working in northern waters to policy changes affecting Pacific Island States. Seven speakers provided overviews of commercial fishing safety programs in developing countries including Tonga, Sri Lanka, Pakistan, India, Senegal, and Chile. The proceedings volume includes manuscripts submitted for 28 of the 40 presentations.

IFISH III (2006). Most recently in early 2006, NIOSH co-sponsored IFISH III in Chennai, India in partnership with the Bay of Bengal program and the Food and Agriculture Organization of the United Nations. The conference was attended by representatives from 16 nations, and focused on small-scale artisan fishermen and unique safety concerns for this group of workers.

Sub goal 6.2: Reduce injuries and fatalities in ***helicopter logging*** operations

Supporting Evidence:

Conference Papers and Presentations

NIOSH [1996]. Proceedings of the Helicopter Logging Safety Workshop, Ketchikan, AK, March 1-2, 1995, Klatt ML, Hudson D, Conway GA, Eds. 128 pages.

Manwaring J [1996]. Synthesis of NTSB aircraft accident data involving helicopter external load operations in the United States and Alaska, 1980-1994. in Proceedings of the Helicopter Logging Safety Workshop, Ketchikan, AK, March 1-2, 1995, Klatt ML, Hudson D, Conway GA, Eds.

Conway GA [1996]. Epidemiology of Alaska Helicopter Logging Deaths, in Proceedings of the Helicopter Logging Safety Workshop, Ketchikan, AK, March 1-2, 1995, Klatt ML, Hudson D, Conway GA, Eds..

Conway GA, Klatt ML, Manwaring JC [1998]. Effective injury prevention using surveillance data: Helicopter logging, Alaska, 1992-1995 in Proceedings of the Tenth International Congress on Circumpolar Health, Anchorage, AK, September, 1998.

Sub goal 6.3: Reduce injuries and fatalities in Alaska ***aviation***

Journal Articles

CDC [1997]. Work-related aviation fatalities, Alaska, 1990-1994. *Morbidity and Mortality Weekly Report 46*(22):496-498.

Garrett LC, Conway GA, Manwaring JC [1998]. Epidemiology of work-related aviation fatalities in Alaska, 1990-94. *Aviation, Space and Environmental Medicine 69*(12):1131-1136. *(4 Citations)*

Husberg BJ, Conway GA, Moore MA, Johnson MS [1998]. Surveillance for nonfatal work-related injuries in Alaska, 1991-95. *American Journal of Industrial Medicine 34*(5):493-498. *(14 Citations)*

Conway GA, Lincoln JM, Husberg BJ, Manwaring JC, Klatt ML, Thomas TK [1999]. Alaska's model program for surveillance and prevention of occupational injury deaths, *Public Health Reports 114*(6):550-558.

Thomas TK, Bensyl DM, Manwaring JC, Conway GA [2000]. Controlled flight into terrain accidents in commuter and air taxi operators in Alaska. *Aviation, Space and Environmental Medicine 71*(11):1098-1103. *(4 Citations)*

CDC [2002]. Factors Associated with Pilot Fatalities in Work-Related Aircraft Crashes - Alaska 1990-1999, *MMWR 50*(11):347-349.

Conway GA, Hill A, Martin S, Mode NA, Berman MD, Bensyl DM, Manwaring JC, Moran KA [2004]. Alaska air carrier operator and pilot safety practices and attitudes: a statewide survey. *Aviation, Space and Environmental Medicine 75*(11):984-991. *(1 Citation)*

Conway GA, Mode NA, Berman MD, Martin S, Hill A [2005]. Flight safety in Alaska: Comparing attitudes and practices of high and low-risk air carriers, *Aviation, Space and Environmental Medicine 76*(1):52-57.

Husberg BJ, Fosbroke DE, Conway GA, Mode NA [2005]. Hospitalized Nonfatal Injuries in the Alaskan Construction Industry. *American Journal of Industrial Medicine* (47):428-433.

NIOSH Publications

Conway GA, Lincoln JM, Hudson DS, Bensyl DM, Husberg BJ, Manwaring JC [2002]. Surveillance and Prevention of Occupational Injuries in Alaska: A Decade of Progress 1990-1999, Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2002-115. *(3,176 distributed; 1,541 requested)*

Conference Papers and Presentations

Garrett LG, Conway GA [1998]. Aviation: a serious occupational hazard--Alaska, 1990-1995, in Proceedings of the Tenth International Congress on Circumpolar Health, Anchorage, AK, September, 1998.

Conway GA, Manwaring J [2003]. Surveys of Alaska's Aviation Industry [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

Manwaring J, Conway GA, Moran K [2003]. Progress in Partnerships for Surveillance and Prevention of Occupational Aircraft Crashes in Alaska 1990-1999 [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

Moran KA, Conway GA, Bensyl D [2003]. Human Errors as a Leading Cause of Occupant Mortality in Air Taxi and Commuter Crashes in Alaska 1990-1999 [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

Conway G, Martin S, Berman M, Hill A, Bensyl D, Manwaring J, Moran K [2004]. Risk factors for air transportation safety among air carrier operators and pilots in Alaska: A major survey and case-control analysis [Abstract] In: The 7th World Conference on Injury Prevention and Safety Promotion, Vienna, Austria, June 6th-9th 2004. Vienna, Austria, Vienna Austria: Kuratorium fur Schutz und Sicherheit/Institut Sicher Leben, NN: 20025703.

Garrett LG, Conway GA [1998]. Moose-Auto collisions, Anchorage, Alaska, 1990-1995. Proceedings of the Tenth International Congress on Circumpolar Health, Anchorage, AK, September, 1998.

Conway G, Moran K [2004]. Scientific worker and licensed professional deaths in Alaska, 1990-2002 [Abstract] In: The 7th World Conference on Injury Prevention and Safety Promotion, Vienna, Austria, June 6th-9th 2004. Vienna, Austria, Vienna, Austria: Kuratorium fur Schutz und Sicherheit/Institut Sicher Leben, NN: 20025707.

Hudson D, Hunt A, Conway G, Ekman R [2004]. Cold-related injuries in Alaska, 1991-1999 [Abstract] In: The 7th World Conference on Injury Prevention and Safety Promotion, Vienna, Austria, June 6th-9th 2004. Vienna, Austria, Vienna Austria: Kuratorium fur Schutz und Sicherheit/Institut Sicher Leben, NN: 20025706.

Other Publications

Bledsoe GL, Klatt MK, Lincoln JM [1996]. Occupational fatalities in Alaska—1995. State of Alaska Epidemiology Bulletin No. 10.

7. Reduce injuries and fatalities among Emergency Responders

Subgoal 7.1: Reduce injuries and fatalities to **fire fighters**

Supporting Evidence:

Journal Articles

Washenitz F, Stoltzfus J, Newton B, Kubinski L [2001]. Fire incidents involving regulators used in portable oxygen systems. *Injury Prevention 7*(Suppl I): i34-37.

Baldwin T N [2001]. Basement Fires: A Lethal Trap. *American Fire Journal*, May 2001, pp. 12-16.

McFall M [2001]. Roadway Assistance. *Fire Chief Magazine 45*(3):62-64

Hodous T, Washenitz F, Newton B [2002]. Occupational burns from oxygen resuscitator fires: The hazard of aluminum regulators. *American Journal of Industrial Medicine 42*(1): 63-69.

Fabio A, Ta M, Strotmeyer S, Li W, Schmidt E [2002]. Incident-level risk factors for firefighter injuries at structural fires. *Journal of Occupational and Environmental Medicine 44*(11):1059-1063.

Hales T, Boal WL, Ross CS [2002]. Hepatitis C virus (HCV) infection among public safety workers (PSW) (letter). *Journal of Occupational and Environmental Medicine 44:*221-4.

Proudfoot SL, Romano NT, Bobick TG, Moore PH [2003]. Ambulance Crash-Related Injuries among Emergency Medical Services Workers—United States, 1991 – 2002. *Morbidity and Mortality Weekly Report 52*(8). (February 28, 2003)

Hodous TK, Pizatella TJ, Braddee RW, Castillo DN [2004]. Fire fighter fatalities 1998-2001: overview with an emphasis on structure related traumatic fatalities. *Injury Prevention 10*(4): pp 222-226.

Boal WL, Hales T, Ross CS [2005]. Blood-borne pathogens among firefighters and emergency medical technicians. *Prehospital Emergency Care 9*(2):236-47.

Proudfoot SL [2005]. Ambulance Crashes: Fatality Factors for EMS Workers, *Emergency Medical Services 34*(6): June 2005.

NIOSH Publications

Braddee R, Washenitz F [1999]. NIOSH hazard ID: Fire fighting hazards during propane tank fires. Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 99-129. *(51,117 distributed)*

McFall M, Schmidt E [2001]. NIOSH hazard ID: Traffic hazards to fire fighters while working along roadways. Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-143. *(71,193 distributed; 30,834 requested)*

Romano N [2002]. NIOSH hazard ID: Fire fighter deaths from tanker truck rollovers. Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2002-111. *(42,039 distributed; 2,595 requested)*

Cortez K, Mezzanotte T [2002]. NIOSH hazard ID: Fire fighters exposed to electrical hazards during wildland fire operations. Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2002-112. *(40,148 distributed; 1,090 requested)*

Tarley J, Proudfoot S, Husting E [2004]. NIOSH Workplace Solutions: Divers beware: training dives present serious hazards to fire fighters. Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-152. *(62,059 distributed; 5,234 requested)*

Tarley J, Guglielmo C [2004]. NIOSH Workplace Solutions: Preventing deaths and injuries to fire fighters during live-fire training in acquired structures. Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005-102. *(37,498 distributed; 2,313 requested)*

Pettit T, Merinar T, Commodore M, Ronk R. NIOSH Alert: Preventing Injuries and Deaths of Fire Fighters. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 94-125

Pettit T, Dunn V, Main G [1999]. NIOSH Alert: Request for assistance in preventing injuries and deaths of fire fighters due to structural collapse. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 99-146. *(71,040 distributed; 22,917 requested)*

Kisner S, Jenkins L. NIOSH ALERT: Preventing Worker Injuries and Deaths from Traffic-Related Motor Vehicle Crashes. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 98-142. *(128,500 distributed; 20,355 requested)*

Merinar TR, Braddee RW, Washenitz F, Mezzanotte T, Dunn V, Brannigan F [2005]. NIOSH Alert: Request for assistance in preventing injuries and deaths of fire fighters due to truss system failures. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005-132. *(42,083 distributed)*

Food and Drug Administration, NIOSH [1999]. FDA/NIOSH Public Health Advisory: Explosions and fires in aluminum oxygen regulators. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Food and Drug Administration, February 1999.

NIOSH, Federal Railroad Administration, Operation Lifesaver [2003]. Your safety 1st: Railroad crossing safety for emergency responders. Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2003-121. *(44,086 distributed; 39,209 requested)*

NIOSH [1997]. NIOSH fact sheet: Exploding flashlights: Are they a serious threat to worker safety? Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 97-149.

Mass Mailings

A mass mailing was completed in the 3rd quarter 2003 encompassing 30,000 fire departments containing the Publication "Your Safety 1st - Pub no. 2003-121.

A packet of six fire fighter reports (F2002-37 SD, F2002-06 NY, F2001-39 WV, F2001-38 NY, F2001-33 TX, and F2001-31 MI) were mailed in the 3rd quarter 2003.

Mass mailing was completed in the 4th quarter 2004 of the NIOSH Workplace Solutions document - Divers Beware: Training Dives Present Serious Hazards to Fire Fighters - Pub no. 2004-152.

Mass mailing was completed in the 3rd quarter of 2005 of the NIOSH Alert *Preventing Injuries and Deaths of Fire Fighters due to Truss System Failures*, publication number 2005-132.

Conference Papers and Presentations

Braddee RW [1998]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the National Volunteer Fire Council, Warwick, RI, October 9, 1998.

Washenitz F [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Baltimore Fire Safety Conference, Baltimore, MD, July 11, 1999.

Cortez K [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Search and Rescue/Disaster Response World Conference and Exposition, Nashville, TN, August 1, 1999.

Braddee R [1999]. NIOSH's FFFIPP. Presented at the IAFF Redmond Conference, Honolulu, Hawaii, August 21-28, 1999.

Hales T [1999]. NIOSH's FFFIPP. Presented at the IAFF Redmond Conference, Honolulu, Hawaii, August 21-28, 1999.

Washenitz F [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Safety and Environmental Management (SEM 334) class, West Virginia University, Morgantown, WV, September 9, 1999.

Braddee RW [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Safety and Environmental Management (SEM 310) class, West Virginia University, Morgantown, West Virginia, September 21, 1999.

Cortez K [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the National Volunteer Fire Council Meeting, Memphis, TN, October 4, 1999.

Washenitz F [1999]. How the NIOSH Fire Fighter Investigation Team Conducts Fatality Investigations. Unpublished paper presented at the NFPA Fall Meeting, New Orleans, LA, November, 1999.

Hodous T [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program, an Overview. Unpublished paper presented at the National Institute for Standards and Technology Conference, Gaithersburg, MD, December, 1999.

Cortez K [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program and Fire Fighter Fatality Statistics. Unpublished paper presented at the Fire Department Instructors Conference, Indianapolis, IN. February, 2000.

Washenitz F [2000]. Fire Fighter Fatality Case Presentations. Unpublished paper presented at the Fire Department Instructors Conference, Indianapolis, IN, February, 2000.

McFall M [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the American Society of Safety Engineers, Pittsburgh, PA, February, 2000.

Braddee RW [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Professional Fire Fighters of Massachusetts Annual Meeting, Springfield, MA, June 19, 2000.

Washenitz F [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program - Fatality Case Presentation. Unpublished paper presented at the Professional Fire Fighters of Massachusetts Annual Meeting, Springfield, MA, June 19, 2000.

Mezzanotte T [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Firehouse Conference and Exposition, Baltimore, MD, July, 2000.

Washenitz F [2000]. Safety Hazards with Oxygen Systems. Unpublished paper presented at the Firehouse Conference and Exposition, Baltimore, MD, July, 2000.

Romano N [2000]. Motor Vehicle Incidents in the Fire Service. Unpublished paper presented at the International Association of Fire Chiefs Conference, Washington, DC, August, 2000.

Cortez K [2000]. Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Journal of Emergency Medicine Society Apparatus Maintenance Workshop, Ft. Worth, TX, August, 2000.

Braddee RW [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Fire Service Leadership Convention, Fairfax, VA, October, 2000.

Washenitz F [2000]. Oxygen Regulator Flash Fires. Unpublished paper presented at the National Occupational Injury Research Symposium 2000, Pittsburgh, PA, October, 2000.

Braddee RW [2000]. Overview of the Fire Fighter Fatality Investigation and Prevention Program and Prevention Recommendations. Unpublished paper presented at the National Occupational Injury Research Symposium 2000, Pittsburgh, PA, October, 2000.

Myduc Ta [2000]. Traumatic Occupational Injury Fatalities to Fire Service Personnel, 1992-1998. Presented at the National Occupational Injury Research Symposiums 2000. Pittsburgh, Pennsylvania, October, 2000.

McFall M [2001]. Fire Fighter Injury Incident - F2000-43. Presented at the Delaware State Fire Chiefs Association, Newark, Delaware, March 22, 2001.

Pizatella T [2001]. Investigating and Preventing Fire Fighter Fatalities. Presented at the program briefing, Atlanta, Georgia, March 23, 2001.

Braddee R [2001]. Investigating and Preventing Fire Fighter Fatalities. Presented at the International Association of Fire Chiefs (West), Oklahoma City, Oklahoma, May 6, 2001.

Cortez K [2001]. NIOSH's Fire Fighter Program and Two Fatality Incidents. Presented at the National Volunteer Fire Council meeting, Wenatchee, Washington, April 20, 2001.

Romano N [2001]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Presented at Firehouse Expo, Rockville, Maryland, July 2001.

Braddee R [2001]. Structure Fire Claims the Life of Three Career Fire Fighters and Three Children – Iowa. Presented at 16th Redmond Symposium, Phoenix, Arizona, September 2001.

Castillo D [2001]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program's Investigation Database. Presented at the 16th Redmond Symposium, Phoenix, Arizona, September 2001.

McFall M [2001]. Restaurant Fire Claims the Life of Two Career Fire Fighters – Texas. Presented at the 16th Redmond Symposium, Phoenix, Arizona, September 2001.

Washenitz F [2001]. Restaurant Fire Claims the Life of Two Fire Fighters – Texas. Presented at the FRESH conference, Emmitsburg, Maryland, October 13, 2001.

Myduc Ta, M Strotmeyer [2001]. Characteristics of fire fighter line-of-duty motor vehicle-related fatal injury, 1992-1998. Presented at the 129th annual meeting of the American Public Health Association, Atlanta, GA, October 21-25, 2001.

Hodous T, Castillo D, Braddee R, Pizatella T. [2002]. NIOSH Fire Fighter Fatality Investigations 1998-2000: Overview with an Emphasis on Structure-related Fatalities. Presented at 6th World Conference: Injury Prevention and Control, May 14, 2002, Montreal, Canada.

Merinar T [2003]. Fatality cases involving roof and floor truss failures. Presented at the 17th Redmond Symposium, San Francisco, California, October 2003.

Tarley J [2003]. Live-fire Training case study. Presented at the 17th Redmond Symposium, San Francisco, California, October 2003.

Tarley J [2003]. Review of NIOSH Fire fighter Structure Fire Fatality – New York. Presented at the NOIRS conference, Pittsburgh, Pennsylvania, November 2003.

Powers J [2003]. Visibility: Which Way is Out? Presented at the NORIS conference, Pittsburgh, Pennsylvania, November 2003.

Bobick TG, Current RS, Romano NT, Green JD, Moore PH [2003]. Ambulance Crash-Related Injuries Among EMS Workers. Presented at NOIRS 2003, October 22-30.

McFall M, Lutz V [2004]. Case Studies of the NIOSH Fire Fighter Fatality Investigation Program. Presented at the annual conference of the Minnesota State Fire Chief's Association, Minneapolis, MN, October 21, 2004.

Bobick, TG, Lucien Brouha [2004]. Selection of Dependent Variables to Evaluate EMS Worker Activities in Ambulance Patient Compartments. Work Physiology Symposium, Keystone, Colorado. September 1-2, 2004.

Current RS [2004]. A Review of NIOSH Research to Support Ambulance Worker Safety. The National Truck Equipment Association's (NTEA), Ambulance Manufacturers Division (AMD) winter business meeting February 2004, Tampa, FL.

Green JD [2004]. Evaluation of Emergency Service Vehicle Occupant Safety. Presented at the National Association of State EMS Directors meeting, October 8. 2004.

Castillo DN [2005]. NIOSH Fire Fatality Investigation and Prevention Program. Overview and Experiences Relevant to a Near-miss Reporting System. Invited presentation at *National Fire Fighter Near-Miss Reporting System Task Force Meeting,* Reston, VA, March 7-8, 2005.

McFall M [2005]. NIOSH Fire Fighter Fatality Investigation and Prevention Program Overview and Case Studies. Presented at the *West Virginia Fireman's Association's Annual Safety Summit,* Weston, WV, April 2, 2005.

Koedam R, Farmer A [2005]. Risk vs. Gain: Considerations for Working Fires in Unoccupied Structures. Presentation at the NFPA World Safety Conference & Exposition, Las Vegas, NV, June 30, 2005.

Koedam R [2005]. Risk vs. Gain: Considerations for Working Fires in Unoccupied Structures. Presentation at the Firehouse Expo, Baltimore, MD, July 30, 2005.

Frederick, L [2005]. NIOSH Fire Fatality Investigation and Prevention Program. Presentation at the Firehouse Expo, Baltimore, MD, July 30, 2005.

Tarley J [2005]. "Live-Fire and Motor Vehicle Fatality Case Studies." Invited presentation at the Ohio State Fire Fighter Association Conference, Wilmington, OH, August 19-20, 2005.

Green JD, Moore PH, Current RS, Yannaccone J, Day D, Proudfoot SL, Bobick TG, Romano NT [2005]. Reducing Vehicle Crash-Related EMS Worker Injuries Through Improvements in Restraint Systems, in Proceedings XVIIth World Safety Congress, Orlando FL, September 20, 2005.

Frederick, L [2005]. Fire Fighter Fatalities due to Carbon Monoxide Poisoning. Presentation at the XVIIth World Congress on Safety and Health at Work, Orlando, Florida, September 18-22, 2005.

Castillo, DN [2005]. NIOSH Fire Fighter Fatality Investigation and Prevention Program. By invitation, presented at the Eighteenth Biennial Symposium on the Occupational Health and Hazards of the Fire Service, Honolulu, HI, October 26, 2005.

Moore, PH [2005]. Ambulance Crash Injuries Among EMS Workers. Presented at International Association of Fire Chiefs, Fire-Rescue Med 2005, April 20-22.

Proudfoot SL [2005]. Ambulance Safety in the Fire Service. Presented at 2005 NFPA World Safety Conference and Exposition, June 6-10.

Green JD [2005]. Reducing Vehicle Crash-Related EMS Worker Injuries Through Improvements in Restraint Systems. Poster presentation at Safety 2005, the American Society of Safety Engineers Annual Conference and Exposition, June 12-15.

Proudfoot SL [2006]. Ambulance Safety in the Fire Service. Fire Department Safety Officers Apparatus Symposium 2006, Las Vegas NV, January 2006.

Moore PH, Current RS, Green JD, Proudfoot SL, Bobick TG, Romano NT, Yannaconne J, Day D, Whitman G [2006]. Evaluation of Emergency Service Occupant Safety. NORA 2006, poster presentation, Washington, DC, May 9 - 10, 2006.

Hales T, Pizatella T [2005]. NIOSH Fire Fighter Fatality Investigation and Prevention Program. Presented at the NIOSH Fire Fighter Fatality Investigation and Prevention Program Stakeholders meeting, Washington DC, March 22, 2006.

Moore PH [2006]. Evaluation of Emergency Service Occupant Safety. EMS Care 2006, Linthicum Maryland, April 30, 2006.

Moore PH, Green JD [2006]. Evaluation of Emergency Service Occupant Safety. EMS Safety Net 2006, Atlanta Georgia, June 9, 2006.

Proudfoot SL, Moore PH [2006]. Ambulance Safety in the Fire Service, an Update. NFPA World Safety Conference & Exposition, Orlando Florida, June 4-8 2006.

Moore PH, Bobick TG, Current RS, [2006]. “National Institute for Occupational Safety and Health Research to Improve Ambulance Safety.” EMS Expo 2006 Las Vegas, Nevada, September 28, 2006.

Standards, Regulations

Text of Bradley’s Law: Introduced by Sens. MEIER, HOFFMANN, MALTESE, McGEE, MENDEZ, RATH, SEWARD, VOLKER, WRIGHT -- read twice and ordered printed, and when printed to be committed to the Committee on Finance

AN ACT to amend the executive law, in relation to the training of firefighters under live fire conditions. The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. The executive law is amended by adding a new section 159-c-l to read as follows: 159-c-l. Training; live fire conditions.

1. In the training of fire-fighters under live fire conditions no person or persons shall play the role of a victim.

2. For purposes of this section, a live fire condition is any unconfined open flame or device that can propagate fire to a building, a training tower, an acquired structure or other combustible material.

3. A violation of this section shall be punishable by a civil penalty not to exceed one thousand dollars paid for by the fire department conducting such training.

§ 2. This act shall take effect immediately.

Anecdotal Feedback

Numerous examples of feedback regarding the use of the TI program's products have also been received, below are some examples*:*

Fire department member: "*I want to extend my thanks and appreciation for your professionalism conducting during the investigation and fact-finding process. … Preventing and reducing fire fighter fatalities should be a top priority goal for every department, and to accept objective recommendations from beneficial sources and organizations such as yours. We are currently taking your recommendations to heart with the following actions already in process for completion……"*

Congressman James McGovern after release of NIOSH report 99-F47 based on a Massachusetts event resulting in the deaths of 6 fire fighters: "*The value of this report goes far beyond Worcester*,"

Deputy Fire Marshal, Colorado: "*I used the Firefighter Fatality reports published by your organization. These are invaluable as case studies to represent to our young rookies the true hazards of their job. These reports bring the aspect of safety into a reality for them. I know they are safe for having reaped the rewards from the hard work your staff puts into the reports. This is a great and invaluable service to my profession*."

Staff member from Training division of Ohio Fire Department: *"I would also like to express my department's appreciation in providing the NIOSH Firefighter, Death in the Line of Duty Reports. We recently printed dozens of the reports for the National Stand-down for Firefighter Safety for our firefighters to review…. The reports, on many occasions, hit close to home in regards to the similarities to our department. The reports stimulate changing an attitude of "it wouldn't happen here" to a attitude and belief that "it COULD happen here". I thank NIOSH for the countless lives they have saved. I believe the NIOSH reports are preventing deaths and serious injury by opening the eyes of those who are involved in the fire service."*

Information on reader response card to NIOSH publications: *"I find the NIOSH Reports and Alerts on fire fighter deaths very informative. We utilize the information to change attitudes."*

Information on reader response card to NIOSH publications: *"Thank you very much. Very informative and easy to be used in our training program."*

Sub goal 3.2: Improve protection for ***ambulance workers*** in patient compartments

Supporting Evidence:

Journal Articles

Proudfoot SL, Romano NT, Bobick TG, Moore PH [2003]. Ambulance Crash-Related Injuries among Emergency Medical Services Workers -- United States, 1991 - 2002. *Morbidity and Mortality Weekly Report 52*:8, February 28, 2003.

Proudfoot SL [2005]. Ambulance Crashes: Fatality Factors for EMS Workers. *Emergency Medical Services 34*:6. June 2005.

A draft manuscript, Ambulance Patient Compartment Safety – A Survey of Registered Emergency Medical Technicians**,** Proudfoot SL, Moore, PH, and Levine R, is currently under editorial review at the *Journal of Emergency Medical Services*.

Conference Papers and Presentations

Bobick TG, Current RS, Romano NT, Green JD, Moore PH [2003]. Ambulance Crash-Related Injuries among EMS Workers, presented at NOIRS 2003, October 22-30. NOIRS 2003, October 29, 2003.

Current RS [2004]. A Review of NIOSH Research to Support Ambulance Worker Safety, presented at the National Truck Equipment Association's (NTEA), Ambulance Manufacturers Division (AMD) winter business meeting in Tampa, FL, February 2004.

Bobick TG [2004]. Selection of Dependent Variables to Evaluate EMS Worker Activities in Ambulance Patient Compartments, presented at the Lucien Brouha Work Physiology Symposium, Keystone, Colorado. September 1-2, 2004.

Green JD [2004]. Evaluation of Emergency Service Vehicle Occupant Safety, presented at the National Association of State EMS Directors meeting, October 8, 2004. (Where?)

Green JD, Moore PH, Current RS, Yannaccone J, Day D, Proudfoot SL, Bobick TG, Romano NT [2005]. Reducing Vehicle Crash-Related EMS Worker Injuries

through Improvements in Restraint Systems. in Proceedings of the XVIIth World Safety Congress, September 20, 2005 in Orlando, FL.

Moore PH [2005]. Ambulance Crash Injuries among EMS Workers, presented at International Association of Fire Chiefs, Fire-Rescue Med 2005, April 20-22, 2005 in Las Vegas, NV.

Proudfoot SL [2005]. Ambulance Safety in the Fire Service, presented at the 2005 NFPA World Safety Conference and Exposition, June 6-10, 2005 in Las Vegas, NV.

Green JD [2005]. Reducing Vehicle Crash-Related EMS Worker Injuries through Improvements in Restraint Systems, poster presentation at Safety 2005, the American Society of Safety Engineers Annual Conference and Exposition, June 12-15, 2005 in New Orleans, LA.

Proudfoot SL [2006]. Ambulance Safety in the Fire Service, Fire Department Safety Officers Apparatus Symposium 2006, Las Vegas, NV, January 2006.

Moore PH, Current RS, Green JD, Proudfoot SL, Bobick TG, Romano NT, Yannaconne J, Day D, Whitman G [2006]. Evaluation of Emergency Service Occupant Safety, poster presentation at the NORA 2006 Symposium, May 9 and 10, 2006 in Washington, DC.

Moore PH [2006]. Evaluation of Emergency Service Occupant Safety, EMS Care 2006, April 30, 2006 in Linthicum, MD.

Moore PH, Green JD [2006]. Evaluation of Emergency Service Occupant Safety, EMS Safety Net 2006, June 9, 2006 in Atlanta, GA.

Proudfoot SL, Moore PH [2006]. Ambulance Safety in the Fire Service an Update, NFPA World Safety Conference & Exposition, June 4-8 2006 in Orlando FL.

Moore PH, Current RS, Bobick TG [2006]. National Institute for Occupational Safety and Health Research to Improve Ambulance Safety, EMS Expo, September 25-29, 2006 in Las Vegas, NV.

Fatality Investigation Reports

NIOSH [2003]. Career Fire Fighter/Emergency Medical Technician Dies in Ambulance Crash, Texas. Report No. F2003-05 available at http://www.cdc.gov/niosh/fire/.

NIOSH [2003] Career Fire Fighter/Emergency Medical Technician Dies and Paramedic is Injured in a Three-Vehicle Collision – Nebraska, Report No. F2003-33, available at http://www.cdc.gov/niosh/fire/.

NIOSH [2005]. Career Fire Fighter/SMT Dies in Ambulance Crash– Florida, Report No. F2005-12, available at http://www.cdc.gov/niosh/fire/

FACE [2001]. 26 Year-Old Emergency Medical Technician Dies in Multiple Fatality Ambulance Crash – Kentucky, Report No. 2001-11, available at http://www.cdc.gov/niosh/face/

NIOSH [2001]. Emergency Medical Technician Dies in Ambulance Crash – New York, Report No. FACE 2001-12, available at http://www.cdc.gov/niosh/face/

Crash Investigation Reports

National Highway Traffic Administration crash reconstruction reports funded by NIOSH documenting environmental and vehicular circumstances and the injury mechanisms for patient compartment occupants present during an ambulance crash. The following reports are available at http://www-nass.nhtsa.dot.gov:

NHTSA CA02-028, 1999 Ford E-350 Super Duty Van Chassis W/Wheeled Coach Type III Ambulance Body, New Jersey, July 2002

NHTSA CA02-009, 2000 Ford E-350 Type III Ambulance, Kentucky, March 2002

NHTSA CA02-033, 1995 Ford E-350 Type III Ambulance, Minnesota, July 2002

NHTSA CA03-004, 1997 Ford E-350 Type III Ambulance, Kentucky, January 2003

NHTSA DS02-003, Wheeled Coach Moduvan Ambulance on a 1997 Ford E-350 Series Chassis, Washington, February 2002

TI Research Partners for the ambulance workers safety program Include:

U.S. and Canadian Private Sector Partners

ARRCA Incorporated (contractor, forensic engineering, crash survivability)

Schroth Safety Products Corp. (material and engineering support, occupant restraints)

H. Koch & Sons Co. (material and engineering support, occupant restraints)

Pacific Scientific (material support, occupant restraints)

Allied Services Systems (material and engineering support, occupant restraints)

Ferno-Washington, Inc. (material support, patient transport equipment)

PMG Technologies (contractor, automotive compliance and research testing, fully staffed test facility)

Dynamic Sciences Incorporated (contractor, vehicle crash reconstruction)

American Medical Response (EMS service provider, provided access to employee injury and compensation data)

EVS Ltd (ambulance seat manufacturer, provided engineering support)

Wheeled Coach, Collins Industries (GSA contract ambulance manufacturer)

CALSPAN Corporation (contractor, engineering services and materials testing)

U.S. Public Sector Partners

U.S. Army Tank-Automotive, Research, Development, and Engineering Center (TARDEC) (crash survivability research, funding and research planning partner)

National Highway Traffic Safety Administration National Center for Statistics and Analysis (NHTSA NCSA) (vehicle crash reconstructions)

U.S. Fire Administration (USFA) (funding partner)

Naval Air Warfare Center Aircraft Division (NAVAIR) (engineering services and materials testing)

National Registry of Emergency Medical Technicians (NREMT) (joint analysis of employee survey data)

National Highway Traffic Safety Administration (NHTSA) Office of Emergency Medical Services (EMS) (facilitated TI collaboration with NREMT)

General Service Administration Engineering and Commodity Management Division, GSA Automotive (Administers ambulance purchase specifications and vehicle procurement contracts)

City of Phoenix, Fire Department (material support)

Winter Park Florida Fire Department (developed new compartment design based in part on TI research)

Monongalia County West Virginia Emergency Medical Services (Mon EMS) (EMS service provider, supported human subjects testing)

<u>Canadian Public Sector Partners</u>

Canadian Forces Health Services Group (funding and research planning partner)

Defence Research Development Canada (test facility and staff support, dynamic testing)

Ministry of Health and Long-Term Care, Ontario (material and funding support)

Sub goal 7.3: Improve protection for **emergency workers responding to large-scale disasters and terrorist attacks**

Supporting Evidence:

NIOSH Publications

Jackson BA et al. [2004]. Protecting Emergency Responders, Volume 3: Safety Management in Disaster and Terrorism Response. NIOSH Publication No. 2004-144; RAND Publication No. MG-170. Cincinnati, OH: National Institute for Occupational Safety and Health. 119 pp. *(16,923 distributed; 11,057 requested)*

NIOSH [2004]. NIOSH Update: RAND-NIOSH Study Says New Approach Needed to Protect Emergency Responders in Terrorist Attacks and Disasters. June 16, 2004.

NIOSH [2002]. Fact Sheet: Protecting Workers at the World Trade Center Site: Response from the National Institute for Occupational Safety and Health. NIOSH Publication Number 2002-143. Available on Web at: http://www.cdc.gov/niosh/pdfs/02-143.pdf. Last accessed on February 27, 2007.

NIOSH [2001]. Eye Safety, Emergency Response and Disaster. Web-based Fact Sheet available on Web at: http://www.cdc.gov/niosh/eyesafe.html. Last accessed on February 27, 2007.

NIOSH [1994]. Update: NIOSH Warns of Hazards of Flood Cleanup Work. NIOSH Publication No. 94-123. Available on Web at: http://www.cdc.gov/niosh/flood.html. Last accessed on February 27, 2007.

Other Publications

Jackson BA, et al. [2002]. Protecting Emergency Responders: Lessons Learned from Terrorist Attacks. Santa Monica, CA: RAND Science and Technology Policy Institute. 89 pp. Available on RAND Website at: http://www.rand.org/pubs/conf_proceedings/CF176/index.html, and the NIOSH Website at:http://www.cdc.gov/niosh/npptl/guidancedocs/rand.html

LaTourrette T, et al. [2003]. Protecting Emergency Responders, Volume 2: Community Views of Safety and Health Risks and Personal Protection Needs. Santa Monica, CA: RAND Science and Technology Policy Institute. 142 pp. Available on RAND Website at:
http://www.rand.org/pubs/monograph_reports/MR1646/index.html
and on the NIOSH Website at:
http://www.cdc.gov/niosh/npptl/guidancedocs/rand.html

Houser A et al. [2004]. Emergency Responder Injuries and Fatalities: An Analysis of Surveillance Data. RAND Publication No. TR-100-NIOSH. Santa Monica, CA: RAND Science and Technology. 92 pp. Available on RAND Website at: (http://www.rand.org/pubs/technical_reports/TR100/).

Willis H et al. [2006]. Protecting Emergency Responders, Volume 4: Personal Protective Equipment Guidelines for Structural Collapse Events. Santa Monica, CA: RAND Infrastructure, Safety, and Environment.

Background on the broader NIOSH-RAND collaboration

On December 9-11, 2001 a conference was held in New York City that brought together individuals with experience in responding to acts of terrorism. The purpose of the conference was to hear and document the firsthand experiences of emergency responders regarding the performance, availability, and appropriateness of personal protective equipment as they responded to those events. The meeting considered the responses to the September 11, 2001 attacks at the World Trade Center and the Pentagon; the 1995 attack at the Murray Federal Building in Oklahoma City; and the responses to the Anthrax incidents in the fall of 2001. The conference attendees represented a diverse range of occupations that fulfill various roles in an emergency response situation: firefighters, police, emergency medical technicians, construction workers, union officials, and representations from local, state, and federal agencies. A final report on the December 2001 Conference proceedings entitled "Protecting Emergency Responders: Lessons Learned from the Terrorist Attacks" was written by RAND and made available electronically via the RAND and NIOSH Websites. This report was the first of a series of four "Protecting Emergency Responders" volumes.

Community Views of Safety and Health Risks and Personal Protection Needs.
Following the success of the first report, RAND began a thorough process of meeting with stakeholders in the emergency response community to define the personal protection technology needs and research priorities for emergency responders. RAND conducted discussions with 190 representatives from 83 organizations involved in emergency response, including structural firefighters, emergency medical service (EMS) providers, police, emergency management officials, technology/service suppliers, researchers and program managers. The product of these discussions was a final report that synthesized the discussions into four main topics: (1) primary tasks that emergency responders undertake; (2) situations in which the risk of injury is the greatest and that have the high priority for improving personal; (3) current and emerging technologies that are critical to protecting the health and safety of emergency responders; and (4) drivers of, impediments to, and gaps in technology development. *A* report entitled "Protective Emergency Responders Volume 2: Community Views of Safety and Health Risks and Personal Protection Needs" was written by RAND and is available on the RAND and NIOSH Websites. The report has been used internally to guide NIOSH research on personal protective technologies. This report was discussed in the National Institute of Science and Technology (NIST) fire.gov Spring 2004 newsletter (http://www.fire.gov/newsletter/spring2004/page_one.htm) and at other industry websites (e.g.,http://www.homelandresponse.org/500/Issue/Article/False/12382/).

Surveillance of Emergency Responders Injuries and Fatalities.
The findings from the Volume 2 report were intended for use in conjunction with emergency responder injury and fatality data. To summarize the available data in this area, RAND developed another report which reviewed and analyzed available databases that provide disease, injury, and fatality data pertinent to emergency response functions and the role of personal protective technologies. The final report entitled "Emergency Responder Injuries and Fatalities: An Analysis of Surveillance Data" was published as a RAND technical report and is available via the RAND website.

Additional RAND Outputs on the RAND-TI Report
The RAND lead author of the report was interviewed by Homeland Response (an online journal). The transcript of that interview can be accessed at: http://www.homelandresponse.org/500/Issue/Article/False/12453/Issue (Last viewed on October 31, 2006.)

The RAND lead author of the NIOSH-RAND report testified before the House Government Reform Committee on March 30, 2006 on the topic: *Information Sharing and Emergency Responder Safety Management*. The text of this testimony can be accessed at: http://reform.house.gov/UploadedFiles/RAND%20-%20Jackson%20Testimony.pdf#search=%22NIOSH%20RAND%20Disaster%20Safety%20Management%22) (Last viewed on October 31, 2006.)

The RAND lead author of the NIOSH-RAND report presented findings at the *Forum on Catastrophe Preparedness: Partnering to Protect Workplace*s, conducted on Friday April 7, 2006 in San Francisco. Sponsored and organized by the California Commission on Health and Safety and Workers' Compensation (CHSWC).

8. Reduce injuries and fatalities to working youth

Sub goal 8.1: Influence ***legislative changes*** *to protect young workers*

Supporting Evidence:

Journal Articles

Hendricks K, Myers J, Layne L, Goldcamp M [2005]. Household youth on minority operated farms in the United States 2000: Exposures to and injuries from work, horses, ATVs and tractors, *Journal of Safety Research 36*:149-157.

Higgins DN, Tierney J, Lins M, Hanrahan L [2004]. School Nurses: A Resource for Young Worker Safety, *Journal of School Nursing 20*(6):317-323.

Goldcamp M, Hendricks KJ, Myers JR [2004]. Farm fatalities to youth 1995-2000: A comparison by age groups, *Journal of Safety Research 35*(2):151-157.

Hendricks K, Goldcamp E, Myers J [2004]. On-farm Falls among Youth Less than 20-years old in the U.S., *Journal of Agricultural Safety and Health 10*(1):27-38. *(19 Citations)*

Higgins DN, Tierney J, Lins M, Hanrahan L [2004]. School nurses: a resource for young worker safety, *Journal of School Nursing 20*(6):10-16.

Mardis AL, Pratt SG [2003]. Nonfatal Injuries to Young Workers in the Retail Trades and Services Industries in 1998, *Journal of Occupational and Environmental Medicine 45*(3):316-323. *(5 Citations)*

Higgins D, Tierney J, Hanrahan L [2002]. Preventing youth worker fatalities: the Fatality Assessment and Control Evaluation (FACE) Program. *American Association of Occupational Health Nurses Journal 50*(11):508-514.

Myers JR, Adekoya N [2001]. Fatal on-farm injuries among youth 16 to 19 years of age: 1982-1994. *Journal of Agricultural Safety and Health 7*(2):101-112. *(5 Citations)*

Castillo DN, Davis L, Wegman DH [1999]. Young workers. *Occupational Medicine: State of the Art Reviews 14*(3):519-536. *(13 Citations)*

Castillo DN, Adekoya N, Myers JR [1999]. Fatal work-related injuries in the agricultural production and services sectors among youth in the United States, 1992-96, *Journal of Agromedicine 6*(3):27-41. *(23 Citations)*

CDC [1999]. Childhood work-related agricultural fatalities--Minnesota, 1994-1997. MMWR 48(16):332-335.

Hendricks K, Layne L [1999]. Adolescent Occupational Injuries in the Fast Food Industry. *Journal of Occupational and Environmental Medicine 41*(12):1146-1153. *(19 Citations)*

CDC [1998]. Youth agricultural work-related injuries treated in emergency departments, United States, October 1995--September 1997. *Morbidity and Mortality Weekly Report 47*(35):733-737.

Castillo DN, Malit BD [1997]. Occupational injury deaths of 16 and 17 year olds in the US: trends and comparisons with older workers. *Injury Prevention 3*(4):227-281. *(7 Citations)*

CDC [1996]. Work-related injuries and illnesses associated with child labor--United States, 1993. *Morbidity and Mortality Weekly Report 45*(22):464-468.

Knight EB, Castillo DN, Layne LA [1995]. A detailed analysis of work-related injury among youth treated in emergency departments. *American Journal of Industrial Medicine 27*: 793-805. *(26 Citations)*

Castillo DN, Landen DD, Layne LA [1994]. Occupational injury deaths of 16- and 17-year-olds in the United States. *American Journal of Public Health 84*(4): 646-649. *(47 Citations)*

Layne LA, Castillo DN, Stout N, Cutlip P [1994]. Adolescent occupational injuries requiring hospital emergency department treatment: a nationally representative sample. *American Journal of Public Health 84*(4): 657-660. *(38 Citations)*

Suruda A, Halperin W [1991]. Work-related deaths in children. *American Journal of Industrial Medicine 19*:739-745. *(29 Citations)*

Schober SE, Handke JL, Halperin WE, Moll MB, Thun MJ [1988]. Work-related injuries to minors. *American Journal of Industrial Medicine 14*: 585-595. *(39 Citations)*

NIOSH publications

NIOSH [2005]. Injury and Asthma Among Youth Less Than 20 Years of Age on Minority Farm Operations in the United States, 2000. Volume 1: racial minority national data. NIOSH Publication Number 2005-147. *(3,041 distributed; 542 requested)*

NIOSH [2004]. Injuries Among Youth on Farms, 2001, NIOSH Publication Number 2004-172. *(8,272 distributed; 5,050 requested)*

NIOSH [2004]. Asthma among household youth on Hispanic farm operations. NIOSH Publication No. 2004-158. *(6,578 distributed; 3,029 requested)*

NIOSH [2004]. Injuries to Youth on Minority Farm Operations. NIOSH Publication No. 2004-157. *(7,257 distributed; 3,309 requested)*

NIOSH [2004]. Worker Health Chartbook, 2004. NIOSH Publication No. 2004-146 (Special Populations: Young Workers Section, pp 266-276.)

NIOSH [2003]. Asthma Among Household Youth on Minority Farm Operations. NIOSH Publication No. 2004-118.

NIOSH [2004]. Injuries to Youth on Minority Farm Operations. NIOSH Publication No. 2004-117.

NIOSH [2003]. Preventing Deaths, Injuries, and Illnesses of Young Workers. NIOSH Publication No. 2003-128. *(31,916 distributed; 29,010 requested))*

Myers JR, Hendricks KJ [2001]. Injuries among youth on farms in the United States, 1998. NIOSH Publication No. 2001-154. *(17 citations)(7,716 distributed; 4,352 requested)*

NIOSH [1997]. Child labor research needs: Recommendations from the NIOSH child labor working team. NIOSH Publication No. 97-143.

NIOSH [1995]. Preventing Deaths and Injuries of Adolescent Workers. NIOSH Publication No. 95-125. *(101,000 distributed)*

Recommendations for/Comments on Regulations

NIOSH [2002]. National Institute for Occupational Safety and Health (NIOSH) Recommendations to the U.S. Department of Labor for Changes to Hazardous Orders. May 3, 2002.

NIOSH [2000]. Comments of the National Institute for Occupational Safety and Health on the Department of Labor notice of proposed rulemaking and request for comments on child labor regulations, orders, and statements of interpretation. Child Labor Violations--- Civil Money Penalties: 29 CFR Parts 570 and 579, January 28, 2000.

NIOSH [1994]. Comments of the National Institute for Occupational Safety and Health on the Department of Labor/Wage and Hour Division advance notice on proposed rulemaking on child labor regulations, orders and statements of interpretation, October 25, 1994.

NIOSH funded cooperative agreements and grants (parentheses include information on specific TI involvement with these projects).

Cooperative Agreements
Enhanced Surveillance of Occupational Injuries to Youth < 18 (Teens at Work project), Principal Investigator: Letitia Davis. (*TI researchers provide technical assistance to the project).*

The Youth Employment Training Pilot Program (Enhanced Surveillance Program- Wisconsin), Principal Investigator: Henry Anderson. (*TI researchers provided technical assistance to the project).*

Analysis of OSHA Investigation Reports, Principal Investigator: Anthony Suruda. *(TI researchers secured funding through DOL/ESA, helped develop the RFA, and provided technical assistance to the project).*

Surveys of Construction Employers and Young Construction Workers, Principal Investigator: Carol Runyan. (*TI researchers secured funding through DOL/ESA, helped develop the RFA, and provided technical assistance to the project).*

15 State-based Fatality Assessment and Control Evaluation Programs, States: Alaska, California, Kentucky, Iowa, Massachusetts, Michigan, Minnesota, Nebraska, New Jersey, New York, Oklahoma, Oregon, Washington, West Virginia, Wisconsin. *(TI researchers helped develop the RFA and provided technical assistance to the projects)*

Grants
Occupational Injury in Hispanic Farmworker Families, Principal Investigator: Stephen McCurdy. (*TI researchers helped develop the RFA)*

Risk Factors for Injury among Migrant and Seasonal Farmworker Children, Principal Investigator: Harlan Amandus. (*TI researchers helped develop the RFA)*

Health and Safety Risks to Children of Migrant Farmworkers, Principal Investigator: Doris Slesinger. (*TI researchers helped develop the RFA)*

The Health of Children Hired to Work on U.S. Farms, Principal Investigator: Don Villarejo. (*TI researchers helped develop the RFA)*

Economic and Psychosocial Impacts of Youth Farm Injury, Principal Investigator: John Schmelzer. (*TI researchers helped develop the RFA)*

Outcomes of Agricultural Injury to Children in Missouri, Principal Investigator: Garland Land. (*TI researchers helped develop the RFA)*

Childhood Health Outcomes in a Rural Cohort, Principal Investigator: James Merchant. (*TI researchers helped develop the RFA)*

Childhood Injuries in Washington State Agriculture, Principal Investigator: Bruce Alexander. (*TI researchers helped develop the RFA)*

Etiology and Consequences of Injuries Among Children in Farm Households, Principal Investigator: Susan Gerberich. (*TI researchers helped develop the RFA)*

Childhood Agricultural Safety and Health, Principal Investigator: David Parker. (*TI researchers helped develop the RFA)*

Childhood Agricultural Trauma Evaluation System, Principal Investigator: Debra Boyle. (*TI researchers helped develop the RFA)*

RRIS II: Agricultural Injury Surveillance, Principal Investigator: Susan Gerberich. (*TI researchers helped develop the RFA)*

Biomarkers of Pesticide Toxicity Among Teen Farmworkers, Principal Investigator: Linda McCauley. (*TI researchers helped develop the RFA)*

Evaluation of Occupational Carrying Tasks for Farm Youth, Principal Investigator: Charles Schwab. (*TI researchers helped develop the RFA)*

Work Injury and Young People: A Prospective Survey, Principal Investigator: Curtis Breslin. (*TI researchers helped develop the RFA)*

Farm Family Total Noise Exposure Assessment, Principal Investigator: Milz. (*TI researchers helped develop the RFA)*

Removing the HOOA Family Farm Exemption: Impact On Injury, Principal Investigator, Barbara Marlenga. (*TI researchers helped develop the RFA)*

Adolescent Toxic Exposures in the Workplace, Principal Investigator: Alan Woolf.

Childrens Injuries on Kentucky Beef Cattle Farms, Principal Investigator: Steven Browning.

On the Job Injury in South Texas Middle School Children, Principal Investigator: Sharon Cooper.

Safety and Youth Employment: A Study of Parents and Teens, Principal Investigator: Carol Runyan.

Study of Work Injuries in Farmworker Children, Principal Investigator: Sharon Cooper.

Pilot Study of Ag-Related Injuries Impacting Amish Community, Principal Investigator: William Field.

Adolescent Farm Work, Fatigue and Injuries in Colorado, Principal Investigator: Lorann Stallones.

Prospective Study of Hearing Damage Among Newly Hired Construction Workers, Principal Investigator, Noah Seixas. (*TI researchers secured partial funding for this project through DOL/ESA).*

Reports from TI Supported Extramural Research (not an exhaustive list):

Runyan CW, Santo JD, Schulman M, Lipscomb JH, Harris TA [2006]. Work hazards and workplace safety violations experienced by adolescent construction workers. *Archives of Pediatric & Adolescent Medicine 160*(7):721-727.

Zierold KM, Anderson HA [2006]. Severe injury and the need for improved safety training among working teens. *American Journal of Health Behavior 30*(5): 525-32.

Zierold KM, Anderson HA [2006]. Racial and ethnic disparities in work-related injuries among teenagers. *Journal of Adolescent Health 39*(3): 422-6.

Zierold MK, Anderson HA [2006]. The relationship between work permits, injury, and safety training among working teenagers. *American Journal of Industrial Medicine 49*:360-366, 2006.

Breslin FC, Smith P [2005]. Age-related differences in work injuries: a multivariate, population-based study. *American Journal of Industrial Medicine 48*(1): 50-56.

Cooper SP, Weller NF, Fox EE, Cooper SR, Shipp EM [2005]. Comparative description of migrant farmworkers vs. other students attending south Texas schools: demographic, employment, and health indicators. *Texas Medicine 101*:58-62.

Cooper SP, Weller NF, Fox EE, Cooper SR [2005]. Comparative description of migrant farmworkers vs. other students attending South Texas schools: substance use, work and injuries. *Journal of Rural Health 21*:361-366.

O'Connor T, Loomis D, Runyan C, Abboud dal Santo J, Schulman M [2005]. Adequacy of health and safety training among young Latino construction workers. *Journal of Occupational and Environmental Medicine 47*:272-277.

Seixas NS, Goldman B, Sheppard L, Neitzel R, Norton S, Kujawa SG [2005]. Prospective noise induced changes to hearing among construction industry apprentices. *Occupational and Environmental Medicine 62*: 309-317.

Zierold KM, Garman S, Anderson HA [2005]. A comparison of school performance and behaviors among working and nonworking high school students. *Family and Community Health 28*:3 214-224.

Weller NF, Basen-Engquist K, Cooper SP, Kelder SH, Tortolero SR, Hassan S [2004]. School-year employment among middle school students in South Texas: prevalence and patterns. *Journal of Children's Health 2*:87-102.

Weller NF, Tortolero SR, Cooper SP, Kelder SH, Hassan S [2004]. School-year employment among South Texas middle school students: effects on academic, social, and physical functioning. *Journal of Children's Health 2*:103-117.

Zierold KM, Anderson H [2004]. Trends in blood lead levels among children enrolled in the special supplemental Nutrition program for women, infants, and children from 1996 to 2000. *American Journal of Public Health 94*:1513-1515.

Zierold KM, Garman S, Anderson H [2004]. Summer work and injury among middle school students, aged 10-14 years. *Occupational and Environmental Medicine 61*(6): 518-22.

Massachusetts Young Worker Initiative Task Force [2003]. Protecting young workers in Massachusetts. Available at: http://www.masscosh.org/documents/ProtectingYoungWorkersinMA1-03.doc

Suruda A, Philips P, Lillquist D, Sesek R [2003]. Fatal injuries to teenage construction workers in the US. *American Journal of Industrial Medicine 44*:510-514.

Weller NF, Cooper SP, Tortolero SR, Kelder SH, Hassan S [2003]. Work-related injury among south Texas middle school students: prevalence and patterns. *Southern Medical Journal 96*(12): 1213-20.

Parker DL, Merchant D, Munshi K [2002]. Adolescent work patterns and work-related injury incidence in rural Minnesota. *American Journal of Industrial Medicine 42*(2):134-41.

Woolf AD [2002]. Health hazards for children at work. *Journal of Toxicoloby-Clinical Toxicology 40*: 477-482.

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Brooks D, Davis LK [1996]. Work-related injuries to Massachusetts teens, 1987-1990. *American Journal of Industrial Medicine 29*(2): 153-60.

Brooks D, Davis LK, Gallagher SS [1993]. Work-related injuries among Massachusetts children: A study based on emergency department data. *American Journal of Industrial Medicine 24*: 313-324.

Sub goal 8.2: Reduce ***child agricultural injuries***

Supporting Evidence:

Journal Articles

Hard DL, Myers JR [2006]. Fatal Work-Related Injuries in the Agriculture Production Sector Among Youth in the United States, 1992-2002. In press, *Journal of Agromedicine*, 6-29-06.

Goldcamp EM, Myers J, Hendricks K, Layne L, Helmkamp J [2006]. Nonfatal all-terrain vehicle-related injuries to youth living on farms in the United States, 2001. *Journal of Rural Health 22*(4): 308-13.

Hendricks KJ, Layne LA, Goldcamp EM, Myers JR. [2005]. Injuries to Youth Living on U.S. Farms in 2001 with Comparison to 1998. *Journal of Agromedicine 10*(4):19-26.

Hendricks K, Myers J, Layne L, Goldcamp M [2005]. Household youth on minority operated farms in the United States 2000: Exposures to and injuries from work, horses, ATVs and tractors, *Journal of Safety Research 36*:149-157.

Goldcamp M, Hendricks KJ, Myers JR [2004]. Farm fatalities to youth 1995-2000: A comparison by age groups, *Journal of Safety Research 35*(2):151-157.

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Higgins DN, Tierney J, Lins M, Hanrahan L [2004]. School Nurses: A Resource for Young Worker Safety, *Journal of School Nursing 20*(6):317-323.

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Landsittel D, Hard DL, Murphy DJ, Kiernan NE [1998]. The Pennsylvania Central Region Farm Safety Pilot project: Part II--Baseline data associations between approach-to-safety and hazard conditions. *Journal of Agricultural Safety and Health (Special Issue 1)***:** 21-28.

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Layne LA, Castillo DN, Stout N, Cutlip P [1994]. Adolescent occupational injuries requiring hospital emergency department treatment: a nationally representative sample. *American Journal of Public Health 84*(4): 657-660. *(38 citations)*

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NIOSH Publications

NIOSH [2005]. Injury and Asthma Among Youth Less Than 20 Years of Age on Minority Farm Operations in the United States, 2000. Volume 1: racial minority national data. NIOSH Publication Number 2005-147. *(3,041 distributed; 542 requested)*

NIOSH [2004]. Injuries Among Youth on Farms, 2001, NIOSH Publication Number 2004-172. *(50,000 copies distributed)*

NIOSH [2004]. Injuries to Youth on Hispanic Farm Operations. NIOSH Publication No. 2004-157. *(25,000 copies distributed)*

NIOSH [2004]. Worker Health Chartbook, 2004. NIOSH Publication No. 2004-146 (Special Populations: Agricultural fatality and nonfatal injury section, pp. 195-211.)

NIOSH [2004]. Injuries to Youth on Minority Farm Operations. NIOSH Publication No. 2004-117. *(25,000 copies distributed)*

NIOSH [2003]. Preventing Deaths, Injuries, and Illnesses of Young Workers. NIOSH Publication No. 2003-128. *(31,916 distributed; 29,010 requested)*

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Schober SE, Handke JL, Halperin WE, Moll MB, Thun MJ [1988]. Work-related injuries to minors. *American Journal of Industrial Medicine 14*: 585-595. *(39 citations)*

NIOSH funded cooperative agreements and grants (parentheses include information on specific TI involvement with these projects).

Grants

Occupational Injury in Hispanic Farmworker Families, Principal Investigator: Stephen McCurdy. *(TI researchers provided support in developing the RFA)*

Risk Factors for Injury among Migrant and Seasonal Farmworker Children, Principal Investigator: Harlan Amandus *(TI researchers provided support in developing the RFA)*

Health and Safety Risks to Children of Migrant Farmworkers, Principal Investigator: Doris Slesinger *(TI researchers provided support in developing the RFA)*

The Health of Children Hired to Work on U.S. Farms, Principal Investigator: Don Villarejo *(TI researchers provided support in developing the RFA)*

Childhood Injuries in Washington State Agriculture, Principal Investigator: Bruce Alexander *(TI researchers provided support in developing the RFA)*

Childhood Agricultural Safety and Health, Principal Investigator: David Parker *(TI researchers provided support in developing the RFA)*

Childhood Agricultural Trauma Evaluation System, Principal Investigator: Debra Boyle *(TI researchers provided support in developing the RFA)*

RRIS II: Agricultural Injury Surveillance, Principal Investigator: Susan Gerberich *(TI researchers provided support in developing the RFA)*

Childrens Injuries on Kentucky Beef Cattle Farms, Principal Investigator: Steven Browning

Study of Work Injuries in Farmworker Children, Principal Investigator: Sharon Cooper.

Pilot Study of Ag-Related Injuries Impacting Amish Community, Principal Investigator: William Field

Work Injury and Young People: A Prospective Survey, Principal Investigator: Curtis Breslin *(TI researchers provided support in developing the RFA)*

Farm Family Total Noise Exposure Assessment, Principal Investigator: Sheryl Milz *(TI researchers provided support in developing the RFA)*

Biomarkers of Pesticide Toxicity Among Teen Farmworkers, Principal Investigator: Linda McCauley *(TI researchers provided support in developing the RFA)*

Evaluation of Occupational Carrying Tasks for Farm Youth, Principal Investigator: Charles Schwab *(TI researchers provided support in developing the RFA)*

Adolescent Farm Work, Fatigue and Injuries in Colorado, Principal Investigator: Lorann Stallones

Etiology and Consequences of Injuries Among Children in Farm Households, Principal Investigator: Susan Gerberich *(TI researchers provided support in developing the RFA)*

Economic and Psychosocial Impacts of Youth Farm Injury, Principal Investigator: John Schmelzer *(TI researchers provided support in developing the RFA)*

Outcomes of Agricultural Injury to Children in Missouri, Principal Investigator: Garland Land *(TI researchers provided support in developing the RFA)*

Childhood Health Outcomes in a Rural Cohort, Principal Investigator: James Merchant *(TI researchers provided support in developing the RFA)*

Psychosocial outcomes in working farm children age 10-12, Principal Investigator: Sharon Barton

Adherence to the NAGCAT and Injury Risk Reduction, Principal Investigator: J.R. Wilkins, III *(TI researchers provided support in developing the RFA)*

Effect of Work Permits in Protecting Youth Workers, Principal Investigator: Janet Dal Santo *(TI researchers provided support in developing the RFA)*

Removing the HOOA Family Farm Exemption: Impact On Injury, Principal Investigator, Barbara Marlenga *(TI researchers provided support in developing the RFA and in providing data for use in the study)*

Empirical Derivation of Work Guidelines for Youth in Agriculture, Principal Investigator: J.R. Wilkins, III *(TI researchers provided support in developing the RFA)*

Evaluation of a School-based Agricultural Health and Safety Curriculum: Work Safe Work Smart, Principal Investigator: Allan Williams

Community-based Health & Safety Interventions for Adolescents Working in Agriculture: Evaluation of a National Initiative, Principal Investigator: Barbara Lee *(TI researchers provided support in developing the RFA)*

Healthy Farm Families Initiative, Principal Investigator: Carruth AK.

Youth Teaching Youth: Are TASK Teens Ready to Teach, Principal Investigator: Robert Petrea *(TI researchers provided support in developing the RFA)*

Ag Disability Awareness and Risk Education, Principal Investigator: Deborah Reed *(TI researchers provided support in developing the RFA)*

Enhancing Agricultural Safety and Health Through Education, Principal Investigator: David Parker *(TI researchers provided support in developing the RFA)*

Evaluating Ohio's Tractor Certification Program: Traditional and Novel, Principal Investigator: J.R. Wilkins, III *(TI researchers provided support in developing the RFA)*

Wisconsin Childhood Agricultural Safety and Health Intervention, Principal Investigator: Larry Chapman *(TI researchers provided support in developing the RFA)*

Partnership for Preventing Farm Injuries to Rural Youth, Principal Investigator: Hank Cole

Work Guidelines: Evaluation of Dissemination Methods, Principal Investigator: Barbara Marlenga *(TI researchers provided support in developing the RFA and obtaining a national sample of farms to participate in the study)*

An Evaluation of the North American Guidelines for Children's Agricultural Tasks, Principal Investigator: Sue Wright *(TI researchers provided support in developing the RFA)*

Evaluation of NAGCAT Using Case Series of Injuries, Principal Investigator: Barbara Marlenga *(TI researchers provided support in developing the RFA and in providing data for use in the study)*

Evaluation of the NAGCAT Tractor Guidelines, Principal Investigator: Fathallah

Adapting NAGCAT for Ethnic Communities, Principal Investigator: John Shutske *(TI researchers provided support in developing the RFA)*

The First Texas Bilingual Occupational Health Safety Curriculum, Principal Investigator: Soledad Vela Acosta.

Enhancement of Health of Agricultural Populations Curriculum, Principal Investigator: Robert McKnight

Education Outreach Program, Principal Investigator: Kelley Donham

Safety Education and Agricultural Injury Among California Rural High School Students, Principal Investigator: Stephen McCurdy

Teaching Kids Safety on the Farm: What Works, Principal Investigator: Anne Gadomski *(TI researchers provided support in developing the RFA)*

Communication of Pesticide Health Risks for Children of Agricultural Farm Families, Principal Investigator: Karr

Pesticide Training for Adolescent Migrant Farm Workers, Principal Investigator: Linda McCauley *(TI researchers provided support in developing the RFA)*

Using the ASHBMP Manual as a Tool to Reduce Farm Hazards, Principal Investigator: Malcolm Legault *(TI researchers provided support in developing the RFA)*

Evaluating Teen Farmworker Education, Principal Investigator: Robin Baker *(TI researchers provided support in developing the RFA)*

Effectiveness of Farm Safety Day Camps for Children, Principal Investigator: Debra McCallum *(TI researchers provided support in developing the RFA)*

Evaluation of Farm Safety 4 Just Kids Day Camp, Principal Investigator: Deborah Reed *(TI researchers provided support in developing the RFA)*

Reports from TI Supported Extramural Research (not an exhaustive list):

Doty B, Marlenga B [2006]. North American Guidelines for Children's Agricultural Tasks: Five-year assessment and priorities for the future. *Journal of Rural Health*, in press.

Doty BC, Marlenga B [2006]. A summary of state laws regulating youth operating tractors on highways. *Journal of Agricultural Safety and Health 12*(1): 46-51.

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Gadomski AM, Ackerman S, Burdick P, Jenkins P [2006]. Efficacy of the North American Guidelines for Childhood Agricultural Tasks. *American Journal of Public Health 96*(4): 722-727.

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Marlenga B, Doty BC, Berg RL, Linneman JG [2006]. Evaluation of a policy to reduce youth tractor crashes on public roads. *Injury Prevention 12*(1): 46-51.

Reed DN, Claunch DT, Cole HP, Mazur JM [2006]. Characteristics of instructors at Farm Safety 4 Just Kids day camps. *Health Education Journal 65*(2): 180-192.

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Cooper SP, Weller NF, Fox EE, Cooper SR [2005]. Comparative description of migrant farmworkers vs. other students attending South Texas schools: substance use, work and injuries. *Journal of Rural Health 21*:361-366.

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Mazur JM, Cole HP, Reed DB, Claunch DT [2005]. Instructional practices at Farm Safety 4 Just Kids (FS4JK) safety day camps. *Journal of Agricultural Safety and Health 11*(2): 257-264.

Pryor SK, Carruth AK, LaCour G [2005]. Occupational risky business: injury prevention behaviors of farm women and children. *Issues in Comprehensive Pediatric Nursing 28*(1): 17-31.

Zentner J, Berg RL, Pickett W, Marlenga B [2005]. Do parents' perceptions of risks protect children engaged in farm work? *Preventive Medicine 40*(6):860-6.

Marlenga BL, Brison RJ, Berg RL et al [2004]. Evaluation of the North American Guidelines for Children's Agricultural Tasks using a case series of injuries. *Injury Prevention 10*:350-357. *(3 citations)*

Marlenga B, Pickett W, Berg RL, Murphy D [2004]. Operational characteristics of tractors driven by children on farms in the United States and Canada. *Journal of Agricultural Safety and Health 10*(1): 17-25.

Ryan AD, Mongin SJ, Gerberich SG et al. [2004]. A comparison of exposure measurements for injury rates: Regional Rural Injury Study-II. *American Journal of Epidemiology 159*(11): 46.

Chapman L, Newenhouse A, Meyer R, et al [2003]. Musculoskeletal discomfort, injuries and tasks accomplished by children and adolescents in Wisconsin fresh market vegetable production. *Journal of Agricultural Safety and Health 9*(2): 91-105.

Gerberich SC, Church TR, Renier CM, et al [2003]. Injury surveillance: Incorporation of a case-control design. *American Journal of Epidemiology 157*(11): 51.

Park H, Reynolds SJ, Kelly et al [2003]. Characterization of agricultural tasks performed by youth in the Keokuk County Rural Health Study. *Applied Occupational and Environmental Hygiene 18*(6): 418-429.

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Reed DB, Westneat SC, Kidd P [2003]. Observation study of students who completed a high school agricultural safety education program. *Journal of Agricultural Safety and Health 9*(4): 275-83.

Gerberich SC, Church TR, Renier CM et al [2002]. Unique occupational injury surveillance: Regional Rural Injury Study-II. *La Med del Lavoro 93*(5): 464-465.

Marlenga B, Pickett W, Berg RL [2002]. Evaluation of an enhanced approach to the dissemination of the North American Guidelines for Children's Agricultural Tasks: A randomized controlled trial. *Preventive Medicine 35*:150-159. *(7 citations)*

Munshi K, Parker DL, Bannerman-Thompson H, Merchant D [2002]. Causes, nature, and outcomes of work-related injuries to adolescents working at farm and non-farm jobs in rural Minnesota. *American Journal of Industrial Medicine 42*(2): 142-9.

Parker DL, Merchant D, Munshi K [2002]. Adolescent work patterns and work-related injury incidence in rural Minnesota. *American Journal of Industrial Medicine 42*(2):134-41.

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Sub goal 8.3: Foster the development and widespread use of **safety materials and intervention strategies** to protect young workers

Supporting Evidence:

Journal Articles

Schulte PA, Stephenson CM, Okun AH, Palassis J, Biddle E [2005]. Integrating occupational safety and health information into vocational and technical education and other workforce preparation programs. *American Journal of Public Health 95*(3): 404-11.

Higgins DN, Tierney J, Lins M, Hanrahan L [2004]. School Nurses: A Resource for Young Worker Safety, *Journal of School Nursing 20*(6):317-323.

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Higgins D, Tierney J, Hanrahan L [2002]. Preventing youth worker fatalities: the Fatality Assessment and Control Evaluation (FACE) Program. *AAOHN Journal 50*(11):508-514.

Castillo DN, Davis L, Wegman DH [1999]. Young workers. *Occupational Medicine: State of the Art Reviews 14*(3):519-536. *(13 citations)*

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Landrigan PJ, McCammon JB [1997]. Child labor still withy us after all these years. *Public Health Reports 112*(6): 466-73.

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Knight EB, Castillo DN, Layne LA [1995]. A detailed analysis of work-related injury among youth treated in emergency departments. *American Journal of Industrial Medicine 27*: 793-805. *(26 citations)*

Castillo DN, Landen DD, Layne LA [1994]. Occupational injury deaths of 16- and 17-year-olds in the United States. *American Journal of Public Health 84*(4): 646-649. *(47 citations)*

Layne LA, Castillo DN, Stout N, Cutlip P [1994]. Adolescent occupational injuries requiring hospital emergency department treatment: a nationally representative sample. *American Journal of Public Health 84*(4): 657-660. *(38 citations)*

Suruda A, Halperin W [1991]. Work-related deaths in children. *American Journal of Industrial Medicine 19*:739-745. *(29 citations)*

Schober SE, Handke JL, Halperin WE, Moll MB, Thun MJ [1988]. Work-related injuries to minors. *American Journal of Industrial Medicine 14*: 585-595. *(39 citations)*

NIOSH Publications

Education Development Center [2005]. Working together for safety: A state team approach to preventing occupational injuries in young people. NIOSH Publication No. 2005-134. *(3,815 distributed; 1,982 requested).*

NIOSH [2004]. NIOSH safety checklist program for schools and other safety databases. NIOSH Publication No. 2004-01. *(64,505 copies distributed)*

NIOSH [2004]. Worker Health Chartbook, 2004. NIOSH Publication No. 2004-146 (Special Populations: Young Workers Section, pp 266-276.)

NIOSH [2004]. Preventing work-related burn injury to youth working in fast food restaurants--- fact sheet. NIOSH non-numbered publication, available at injuryhttp://www.cdc.gov/niosh/topics/youth/pdfs/burninjury.pdf.

NIOSH [2003]. Safe work for youth in construction--- information for employers. NIOSH Publication No. 2004-113. *(16,932 distributed; 7,446 requested)*

NIOSH [2003]. Preventing Deaths, Injuries, and Illnesses of Young Workers. NIOSH Publication No. 2003-128. *(31,916 distributed; 29,010 requested)*

NIOSH [2002]. Electrical safety: safety and health for electrical trades student manual. NIOSH Publication No. 2002-123.

Bush D, Gonzalez-Arroyo M, Stock L, Delp L, Miara C, Dewey R, Sinclair R, Ortega M [1999]. Promoting safe work for young workers: A community-based approach. NIOSH Publication No. 99-141. *(16,300 distributed; 8,165 requested)*

NIOSH [1998]. Safety & health on the job [poster]. NIOSH Publication No. 98-120. *(82,835 distributed; modified from extramural community-based demonstration projects product).*

NIOSH [1997]. Child labor research needs: Recommendations from the NIOSH

child labor working team. NIOSH Publication No. 97-143.

NIOSH [1997]. Are you a working teen? What you should know about safety and health on the job. NIOSH Publication No. 97-132. *(291,703 distributed; 106,606 requested—modified from extramural community-based demonstration product).*

NIOSH [1997]. Control of scrap paper baler crushing hazards: Hazard Control 14. NIOSH Publication No. 97-113. *(26,416 distributed; 2,717 requested)*

NIOSH [1995]. Preventing Deaths and Injuries of Adolescent Workers. NIOSH Publication No. 95-125. *(101,000 copies distributed)*

NIOSH funded cooperative agreements and grants (parentheses include information on specific TI involvement with these projects).

Cooperative Agreements
Enhanced Surveillance of Occupational Injuries to Youth < 18, "Teens at Work" project, Massachusetts Department of Public Health, Principal Investigator: Letitia Davis (*TI researchers provide technical assistance to the project).*

The Youth Employment Training Pilot Program (Enhanced surveillance program), Wisconsin Division of Health, Principal Investigator: Henry Anderson. (*TI researchers provided technical assistance to the project).*

Protecting Young Workers in Brockton, Massachusetts Department of Public Health and the Education Development Center, Principal Investigators: Letitia Davis and Susan Gallagher. *(TI researchers provided support in developing the RFA and provided technical assistance to the project).*

Protecting Young Workers in Oakland, University of California at Berkeley, Labor Occupational Health Program, Principal Investigator: Robin Baker. *(TI researchers provided support in developing the RFA and provided technical assistance to the project).*

Protecting Young Workers in Los Angeles:, University of California at Los Angeles, Labor Occupational Safety and Health Program, Principal Investigator: Marianne Brown. *(TI researchers provided support in developing the RFA and provided technical assistance to the project).*

Northeast Young Worker Resource Center, Education Development Center, Principal Investigator: Susan Gallagher. *(TI researchers provided support in developing the RFA and provided technical assistance to the project).*

Education Intervention to Reach Working Teenagers, University of Los Angeles, Labor Occupational Safety and Health Program, Principal Investigator: Marianne Brown. *(TI researchers provided support in developing the RFA and provided technical assistance to the project).*

15 State-based Fatality Assessment and Control Evaluation Programs, States: Alaska, California, Kentucky, Iowa, Massachusetts, Michigan, Minnesota, Nebraska, New Jersey, New York, Oklahoma, Oregon, Washington, West Virginia, Wisconsin. *(TI researchers helped develop the RFA and provided technical assistance to the projects)*

Analysis of OSHA Investigation Reports, Principal Investigator: Anthony Suruda. *(TI researchers secured funding through DOL/ESA, helped develop the RFA, and provided technical assistance to the project).*

Surveys of Construction Employers and Young Construction Workers, Principal Investigator: Carol Runyan. (*TI researchers secured funding through DOL/ESA, helped develop the RFA, and provided technical assistance to the project).*

Grants
Prospective Study of Hearing Damage Among Newly Hired Construction Workers, Principal Investigator, Noah Seixas. (*TI researchers secured partial funding for this project through DOL/ESA).*

Work Injury and Young People: A Prospective Survey, Principal Investigator: Curtis Breslin.

Adolescent Toxic Exposures in the Workplace, Principal Investigator: Alan Woolf.

On the Job Injury in South Texas Middle School Children, Principal Investigator: Sharon Cooper.

Safety and Youth Employment: A Study of Parents and Teens, Principal Investigator: Carol Runyan.

Curricula Developed in TI- Supported Community-based Demonstration Projects
Safe work/safe workers: a guide for teaching high school students about occupational safety and health. Massachusetts Department of Public Health and Children's Safety Network, 1997.

Teens, work, and safety: a curriculum for high school students. University of California, Berkeley Labor Occupational Health Program, 1998.

Safe jobs for youth. UCLA Labor Occupational Safety and Health (LOSH) Program, 1998.

Educational Materials Used in Outreach by Massachusetts Young Worker Surveillance Project, some Modified from Brockton Community-based Demonstration Project. Similar products were developed in the other Community-based projects, but are not reflected below:

Protecting Young Workers: A Guide for Building a State Surveillance System for Work-Related Injuries to Youths. *A how-to guide on conducting surveillance for work-related injuries to youths.* (2005)

Are You a Working Teen? *Pamphlet for teens with information on child labor laws and health and safety* (2004)

Under 18 and hurt on the job?: Information on Workers' Compensation. *Pamphlet for teens on workers' compensation*. (2002)

Massachusetts Employers' Guide: Young Worker Health & Safety and the Child Labor Laws. *Recommendations for employers and a poster of the child labor laws applicable in Massachusetts.* (2003)

Child labor Laws in Massachusetts. *Revised poster summarizing state and federal child labor laws*. (2006)

Protecting Your Working Teen: A Guide for Parents. *One sheet version of former pamphlet containing child labor laws and related information. Available in English and Portuguese*. (2002)

Protecting Working Teens: A Guide for Health Care Providers. *Pamphlet for health care providers with information about child labor laws and what to talk to teens about regarding work.* (2003)

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Runyan CW, Santo JD, Schulman M, Lipscomb JH, Harris TA [2006]. Work hazards and workplace safety violations experienced by adolescent construction workers. *Archives of Pediatric & Adolescent Medicine 160*(7):721-727.

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Lipscomb HJ, L Li [2001]. Injuries among teens employed in the homebuilding industry in North Carolina. *Injury Prevention 7*:205-209.

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Woolf AD, Garg A, Hillel AR, Lesko S [2001]. Adolescent toxic exposures in the workplace: trends in the United States and comparisons to adults. *Pediatric Research 49* (Part 2): A7.

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Appendix 2: Traumatic Injury Intramural and Extramural Projects

Intramural

More information is available for selected listed intramural projects. Follow the links to access additional detail on the goals, activities, outputs and outcomes of these studies.

Acute Back Injury

9278000	Evaluation of Best Practices Back Injury Prevention Program
9278435	Effectiveness of Training and Controls in Nursing Homes
9278879	Evaluation of the Efficacy of Back Belts in Material Handling Workers
9278943	Psychosocial Risk Factors for Injury in Retail Material Handling Workers
9278823	Laboratory Evaluation of Back Support Belts
VLD8890	Evaluation of Muscle Strength for Handling Lg-Size Materials
VLE824	Nursing Home Back Intervention Study
VLE8944	Evaluation of Retail Material Handlers Communication Intervention

Emergency Responders

927002N	Communication Materials for 1st Responders
927008F	Ambulance Crash Survivability Improvement Project
92700BK	Biomechanical and Physiological Study of Firefighter Boots
9277136	Evaluation of Emergency Services Occupant Safety
9277136D	Evaluation of Emergency Services Occupant Safety
9278861	Fire Fighter Fatality Investigation and Prevention Program
927AT13	World Trade Center Surveillance Study
927AT15	Disaster Recommendations for Emergency Worker Safety & Health

Falls from Elevation

9270025	Fall Prevention for Aerial Lifts in the Construction Industry
9277110	Preventing Injuries in Telecommunication Tower Construction
9277271	Occupational Hazards of Roofers
9278426	Harness Design and Sizing Effectiveness
9278884	Dynamic Scaffold Modeling for Fall Protection
9278955	Influence of Visual Cues Work at Heights
59278104B	Suspension Tolerance in Men/Women Wearing Safety Harnesses
927000A	Lab Testing of Adjustable Safety Rail-Roof Bracket Assembly
927006Q	Sensory-Enhanced Balance Control at Elevated Workplaces
9278066	Footwear for Improved Balance Control in Construction Work

Machines

9277051	Prevention of Vehicle and Mobile Equipment-Related Injury
9277085	Lockout/Tagout, Jammed and Moving Machinery Controls
9277241	Safety System to Protect Workers from Caught-In Injury
9278061	Evaluation of a New Method for Machinery Risk Reduction
9278818	Development of Automatic ROPS
9278885	Development of Automatic ROPS Overturn Sensor
927006T	Commercialization of a Cost-Effective ROPS (CROPS) Design
9277178	New Technology to Increase ROPS Use on Tractors
9277178D	New Technology to Increase ROPS Use on Tractors

927P148	Lockout/Tagout, Jammed and Moving Machinery Controls
VAJ882	Hazard Control Evaluation of Cardboard Paper Baler Safety Device Tech

Motor Vehicles

9277051	Prevention of Vehicle and Mobile Equipment-Related Injury
9278810	Developing a CIB on Occupational Motor Vehicle Deaths
927008D	Motor Vehicle Safety and Health Research Coordination
927008E	Risk Factors for Vehicle Crashes among Public Employees
927008X	Evaluation of Safety Training for Spanish Speaking Roadway Workers
92700B9	Occupational Motor Vehicle Safety & Health Research Center
9278107	Effectiveness of Collision Warning System in Large Trucks
927P151	Evaluating Roadway Construction Work Zone Interventions
927S163	Evaluating Roadway Construction Work Zone Interventions
VLB808	Motor Vehicle Safety and Injury Prevention

Workers in Alaska

9277041	Aviation Safety in Alaska
9277173	Surveillance of Non-Fatal Work-Related Injuries in Alaska
9277394	Injury Prevention in the Commercial Fishing Industry
9278893	Occupational Injury Prevention in Alaska
92700BL	Deck Safety for Commercial Fishing Vessels

Workplace Violence

9277120	Evaluation of State-Based Workplace Violence Prevention
9277166	Intervention Strategies for Taxi Cab Drivers
9278109	Prevention of Violence Against Nurses: Feasibility Study
9278313	Workplace Violence Initiative: Research and Implementation
9277327D	Work-Related Violence Against Women
9278180R	Evaluation of Workplace Violence Prevention in VA Hospitals
Q	Workplace Violence: Research for Prevention
VLE843	Homicide in Convenience Stores: An Evaluation of Prevention Strategies

Youth

9277059	Young Worker Regional Health Education Center
9277269	Injuries and Illnesses Among Farm Youth in the U.S.
9277407	NIOSH Internet Page/Site for Adolescents
9278953	Childhood Agricultural Injury Surveillance
9278954	Child Ag. Injury Prevention
927006N	OS&H Assistance to Vocational/Technical Schools
927008W	Evaluation of OSH Training of Young Workers
9277187R	Young Worker Safety
VIE8088	OS&H Training for Voc. Ed.
VLB8806	Surveillance of Occupational Injuries Among Children and Adolescents

PROJECT ID: 9278435 - Effectiveness of Training and Controls in Nursing Homes

PROJECT OFFICER: Robert Park

END OUTCOMES: An estimation of what effects various intervention programs in nursing homes have had on reducing workers compensation claims and costs.

INTERMEDIATE OUTCOMES (IO): provide knowledge that will lead directly to intervention programs for reducing injuries in nursing home workers.

FINAL CUSTOMERS: Bureau of Workers Compensation (BWC).

INTERMEDIATE OUTPUTS:

INTERMEDIATE CUSTOMERS:

TRANSFER ACTIVITIES:

OUTPUTS:

ACTIVITIES:

INPUTS: Using workers compensation records for the period 1995-2001, we have performed preliminary analyses of intervention effectiveness in Ohio nursing homes focusing on programs offered by Ohio Bureau of Workers Compensation (BWC).

PROJECT ID: VLE8944, 9278879, 9278943
Project name: Evaluation of Retail Material Handlers Communication Intervention
PROJECT ID: 9278879
Project name: Evaluation of the Efficacy of Back Belts in Material Handling Workers
PROJECT ID: 9278943
Project name: Psychosocial risk factors for injury in retail material handling workers

END OUTCOMES:

The expected or potential end outcomes of the evaluation of back belts (that concludes that there is no reduction in back injuries or back pain) is to redirect efforts and attention toward other measures (e.g. engineering controls) that could reduce the burden of back injury and back pain among material handlers. Data from the Department of Labor, Bureau of Labor Statistics indicates that the number of lost time injuries has steadily decreased. Following the publication of the research results in 2000, there was a 10% decline the first year (255,774 overexertion back injuries reported involving lost work days in 2000, to 230,523 in 2001) and 8% decline in 2002 (212,229 injuries reported) followed by a 13% decline in 2003 (184,850 injuries reported). Other external factors may be responsible for the reduction in injuries, but specific causes have not been definitively identified.

INTERMEDIATE OUTCOMES (IO):

Although not well quantified, some intermediate outcomes have been noted. Anecdotally, there has been a shift in the type of safety products advertised in safety trade journals. The emphasis on back belts before the publication of the research results has shifted to other safety products and there has been a reduction in the number of advertisements for back belts. Annual sales figures for back belts are not available.

FINAL CUSTOMERS:

The final customers for this research include material handling workers, their employers, safety managers, unions and manufacturers of safety equipment. The result of this research is intended to change the emphasis on back belts for back injury and back pain prevention. Alternative practices and behaviors toward different measures to reduce back injuries and back pain should be considered, instead of back belts.

INTERMEDIATE OUTPUTS:

Anecdotally, it was noticed that there was a shift in the type of safety products advertised in safety trade journals. The emphasis on back belts before the publication of the research results has shifted to other safety products and there has been a reduction in the number of advertisements for back belts. Annual sales figures for back belts are not available.

INTERMEDIATE CUSTOMERS:
Intermediate customers consist of the extensive press coverage through an Associated Press article that appeared in about 400 newspapers nationally and a video news release. CBS Evening News' covered the back belt study on Dec. 5,2000 including an interview with Acting NIOSH Director, Dr. Larry Fine.

TRANSFER ACTIVITIES:

Partners: A number of partners were involved in this project including:

- Wal*Mart corporation. Provided employees time to participate in the telephone surveys.
- Battelle Corporation. Conducted the telephone surveys and data management under contract.
- University of Massachusetts, Lowell. Dr. Laura Punnett conducted a direct observation task analysis in a limited number of workplaces.
- University of Pittsburgh. Dr. Roslyn Stone, consultant on design and analysis.
- Dr. David Kleinbaum, informal consultation.
- Manuscript reviewers: Thomas Hodous, Harvey Checkoway, Barbara Silverstein, Ellen Eisen, and Laura Punnett.

Scientific Publications:

1. Johnston JM, Landsittel DP, Nelson NA, Gardner LI, Wassell JT [2003]. Stressful psychosocial work environment increases risk for back pain among retail material handlers, Am J Ind Med 43(2):179-187.

2. Wassell JT [2003]. Studies on Back Belts in the Workplace, Salud (i) (SIIC) (i)Ciencia-Voice of the Sociedad Iberoamericana de Informacion Cientifica (SIIC), March 3, 2003.

3. Bobick TG, Belard J-L, Hsiao H, Wassell JT [2001]. Physiological effects of back belt wearing during asymmetric lifting, Applied Ergonomics 32(2001):541-547.

4. Giorcelli RJ, Hughes RE, Wassell JT, Hsiao H [2001]. The effect of wearing a back belt on spine kinematics during asymmetric lifting of large and small boxes, Spine *26*(16):1794-1798.

5. Wassell JT, Gardner LI, Landsittel DP [2001]. A Study of Back Belts to Prevent Back Pain and Injury, Injury Insights Newsletter, June 2001 (June):1-2.

6. Wassell JT, Gardner LI, Landsittel [2001]. Does back belt use prevent on-the-job back pain and injury? Injury Insights *2001*(June/July):1.

7. Wassell JT, Landsittel DP, Gardner LI, Johnston JM [2001]. Do Back Belts Prevent Back Injury? In reply to letters to the editor. JAMA 285(9):1152.

8. Wassell JT, Gardner LI, Landsittel DP, Johnston JJ, Johnston JM [2000]. A prospective study of back belts for prevention of back pain and injury, Journal of the American Medical Association 284(21):2727-2732.

9. Gardner LI, Landsittel DP, Nelson NA [1999]. Risk factors for back injury in 31,076 retail merchandise store workers, Am J Epidemiol 150(8):825-833.

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11. Gardner LI, Collins JW, Johnston JJ, Wassell JT [1997]. Efficacy of back belts for prevention of back injuries in material handling workers. Presented and published in the proceedings of the 4th Annual Conference for Managing Ergonomics in the 1990's: A Discussion of Science and Policy Issues, Cincinnati, OH, June 17-20, 1997.

ACTIVITIES

This effort consisted of three projects. The main project was a prospective evaluation of the efficacy of back belts to prevent back injury and back pain in material handling workers.

The aim of this study was to evaluate stretchable industrial-type back supporting belts in preventing initial and recurrent low back injuries in retail store employees. The study was conducted in workers with the highest lifting exposures from 160 Wal-Mart stores distributed across 30 different which ranged geographically from New Hampshire to Michigan in the north and from Florida to Texas in the south. Between April 1996 and April 1998, 50 new stores and 110 newly expanded stores (combination supermarket and merchandise) were enrolled in the study on the day they first opened for customer sales. A prospective cohort study was conducted following sequential assignment (according to store opening date) of groups of store to either the usual belt wearing policy or voluntary belt use. In this study, 89 stores required back belt use and 71 stores had voluntary belt use.

Limitations of previous epidemiologic studies were addressed through longitudinal data collection, assessment of physical work exposures, data collection of adequate sample sizes, and assessment of psychosocial factors using validated scales. A survey contractor conducted telephone interviews using trained interviewers. Baseline and follow-up interviews (approximately 6 months later) consisted of questions covering work history, lifestyle habits, medical history, job activities, psychosocial factors, belt wearing habits and demographic information.

Study results made significant contributions to the literature by providing higher quality information on the value of back belts in preventing workplace injuries, and thus provided a more definitive, scientific basis for future recommendations to industry and the public. The study found no statistically significant differences in back injury rate or the percentage reporting back pain comparing workers who often used back belts and those whose self-reported back belt use was infrequent or never.

A second project was undertaken to develop and implement a comprehensive communication strategy to increase worker and management understanding of, and participation in, the NIOSH back belt study. This study increased awareness of the study and facilitated the telephone interview process through enhanced public relations between the employees, their managers and the contract interview staff.

A third project focused on the psychosocial factors (such as job satisfaction, job demands, and worker control). The interview data for approximately 8,000 workers in 160 retail stores was analyzed to determine if psychosocial factors are causally related to low-back injuries. Previously, these factors had not been definitely established as causes of injury, therefore this study addressed the issue that psychosocial factors are risk factors for back strain injuries and falls. The study involved baseline data and data over a 26-month period in 160 Wal-Mart Stores. This research generated new information about the etiology of injury and its relationship to both individual and larger organizational influences. The results provided information to prioritize and guide future organizational-level intervention strategies. The results were published in the scientific peer review literature.

In this study, WalMart Corporation contributed thousands of employee hours, as interviews were conducted during regular work hours, in a separate area. Battelle developed the interview instrument and conducted the extensive telephone interviews consisting of 151 items. There were 9,377 completed baseline interviews and 6,311 completed follow-up interviews. AFEB staff developed the research protocol, secured Human Subjects Research Board approval, Office of Management and Budget approval and had general oversight of the study. AFEB received data from Battelle and conducted the full statistical analysis of the data. PTB participated in the direct observation task analysis in a small number of selected stores. PTB also conducted laboratory evaluations of the back belts effects on human physiology and biomechanics parameters which were published in separate peer reviewed papers.

INPUTS

Study Management structure:

AFEB staff developed the research protocol, secured Human Subjects Research Board approval, Office of Management and Budget approval and had general oversight of the study. AFEB received data from Battelle and conducted the full statistical analysis of the data. WalMart Corporation contributed thousands of employee hours, as interviews were conducted during regular work hours, in a separate area. Battelle developed the interview instrument and conducted the extensive telephone interviews consisting of 151 items. There were 9,377 completed baseline interviews and 6,311 completed follow-up interviews. PTB participated in the direct observation task analysis in a small number of selected stores. PTB also conducted laboratory evaluations of the back belts effects on human physiology and biomechanics parameters which were published in separate peer reviewed papers.

Summary of stakeholder input:

WalMart Corporation developed an interest in the effectiveness of back belts in response to questions from employees and a recognition by their management that NIOSH guidelines and some published studies were equivocal in the assessment of the value of back belts. Prompted by employees' questions, WalMart agreed to partner with NIOSH to determine the efficacy of back belts.

PROJECT ID: Evaluation of Muscle Strength Capability for Handling Large-Size Materials

END OUTCOMES: None to report at this time.

INTERMEDIATE OUTCOMES (IO): None to report at this time.

FINAL CUSTOMERS: The final customers are construction contractors and sub-contractors who are involved with scaffolding work, either in original construction or maintenance and repair activities. This will include health and safety practitioners who are responsible for keeping these workers safe.

INTERMEDIATE OUTPUTS: None to report at this time.

INTERMEDIATE CUSTOMERS: Scaffold manufacturers, scaffold renting companies; labor associations; safety and health professionals; and other fall-prevention researchers.

TRANSFER ACTIVITIES: This project provided practical recommendations for scaffold workers to mitigate the likelihood of postural imbalance while allowing for the generation of sufficient isometric force to handle the weight of a scaffold end frame. A hand separation of 46 cm at between the elbow and chest heights is suggested as an optimal hand location for a conceptual assistive lifting device (e.g., a light-weight clip bar) for scaffold disassembly job. At least 95% of the construction population would have isometric forces in excess of the weight of scaffold end frame and also be able to mitigate the likelihood of postural imbalance. An alternative method without an assistive device would be a hand location slightly higher than the elbow height with a hand separation of 116.8 cm. This is a compromised situation that yields 2.4 times isometric strength of the scaffold weight with a little risk of postural imbalance. The research results also suggested that scaffold erectors adopt the symmetric side-carrying method as the primary technique for handling the current scaffold end-frames and that a light-weight end frame (e.g., use of reinforced light-weight materials) has the potential to reduce injury risk among scaffold handlers during their scaffold erection and dismantling jobs, based on the study results on worker stepping response, postural stability, and perceived task difficulty. All the recommendations were published in peer-reviewed journals and were presented in both scientific and trade association conferences.

OUTPUTS:

Hsiao H., Hause M., Powers J., Kau T., Hendricks C., Simeonov P., Effect of Scaffold-End-Frame Carrying Strategies on Worker Stepping Response, Postural Stability, and Perceived Task Difficulty (Submitted to Human Factors, 2006)

Cutlip R., Hsiao H*., Becker E., Garcia R., and Mayeux, B., Optimal Hand Locations for Safe Scaffold-End-Frame Disassembly, Applied Ergonomics, 33(4): 349-355, 2002

Hsiao H., Guan J., Mayeux B., and Cutlip R. Identifying Less Stressful Work Methods: Computer-aided Simulation vs. Human Subject Study, Society of Automotive Engineers Technical Paper #2000-01-2163, 2000.

Cutlip R., Hsiao H. Mayeux B. [2000] Laboratory Evaluation of Isometric Strength Associated with Typical Scaffold End Frame Disassembly Postures, 14th Triennial Congress on the International Ergonomics Association, San Diego, California, July 30 - Aug 4, 2000.

Cutlip R., Hsiao H*., Becker E., Garcia R., and Mayeux B., Comparison of Postures for Scaffold End Frames Disassembly, Applied Ergonomics, 31, pp 507-513, 2000.

Cutlip R., Hsiao H., Becker E., Garcia R., and Myers J. Isometric Strength during Scaffold End Frames Disassembly, Society of Automotive Engineers Technical Paper #1999-01-1907, 1999.

Hsiao, H. [1997] Erection and Dismantling of Frame Scaffolds: Safety and Ergonomics, Proceedings of the 13th Triennial Congress of International Ergonomics Association, Finland, June 29 - July 4, 1997.

Hsiao H. and Stanevich R., Biomechanical Evaluation of Frame Scaffolding Tasks, International Journal of Industrial Ergonomics, 18, pp407-415, 1996.

ACTIVITIES:
Four experiments were conducted to address the overexertion and fall injury hazards associated with scaffold end-frame disassembly. The first experiment involved with 12 construction sites and 29 workers to identify commonly used scaffold disassembly techniques; computer simulations were also performed to determine the biomechanical stress induced on workers for each disassembly technique. The second experiment identified the most favorable scaffold end-frame disassembly techniques by measuring whole-body isometric strength capability of 46 participants for each disassembly posture. The third experiment determined the optimal hand location for a conceptual assistive lifting device to mitigate potential postural imbalance while reducing overexertion hazards during scaffold disassembly. The whole-body maximum isometric strength of 54 construction workers was measured in nine postures; these postures were selected based on the results from the second experiment. The last experiment evaluated the effect of scaffold end-frame carrying methods on worker performance, under various work conditions, to determine the most favorable strategy to carry scaffold end frames for minimizing the risk of being struck by an object, falls, and overexertion injuries. Three carrying methods, four types of work surfaces, two weight levels of scaffold frames, and three directions of stepping movement were tested in a laboratory with eighteen healthy construction workers, using a repeated-measures design. Stepping-response time, postural instability, and task difficulty rating were appraised.

The first experiment identified six common lifting techniques used by scaffold workers. Computer simulations showed that considerable biomechanical stress occurs to most of the workers at their shoulders, elbows, and hips. The second experiment indicated that symmetric front-lift method with hand locations at knuckle height would be the most favorable posture; at least 93% of the male construction worker population could handle the end frame with minimum overexertion risk. However, adequate postural stability cannot be reached when the workers placed their hands at the knuckle height. The third experiment determined that a hand location between elbow height and chest height with a hand separation distance of 46 cm (a conceptual, light-weight assistive bar) would allow workers to generate sufficient isometric strength (about twice that of the scaffold weight) to disassemble the typical 22 kg scaffolds while concurrently allowing them to mitigate the likelihood of postural imbalance. The last experiment suggested that scaffold erectors adopt the symmetric side-carrying method as the primary technique for handling the current scaffold end-frames and that a light-weight end frame (e.g., use of reinforced light-weight materials) has the potential to reduce injury risk among scaffold handlers during their scaffold erection and dismantling jobs, based on the study results on worker stepping response, postural stability, and perceived task difficulty.

INPUTS: The primary input for the development of this project was the Bureau of Labor Statistics data and a National Constructors Association report on assessment of carpenter injury risks needing research.

PROJECT ID: 927002N - Communication Materials for 1st Responders

PROJECT OFFICER: Ralph Zumwalde

END OUTCOMES: Update of recommendations posted on the NIOSH web site for emergency responders in the use of eye protection drafted for external review; revisions to interim recommendations for respirator cleaning and sanitation and for traumatic stress was drafted for internal review.

INTERMEDIATE OUTCOMES (IO): Educational materials for emergency responders that address the proper selection and use of personal protective equipment (PPE) as well as other recommendations intended to prevent injury and illness during rescue and recovery operations.

FINAL CUSTOMERS: Emergency responders

INTERMEDIATE OUTPUTS: Subsequent evaluations of the hazardous conditions found at these disaster sites will be used to update existing and develop new recommendations..

INTERMEDIATE CUSTOMERS:

TRANSFER ACTIVITIES: collaborate with other NIOSH research staff and external partners in the development of appropriate communication products to convey recommendations (i.e., PPE, hazard assessment) for protecting emergency responders at disasters involving the structural

OUTPUTS: Updated recommendations for eye safety have been drafted while revisions to recommendations on respirator cleaning and sanitation, and on reducing traumatic stress for responders have been initiated

ACTIVITIES: identify the safety and health risks associated with rescue and recovery operations at a structural collapse of a large building and provide recommendations for protecting emergency responders.

INPUTS:

PROJECT ID: CAN 008F, Ambulance Crash Survivability Improvement Project

END OUTCOMES:

The end outcome for this project has yet to be realized. However, the project expects to significantly reduce the risk of ambulance crash-related injury and death to emergency medical service (EMS) workers by influencing ambulance manufacturers, emergency medical service (EMS) providers, and standards setting bodies to improve ambulance crashworthiness by design revision.

INTERMEDIATE OUTCOMES (IO):

The Winter Park Fire Department has requested NIOSH assistance in evaluating the efficacy of new ambulance designs which they recently placed into service.

NIOSH was invited to collaborate with the National Highway Traffic Safety Administration (NHTSA) and the National Registry of Emergency Medical Technicians (NREMT) in analyzing NREMT survey data characterizing EMS worker ambulance safety.

FINAL CUSTOMERS:

Fire fighters – Currently, 45% of all Emergency Medical Service is fire department based, and 65% of fire department responses are for medical aid.

EMS workers throughout the U.S – Researchers estimate that there are over 800,000 volunteer and professional EMS workers nationwide.

INTERMEDIATE OUTPUTS:

INTERMEDIATE CUSTOMERS:

The International Association of Fire Fighters

GSA Engineering and Commodity Management Division

Ambulance Manufacturers Division (AMD) of the National Truck Equipment Association

Ambulance manufacturers including; Collins Industries, Medtec Ambulance Corporation, Horton Emergency Vehicles Co., AEV Inc./American Emergency Vehicles, Marque Inc.

EMS equipment manufacturers including EVS Ltd. and Ferno-Washington Inc.

The National Association of State EMS Directors

National Registry of Emergency Medical Technicians (NREMT)

The National Highway Traffic Safety Institute (NHTSA) Office of Emergency Medical Services.

Occupant restraint manufacturers including Allied Services Systems and Schroth Safety Products

TRANSFER ACTIVITIES:

Project staff routinely present at EMS conferences and meetings

OUTPUTS:

Presentations:

"Selection of Dependent Variables to Evaluate EMS Worker Activities in Ambulance Patient Compartments" Bobick, TG, Lucien Brouha Work Physiology Symposium, Keystone, Colorado. September 1-2, 2004.

"National Institute for Occupational Safety and Health Research to Improve Ambulance Safety" Moore PH, Bobick TG, Current RS, EMS Expo 2006 Las Vegas, Nevada, September 28, 2006.

ACTIVITIES:

This project builds upon research results and cooperative relationships stemming from a previous project, the Evaluation of Emergency Service Vehicle Occupant Safety.

The project staff are currently conducting a human factors evaluation aimed to identify obstacles to occupant restraint use in ambulance patient compartments. Three systems are being evaluated, the lap belts that are currently equipping U.S. ambulances, and two mobile occupant restraints that incorporate harnesses and retractor-mounted tethers. Evaluation of the crash performance of the mobile restraints by the previous project indicated that they offered a significant improvement over lap belts in preventing harmful contact with patient compartment cabinets and bulkheads. The human factors evaluation is exploring the impact that using the restraints may have on the ability of EMS workers to perform their work. As of September 18, 2006, heart rate and task-completion time data for 8 subjects have been collected in a pilot testing phase of the study. The data is collected while the subjects perform simulated patient care tasks in a moving ambulance patient compartment using an EMS training manikin. The pilot data will support refinement of the test methodology in preparation for a more extensive test of 30 or more subjects in the early spring of 2007.

NIOSH has contracted with ARCCA Inc. to identify typical mounting techniques for EMS equipment normally carried in the patient compartment. This equipment, if not adequately mounted to the vehicle, may become injury causing projectiles during a crash. Under NIOSH direction, ARCCA Inc. has begun engineering studies of the equipment and mounts. This study is expected to result in recommendations for standards and testing methods to eliminate the danger of crash-induced projectile injury.

NIOSH, through an inter-agency agreement with the Naval Air Warfare Center Aircraft Division (NAVAIR), is supporting head impact studies of the performance of energy absorbing foams. These foams may be strategically placed within the patient compartment to prevent transfer of injury causing energy during crash-induced occupant head impacts with cabinets and bulkheads. NAVAIR is conducting computer simulations and impact tests at 17 mph using 50^{th} and 95^{th} percentile manikins that will identify the material specifications and recommendations to support the proper selection of foam for padding. In addition, NIOSH has contracted with CALSPAN Corporation to conduct supplemental impact tests at 3 different temperatures and speeds of 23 and 30 mph. Results of these tests will be used to expand and refine recommendations resulting from the NAVAIR study.

Project staff are assisting the Winter Park Florida Fire Department in evaluating the department's new ambulances. The patient compartments of these vehicles use a non-typical layout that is intended to reduce the need for EMTs to move about the compartment during patient transport. The department is administering a user survey using methodology suggested by project staff. Winter Park FD is supplying engineering drawings of the layout to NIOSH that will be used to construct a computer model. NIOSH will use the model along with anthropometry data to evaluate the layout ergonomics. Using the same techniques and a NIOSH owned ambulance, the project is evaluating the ergonomics of the GSA KKK-1822E Specifications for the Star-of-Life ambulance. These efforts are expected to support recommended changes to the specifications that will result in safer and more efficient patient compartments.

NIOSH is working with AMR, the NREMT and NHTSA's Office of Emergency Medical Services to characterize the scope of non-fatal injuries to EMS workers in patient compartments. Previous NIOSH work identified an injury surveillance gap for non-fatal ambulance crash-related injury. Contrary to national level crash-related fatality data, similar data for non-fatal injury does not exist at a national level. What data exists, resides in the custody of private sector entities and is not generally available to public sector researchers. NIOSH, at NHTSA's invitation, conducted joint analysis with NREMT of their 2004 membership survey of ambulance safety. This work resulted in a draft article that has been submitted for publication to the Journal of Emergency Medical Services. The draft is currently undergoing journal review. Through a letter of agreement, AMR has provided NIOSH access to their employee injury and compensation database. AMR has over 4000 employees in 34 states, and this joint effort has potential to provide a more comprehensive picture of the non-fatal ambulance crash injury situation than previously available to government researchers.

INPUTS:

Preliminary results from the NIOSH project, "Evaluation of Emergency Service Vehicle Occupant Safety."

PROJECT ID: Biomechanical and Physiological Study of Firefighter Boots

ROJECT OFFICER: Sharon Chiou, Ph.D.

PROJECT START DATE: 01/01/05

PROJECT END DATE: 09/30/07

END OUTCOMES:
No outcomes have been achieved.
This project is still in the phase of data collection. The project is scheduled for completion in FY07. The end outcome of this project is expected to a reduction of biomechanical and physiological stresses upon firefighters caused by the weight of firefighter boots if results are incorporated into new consensus standards about boot selection.

INTERMEDIATE OUTCOMES (IO):
No intermediate outcomes have been achieved, other than completion of annual research milestone targets. The intermediate outputs for this study include (1) NFPA 1971 standard update and revisions regarding how firefighter boot weight and design affect firefighters' physiological and biomechanical stress; (2) boot selection guidelines for firefighters and fire departments; (3) boot performance guidelines (rubber vs. leather; light vs. heavy) for boot manufacturers.

FINAL CUSTOMERS:
The customer for this research includes 1.1 million firefighters (who are 95% male, 5% female, 3% black, & 2% Hispanic), as well as federal and industrial firefighters, and 670,00 emergency medical service workers who are employed in over 28,579 municipal fire departments and 6,000 EMS departments.

INTERMEDIATE OUTPUTS:
No intermediate outcomes have been achieved, other than completion of annual research milestone targets. The primary intermediate output will be the establishment of a new boot performance and selection guideline created by the NFPA or adopted by local fire departments.

INTERMEDIATE CUSTOMERS:
The intermediate customers include (1) The National Fire Protection Association (NFPA) 1971 Standards Committee – Protective Ensemble for Structural Fire Fighting; (2) US and Canadian Certified Firefighter Boot Manufacturers; (3) International Safety Equipment Association (ISEA); (4) Canadian Safety Organization (CSO); and (5) International Standards Organization (ISO).

TRANSFER ACTIVITIES:
Findings from this study will be disseminated through firefighter conferences, the NFPA, journal publications, trade magazines, and stakeholder meetings. Results from this study will be delivered to the NFPA technical committee and recommendations will be incorporated into their guidelines and standards to improve firefighter boot performance standards. Furthermore, findings from this project will be translated to the workplace through collaborative efforts between NIOSH and certified firefighter boot manufacturers.

OUTPUTS:
The outputs of this project will include conference presentations, peer-review journal articles (External Publication Sub-Category), and meetings with stakeholders -- NFPA 1971 standards committee in FY08 (Dissemination).

ACTIVITIES:
This project is a laboratory study which will be conducted over a two-and-one-half-year period. Twenty-five female and 25 male career or volunteer firefighters will be recruited and tested for physiological and biomechanical responses while performing several simulated firefighting tasks (e.g., climbing a ladder, carrying a hose pack, and dragging a 145-lb dummy) in the laboratory. Subjects' physiological responses will be determined by metabolic and respiratory variables including energy expenditure, minute ventilation, and peak flow. Standard anthropometric measurements will be recorded of the lower extremity and foot for both genders. Subjects' biomechanical responses in performing simulated fire fighting tasks will be determined by examining their whole-body center-of-mass movements as well as joint loadings (e.g., joint forces and moments).

This laboratory-based study will provide important outcomes which are expected to impact emergency response and fire department workers, emergency response and firefighter boot manufacturers, and the US national standards setting body responsible for oversight of structural fire fighting policy (NFPA). The long-term outcome goal is to provide much needed biomechanical and physiological data to the NFPA 1971 standards committee to revise and update their standards for protective ensembles for structural fire fighting.

INPUTS:
The National Fire Protection Association (NFPA) Standard 1971 technical committee is in the process of revising its Structural Fire Fighting standard. The committee is very interested in including recent, objective data on the physiological and biomechanical effects of firefighter boot weight and design for men and women in future standard revisions and has specifically requested the assistance of NIOSH, DSR, Protective Technology Branch, in conducting and interpreting this research.

PROJECT ID: CAN 7136, Evaluation of Emergency Services Vehicle Occupant Safety

END OUTCOMES:

To date, the end outcome has not been accomplished. However the project expects to significantly reduce the risk of ambulance crash-related injury and death to emergency medical service (EMS) workers by influencing revision of the General Service Administration KKK1822 Specifications for the Star-of-Life Ambulance; by disseminating information regarding crash injury mitigating tactics to emergency EMS service providers and workers; and by introducing manufacturers of occupant restraints to the EMS vehicle and equipment market.

INTERMEDIATE OUTCOMES (IO):

This project has identified an untapped market for manufacturers of vehicle occupant restraints. In implementing the project, NIOSH worked collaboratively with four private sector restraint system manufacturers. As a result, Schroth Safety Products, with over 40 years of experience designing products and applications for a wide range of international vehicle users and manufacturers (including amateur and professional automobile racers, military and civilian aviation, and military ground vehicles), is actively marketing restraints to ambulance manufacturers and has developed collaborations with several ambulance manufacturers, and a seat manufacturer to incorporate Schroth restraints into new ambulances.

American Medical Response (AMR) and American Emergency Vehicles' (AEV) concept ambulance incorporates restraint systems influenced by NIOSH sled and crash test results. AMR, in cooperation with AEV, has incorporated the Schroth restraints, as tested by the NIOSH project, into one concept vehicle. This vehicle incorporates several new innovations intended to increase patient compartment safety, including improved occupant restraints. The vehicle is being used as a demonstrator at various EMS conferences throughout 2005 and 2006, and to gauge AMR employee acceptance of its features.

EMS Ltd, a manufacturer of seats for use in ambulance patient compartments, has developed first generation seats that replace the standard 3-point lap and shoulder belt with mobile occupant restraints manufactured by Schroth Safety Products, or Allied Services Systems. EVS is currently working to refine their seat design to better utilize the capabilities of the restraints.

The Winter Park Fire Department's newly purchased ambulances incorporate design changes based on NIOSH sled and crash test results. The Winter Park Fire Department in cooperation with Med Tec Industries, an ambulance manufacturer, has developed two new ambulances that incorporate redesigned patient compartments. These compartments are designed to minimize the need for emergency medical technicians (EMTs) to move around the patient compartment. Of note, the Winter Park Fire Department eliminated the CPR seat location and adjacent equipment cabinet based on information contained in NIOSH crash test videos. The new ambulances also incorporate an improved 5-point occupant restraint manufactured by Schroth Safety Products. Use of the Schroth 5-point restraint resulted from Schroth's marketing campaign to ambulance manufacturers.

The General Services Administration (GSA) and the Ambulance Manufacturers Division (AMD) of the National Truck Equipment Association have used NIOSH project results and NIOSH supplied anthropometric data to support development of revision E to the KKK 1822 Specification for the Star-of-Life Ambulance. This specification, which has been adopted by 34 state Emergency Medical Services (EMS) departments, is the principal driver of U.S. ambulance design and is maintained by GSA, in cooperation with AMD. Virtually every U.S. ambulance and EMS equipment manufacturer is a member of AMD. KKK 1822E is currently undergoing industry and public comment and includes specifications for increased head clearance above seats, based in part on NIOSH project results. Revision E is scheduled for full implementation during the 3rd quarter of FY2007.

FINAL CUSTOMERS:

Fire fighters – Currently, 45% of all Emergency Medical Service is fire department based, and 65% of fire department responses are for medical aid.

EMS workers throughout the U.S – Researchers estimate that there are over 800,000 volunteer and professional EMS workers nationwide.

INTERMEDIATE OUTPUTS:

NIOSH ambulance crash test videos were incorporated into an emergency vehicle operators training DVD and course curriculum developed by the International Association of Fire Fighters (IAFF) for its membership. As well, numerous professional and volunteer EMS services and fire departments have requested NIOSH crash test footage to support their local training programs.

INTERMEDIATE CUSTOMERS:

The International Association of Fire Fighters

GSA Engineering and Commodity Management Division

Ambulance Manufacturers Division of the National Truck Equipment Association

Ambulance manufacturers including; Collins Industries, Medtec Ambulance Corporation, Horton Emergency Vehicles Co., AEV Inc./American Emergency Vehicles, Marque Inc.

EMS equipment manufacturers including EVS Ltd. and Ferno-Washington Inc.

The National Association of State EMS Directors

National Registry of Emergency Medical Technicians

The National Highway Traffic Safety Institute (NHTSA) Office of Emergency Medical Services.

U.S. Fire Administration

The Phoenix Arizona Fire Department

The Ontario Ministry of Health and Long Term Care, Ontario Canada

United States Army Tank-Automotive Research and Development Center

The Canadian Forces Health Services Group

TRANSFER ACTIVITIES:

Because the project was implemented in cooperation with private sector partners, data from sled and crash testing has been to four restraint system manufacturers and one cot manufacturer. Schroth Safety Products, H. Koch & Sons Co, Pacific Scientific, and Allied Services Systems have received test data packages that can be used to support design refinements that will improve the crash performance of their restraint systems. Ferno Washington has received a data package that can be used to improve the crashworthiness of patient cots and cot mounting systems.

Public sector project partners include: The Phoenix Arizona Fire Department; the Ontario Canada Ministry of Health and Long Term Care, the United States Army Tank-Automotive Research and Development Center, and the Canadian Forces Health Services Group. Each of these entities received a complete data package containing sled and crash test results that can be used to support improvement of EMS transport safety and vehicle safety in general.

From 2002 to 2006, members of the project staff have disseminated preliminary data results at EMS and firefighter conferences.

Crash test data, including vehicle acceleration pulses, was disseminated through a presentation before the February 2002 AMD meeting.

Members of the project staff have disseminated preliminary project results in face-to-face meetings with ambulance manufacturers including; Collins Industries, Med Tec Ambulance, Horton Emergency Vehicles, and AEV Inc./American Emergency Vehicles.

DVDs containing NIOSH and NHTSA ambulance crash investigation reports have been sent to numerous EMS and Fire Departments.

NIOSH staff are in regular communication with GSA, and have provided GSA with data to inform revisions to the KKK 1822E standard.

The final report for the sled and crash tests will be widely disseminated to the EMS community, and associated peer-review journal articles will be published.

OUTPUTS:

Crash Investigation Reports:

National Highway Traffic Administration crash reconstruction reports funded by NIOSH documenting environmental and vehicular circumstances and the injury mechanisms for patient compartment occupants present during an ambulance crash:

NHTSA CA02-028, 1999 Ford E-350 Super Duty Van Chassis W/Wheeled Coach Type III Ambulance Body, New Jersey, July 2002

NHTSA CA02-009, 2000 Ford E-350 Type III Ambulance, Kentucky, March 2002

NHTSA CA02-033, 1995 Ford E-350 Type III Ambulance, Minnesota, July 2002

NHTSA CA03-004, 1997 Ford E-350 Type III Ambulance, Kentucky, January 2003

NHTSA DS02-003, Wheeled Coach Moduvan Ambulance on a 1997 Ford E-350 Series Chassis, Washington, February 2002

Three NIOSH investigation reports documenting the circumstances present during fatal ambulance crash incidents.

F2003-33, Career Fire Fighter/Emergency Medical Technician Dies and Paramedic is Injured in a Three-Vehicle Collision – Nebraska

FACE 2001-11, 26 Year-Old Emergency Medical Technician Dies in Multiple Fatality Ambulance Crash – Kentucky

FACE 2001-12, Emergency Medical Technician Dies in Ambulance Crash – New York

Papers:

Proudfoot, SL, Romano, NT, Bobick, TG, Moore, PH, *"Ambulance Crash-Related Injuries Among Emergency Medical Services Workers -- United States, 1991 - 2002"* Morbidity and Mortality Weekly Report, February 28, 2003/Vol. 52/No. 8.

Proudfoot, SL, *"Ambulance Crashes: Fatality Factors for EMS Workers,"* published in Emergency Medical Services, Volume 34, Number 6, June 2005.

Green JD, Moore PH, Current RS, Yannaccone J, Day D, Proudfoot SL, Bobick TG, Romano NT, *"Reducing Vehicle Crash-Related EMS Worker Injuries Through Improvements in Restraint Systems"* Conference proceedings XVIIth World Safety Congress, Orlando FL, September 20, 2005.

Presentations:

Ambulance Crash-Related Injuries Among EMS Workers, Bobick TG, Current RS, Romano NT, Green JD, Moore PH, presented at NOIRS 2003, October 22-30. NOIRS 2003, October 29, 2003.

"A Review of NIOSH Research to Support Ambulance Worker Safety," Current RS, the National Truck Equipment Association's (NTEA), Ambulance Manufacturers Division (AMD) winter business meeting February 2004, Tampa, FL.

"Evaluation of Emergency Service Vehicle Occupant Safety" Green JD, presented at the National Association of State EMS Directors meeting, October 8. 2004

"*Ambulance Crash Injuries Among EMS Workers,"* Moore, PH, presented at International Association of Fire Chiefs, Fire-Rescue Med 2005, April 20-22.

"*Ambulance Safety in the Fire Service,"* Proudfoot SL, presented at 2005 NFPA World Safety Conference and Exposition, June 6-10.

"Reducing Vehicle Crash-Related EMS Worker Injuries Through Improvements in Restraint Systems," Green JD, poster presentation at Safety 2005, the American Society of Safety Engineers Annual Conference and Exposition, June 12-15.

"Ambulance Safety in the Fire Service," Proudfoot SL, Fire Department Safety Officers Apparatus Symposium 2006, Las Vegas NV, January 2006.

"Evaluation of Emergency Service Occupant Safety," Moore PH, Current RS, Green JD, Proudfoot SL, Bobick TG, Romano NT, Yannaconne J, Day D, Whitman G, NORA 2006, poster presentation, Washington, DC, May 9 and 10, 2006.

"*Evaluation of Emergency Service Occupant Safety,"* Moore PH, EMS Care 2006, Linthicum Maryland, April 30, 2006.

"*Evaluation of Emergency Service Occupant Safety,"* Moore PH, Green JD, EMS Safety Net 2006, Atlanta Georgia, June 9, 2006.

"*Ambulance Safety in the Fire Service, an Update,"* Proudfoot SL, Moore PH, NFPA World Safety Conference & Exposition, Orlando Florida, June 4-8 2006.

ACTIVITIES:

This project used the public health model to identify the risk and engineering interventions for vehicle crash-related injury for EMS workers in ambulance patient compartments. The project was implemented through a series of cooperative and contractual partnerships, and shared funding and staff resources from public and private sector organizations.

The NIOSH project staff conducted analysis of NHTSA's Fatality Analysis Reporting System (FARS) to identify and describe the scope of the problem.

NIOSH conducted fatality investigations to identify incident circumstances and injury risks for patient compartment occupants during ambulance crashes. Through an Interagency Agreement, NIOSH funded NHTSA's Center for Statistics and Analysis Crash Investigation Division NRD-32 to conduct crash reconstructions of ambulance crashes. These reconstructions identified environmental and vehicular circumstances and the injury mechanisms for patient compartment occupants during ambulance crashes. The NIOSH and NHTSA investigations identified contact with patient compartment interior surfaces as the primary injury source, and that EMS workers rarely used the lap belt restraints equipping current ambulances because they precluded patient access.

NIOSH and its engineering services contractor, ARCCA Inc., partnered with the U.S. Army Tank-Automotive Research, Development, and Engineering Center (TARDEC) to identify crash injury interventions. Through a FedBiz Ops announcement, 9 restraint systems that allowed EMT mobility within the patient compartment while providing crash protection were identified. Four mobile-type occupant restraint systems that addressed the injury risks and circumstances identified through the crash investigations were selected for further engineering evaluation. ARCCA Inc, supported by TARDEC and NIOSH funds, evaluated system performance using computer simulation. Based on the computer simulation, NIOSH invited Schroth Safety Products, H. Koch and Sons Co, Pacific Scientific, and Allied Services Systems to partner in conducting dynamic testing of each manufacturer's restraint system.

A series of 29 dynamic tests using instrumented crash test dummies were conducted on the horizontal accelerator (HyGe sled) at Defence Research and Development Canada (DRDC), Toronto, Ontario. Development of the test plan was led by ARCCA Inc. with oversight from NIOSH and significant contribution by DRDC, and Canadian Forces Health Services Group (CFHSG) staff. Testing materials were supplied by the four restraint manufacturers and the Phoenix Fire Department. Logistics and test facility fees were supported by funding resources contributed by NIOSH, CFHSG, and U.S. Army TARDEC. Based on the results of the HyGe sled tests, two restraint systems were selected for further evaluation though full scale vehicle crash tests.

Full scale crash testing was conducted at PMG Technologies in Blainville, Quebec. A series of 4 crash tests were conducted: 3 frontal barrier crash tests at 30 mph using Type III ambulances, and 1 vehicle to vehicle side crash using a Type I ambulance and a small truck. Each test used instrumented crash test dummies to evaluate the 2 mobile-type restraint systems as well as the currently used lap belt system. The test plan was developed jointly by ARCCA Inc, NIOSH, and CFHSG. NIOSH, CFHSG, MOH, TARDEC, Allied Services Systems, and Schroth Safety Products shared funding resources to support facility fees, material costs, and engineering support.

Primary responsibility for test data analysis resided with ARCCA Inc. whose services were supported by shared resources from NIOSH, TARDEC, CFHSG, and the U. S. Fire Administration. Analysis is still ongoing. However, preliminary results have been disseminated by NIOSH staff at various EMS conferences and meetings with ambulance manufacturers and EMS industry leaders.

INPUTS:

A March 2001 seminar by Dr. Nadine Levick and Brian Maguire presented at the NIOSH Morgantown, West Virginia facility. This seminar focused on the gaps in injury surveillance for EMS workers and the lack of engineering interventions for ambulance crash-related injuries.

Discussions with staff from the NHTSA Office of EMS during the spring of 2001 encouraged NIOSH to pursue further research.

Meetings with David Tenenbaum, U.S. Army TARDEC and Gary Whitman, ARCCA Inc. during May 2001.

Discussions and meetings with staff from GSA’s Engineering and Commodity Management Division, in particular Mr. Mel Globerman, since retired. These discussions, beginning in June 2001, indicated support for NIOSH research into ambulance safety and resulted in a regular and continuing dialogue with Mr. Globerman’s replacement John McDonald.

PROJECT ID: CAN 8861, Fire Fighter Fatality Investigation and Prevention Program

END OUTCOMES:

None to report.

INTERMEDIATE OUTCOMES (IO):

- Voluntary consensus standards issued by the National Fire Protection Association (NFPA) incorporate findings and recommendations from the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP). In 2001, NFPA issued a new standard, NFPA 1710 *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*. This standard recommends staffing based on the types of emergency response fire departments are likely to encounter. Mr. Richard Duffy, the Secretary of the Technical Committee that developed this standard, reported that NIOSH fatality investigation reports were used extensively in development of this standard. Many provisions of this standard are also included in a counterpart for volunteer departments, NFPA 1720. Additionally, NIOSH findings and recommendations were referenced in 2002 revisions to NFPA 1500 *Standard on Fire Department Occupational Safety and Health Program,* and NFPA 1561 *Standard on Emergency Services Incident Management System*. These standards cover minimum requirements for a fire service related occupational safety and health program (NFPA 1500), and minimum requirements for an incident management system (NFPA 1561). The following statements are included at the beginning of the NFPA 1561, "*It is interesting to note that their [NIOSH] recommendations listed the use of an incident management system and its associated areas as key components to reducing fire fighter fatalities. NFPA 1561 provides the template on how this can be accomplished; it is imperative that fire departments look at how they operate on a daily basis and use an incident management system. Only then can the technical committee begin to address those other areas that kill over 100 fire fighters a year.*"

- In July 2003, New York State Governor Pataki signed a law that makes it illegal to use people in the role of victims during live-burn fire fighting training exercises. A civil penalty of up to $1,000 can be imposed for violations of the law, which is referred to as Bradley's Law. In late 2001, a volunteer fire fighter died from smoke inhalation and another fire fighter was severely burned during a live training drill. After investigating the death, NIOSH recommended that fire departments prohibit anyone from playing the role of victim during live-burn training, along with other recommendations to improve safety during live-burn training. NIOSH's findings and recommendations were instrumental in leading to the enactment of the New York law.

- In July 1998, the International Association of Fire Fighters requested that NIOSH investigate the circumstances surrounding a series of incidents involving fire fighters who were injured when portable oxygen resuscitators spontaneously ignited and burned. NIOSH worked with the Food and Drug Administration (FDA) that regulates these devices and the National Aeronautics and Space Administration (NASA) that has a long history of relevant expertise in oxygen safety. Investigation into this and similar events revealed that aluminum in the regulator was a contributing factor, and there were a number of safe handling techniques which firefighters and emergency medical technicians could use to reduce the risk of regulator fires. NIOSH and FDA developed a joint public health advisory that was widely distributed to the fire service, and a training video on safe handling of oxygen systems. Most of the reported incidents involved a single manufacturer who voluntarily recalled all regulators of the same model and offered its customers trade-ins to replace the aluminum regulator with a brass regulator. NIOSH is not aware of any subsequent injuries associated with explosions and fires in aluminum oxygen regulators.

- As a result of NIOSH and FDA investigation of oxygen regulator fires, NASA, in collaboration with NIOSH, developed methods to assure that oxygen regulators did not have a propensity to flash or explode from particle impact. The new test method, "Standard Test Method for Evaluating the Ignition Sensitivity and Fault Tolerance of Oxygen Regulators Used for Medical and Emergency Applications" is more reliable than prior test methods and was adopted in 2006 as an active standard by the American Society for Testing and Materials standard (ASTM) (G175-03). Information on this new standard is available at http://www.astm.org/cgi-bin/SoftCart.exe/DATABASE.CART/REDLINE_PAGES/G175.htm?L+mystore+xoqp4502+1158875864).

- In a letter dated April 20, 2005, to the National Fire Protection Association (NFPA), NIOSH raised the issue of probable performance problems associated with Personal Alert Safety Systems (PASS) identified in NIOSH investigations. PASS systems are used by fire and emergency services personnel during emergency operations and emit a signal to summon aid in the event the user becomes incapacitated or needs emergency rescue assistance. NFPA proposed new test methods for the 1982 standard (e.g. Heat Immersion/Leakage Resistance Test and the High Temperature Functionality Test) which were distributed for public comment in December 2005, and will become effective in February 2007.

- A December 5, 2005 article in the Worcester Telegram & Gazette, *5 Years Later: Worcester Warehouse Fire: Lessons Learned Taken to Heart* documented that the fire department which lost 6 fire fighters in a single incident adopted 12 of 13 NIOSH recommendations, including ensuring full implementation of an Incident Command system and using guide ropes to help guide fire fighters out of buildings.

- In February 2006, NIOSH released the fire fighter fatality report F2004-17, "Career Battalion Chief and Career Master Fire Fighter Die and Twenty-Nine Career Fire Fighters are Injured during a Five Alarm Church Fire – Pennsylvania." The Wilkes Barre Times-Leader published an article on March 22, 2006, which included the following statements from the Fire Chief who was hired one year after the fire, "This incident shows the need for how the collapse zone has to be maintained;" "I agree with the recommendations and we're going to try to implement them to the best of our ability." As of September 2006, the Fire Chief has verbally reported implementing 8 of the 10 recommendations made by NIOSH.

FINAL CUSTOMERS:

- Fire Fighters
- Fire Chiefs
- Incident Commanders
- Safety Officers

INTERMEDIATE OUTPUTS:

- Based on preliminary findings from a national sample survey of fire chiefs conducted for NIOSH by RTI international, NIOSH recommendations have been used by some 11,000 fire departments to update the content of their training programs on personal protective equipment, self-contained breathing apparatus, Personal Alert Safety System (PASS) devices, Incident Command System, traffic hazards, radio communications, and other topics. [RTI. Fire Fighter Fatality Investigation and Prevention Program Evaluation: Volume 1: Draft Final Report, August 2006]

- NIOSH has received feedback on a variety of ways in which the fire service, public safety departments, and universities are using fatality investigation reports from the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) to improve fire fighter safety. State fire training academies, including those in Pennsylvania, West Virginia and Tennessee, consider findings and recommendations when reviewing and developing new curriculum. As an example, in Pennsylvania, the training academy instructed 1,200 local instructors to incorporate training on "accountability" into their classes based on a series of NIOSH investigations making recommendations for improving accountability on the fire scene. State agencies involved with transportation safety have also reported using fatality investigation reports in their safety training, including the Pennsylvania Motor Vehicle Training Division and the North Carolina State Highway Patrol. NIOSH is also aware of reports used in university fire safety curriculum, including courses at West Virginia University and Northern Virginia Community College.

- The Pennsylvania State Fire Marshal's office has instituted the use of NIOSH's fire fighter fatality reports in the curriculum of their State-wide fire fighter training. The reports are used to point out facts about Pennsylvania line-of-duty deaths. The Fire Marshal's office is also continuing to work on a CD that will be handed out at each training session. The CD will include all of the NIOSH reports that have been completed in Pennsylvania and will also include other NIOSH reports that cover a variety of line-of-duty deaths. Dissemination of the CD will include an introductory letter that indicates the CD contains NIOSH reports and thanks NIOSH for their help. Note: There have been 19 fire fighter fatality investigations conducted in Pennsylvania.

- A Deputy Fire Marshal provided the following input via email: *"I used the Firefighter Fatality reports published by your organization. These are invaluable as case studies to represent to our young rookies the true hazards of their job. These reports bring the aspect of safety into a reality for them. I know they are safe for having reaped the rewards from the hard work your staff puts into the reports. This is a great and invaluable service to my profession."*

- On April 4th, 2006, the Director/Chief of Safety of the Chicago Fire Department informed the NIOSH FFFIPP that the department uses FFFIPP products in its in-house training of fire fighters, and requested 325 copies of various reports and documents. NIOSH is also aware of routine use of FFFIPP products for training purposes in the following fire departments: Baltimore City, Maryland; Howell Township, New Jersey, and Portland, Oregon.

- In September, 2005, the Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) received written feedback from the training division of a fire department in Ohio regarding the use of the investigative reports in multi-department functions and training exercises for fire fighters. The written feedback stated: "I would also like to express my department's appreciation in providing the NIOSH Firefighter, Death in the Line of Duty Reports. We recently printed dozens of the reports for the National Stand-down for Firefighter Safety for our firefighters to review. The reports are extremely valuable in addressing the need for training. They also address many issues that exist in our department related to training, equipment, procedures and education. The reports, on many occasions, hit close to home in regards to the similarities to our department. The reports stimulate changing an attitude of "it wouldn't happen here" to an attitude and belief that "it COULD happen here." I thank NIOSH for the countless lives they have saved. I believe the NIOSH reports are preventing deaths and serious injury by opening the eyes of those who are involved in the fire service. The reality is, for the most part we, as a fire service, are not killing firefighters in new ways, they are usually similar circumstances. The NIOSH reports continually address these elements that still need to be addressed by each department. I personally and professionally cannot thank NIOSH enough for all the effort and education that results from the NIOSH Firefighter Fatality Reports for the fire service." This feedback provides written evidence of similar verbal feedback that the FFFIPP staff receive across the country at conferences and during investigations.

- The Occupational Safety and Health Reporter (OSHR) published a summary of the March 22, 2006 Stakeholders' meeting [Volume 36 Number 13, March 30, 2006 (ISSN 1522-4082)]. The article concluded that fire service representatives who attended the meeting sent the resounding message that the FFFIPP is successful and should be expanded. The article also documented statements from participants on how their agencies utilize FFFIPP products and recommendations in their efforts to prevent fire fighter deaths. The following are excerpts from representatives at the meeting

  – *"This is a very important program for the International Association of Fire Fighters and we fully support the continuation of this program,"*
  – *"The Program is a consistent reference for safety initiatives and a trusted broker for fire fighter fatality reports" (International Association of Fire Chiefs),*
  – *"Program information is also used by the National Fire Protection Association in the association's annual fire fighter fatality study, its fire service standards, and outside requests for information,"* and

  "Overall the program is well worth it" (National Fallen Firefighter Foundation).

- In July 2005, the Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) received an email from the widow of a fire fighter whose line-of-duty death was investigated through the FFFIPP. The email expressed her gratitude for the comprehensive and informative report that was written as a result of the investigation. The content of the letter follows:

"On behalf of myself and Steve's entire family, I would like to thank you for writing such a comprehensive and informative report. I would especially like to thank you for placing the conclusion to "ensure that the authority to conduct firing out or burning out operations is clearly defined in the SOP and the IAP" in the first position. It pleases me greatly. Above all, I want for other firefighters to learn from the factors that may have caused my husband's death. In my opinion, the rouge backfiring was the most important one.

I would also like to thank you for the examples of "firing" safety guidelines. In May I wrote to the California Occupational Safety and Health Standards Board about the need for such safety guidelines. My petition file number is 469. I will forward a copy of the NIOSH report to their office immediately. I believe that the deadline for their decision will be November 11, 2005. It is my wish that Federal OSHA will consider and adopt firing safety standards as well."

- In response to NIOSH notifying the National Fire Protection Association (NFPA) of potential performance issues with PASS devices, NFPA posted a notice on their website, PASS Alarm Signals Can Fail at High Temperatures, http://www.nfpa.org/itemDetail.asp?categoryID=823&itemID=26606&URL=Codes%20and%20Standards/Code%20development%20process/Technical%20Committees/Special%20 Numerous fire agencies and fire related magazines subsequently ran articles which highlighted the possible problems with PASS devices. The following are a sampling of websites with these articles:

  http://firechief.com/news/niosh_pass_12022005/ Fire Chief Magazine
  http://fe.pennnet.com/Articles/Article_Display.cfm?ARTICLE_ID=242886&p=25&cat=HLTHS Firehouse Magazine
  http://01e.pentonstage.com/500/GlobalSearch/Article/False/12828/ Homeland Response
  http://www.chautcofire.org/pass_alarm_info.htm Oklahoma State Firefighters Association
  http://www.vcos.org/pd-2005/PASSalarm.pdf New York State Department of State Office of Fire Prevention and Control
  http://www.iaff.org/across/news/Archive2005/113005pass.html International Association of Fire Fighters
  http://www.chautcofire.org/pass_alarm_info.htm Chautauqua County Office of Emergency Services

- In July 2003, William Mora, a Captain with the San Antonio Fire Department in Texas, finalized a report that proposed solutions to fire fighter deaths resulting from disorientation, *U.S. Fire Fighter Disorientation Study*. Captain Mora made extensive use of 12 NIOSH fire fighter fatality investigations in his study: "…the study was facilitated by the detailed information provided by the Firefighter Fatality Investigation Reports of the National Institute for Occupational Safety and Health. The reports allowed for the study of specific incidents in which disorientation was known to occur." Captain Mora's report, which proposed four broad-based solutions (Increasing awareness of the hazard, firefighter training, changing fire fighting tactics, and ensuring proper functioning of fire protection systems such as sprinklers), was highlighted in the annual U.S. Fire Administration's annual Firefighter Fatality Report.

- The State of Texas Fire Marshal's office issued an Alert, "Crashes involving fire department water tanker trucks are the leading cause of death in fire service motor vehicle incidents," in March 2006. The Alert was distributed to all fire departments in the State of Texas. The Alert contained recommendations from the NIOSH Hazard ID "Fire Fighter Deaths from Tanker Truck Rollovers," and contained a link to the entire publication.

- By request, the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) provided copies of the FFFIPP Investigation Procedures Manual to fire departments in Utah and Ohio. The Procedures Manual will be used by these fire departments to perform internal investigations into injury incidents and near-misses. Feedback from one of the departments stated "The intent of using the program is to coincide our investigations along with NIOSH in the event of an incident involving fatality or serious injury to a firefighter. We also intend to use the investigation model for any instances that we may have related to serious injuries and any close calls."

- The scenarios and recommendations from five fire fighter fatality investigation reports (F99-34, F2000-07, F2002-04, F2002-24, and F2002-37) were included in a training book regarding fire fighter safety. The book highlights all the recommendations contained in these reports which encompass: fall from ladder, heart attack, protective clothing in wildland fire fighting, vehicular fire, and vehicular crash. The book, Safe Firefighting, Vol. 1: First Things First was published by the Carlisle Publishing Services (McGraw-Hill Companies, Inc). The ISBN number is ISBN-13: 978-007-297913-8.

- On Wednesday, June 21, 2006, thousands of fire departments across the United States and Canada conducted a stand down for fire fighter safety. Every fire department—career, volunteer and combination—was urged to participate by suspending all non-emergency activity and instead focusing on fire fighter safety. This year's Stand Down was focused on emergency vehicle safety, including seatbelt usage and safe driving through intersections. The NIOSH Fire Fighter Fatality Investigation and Prevention Program was a partner with the IAFC and other fire service organizations in this effort. NIOSH reports and recommendations were identified as training tools for the Stand Down, including in a radio announcement. NIOSH also partnered on the first safety Stand Down, held in June 2005.

- The fire fighter fatality report F2002-31 ND (Volunteer Fire Fighter Dies Due to Inadvertent Fireworks Discharge - North Dakota), was reprinted in the Occupational Safety and Health Reporter, Vol. 33, No. 9, pp 193-195.

- "Preventing Deaths and Injuries to Fire Fighters During Live-Fire Training in Acquired Structures" (NIOSH Pub. No. 2005-102) was covered on the Homeland Response website at http://www.homelandresponse.org/full_story.php?WID=12939. Homeland

Response is published by Penton Media, Inc., and is an online resource for the latest personal protection news and products.

- Recommendations for the prevention of struck-by-incidents to fire fighters working along roadways (NIOSH Hazard ID – McFall M., Schmidt E [2001]. *Traffic Hazards to Fire Fighters While Working Along Roadway*, HID 12 - June 2001, Publication No. 2001-143), were published in the American Society of Safety Engineers newsletter *Perspectives* and disseminated nationwide. Arnold, K[2006]. *Perspectives.* American Society of Safety Engineers, Spring 2006, Vol 5, No. 3.

- The Occupational Safety and Health Reporter published the safety hazard warnings developed by FDA/NIOSH regarding the use of plastic crush gaskets on oxygen regulators, and disseminated the information nationwide. BNA [2006]. *FDA, NIOSH Warn of Oxygen Regulator Fires.* Occupational Safety and Health Reporter, Volume 36 Number 18, May 2006.

- Bureau of National Affairs [2006]. "FDA, NIOSH Warns of Oxygen Regulator Fires." Occupational Safety and Health Reporter, Volume 36 Number 18, May 2006. Note: This is a reprint of the joint FDA/NIOSH PHN appearing on the FDA web site.

- *The Occupational Safety and Health Reporter* reprinted several fire fighter fatality investigation reports.

INTERMEDIATE CUSTOMERS:

- International Association of Fire Fighters
- International Association of Fire Chiefs
- National Volunteer Fire Council
- Fire Departments Nationwide (Career, Volunteer, and Combination)
- National Fire Protection Association
- National Wildland Coordinating Group
- State Fire Marshals
- US Fire Administration
- Department of Labor/OSHA
- National Institute of Standards and Technology
- Food and Drug Administration
- Federal Railway Administration
- Equipment manufacturers

TRANSFER ACTIVITIES:

The primary venue for the dissemination of NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) products is the webpage which was specifically designed for the program. The webpage contains links to all fire fighter fatality and injury reports, and publications such as Alerts, Hazard IDs, Workplace Solutions, Bulletins, and Advisories. To encourage routine visits to the webpage for safety and health information, the webpage includes a biweekly quiz requiring users to access NIOSH publications on the webpage to find the correct answer and related information. Also, the webpage provides a section where users can subscribe to the webpage and be automatically notified when a new product is available. The webpage has been an enormous success, for example, there were around 60,000 visits in 2005. Additionally, the webpage provides links to other fire fighter related organizations and pages, including the International Association of Fire Fighters, International Association of Fire Chiefs, Fire Department Safety Officers Association, National Volunteer Fire Council, National Association of Fire Marshals, National Wildfire Coordinating Group, National Fire Protection Association, Fire Marshals Association of North America, Firehouse, and the U.S. Fire Administration. Also, the previously listed fire related organizations provide links to the NIOSH fire fighter webpage.

NIOSH conducts periodic mass-mailings to all 30,000+ fire departments in the United States. The mass mailings are typically done once per year and may contain a packet of five to six reports addressing a variety of situations in which fire fighters have died in the line-of-duty, or a single report thought to be of particular import for the fire service as a whole. Examples of individual reports that have been distributed to all fire departments in the United States include a warehouse fire in Massachusetts that ended in the deaths of six fire fighters (Report No. F99-47), and a training incident in California in which an instructor fell to his death demonstrating an escape procedure portrayed on a training video marketed to the fire service (Report No. F99-25). The escape procedure, which was not recommended by any fire service organization (such as the NFPA, USFA or the International Association of Fire Instructors), involved the potentially dangerous maneuver of exiting a window head first down a ladder.

NIOSH has partnered with fire service magazine editors to reprint summaries of NIOSH fatality reports in their publications and on their websites. These magazines include, *Firehouse*, *Fire Rescue*, *Fire Chief*, *NFPA Journal*, *Responder Safety*, *Responder Magazine*, and *Wildland Fire Journal*. These journals reprinted over 70 fire fatality report summaries through March 2006. The total monthly combined circulation for the 6 magazines is approximately 300,000, reaching a potential audience of over 1,400,000 fire service professionals per month.

In 2005, NIOSH signed a Memorandum of Understanding with the U.S. Fire Administration (USFA) towards encouraging the use of NIOSH Fire Fighter Fatality Investigation Program (FFFIPP) fatality reports and other products in USFA curricula and training. A similar agreement was finalized with the Pennsylvania State Fire Commissioner's office in 2006.

FFFIPP staff participate on the National Fire Protection Association (NFPA) 1500 Committee, *Standard on Fire Department Occupational Safety and Health Program,* and communicate with other NIOSH staff on NFPA committees, such as those addressing equipment. Participation on these committees helps ensure that the committees are aware of findings from the FFFIPP which may warrant revisions to standards.

NIOSH has a representative on the International Association of Fire Chiefs (IAFC), Safety, Health and Survival Section, and works with groups such as the Emergency Responder Safety Institute on safety initiatives.

In the continuing effort to disseminate safety related materials to the fire service, the fire fighter fatality investigation and prevention program has given 44 oral presentations and presented 18 poster sessions. NIOSH routinely has informational booths at major fire service meetings, such as those of the International Association of Fire Fighters and International Association of Fire Chiefs.

OUTPUTS:

Top-Level Category Patent, Print Publication, Web Document, Software, Training, Video, Workshop/Seminar, Database or Information Resource, or Other (w/ narrative description)

- The NIOSH webpage - http://www.cdc.gov/niosh/fire/ - was designed especially for the fire fighter program.
- FEMA produced a video on the Fire Fighter Fatality Investigation and Prevention Program that was aired on the EEnet broadcast system during the Month of April, 2001. NIOSH staff helped develop the format and content for the video and were featured in the video.
- Video - "Hidden Danger: Oxygen Regulator Fires" Rockville, MD: Food and Drug Administration. Available at http://www.fda.gov/cdrh/ocer/dcm/html/gallery.html (NIOSH provided technical and funding support)
- CD-ROM – Fire Fighter Fatality/Injury Reports and Other Related Publications, DHHS (NIOSH) Publication No. 2002-136
- CD-Rom – Fire Fighter Fatality Investigation and Prevention Program, August 2006
- CD-Rom – Fire Fighter Fatality Investigation and Prevention Program, July 2005.

NIOSH Publication Sub-Category: Alert, Criteria Document, Current Intelligence Bulletin, Fact Sheet, Federal Register Notice, Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) report, Fatality Assessment and Control Evaluation (FACE) report, Hazard Control, Hazard ID, Health Hazard Evaluation (HHE) report, Press Release (HHS or CDC press release or NIOSH Update), Workplace Solutions, or Other.

- Fatality and injury reports – Three hundred thirty-two finalized reports can be viewed at the following web page address - http://www.cdc.gov/niosh/fire/
- FDA/NIOSH Public Health Advisory: Explosions and Fires in Aluminum Oxygen Regulators. February 1999
- NIOSH Hazard ID - Braddee R., Washenitz F [1999]. *Fire Fighting Hazards During Propane Tank Fires*, Hazard ID 7 - June 1999, Publication No. 99-129.
- NIOSH Alert – Pettit T., Dunn V., and Main G [1999]. *Preventing Injuries and Deaths of Fire Fighters due to Structural Collapse. August 1999. Publication No. 99-146.*
- NIOSH Alert - Merinar T., Braddee R.W., et al. *Preventing Injuries and Deaths of Fire Fighters due to Truss System Failures*. May 2005. Publication No. 2005-132.

- NIOSH Hazard ID – McFall M., Schmidt E [2001]. *Traffic Hazards to Fire Fighters While Working Along Roadway,* HID 12 - June 2001, Publication No. 2001-143.

- NIOSH Hazard ID – Romano N [2001]. *Fire Fighter Death From Tanker Rollovers*. HID 14 – December 2001, Publication No. 2002-111.

- NIOSH Hazard ID – Cortez K., Mezzanotte T [2002]. *Fire Fighters Exposed to Electrical Hazards During Wildland Fire Operations,* HID 15 - January 2002, Publication No. 2002-112.

- NIOSH Workplace Solutions document - Tarley J, Guglielmo C [2004]. Preventing Deaths and Injuries to Fire Fighters during Live-Fire Training in Acquired Structures. NIOSH Pub. No. 2005-102.

- NIOSH Workplace Solutions document *Divers Beware: Training Dives Present Serious Hazards to Fire Fighters,* NIOSH Publication No. 2004-152.

- NIOSH, Federal Railroad Administration, Operation Lifesavers Inc. Your Safety 1st - Railroad Crossing Safety for Emergency Responders, NIOSH Publication No. 2003-121.

- FDA and NIOSH Public Health Notification: Oxygen Regulator Fires Resulting from Incorrect Use of CGA 870 Seals. June 2006.

- Guidelines - Berardinelli S., McFall M, and Romano N [2005]: *Interim Guidelines for Fire Fighting Operations in the Hurricane Katrina Response,* http://www.cdc.gov/niosh/topics/flood/ff-katrina.html, September 2005.

External Publication Sub-Category: Book/book chapter; Conference proceedings; final grant report; journal article (peer-reviewed); journal article (non-peer-reviewed); etc.

- Baldwin, T. N. [2001]. *Basement Fires: A Lethal Trap.* American Fire Journal, May 2001, p.p. 12-16.

- McFall M [2001]. *Roadway Assistance.* Fire Chief Magazine, 45(3):62-64.

- Washenitz F, Stolfus J. et. al. [2001]. *Fire Incidents Involving Regulators Used in Portable Oxygen Systems.* Injury Prevention. September 2001. pp 24-37.

- Hodous T, Washenitz F, Newton B [2002]. *Occupational burns from oxygen resuscitator fires: The hazard of aluminum regulators.* Am J Industr Medicine 42(1): 63-69.

- Fabio A, Ta M, Strotmeyer S, Li W, Schmidt E [2002]. *Incident-level risk factors for firefighter injuries at structural fires.* JOEM 44(11):1059-1063.

- Hodous TK, Pizatella TJ, Braddee RW, Castillo DN [2004]. *Fire fighter fatalities 1998-2001: overview with an emphasis on structure related traumatic fatalities*. Injury Prevention 2004; 10(4): pp 222-226.

Presentations:

1) Braddee RW [1998]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the National Volunteer Fire Council, Warwick, RI, October 9, 1998.

2) Washenitz F [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Baltimore Fire Safety Conference, Baltimore, MD, July 11, 1999.

3) Cortez K [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Search and Rescue/Disaster Response World Conference and Exposition, Nashville, TN, August 1, 1999.

4) Washenitz F [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Safety and Environmental Management (SEM 334) class, West Virginia University, Morgantown, WV, September 9, 1999.

5) Braddee RW [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Safety and Environmental Management (SEM 310) class, West Virginia University, Morgantown, West Virginia, September 21, 1999.

6) Cortez K [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the National Volunteer Fire Council Meeting, Memphis, TN, October 4, 1999.

7) Washenitz F [1999]. How the NIOSH Fire Fighter Investigation Team Conducts Fatality Investigations. Unpublished paper presented at the NFPA Fall Meeting, New Orleans, LA, November, 1999.

8) Hodous T [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program, an Overview. Unpublished paper presented at the National Institute for Standards and Technology Conference, Gaithersburg, MD, December, 1999.

9) Cortez K [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program and Fire Fighter Fatality Statistics. Unpublished paper presented at the Fire Department Instructors Conference, Indianapolis, IN. February, 2000.

10) Washenitz F [2000]. Fire Fighter Fatality Case Presentations. Unpublished paper presented at the Fire Department Instructors Conference, Indianapolis, IN, February, 2000.

11) McFall M [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the American Society of Safety Engineers, Pittsburgh, PA, February, 2000.

12) Braddee RW [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Professional Fire Fighters of Massachusetts Annual Meeting, Springfield, MA, June 19, 2000.

13) Washenitz F [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program - Fatality Case Presentation. Unpublished paper presented at the Professional Fire Fighters of Massachusetts Annual Meeting, Springfield, MA, June 19, 2000.

14) Mezzanotte T [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Firehouse Conference and Exposition, Baltimore, MD, July, 2000.

15) Washenitz F [2000]. Safety Hazards with Oxygen Systems. Unpublished paper presented at the Firehouse Conference and Exposition, Baltimore, MD, July, 2000.

16) Romano N [2000]. Motor Vehicle Incidents in the Fire Service. Unpublished paper presented at the International Association of Fire Chiefs Conference, Washington, DC, August, 2000.

17) Cortez K [2000]. Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Journal of Emergency Medicine Society Apparatus Maintenance Workshop, Ft. Worth, TX, August, 2000.

18) Braddee RW [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Fire Service Leadership Convention, Fairfax, VA, October, 2000.

19) Washenitz F [2000]. Oxygen Regulator Flash Fires. Unpublished paper presented at the National Occupational Injury Research Symposium 2000, Pittsburgh, PA, October, 2000.

20) Braddee RW [2000]. Overview of the Fire Fighter Fatality Investigation and Prevention Program and Prevention Recommendations. Unpublished paper presented at the National Occupational Injury Research Symposium 2000, Pittsburgh, PA, October, 2000.

21) Myduc Ta, [2000]. Traumatic Occupational Injury Fatalities to Fire Service Personnel, 1992-1998. Presented at the National Occupational Injury Research Symposiums 2000. Pittsburgh, Pennsylvania, October, 2000.

22) McFall M [2001]. Fire Fighter Injury Incident - F2000-43. Presented at the Delaware State Fire Chiefs Association, Newark, Delaware, March 22, 2001.

23) Pizatella T [2001]. Investigating and Preventing Fire Fighter Fatalities. Presented at the program briefing, Atlanta, Georgia, March 23, 2001.

24) Braddee R [2001]. Investigating and Preventing Fire Fighter Fatalities. Presented at the International Association of Fire Chiefs (West), Oklahoma City, Oklahoma, May 6, 2001.

25) Cortez K [2001]. NIOSH's Fire Fighter Program and Two Fatality Incidents. Presented at the National Volunteer Fire Council meeting, Wenatchee, Washington, April 20, 2001.

26) Romano N [2001]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Presented at Firehouse Expo, Rockville, Maryland, July 2001.

27) Braddee R [2001]. Structure Fire Claims the Life of Three Career Fire Fighters and Three Children – Iowa. Presented at 16th Redmond Symposium, Phoenix, Arizona, September 2001.

28) Castillo D [2001]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program's Investigation Database. Presented at the 16th Redmond Symposium, Phoenix, Arizona, September 2001.

29) McFall M [2001]. Restaurant Fire Claims the Life of Two Career Fire Fighters – Texas. Presented at the 16th Redmond Symposium, Phoenix, Arizona, September 2001.

30) Washenitz F [2001]. Restaurant Fire Claims the Life of Two Fire Fighters – Texas. Presented at the FRESH conference, Emmitsburg, Maryland, October 13, 2001.

31) Myduc Ta, M Strotmeyer [2001]. Characteristics of fire fighter line-of-duty motor vehicle-related fatal injury, 1992-1998. Presented at the 129th annual meeting of the American Public Health Association, Atlanta, GA, October 21-25, 2001.

32) Hodous T, Castillo D, Braddee R, Pizatella T. [2002]. NIOSH Fire Fighter Fatality Investigations 1998-2000: Overview with an Emphasis on Structure-related Fatalities. Presented at 6th World Conference: Injury Prevention and Control, May 14, 2002, Montreal, Canada.

33) Merinar T [2003]. Fatality cases involving roof and floor truss failures. Presented at the 17th Redmond Symposium, San Francisco, California, October 2003.

34) Tarley T [2003]. Live-fire Training case study. Presented at the 17th Redmond Symposium, San Francisco, California, October 2003.

35) Tarley J [2003]. Review of NIOSH Fire fighter Structure Fire Fatality – New York. Presented at the NOIRS conference, Pittsburgh, Pennsylvania, November 2003.

36) Powers J [2003]. Visibility: Which Way is Out? Presented at the NORIS conference, Pittsburgh, Pennsylvania, November 2003.

37) McFall M, Lutz V [2004]. Case Studies of the NIOSH Fire Fighter Fatality Investigation Program. Presented at the annual conference of the Minnesota State Fire Chief's Association, Minneapolis, MN, October 21, 2004.

38) Castillo DN. [2005]. NIOSH Fire Fatality Investigation and Prevention Program. Overview and Experiences Relevant to a Near-miss Reporting System. Invited presentation at *National Fire Fighter Near-Miss Reporting System Task Force Meeting*, Reston, VA, March 7-8, 2005.

39) McFall M. [2005]. NIOSH Fire Fighter Fatality Investigation and Prevention Program Overview and Case Studies. Presented at the *West Virginia Fireman's Association's Annual Safety Summit*, Weston, WV, April 2, 2005.

40) Koedam R, Farmer A. [2005]. Risk vs. Gain: Considerations for Working Fires in Unoccupied Structures. Presentation at the NFPA World Safety Conference & Exposition, Las Vegas, NV, June 30, 2005.

41) Koedam R. [2005]. Risk vs. Gain: Considerations for Working Fires in Unoccupied Structures. Presentation at the Firehouse Expo, Baltimore, MD, July 30, 2005.

42) Frederick, L. [2005]. NIOSH Fire Fatality Investigation and Prevention Program. Presentation at the Firehouse Expo, Baltimore, MD, July 30, 2005.

43) Tarley J. [2005]. Live-Fire and Motor Vehicle Fatality Case Studies. Invited presentation at the Ohio State Fire Fighter Association Conference, Wilmington, OH, August 19-20, 2005.

44) Frederick, L [2005]. Fire Fighter Fatalities due to Carbon Monoxide Poisoning. Presentation at the XVIIth World Congress on Safety and Health at Work, Orlando, Florida, September 18-22, 2005.

Posters:

1) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the National State Fire Marshals Convention, 3rd quarter FY99, Las Vegas, Nevada.

2) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the Fire Department Instructors Conference, February, 2000, Indianapolis, Indiana.

3) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the State Fire Marshals Convention, July, 2000, Lexington, Kentucky.

4) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the Firehouse Conference and Exposition, July 2000, Baltimore, Maryland.

5) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Fighters Annual Conference, August, 2000, Chicago, Illinois.

6) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Chiefs Convention, August, 2000, Dallas, Texas.

7) Poster regarding A Potential Univariate Risk Factors for Severe Firefighter line-of-duty injuries. Displayed and presented at the American Public Health Association Annual Meeting, November, 2000, Boston, Massachusetts.

8) Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the 16th Redmond Symposium, September 2001, Phoenix, Arizona.

9) Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the Fire Chiefs Conference, August 2001, New Orleans, Louisiana.

10) Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented Fire-Rescue International Conference, August 2001, New Orleans, Louisiana.

11) Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the Firehouse Expo Convention, July 2001, Baltimore, Maryland.

12) Poster regarding Fire Fighters Deaths From Tanker Truck Rollovers. Displayed and presented at SAFEUSA Leadership Conference, December 2001, Atlanta, Georgia.

13) Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Fighters Conference, August 2002, Las Vegas, Nevada.

14) Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Chiefs Conference, August 2002, Kansas City, Missouri.

15) Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Fighters’ Redmond Conference, October 2003, San Francisco, California.

16) Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the National Safety Congress, October 26-29, 1998, Los Angeles, California.

17) Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program Displayed and presented at the International Association of Fire Chiefs, Fire Rescue International Conference, August 11-14, 2005, Denver, Colorado.

18) Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Fighters’ Redmond Conference, October 23-27, 2005, Honolulu, Hawaii.

ACTIVITIES:

- Identify work situations at high risk for fatal injury or serious injury
- Conduct fatality and injury investigations
- Formulate prevention strategies for those who can intervene in the workplace
- Write Alerts, Hazard IDs, Workplace Solutions documents, Public Health Advisories, and Journal Articles
- Disseminate materials developed through the project
- Conduct meetings with stakeholders to refine and enhance the project
- Make presentations regarding the program to stakeholders
- Attend stakeholders' conferences and distribute safety related materials and network with stakeholders

INPUTS:

In Fiscal Year 1998, Congress recognized the need for further efforts to address the continuing problem of occupational fire fighter fatalities, and funded NIOSH to undertake this effort. NIOSH was given a $2.5 million congressional appropriation to "… conduct fatality assessment and control evaluation investigations to gather information on factors that may have contributed to traumatic occupational fatalities, identify causal factors common to fire fighters fatalities, provide recommendations for prevention of similar incidents, formulate strategies for effective intervention, and evaluate the effectiveness of those interventions."

NIOSH held public meetings to seek stakeholder input on the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) in January 1999, and again in March 2006. This input was used to design, refine and enhance the FFFIPP to ensure it meets stakeholders' needs.

PROJECT ID: World Trade Center Surveillance Study (CAN AT13)

END OUTCOMES:

No end outcomes have resulted from this project.

INTERMEDIATE OUTCOMES (IO):

Although no intermediate outcomes have resulted from this project, findings indicate that emergency responders and disaster site workers are likely to utilize on-site medical care providers for treatment of mild illnesses and minor injuries. Information resulting from this project on the specific types of illnesses and injuries treated on the site of the World Trade Center disaster may be used by these providers in preparing for future disasters.

FINAL CUSTOMERS:

- Disaster site rescue and recovery workers and volunteers
- Leaders of rescue and recovery teams and volunteer organizations
- Emergency responders
- Employers of emergency responders

INTERMEDIATE OUTPUTS:

No intermediate outputs have resulted from this project.

INTERMEDIATE CUSTOMERS:

- Federal Emergency Management Agency, oversees deployment of Disaster Medical Assistance Teams that provide on-site medical care
- Mount Sinai School of Medicine, conducting a medical screening and evaluation program for World Trade Center responders
- Emergency preparedness and response planners

TRANSFER ACTIVITIES:

Results from this project have been disseminated through a peer-reviewed journal and a presentation. An external factor that continues to impact the effective transfer of project findings to our intermediate customers is centered on the multiple governmental reorganizations that occurred following the September 11 tragedy. The most significant for this project was the transfer of responsibility for overseeing the deployment of disaster site medical care units, which moved from an office under the Department of Health and Human Services to an agency under the Department of Homeland Security. Staff reassignments and shifting priorities that transpired during this lengthy transition phase have challenged collaborative transfer activities.

OUTPUTS:

Peer-reviewed journal article:

Perritt KR, Boal WL, The Helix Group Inc [2005]. Injuries and illnesses treated at the World Trade Center, 14 September – 20 November 2001. Prehosp Disast Med 20(3):177 183.

Presentation:

Perritt KR [2005]. Injuries and illnesses treated at the World Trade Center Sept 14 – Nov 20, 2001. Presented for West Virginia University, Institute of Occupational and Environmental Health, April 19, 2005, Morgantown, West Virginia.

ACTIVITIES:

The objective of this project was to evaluate injuries and illnesses sustained by emergency responders and rescue and recovery workers at the World Trade Center disaster site following the September 11 attacks. Two different pre-existing datasets were to be evaluated. First, data recorded on medical forms completed when patients were treated at the on-site Disaster Medical Assistance Team (DMAT) stations were analyzed. These data were obtained through a Letter of Agreement with the Office of Emergency Preparedness, which at the time oversaw DMAT deployments from within the Department of Health and Human Services. The data analysis results have been disseminated through a journal article publication and a presentation. The second pre-existing dataset was obtained from the Mount Sinai School of Medicine, where a medical screening and evaluation program for World Trade Center responders is ongoing. Prior to the program implementation, NIOSH assisted Mount Sinai in developing an injury and illness questionnaire that was self-administered by program participants. Through this module, detailed information was collected on injuries and illnesses that were experienced at the World Trade Center disaster site during the active rescue and recovery operation period. These data, obtained through a data use agreement with Mount Sinai, are being analyzed by NIOSH and will be published along with other findings from the Mount Sinai evaluation program.

INPUTS:

In the month following the September 11, 2001 tragedy, NIOSH was provided with funds to address the needs of workers responding to the attacks. A portion of the funding was used to support this project with the objective of evaluating injuries and illnesses experienced on-site by World Trade Center responders.

Several factors influenced the methods used to accomplish the project objective. First, in October 2001, NIOSH staff were requested to provide technical support to the New York City Department of Health in efforts to develop a registry of those affected by the World Trade Center disaster. In this supporting role, project staff traveled to New York City, witnessing firsthand the need for information related to the distribution of responder injuries and illnesses. A second influencing factor precipitated in November 2001, when NIOSH was approached by a representative of the Office of Emergency Preparedness regarding the possibility of NIOSH obtaining and analyzing data from DMAT records. The ensuing discussions and resulting collaboration directly led to the development of the project protocol for evaluating on-site injuries and illnesses. The final influence occurred through NIOSH support of the Mount Sinai School of Medicine program that provides medical screening and evaluation for World Trade Center responders. In June 2002, the collaboration began for including a respondent-administered injury and illness questionnaire in the Mount Sinai program. This collaboration will continue through the analysis, result interpretation, and publication efforts.

PROJECT ID: HCCB7 9270025 – Fall Prevention for Aerial Lifts in the Construction Industry

END OUTCOMES: The outcome of this project will be the immediate use of the outputs by aerial lift companies involved with design and production of equipment — represent a step forward in the r2p process, and involves purposeful collaboration between a leading manufacturing partner and NIOSH. NIOSH partners have indicated that they are willing to be instrumental in the distribution of this information to end users, design engineers, industrial partners, and other stakeholders. External partners have also expressed a willingness to support future NIOSH endeavors in this area and to express public support for NIOSH research endeavors in public and private forums. This project has implications for many types of lift equipment used in construction, building maintenance, warehousing, and other applications. The involvement of NIOSH in addressing advanced engineering aspects of cross-sector safety research is directly extendable to boom trucks, cranes, scaffolds, and other elevating equipment. Additionally, this project has implications for the entire area of fall safety, in that the safe engineering of mechanized lift equipment is significantly related to many aspect of fall safety for workers operating at height.

INTERMEDIATE OUTCOMES (IO): This project solicited and acted on criteria submitted by industry and union partners from the initial stages. As such, the project has focused on practical value to the occupational and industrial community using aerial lifts. Aerial lifts have different configurations; most companies specialize in one type of aerial lift or another, although there is direct competition in most categories. The company we partnered with is the leading manufacturer (i.e., SkyJack Inc.) of a particular kind of aerial lift, a scissor lift, which is a general purpose, widely used lift with applications in construction, maintenance, warehouse operations, and other applications. SkyJack will review the study results and suggest possible alternative designs, including interventions, for further testing and fabricate possible revised designs of the lift. NIOSH and SkyJack will jointly provide interested parties with test progress results and recommendations. SkyJack Inc. has agreed to extend its letter of agreement with NIOSH, and continue its collaboration with NIOSH in FY07 and beyond to develop, transfer, commercialize the product. So far, all demonstrations perform effectively.

FINAL CUSTOMERS: Aerial lift manufacturers and rental/lease agencies are two major customers of the project. Because of the high risk of litigation related to the use of aerial lifts, corporate officers in the manufacturing sector have high awareness of technological issues related to safety.

INTERMEDIATE OUTPUTS: A letter of agreement (LOA) was signed in 2004 and runs through FY 2007 with the leading scissor lift manufacturer – SkyJack Inc. SkyJack will review the study results and suggest possible alternative designs, including interventions, for further testing and fabricate possible revised designs of the lift. NIOSH and SkyJack will jointly provide interested parties with test progress results and recommendations.

INTERMEDIATE CUSTOMERS: Mr. Boehler from the leading manufacturer – SkyJack Inc., serves as a representative of the industry as a whole. He is a committee member of a number of standards committees relating to aerial lifts. These include the American National Standards Institute (ANSI) A92 Aerial Platforms Main Committee and various A92 sub-committees, the US Technical Advisory Group to ISO Technical Committee 214 Elevating Work Platforms, and the Canadian Standards Association (CSA) B354 Elevating Work Platforms

Technical Committee. Mr. Boehler is also a contributing member of various industry associations including the International Powered Access Federation (IPAF) and Aerial Work Platform Training (AWPT). The latter is a North American subsidiary of IPAF and is dedicated to standardizing the training of aerial work platform operators throughout North America. SkyJack is an AWPT training center, and he is a registered AWPT Operator Instructor. Further, he has presented papers regarding safety and standards within the industry at both Aerial Platform Safety Conferences to be held to date. SkyJack and all other manufacturers will transfer the technologies.

TRANSFER ACTIVITIES: The study has established several media channels to disseminate the progresses and update the project status for all interested parties. These include the Bureau of National Affairs (BNA) Inc. (i.e., the Occupational Safety and Health Reporter), the Lift and Access^{360} (eMagazine), and the newsletter of the Center to Protect Workers' Rights (CPWR). A dissemination strategy for the findings of the project will be developed with the assistance of the American National Standards Institute (ANSI) A92 (Elevating Work Platforms) and A10.29 (Aerial Lifts in the Construction Industry), ISO 16368 (Mobile Elevating Work Platforms), CSA B354 (Elevating Work Platforms) committees. Additionally, the findings and outputs of this project will be disseminated with the collaboration of CPWR, lift manufacturers, and interested parties in the insurance industry.

Also, Aerial Work Platform Training (AWPT) in conjunction with the International Powered Access Federation (IPAF) will examine the findings of the study and potentially adopt useful safety findings of this study for its operator safety training. The Manufacturer's Elevating Work Platforms Council of the Association of Equipment Manufacturers (AEM) will collaborate with the study and disseminate equipment stability findings and operator safety recommendations.

OUTPUTS: Three major outputs for improved equipment design and appropriate safe work practices could be generated. They are outlined as follows:

1. A validated model that could be used to analyze the impact of the following changes on the definition and design of a scissor lift's operational envelope:

   A. Work practices when on the platform at different heights.
   B. Weight and size of tools and building materials used on the platform at different heights.
   C. Existing safety features.

2. An evaluated dynamic effect attributed to the completion of task(s) on a scissor lift platform at different heights (e.g., dynamic curb test and depression test). An evaluated dynamic effect attributed to driving and stopping (jerking) a scissor lift at a range of heights and with a range of loadings on the platform. These measured effects could then be used by future designers as dynamic load amplification factors in standard tip-over analyses.

3. Recommendations for modifications of some design parameters to make the lift safer without significantly increasing its weight, cost, and convenience of use. Some improved designs for safety structures, accompanied with newly-developed intervention techniques, will be proposed, prototyped, and tested in collaboration with lift manufacturers.

Several expected outputs for equipment design and operators' training could be generated. Consensus equipment standards and safe work practices will be proposed through appropriate standards subcommittee(s) (e.g., ANSI A10.29 and/or ANSI A92). Results and recommendations from this study will be disseminated in collaboration with major manufacturers, construction unions, and public service organizations. Further intervention studies and collaborative opportunities can be expected to develop for those workforces operating heavy construction equipment, targeting machinery safety and fall prevention programs.

This study uniquely incorporates a multidisciplinary approach to the engineering design and analysis of a multifactorial safety hazard; the integration of these approaches to develop a comprehensive method for injury prevention represents an opportunity to apply these methods to a range of equipment used in construction, maintenance, telecommunications, and other industries. Engineering designs and analyses that eliminate fall hazards associated with heavy construction equipment are generally accepted as preferred over other methods that attempt to mediate injury outcomes following a fall incident.

Patents, peer-reviewed publications and conference presentations from the project will be produced. A mechanism to develop and commercialize any inventions through the technology transfer process with the collaborating manufacturer (e.g., SkyJack Inc) will be investigated.

ACTIVITIES: In FY03-FY04, the project team reviewed literature and analyzed data to examine injury and fatality databases. The objective of this component was to establish a mechanism to determine research priorities for addressing fall incidents associated with aerial lifts. After completing this data review, a widely used scissor lift model and several key work-tasks were identified for further study. In FY04, a peer review public meeting was completed at the NIOSH Morgantown facility. Manufacturers' representatives, project collaborators, and interested parties proposed constructive comments and possible research directions for consideration for this study at a public meeting. A consensus on the usefulness and research implications of this study for the aerial lift industry and related industries was established.

After the meeting, the objectives of this study were re-examined in light of the peer reviewers' and collaborators' suggestions. The basic project focus was validated as sound, as per suggestions from the interested parties and further study by the Project Officer. The primary focus remained that of developing a comprehensive dynamic computer-simulation model of a 19-foot electric scissor lift, systematically investigating the mechanisms of the tip-over of the lift and the related fall of workers from the lift platform, forming preventive strategies and work practices, and exploring the development of effective safety devices. Additional possible goals include: the examination of the role of pothole guards as an intervention technology and future research directions including the possibility of a feasibility study on the value of instituting a retrofit program for pre-year 2000 scissor lifts without pothole guards, the role of maintenance and bearing wear in older lifts, and the use of aerial lifts as anchorages.

In FY05-FY06, four separate study components have been conducted: (1) A computer simulation model was developed and refined; (2) A workstation to statically measure the center of gravity (CG) of the lift at different heights and to determine horizontal load/stability limits at different heights and workloads was built; (3) Tests to collect interactions and changes in CG and loadings of operator(s) within the platform were conducted; and (4) Dynamic response data for the lift during its horizontal movements were collected. The final model was validated and refined using collected data which includes the following essential parameters: (a) the gravity centers of the lift when the lift is raised to different heights; (b) the dynamic loadings and changes of CG locations due to human operations and placement of tools and building materials on the platform of the lift; and (c) the accelerations and displacements that could be generated during start and stop movements of the lift.

In FY07, a field validation test and additional engineering data from construction worksites will be collected to provide the model with information, which will be used to refine and expand the model, and more importantly, to demonstrate to the audience of union workers, laborers, manufacturers, and users of aerial lift technology, that NIOSH study results can be validated as safe, beneficial and valuable to them and the industry. This approach represents a substantial commitment to the r2p program developed by the Institute, for the development of products jointly with industry, to address hazards known to exist within industrial sectors, and which represent a human and economic burden to the industry, to the workforce, and to society.

INPUTS: Aerial lifts are complex systems, subject to failure from both mechanical problems and operator error. Manufacturers have typically relied on the failure statistics of individual component manufacturers to generate information on times to failure, and have done limited modeling, such as finite element analysis or solid materials modeling, to estimate the service life of individual components subject to failure. This study was formulated to build a research model which can be employed throughout the aerial lift manufacturing industry. This modeling approach is generally done in a highly restrictive fashion, usually in response to a consensus standard calling for system survivability to a specific environmental exposure, such as encountering a pothole while in motion. This study attempts to build upon the limited modeling being done within the industry by adding research data on the dynamic loading effects and center-of-gravity changes imposed by human subjects, as well as, on the dynamic loads imposed by equipment operation in the vertical and horizontal planes.

The specific objectives of this laboratory study are to develop a comprehensive dynamic model of a scissor lift, to systematically investigate the mechanisms of the tip-over of the lift and the related fall of workers from the lift platform, to form preventive strategies and work practices, and to develop effective safety devices. The ultimate goal is to significantly reduce the fatalities and injuries in the operation of scissor lifts.

These objectives represent a unique application of engineering methods and technologies to an emerging occupational safety hazard, and represent an attempt to apply basic and applied engineering research to develop a systematic approach to the prevention of fall-related injuries from aerial lifts. As such, the engineering and scientific expertise being applied to this problem is drawn from a range of disciplines, and includes mathematical modeling, computerized simulations, sensor-based force-data analysis, computer aided design (CAD), biomechanical analysis, human factors engineering, as well as traditional mechanical engineering.

Based on the results of the modeling and laboratory experiments conducted within two DSR laboratories (i.e., High Bay and Human Factors laboratories), the project team will investigate opportunities to increase the overall stability of the aerial lift and improve work practices to minimize human errors. The effectiveness of improved equipment designs and work practices will be evaluated using dynamics analyses (i.e., computer modeling). After potential equipment failures and human errors for causing fall incidents are identified, different corresponding solutions will be proposed.

A dissemination strategy for the findings of the project will be developed with the assistance of the ANSI A92 (Elevating Work Platforms) and A10.29 (Aerial Lifts in the Construction Industry) committees. Additionally, the findings and outcomes of this project will be disseminated with the collaboration of CPWR, lift manufacturers, and interested parties in the insurance industry.

PROJECT ID: 9277110 - Preventing Injuries in Telecommunication Tower Construction

PROJECT OFFICER: Thomas Lentz

END OUTCOMES: Safety messages will be communicated using partnerships with OSHA and industry to produce trade journal articles, compliance directives, NIOSH documents and presentations.

INTERMEDIATE OUTCOMES (IO):

FINAL CUSTOMERS: small business, nonunion workers, and OSHA

INTERMEDIATE OUTPUTS: development of strategies to prevent injuries and fatalities in

INTERMEDIATE CUSTOMERS: safety and health of tower construction workers, and involves hazard characterization

TRANSFER ACTIVITIES: produce trade journal articles, compliance directives, NIOSH documents and presentations.

OUTPUTS: Information for OSHA's priority areas of fall hazards and crane and hoist safety; as well as the objective in the Healthy People 2000 Agenda to reduce deaths from work-related injuries to no more than 4 per 100,000 full-time workers.

ACTIVITIES: conduct surveillance of injuries and fatalities during tower construction; identification of hazards and high-risk activities for tower workers; and increased awareness of hazards and safe practices.

INPUTS: National Traumatic Occupational Fatalities (NTOF) data (1980-1994) identified 123 fatalities related to tower work; eight additional fatal falls from towers were investigated by NIOSH within the past year.

PROJECT ID: 9277271 - Occupational Hazards of Roofers

PROJECT OFFICER: Jerry Flesch,

END OUTCOMES: NIOSH policy/technical document containing a comprehensive evaluation of the work-related health and safety risks of roofers and providing appropriate intervention recommendations to remediate the risks.

INTERMEDIATE OUTCOMES (IO A hazard review or criteria document will be developed to address the hazards and provide recommendations that can be used by OSHA and health and safety professionals.

FINAL CUSTOMERS: Roofers

INTERMEDIATE OUTPUTS: Roofing industry and labor representatives

INTERMEDIATE CUSTOMERS: A hazard review or criteria document will be developed to address the hazards and provide recommendations.

TRANSFER ACTIVITIES: Products will be transferred to be used by OSHA and health and safety professionals.

OUTPUTS:

ACTIVITIES: critically evaluate the health and safety risks associated with roofing work and determine the types of strategies, including training and education that may be required to reduce injuries and exposure to hazardous substances.

INPUTS: BLS data and information from construction industries and labor groups.

PROJECT ID: Harness Design and Sizing Effectiveness

END OUTCOMES: None to report at this time.

INTERMEDIATE OUTCOMES (IO): None to report at this time.

FINAL CUSTOMERS: The final customers are workers, construction contractors and sub-contractors who are involved with roofing work or other jobs that are performed at 6-feet height or above, either in original construction or maintenance and repair activities. This will include health and safety practitioners who are responsible for keeping these workers safe.

INTERMEDIATE OUTPUTS: Research and development efforts at two major US fall-arrest harness manufacturers (MSA Fall Protections Inc. and DBI-SALA Fall Protections Inc.) are currently underway, using NIOSH research results to modify their current harness designs, as well as more extensive efforts to develop the next-generation harness designs and prototypes.

INTERMEDIATE CUSTOMERS: Fall-arrest harness manufacturers, heavy construction equipment renting companies; labor associations; safety and health professionals; and other fall-prevention researchers.

TRANSFER ACTIVITIES:
This project involves significant technology transfer activities with harness manufactures. Letters of agreement have been signed with two harness manufacturers, MSA Fall Protection and DBI-SALA Fall Protection. These agreements provide a framework for conducting research and development activities, as well as subsequent marketing activities, to advance the adoption of this technology by the construction industry and its customers. These two partners have provided design criteria and blueprints for current harness models, as well as consultative services, and continued collaboration on the process of transferring and converting TI findings and intellectual property into harness design. MSA and DBI-SALA are finalizing the adjustment range of each harness component with the NIOSH research team and will complete the prototypes of the new generation harnesses in year 2007 for NIOSH to conduct validation studies to determine the validity and reliability of the newly established sizing system.

American Society of Safety Engineers (ASSE) participation in this process is ongoing, and members have indicated strong support for establishing ASSE/ANSI recommendations for harness design.

OUTPUTS:
NIOSH research has found that thigh strap angle and back D-ring location could be utilized along with current harness static-fit-test criteria to further enhance post-fall harness-fit predictions. The information is useful for construction workers to assure that they select the right size of harness and to don the harness properly. Presentations on this research have been made in national and international trade symposia and have as well been published in leading peer reviewed journals, such as Ergonomics and Human Factors.

Fit-performance-criteria tests revealed that current sizing schemes did not provide adequate fit to as many as 40% of workers due to variations in human body shape, size, and torso composition, strongly suggesting the need for more robust and sophisticated sizing schemes. Mathematical parameters were established to determine the points of contact between the safety harness and human body in its various shapes to define optimal sizing schema. This finding was pivotal in developing relationships with manufacturers and standards committees for more extensive design-criteria development. Additionally, this finding informed discussions with the harness subcommittee of the American Society of Safety Engineers (ASSE) in establishing the need for modification of harness sizing schema. Upon finalization, this project will have two discrete and significant products: A mathematically sophisticated algorithm for minimizing the number of harness-design configurations while simultaneously maximizing the number of workers accommodated by this scheme; and a set of recommendations for producing this limited set of harnesses. Current recommendations are for 4 sizes of harnesses for men, three sets for women for over-the-head style harnesses and 4 to 7 sizes for the vest style harnesses.

Some project-related publications are listed below, which provide new human-body-size-and-shape-quantification methods for anthropometry researchers to advance human-protective-equipment-fit evaluations and provide practical criteria for equipment designers to advance their designs.

Hsiao H., Whitestone J., and Kau T., Evaluation of Fall-Arrest Harness Sizing Scheme, Human Factors, 48, 2006. [in press]

Hsiao H., Bradtmiller B., Whitestone J., Sizing and Fit of Fall-Protection Harnesses, Ergonomics, Vol. 46, No. 12, 1233-1258, 2003.

Hsiao H., Long D., Snyder K., Anthropometric Differences among Occupational Groups, Ergonomics, 45 (2), pp 136-152, 2002.

Hsiao H., Anthropometric Procedures for Design Decisions: From Flat Map to 3D Scanning, Contemporary Ergonomics 2004: Proceedings of the Ergonomics Society Conference. Boca Raton, FL: CRC Press, 2004, April: 144-148.

Friess M., Rohlf F.J., Hsiao H., Quantitative assessment of human body shape using Fourier analysis, SPIE—The International Society For Optical Engineering conference, January 18-22, 2004, San Jose, California.

Bradtmiller B., Whitestone J., Feldstein J., Hsiao H., and Snyder K., Improving Fall Protection Harness Safety: Contributions of 3-D Scanning, Scanning 2000--Numerisation 3D. 5th ed. Proceedings of the Industrial Congress on 3D Digitizing, Paris, France, May 24-25, 2000. Dinard Cedex, France: Harbour, pp. 117-128.

ACTIVITIES:

The overall goal of this research effort is the establishment of anthropometric guidelines for the design of improved full-body harnesses, and the development of an effective harness sizing schema that will best accommodate the current population of U.S. workers. The Traumatic Injury program was in a unique position to address this issue. The program is at the forefront of emerging technology, having acquired the advanced scanning hardware (Cyberware Whole Body Scanner) and associated analytic software systems to perform whole-body 3D scans of workers in both standing and suspended conditions, the same conditions that workers would encounter during work and following a fall from height. The tools and methods of this research overcame a long-standing problem: Human subjects in suspended conditions could go into distress in as little as 5 minutes, making it too hazardous to conduct human-subjects harness-fit tests with traditional anthropometric tools and methods, which were time-intensive and therefore unacceptable for this purpose.

Mathematical parameters were established to determine the points of contact between the human body in its various shapes and the safety harness and to define optimal sizing schema.

Additionally, the power of the NIOSH studies was increased through the addition of data from an international anthropometric database of 2400 subjects, known as CAESAR (Civilian American and European Surface Anthropometry Resource) project. Along with two harness manufacturers, NIOSH researchers have applied the mathematical parameters that were developed through the NIOSH pilot studies to the CAESAR database to establish the adjustment range of each harness component. This is an important step to transfer the scientific research results into industrial design practice.

Two major harness manufacturers have actively participated in this research and are finalizing the adjustment range of each harness component with the NIOSH research team. In the final phase of this research, researchers will conduct validation studies to determine the validity and reliability of the newly established sizing system when the manufacturers complete the prototypes of the new generation harnesses in year 2007.

INPUTS: The primary input for the development of this project were the Bureau of Labor Statistics data on magnitude and cost of construction-related fall incidents and a request from multiple stakeholders through professional meetings with a goal to advance scientific knowledge on formulating harness-sizing schemes and harness designs for various populations, including women and minorities, to assure the required level of protection, productivity, and comfort of harnesses to workers.. These stakeholders include two harness manufacturers, American Society of Safety Engineers (ASSE), International Safety Equipment Association (ISEA), International Society of Fall Protection (ISFP) and California OSHA.

PROJECT ID: HCCB7 9278955 – Influence of Visual Cues at Heights

END OUTCOMES: none to report at this time

INTERMEDIATE OUTCOMES (IO):
The results from this project established the scientific basis for conducting fall prevention research with application of Virtual Reality simulations, and allowed the development of new projects for evaluation of innovative strategies for improving workers balance at elevation. Two new projects have been developed and one project has already been completed with results having direct practical implications for improving workers' safety at elevation.

FINAL CUSTOMERS:
The final customers for the project results will be the workers involved in work at elevation who are at risk for falls, including workers in the construction industry, service, maintenance, transportation, and firefighters.

INTERMEDIATE OUTPUTS:
The study contributions will be to advance knowledge in the area of virtual reality. Potential applications include research on balance control and fall prevention, with emphasis on sensory interfaces interactions – an area in which active research is ongoing.

INTERMEDIATE CUSTOMERS:
Intermediate customers include the scientific community as well as the safety professionals, trainers, developers of safety training programs and employers who have to make safety-related decisions.

TRANSFER ACTIVITIES:
The results of the project have been reported at scientific meetings attended by many safety professionals, and have been published in leading peer-reviewed journals.

OUTPUTS:
Hsiao H, Simeonov P, Dotson B, Ammons D, Kau T, Chiou S.: Human responses to augmented virtual scaffolding models, *Ergonomics*, *48(10)*, 1223-42 (2005).
Simeonov P, Hsiao H, Dotson B, Ammons D.: Height effects in real and virtual environments, *Human Factors, 47(2)*, 430-438 (2005).
Simeonov P, Hsiao H, Dotson B, Ammons D.: Comparing standing balance at real and virtual elevated environments, *Proceedings of the Human Factors and Ergonomics Society 46th Annual Meeting 2002*, Sep-Oct, 2169-2173 (2002).
Dotson-BW; Hsiao-H: Safe work at elevation through virtual reality simulation. NOIRS 2000--Abstracts of the National Occupational Injury Research Symposium 2000, Pittsburgh, PA, October 17-19, 200, Pittsburgh, PA: National Institute for Occupational Safety and Health, 2000 Oct; :60-61

ACTIVITIES:
This project involved a complex and extensive effort of a multidisciplinary team of researchers with diverse qualifications and expertise. The activities included the development and validation of an advanced visualization and modeling laboratory (using a surround screen virtual reality system) and the development and completion of experimental studies with human participants.

The studies applied both real and virtual models of elevation and used augmented virtual scaffolding models to evaluate human psycho-physiological and balance control responses during standing and walking activities (static and dynamic tasks).

One study compared human perceptions of height, danger, and anxiety, as well as skin conductance and heart rate responses and postural instability effects, in real and virtual height environments. The participants performed "lean-over-the-railing" and standing tasks on real and comparable virtual balconies, using a surround-screen virtual reality (SSVR) system. The results indicate that the virtual display of elevation provided realistic perceptual experience and induced some physiological responses and postural instability effects comparable to those found in a real environment. It appears that a simulation of elevated work environment in a SSVR system, although with reduced visual fidelity, is a valid tool for safety research. Potential applications of this study include the design of virtual environments that will help in safe evaluation of human performance at elevation, identification of risk factors leading to fall incidents, and assessment of new fall prevention strategies.

A second study investigated the effect of adding real planks, in virtual scaffolding models of elevation, on human performance in a surround-screen virtual reality (SSVR) system. Construction workers performed walking tasks on real and virtual planks at three virtual heights and two scaffolding-platform-width conditions. Gait patterns, walking instability measurements and cardiovascular reactivity were assessed. The results showed differences in human responses to real vs. virtual planks in walking patterns, instability score and heart-rate inter-beat intervals; it appeared that adding real planks in the SSVR virtual scaffolding model enhanced the quality of SSVR as a human – environment interface research tool. The practical implications of this study are in the adoption of augmented virtual models of elevated construction environments for injury prevention research, and the development of program for balance-control training to reduce the risk of falls at elevation before workers enter a construction job.

INPUTS:
The project concept emerged from in-depth analysis of the information available in the scientific knowledge base and the latest technological developments in the Virtual Reality systems, combined with information from previous research studies at DSR.

PROJECT ID: Suspension Tolerance in Men and Women Wearing Safety Harnesses

PROJECT OFFICER: Nina L. Turner, Ph.D.

PROJECT START DATE: 01/01/2004

PROJECT END DATE: 09/30/2005

END OUTCOMES:
The end outcomes will be to reduce the incidence of suspension trauma in workers who fall while wearing full-body safety harnesses.

INTERMEDIATE OUTCOMES (IO):
The intermediate outcomes will be successful commercialization of the NIOSH-developed harness accessory for the prevention of suspension trauma.

FINAL CUSTOMERS:
Final customers include construction workers and other workers required to wear full-body safety harnesses.

INTERMEDIATE OUTPUTS:
The intermediate outputs will include licensing agreements between NIOSH and those who might be interested in producing the harness accessory.

INTERMEDIATE CUSTOMERS:
Intermediate customers are harness manufacturers and those who are interested in producing the harness accessory.

TRANSFER ACTIVITIES:
Findings are being disseminated at an industrial hygiene conference, and a provisional patent application has been filed.

OUTPUTS:

1) Slide presentation at the American Industrial Hygiene Conference and Exposition:

Turner, N., Weaver, D., Whisler, R., Zwiener, J., and Wassell, J. Suspension tolerance in men and women wearing safety harnesses, American Industrial Hygiene Conference and Exposition, Chicago, IL, 2006. (Abstract No. 144)

2) Provisional patent application filed on July 14, 2006 (CDC Ref. No. I-002-06).

3) Draft manuscript to be submitted to the Journal of Occupational and Environmental Hygiene.

ACTIVITIES:
A total of 22 men and 18 women completed front O-ring and back D-ring suspension tests. A total of 14 men and 11 women completed testing of a unique harness accessory designed to delay/prevent suspension trauma. There were no significant gender differences in suspension time. Mean suspension times for all subjects were 24.4 ± 13.5 min (range 4 – 60 min) and 29.2 ± 12.1 min (range 5 – 56 min, $p < 0.05$) for the CHEST and BACK conditions, respectively. Medical symptoms were the cause of suspension termination in 69% of CHEST tests and 81% of BACK tests, while suspensions were voluntarily terminated in 28% of CHEST tests and 19% of BACK tests. One subject completed a 60-min CHEST suspension. Mid-thigh circumference changes were 1.4 and 1.9 cm ($p < 0.05$), and changes in minute ventilation were 1.2 and 1.5 L/min for CHEST and BACK, respectively. Suspension time was 57.9 ± 5.6 min (range 39 – 60 min) for all subjects for the harness accessory test (CAN 8104C). There were no medical symptoms during tests with the accessory, and 85% of accessory wearers completed 60-min suspensions. These data provide information on tolerance time for wearers of full-body harnesses for standards-setting organizations and demonstrate the potential of a harness accessory to delay or prevent suspension trauma.

INPUTS:
There are no additional inputs.

PROJECT ID: Lab Testing of Adjustable Safety Rail-Roof Bracket Assembly

END OUTCOMES: None to report at this time.

INTERMEDIATE OUTCOMES (IO): None to report at this time.

FINAL CUSTOMERS: The final customers will be construction contractors and sub-contractors who are involved with working on roofs, either in original construction or maintenance and repair activities. This will include health and safety practitioners who are responsible for keeping these workers safe.

INTERMEDIATE OUTPUTS: None to report at this time.

INTERMEDIATE CUSTOMERS: Manufacturers of roofing products; Labor associations; safety and health professionals; and other fall-prevention researchers.

TRANSFER ACTIVITIES: This project has just recently gotten started. One presentation was given at NORA 2 Conference in Washington, D.C. in April 2006. This 5-min presentation was accompanied by a Poster that provided background about the development of the adjustable bracket assembly. A reporter from the newsletter, Inside OSHA, attended the NORA 2 Conference and stopped at the Poster for this project and asked numerous questions. The reporter was interested enough to prepare a short highlight piece on the prototype assembly that was published in May 2006.

OUTPUTS:
1. An Abstract, "NIOSH-Designed Adjustable Roof Bracket and Safety Rail Assembly," was published in the Proceedings of the NORA Symposium 2006, *Research Makes a Difference*, held in Washington, D.C., April 18-19, 2006.

2. A 5-min overview presentation (by the same title) was given at the NORA Symposium 2006.

3. A Poster (by the same name) was prepared and presented at the NORA 2006 Symposium. The Poster provided more detail than the Abstract or the 5-min talk. However, details had to be kept vague since the prototype safety product is going through the patent process. Until the Patent Application is published on the U.S. Patent and Trademarks website, the assembly has to be protected from others acquiring this design and manufacturing it before the prototype can be protected.

ACTIVITIES: Research from a previous project helped to define the need for such an adjustable bracket. The basic design of the prototype assembly was developed and through iterative testing, the design was improved and refined. While the laboratory evaluations were on-going, the patent application was slowly going through the filing process. The Employee Invention Report was submitted during April 2004. The Patent Application was finally filed on October 24, 2005. After the application was filed, an announcement was posted on the Federal Business Opportunities website. A manufacturer of roofing products has been sought to partner with NISOH to manufacture and market this prototype design. We have had discussions with four companies, but none of them has yet agreed to partner with NIOSH in this manufacturing and marketing venture.

INPUTS: The primary input for the development of this prototype safety product was a previous pilot study that evaluated the effectiveness of different guardrail systems. This project identified the need for a highly adjustable roof bracket that could be used in residential construction. Input from external stakeholders could not really be obtained because of the privacy issue related to the filing of the Patent application. After the application was filed in October 2005, a few external researchers and safety practitioners were asked to comment on the basic design of the bracket assembly.

PROJECT ID: HCCB7 927006Q - Sensory-Enhanced Balance Control at Elevated Workplaces

END OUTCOMES: none to report at this time

INTERMEDIATE OUTCOMES (IO): none to report at this time

FINAL CUSTOMERS: The final customers for the project results will be the workers involved in work at elevation who are at risk for falls, including workers in the construction industry, service, maintenance, transportation, and firefighters.

INTERMEDIATE OUTPUTS: none to report at this time

INTERMEDIATE CUSTOMERS: Intermediate customers include footwear designers and manufacturers, safety professionals and employers who have to make safety-related decisions, as well as the research community in the filed of fall prevention.

TRANSFER ACTIVITIES: From the start of the project the research team established collaboration with the inventors of this new technology from the Center of Biodynamics at Boston University, and the developers of sensory-enhancing devices (based on this technology) at Afferent Corporation. At the end of the study, the research findings will be directly transferred to the researchers and the developers of this innovative technology which may facilitate its further development and application in the occupational field.

OUTPUTS: none to report at this time – the study is still ongoing (not completed)

ACTIVITIES:
This project will evaluate the effectiveness of a novel sensory-enhancing technology to improve workers balance at elevation. NIOSH researchers, in collaboration with researchers-inventors from Boston University, built and tested a prototype of randomly-vibrating (smart) shoe inserts. The “smart” shoe inserts increase the pressure-sensitivity under the feet by inducing undetectable mechanical vibrations. The effect of this new device on workers’ postural stability will be evaluated with motion analysis methods, and in simulated construction environments using a surround-screen virtual reality system. Improvements in workers’ balance control will ultimately result in a reduced number of fall incidents in the elevated workplace.

INPUTS:
The project concept emerged from in-depth analysis of the latest information available in the scientific knowledge base, combined with information generated in preliminary research studies at DSR. Stakeholders input (from the inventors from Boston University and the developers from Afferent Corporation) helped to develop a sensory-enhancing device prototype and define the experimental conditions for the study (see transfer activities). Additional input was also received from leading researchers in the field, who served as external reviewers for the project.

PROJECT ID: HCCB7 9278066 - Footwear for Improved Balance Control in Construction Work

END OUTCOMES: none to report at this time

INTERMEDIATE OUTCOMES (IO):
The study triggered a new NORA-related research project, entitled “Sensory-enhanced balance control at elevated workplaces.” The new project will explore the potential effectiveness of an emerging technology “randomly-vibrating shoe inserts,” to improve workers’ balance at height.

FINAL CUSTOMERS: The final customers for the project results will be the workers involved in work at elevation who are at risk for falls, including workers in the construction industry, service, maintenance, transportation, and firefighters.

INTERMEDIATE OUTPUTS:
The study contributions will be to the advancement of knowledge in the area of balance control, and the role of sensory interfaces, i.e., footwear – an area in which active research is ongoing. Specifically, the study results indicate a good potential for developing practice-centered interventions, i.e., the application of procedures for optimal selection and improved design of footwear for work at elevation.

INTERMEDIATE CUSTOMERS:
Intermediate customers include footwear designers and manufacturers, safety professionals and employers who have to make safety-related decisions, as well as the research community.

TRANSFER ACTIVITIES:
From the start of the project the research team established contacts with a leading work-shoe manufacturer (Iron Age Corp.) and the ANSI Accredited Standards Committee Z41 “Performance Requirements for Protective Occupational Footwear,” to pursue the best possible ways for transfer of the research results (the new knowledge for improved footwear selection and design) after the study is completed. Other collaborators included a recognized footwear-biomechanics research laboratory (University of Massachusetts, Amherst), and world leading footwear testing companies (SATRA, Artech Testing), and manufacturers of shoe-testing equipment (Exeter Research). The research results have been reported at two scientific meetings, attended by many safety professionals from the US and internationally, and have been summarized in a research paper and submitted for publication in a leading peer-reviewed journal.

OUTPUTS:
Simeonov P, Hsiao H , Powers J, Ammons D, Amendola A, Kau T, Cantis D. (2005). Footwear effects on walking balance at elevation. (submitted to the journal *Ergonomics*)

Simeonov P, Hsiao H , Amendola A, Powers J, Ammons D, Kau T, Cantis D. (2005) Evaluation of footwear for improved balance at height using virtual reality technology. Presentation at the *XVIIth World Congress on Safety and Health at Work, Orlando, FL.*

Simeonov P, Hsiao H , Amendola A, Powers J, Ammons D, Kau T, Cantis D. (2005) Footwear effects on workers’ instability in a virtual roof workplace. Abstract, in *Proceedings of the American Industrial Hygiene Conference and Expo 2005,* May 21-26, Anaheim, CA, pp. 49-50.

ACTIVITIES:
This laboratory study used virtual reality technology to evaluate footwear style effects on workers' instability at elevation. Construction workers performed standing and walking tasks with three athletic and three work shoe styles on 10"- and 6"-wide planks on a virtual roof. Trunk and foot kinematics and workers' perceptions were collected. Dependent variables included angular velocity of the trunk and the rear foot, and perceived instability and comfort. The study demonstrated that workers' balance on elevated and narrow surfaces was significantly improved with footwear styles which provide good motion control, and shoes with high upper, i.e., boot style. Overall, the study indicated that proper shoe selection and improvements in the design of specialized work footwear would enhance workers' stability at height, and can be an effective intervention strategy to reduce the risk of falling.

INPUTS:
Falls are the leading cause of work-related death in the US construction industry, which employs 9.6 million workers. Each year, on average 367 construction workers die and 22,000 are seriously injured in falls from elevation. The consequences of fall injuries are extremely severe, and result in substantial medical cost - $4.4 billion (Liberty Mutual, 2004). Losing balance has been determined as a triggering event for fall incidents in construction. Field observations indicate that in work at heights i.e., roof construction, workers use various footwear types, some of which may be a contributing factor for loss of balance and fall initiation.

The project concept emerged from in-depth analysis of information available in the scientific knowledge base which was combined with information from field observations of roof construction work. Stakeholders input (from footwear industry and footwear testing experts) further helped to define the experimental conditions for the study (see transfer activities).

PROJECT ID: 7085 – Lockout/Tagout, Jammed and Moving Machinery Controls

END OUTCOMES:

None to report.

INTERMEDIATE OUTCOMES (IO):

Findings from this research have been used by the standards committee that completed a revision of ANSI Z245.5 "Baling Equipment Safety". The latest program information on baler hazards was provided to the committee. The committee is composed of safety experts from baler manufacturers, municipal waste authorities, and waste handling companies.

This project has produced an engineering control for balers referred to as the "JamAlert" System. The project has also entered into a Cooperative Research and Development Agreement (CRADA) with HJA International, a baler controls manufacturer. The CRADA will allow for further development of the "JamAlert" system with the final goal being commercialization of the device.

FINAL CUSTOMERS:

Baler Owners, Baler Manufacturers

INTERMEDIATE OUTPUTS:

None to report.

INTERMEDIATE CUSTOMERS:

Baler Controls Manufacturers

TRANSFER ACTIVITIES:

None to report.

OUTPUTS:

Peered Reviewed Articles:

Mick, T., Means, K., Etherton, J., Powers, J., McKenzie, E.A., "Design Recommendations For Controlling The Jam-Clearing Hazard On Recycling Industry Balers", In the Proceedings of the 2005 American Society of Mechanical Engineers Congress and Exposition, Orlando, FL, November 5-11, 2005.

ACTIVITIES:

This project developed a new safety system for baling equipment that warns the operator of a jam condition. The "JamAlert" System that was developed, is a microprocessor controlled, captured key, system that is integrated with the baler control system and main power. The system monitors the readings from a strain gauge mounted to the shear bar of the baler. If these readings indicate an unsafe condition (baler jammed) the "JamAlert" system will shut down the baler and warn the operator that a jammed condition exists. The operator must then follow a set procedure to lock out the main power, clear the jam, and then reset the system to allow normal operation to continue. A used baler was purchased to perform testing of the "JamAlert" System.

To test the "JamAlert" System, a used horizontal baler was purchased and setup at our local recycling center. Testing was done utilizing various test blocks of cardboard, newspaper, and magazines. To verify the operation of the strain gauge specifically, tests were conducted at West Virginia University utilizing a shear bar mounted to Baldwin testing machine. Test blocks consisting of cardboard, newspaper, and magazines were used. Identical test blocks were used on the research baler and the results of both tests were compared. These results were presented at the 2005 ASME International Mechanical Engineering Congress and Exposition.

This project was also fortunate to create a partnership with HJA International. HJA International was the successful responder to a Sources Sought announcement in Fed Biz Ops for a "JamAlert" commercialization partner. HJA and NIOSH entered into a Cooperative Research and Development Agreement (CRADA) to continue to modify and refine the "JamAlert" System. The goal of the CRADA is to commercialize the "JamAlert" System so that it can be offered on new balers as well as on existing balers.

INPUTS:

None to report.

PROJECT ID: HCCB7 9278061 - Evaluation of a New Method for Machinery Risk Reduction

END OUTCOMES:

This project will contribute to wider use of machine risk assessment methods throughout US industry. NIOSH needs to maintain focus on this project area to measure the rate of adoption of machine risk assessment in the US. Use of risk assessment will contribute to the self-improvement of machine safety by companies rather than waiting for OSHA leverage to improve safety. Machine-related injury rates should decline as a result. Again NIOSH needs to make it a priority to register machine-related injury. The NIOSH project activities have been communicated to the ANSI B11 Machine Tool Safety Accredited Standards Committee and they are taking NIOSH's results into account as they begin to assimilate the ISO 14121 standard on machine risk assessment for application in the US. The ANSI B11 machine risk assessment standard (to replace the current TR3 guideline) is expected to be completed by 2008.

INTERMEDIATE OUTCOMES (IO):

The sites that participated in the evaluation made changes to their machine systems and experienced the benefit of safer operation.

FINAL CUSTOMERS:

The final customers will be machine systems manufacturers, the management in industries using machine systems and the employees operating the machine systems.

INTERMEDIATE OUTPUTS:

The intermediate outputs are the pilot studies at industrial locations, the "train the trainer" workshops that were given to the program teams and the reconfiguring of the safety systems associated with the machine systems at the pilot sites.

INTERMEDIATE CUSTOMERS:

The intermediate customers were the teams that were trained at the Machine Risk Reduction Workshops in the TR3 methodology (based on "Risk assessment and risk reduction – A guide to estimate, evaluate and reduce risks associated with machine tools", ANSI B11-TR3, New York, 2000) who directed the changes to be made to machine systems and evaluated the changes that occurred due to those changes.

TRANSFER ACTIVITIES:

As part of the transfer activities two Machine Risk Reduction Workshops were held in 2002 and 2004.

OUTPUTS:

Results of the pilot study will be published in the Risk Analysis Journal (Etherton J, Main B, Cloutier D, and Christensen W, *Industrial Machine Systems Risk Assessment: A Critical Review of Concepts and Methods*, in press, Risk Analysis Journal. and Etherton J, Main B, Cloutier D, and Christensen W, *Reducing Risk on Machinery: A Field Evaluation Pilot Study of Risk Assessment*, being peer reviewed, Risk Analysis Journal).

An article, Machinery Risk Assessment for Risk Reduction was published in *Human and Ecological Risk Assessment* in 2001. A paper entitled, "Related Machinery Controls for Maintenance Risk Reduction" appeared in the Proceedings of American Society of Safety Engineers Professional Development Conference in 2002 and another, "Empowering Effective Teamwork for Machine Risk Reduction in the Workplace" is in the 2003 proceedings of the American Society of Mechanical Engineers, Congress and Exposition. Two presentations on current NIOSH research on machine safeguarding were given to the ANSI B-11 Committee in 1997 and 1998. Another presentation was made to that group in 2001 concerning machinery risk reduction evaluation. "Risk Reduction with Mechanical Guards" was presented at the 2000 American Society of Safety Engineers Annual Meeting. A presentation, "Empowering Effective Teamwork for Machine Risk Reduction in the Workplace" was made at the 2004 American Society of Mechanical Engineers, Congress and Exposition. The presentation, "We Can Live with Risk: The New ANSI Machine Risk Assessment Guidelines", was presented at the Ohio Safety Congress, and the United Steel Workers/PACE Safety School in 2005. A NIOSH Update: NIOSH, Partners Enter Third Phase of Project to Evaluate ANSI Machine Safety Guideline, was released in 2004. A poster, "A NIOSH Machine Risk Reduction Workshop", was presented at the NORA Annual Meeting in 2003 and a technical session "New Directions in Machinery Risk Assessment" was organized for the 2000 NIOSH Occupational Injury Research Symposium (NOIRS) in 2000.

ACTIVITIES:

In 1995, a US safety standards consensus subcommittee (TR3) was formed under the auspices of the ANSI B11 Machine Tool Safety Standards Committee. NIOSH provided voting member expertise to this group that also includes labor, machine builder, and machine user experts. The ANSI B11 TR3 "Machine Risk Assessment" guideline became available for application in the US in November 2000. The International Standards Organization decided in 2002 to consider implementing the new US machine risk assessment practice into International standard ISO 14121 "Safety of Machinery: Risk Assessment". NIOSH was a member of the US experts ISO team that included automotive industry, packaging industry, and general machine risk reduction experts. Other countries on this ISO committee include Great Britain, England, France, Canada, and Denmark. In 2004, the ISO committee, with NIOSH represented, began work on a final draft of the revised standard. Both the ANSI guideline and the ISO standard provide a process that is being followed in workplaces to ensure that safety measures are appropriate to the risks in machine operation and servicing tasks.

NIOSH and diverse business, labor, and insurance industry partners participated in an extensive three-part study to evaluate the effectiveness of an American National Standards Institute (ANSI) voluntary guideline for preventing occupational injuries from industrial machines.

The NIOSH-led study compares operations involving two similar machines within several companies. In one setting, the ANSI TR3 process was adopted. The matched operation continues to follow traditional safety practices.

In the first phase, completed in 2002, NIOSH led a process to train representatives from the participating companies in the understanding of the TR3 process and the computer software used to put the process into place.

In the second phase, completed in 2003, the representatives in turn formed and trained risk-reduction teams in their companies. The teams were composed of engineering, maintenance, and operating personnel. The teams conducted TR3-based risk assessments using the computer software provided by NIOSH, identified protective measures that would reduce risks, and implemented or tried to implement those measures.

In the third phase, the sites that adopted the TR3 assessment process used the protective measures that they identified through the assessment. This phase took one year. Then NIOSH and its partners reassessed occupational injury data and other safety indicators in the workplaces, to determine whether there were any differences between the operations that adopted the TR3 process, and those that followed traditional safety practices (importantly, whether indicators suggest that the TR3 process enhanced workplace safety). The results of the assessments will soon be published and made widely available to employers, employees, safety professionals, and other partners.

INPUTS:

NIOSH had a representative on the ANSI B11-TR3 committee who provided input to the creation of the risk assessment/risk reduction framework. This approach to machine safety formed the basis for the evaluation and will aid in validating the approach. Inputs of support for the project resulted from NIOSH press releases. Public response to the information in the releases added partners to the project.

PROJECT ID: HCCB7 9278818 - Development of Automatic ROPS

END OUTCOMES: None given

INTERMEDIATE OUTCOMES (IO): Project developed a prototype AutoROPS. This supported a new NIOSH project to develop a marketable versions of the AutoROPS (7178D-New ROPS Technology to Increase Use), which has resulted in a partnership with SCAG Power Equipment, a zero turn mower manufacturer, to pursue an AutoROPS design for a zero turn mowers.

FINAL CUSTOMERS: None given

INTERMEDIATE OUTPUTS: None given

INTERMEDIATE CUSTOMERS: None given

TRANSFER ACTIVITIES: None given

OUTPUTS:
P*eer Reviewed Articles:*
Etherton JR, McKenzie Jr EA, Lutz TJ, Cantis DM, Kau TY. [2004]. An Initial Farmer Evaluation of a NIOSH AutoROPS Prototype. International Journal of Industrial Ergonomics 34:155-165

Etherton JR, Cutlip RG, Harris JR, Ronaghi M, Means KH, Howard S. [2002]. Dynamic performance of the mechanism of an automatically deployable ROPS. Journal of Agricultural Safety and Health 8(1):113-118.

Etherton JR, Cutlip RG, Harris JR, Ronaghi M, Means KH, Gillispie A. [2002]. Static load test performance of a telescoping structure for an automatically deployable ROPS. Journal of Agricultural Safety and Health 8(1):119-126.

Powers JR, Harris JR, Etherton JR, Snyder KA, Ronaghi M, Newbraugh BH. [2001]. Performance of an automatically deploying ROPS on ASAE Tests. Journal of Agricultural Safety and Health 7(1):51-61.

Powers JR, Harris JR, Etherton JR, Ronaghi M, Snyder KA, Lutz TJ, Newbraugh BH. [2001]. Preventing tractor rollover fatalities: performance of the NIOSH AutoROPS. Injury Prevention 7(Suppl. I):54-58.

Harris JR, Ronaghi M, Snyder KA. [1998]. Analyzing tractor rollovers using finite element modeling. Analysis Solutions 2(4):24-25.

Conference Papers

Powers J.R., Harris J.R., Snyder K.A., Ronaghi M., Etherton J.R., Newbraugh B.H., APerformance of the NIOSH AutoROPS@, National Occupational Injury Research Symposium (NOIRS) 2000, Pittsburgh, Pennsylvania, October 17-19, 2000, Abstract, p.12.

Ronaghi M., Harris J.R. , Powers J.R., Snyder K.A., ADynamic Nonlinear Analysis of Tractor Rollovers@, In the Proceedings of the 9th International ANSYS Conference and Exhibition, Pittsburgh, Pennsylvania, August 28-30, 2000.

Powers J.R., Harris J.R., Etherton J.R., Snyder K.A., Ronaghi M., Newbraugh B.H., APerformance of a New ROPS on ASAE Tests@, In the Proceedings of the 93rd Annual International Meeting of ASAE, Paper No. 007005, Milwaukee, Wisconsin, July 9-12, 2000.

Harris J.R., Mucino V., Etherton J.R., Snyder K.A., Means K.H., “Computer simulation of ROPS testing in ASAE S519”, National Occupational Injury Research Symposium (NOIRS) 1997, Morgantown, West Virginia, October 15-17, 1997, Abstract, p.46.

INTERMEDIATE OUTCOMES:
Project developed a prototype AutoROPS. This supported a new NIOSH project to develop a marketable versions of the AutoROPS (7178D-New ROPS Technology to Increase Use), which has resulted in a partnership with SCAG Power Equipment, a zero turn mower manufacturer, to pursue an AutoROPS design for a zero turn mowers.

ACTIVITIES:
A spring-action, telescoping ROPS structure and mechanism have been designed by NIOSH and will be combined with a sensor that detects tractor rollover parameters. The single-post auto-deploying ROPS prototype has been fabricated. The functional components of the single-post of the prototype are being tested in the lab for proof-of-concept for concurrent release, time of deployment, reliable latching, ASAE S519/SAE J2194 static load test satisfaction, and ease of hydraulically resetting the structure after a deployment. During FY99 the laboratory testing of the two-post structure will be completed. The prototype will be field tested where its performance with the overturn sensor will be evaluated. When this device is made available on new tractors, fewer new tractor owners should remove their ROPS and the tractor rollover fatality rate will decrease more rapidly. A review of similar patents was conducted for the patent application on this concept. Further research on the concept is needed to justify a patent. Other project activities have included the acquisition and calibration of a hydraulic testing platform for mechanical test and simulation with full-scale ROPS. A commercially available fixed-post ROPS was tested to ASAE S519 requirements.

INPUTS: None given

PROJECT ID: 8885 – Development of Automatic ROPS Overturn Sensor

END OUTCOMES:

None to report.

INTERMEDIATE OUTCOMES (IO):

Project developed the sensors needed to trigger a prototype AutoROPS. This supported a new NIOSH project to develop a marketable versions of the AutoROPS (7178D-New ROPS Technology to Increase Use), which has resulted in a partnership with SCAG Power Equipment, a zero turn mower manufacturer, to pursue an AutoROPS design for a zero turn mower.

FINAL CUSTOMERS:

Farmers, Tractor Owners

INTERMEDIATE OUTPUTS:

None to report.

INTERMEDIATE CUSTOMERS:

ROPS Manufacturers, Tractor Manufacturers, Mower Manufacturers

TRANSFER ACTIVITIES:

None to report.

OUTPUTS:

Peered Reviewed Articles:

Powers J.R., Harris J.R., Etherton J.R., Snyder K.A., Ronaghi M., Newbraugh B.H., "Performance of an Automatically Deploying ROPS on ASAE Tests", *Journal of Agricultural Safety and Health,* 2001, 7(1):51-61.

Powers J.R., Harris J.R., Etherton J.R., Ronaghi M., Snyder K.A., Lutz T.J., Newbraugh B.H., "Preventing Tractor Rollover Fatalities: Performance of the NIOSH AutoROPS", *Injury Prevention,* 2001, 7(Suppl I):i54-58.

Conference Papers

Ronaghi M., Harris J.R. , Powers J.R., Snyder K.A., "Dynamic Nonlinear Analysis of Tractor Rollovers", In the Proceedings of the 9th International ANSYS Conference and Exhibition, Pittsburgh, Pennsylvania, August 28-30, 2000.

Etherton J.R., Snyder K.A., Ronaghi M., Newbraugh B.H., "Performance of a New ROPS on ASAE Tests", In the Proceedings of the 93rd Annual International Meeting of ASAE, Paper No. 007005, Milwaukee, Wisconsin, July 9-12, 2000.

ACTIVITIES:

This project, in conjunction with CAN 8818, Development of an Automatically Deployed Roll-Over Protective Structure, developed a prototype ROPS that extends automatically if an overturn, in any direction, is imminent. CAN 8818 developed the roll bar, or ROPS structure. This project developed a sensor that will initiate the extension of the ROPS structure. Under normal operating conditions the roll bar will normally be stored out of the way, but will extend to its full dimensions to protect the operator if an overturn occurs. The sensor will be evaluated through laboratory testing and actual field overturns with an instrumented, unmanned tractor, according to the test sequence prescribed in ASAE Standard S519. An automatically-extending ROPS should reduce the risk of injuries from not raising a manually-raised ROPS and from not using a ROPS in a low clearance situation.A spring-action, telescoping ROPS structure and mechanism have been designed by NIOSH and will be combined with a sensor that detects tractor rollover parameters. The single-post auto-deploying ROPS prototype has been fabricated. The functional components of the single-post of the prototype were tested in the lab for proof-of-concept for concurrent release, time of deployment, reliable latching, ASAE S519/SAE J2194 static load test satisfaction, and ease of hydraulically resetting the structure after a deployment. The field testing demonstrated that the sensor and AutoROPS system could detect an overturn and be deployed in sufficient time to protect the operator. The static testing demonstrated that the structure would pass the current testing criteria for ROPS structures. By the completion of the project, there potential improvements to the design had been identified. When this device is made available on new tractors, fewer new tractor owners should remove their ROPS and the tractor rollover fatality rate will decrease more rapidly. A review of similar patents was conducted for the patent application on this concept.

INPUTS:

None to report.

PROJECT ID: HCCB7 927006T - Commercialization of a Cost-Effective ROPS (CROPS) Design

END OUTCOMES: None given

INTERMEDIATE OUTCOMES (IO):
CROPS designs were developed for the Farmall-M, Farmall-H, Ford-3000, Ford-4000, and Ford-8N. These designs were delivered to FEMCO, Inc. and included all engineering assembly drawings necessary for CROPS fabrication. NIOSH researchers located these tractors in the field or at dealerships to collect relevant tractor dimensions for development of CROPS designs. CROPS prototypes for the Ford-3000 and Ford-4000 successfully passed load testing specified in SAE J2194. FEMCO plans to evaluate performance of the remaining three prototypes.

FINAL CUSTOMERS: None given

INTERMEDIATE OUTPUTS: None given

INTERMEDIATE CUSTOMERS: None given

TRANSFER ACTIVITIES: None given

OUTPUTS:
Harris J.R., McKenzie, Jr., E.A., Etherton J.R., Cantis D.M., "Designing Cost-effective Rollover Protective Structures (CROPS) at NIOSH", In the Proceedings of the National Institute for Farm Safety (NIFS) Annual Conference, Ponte Vedra, Florida, June 23-27, 2002.

ACTIVITIES:
In previous work, a cost-effective ROPS (CROPS) with no welds was developed. During the current project, NIOSH researchers collaborated with a ROPS manufacturer to develop and test CROPS designs for five common non-ROPS tractor models.

Comprehensive tractor data from both 1993 and 2001 were used to identify the most popular non-ROPS tractors. "Non-ROPS" does not imply that a ROPS was not available for the tractor, but means that the tractor did not have a ROPS installed when surveyed. NIOSH researchers worked with a ROPS manufacturer, FEMCO, Inc., by Letter of Agreement, to identify popular non-ROPS tractors for investigation. The five tractor models chosen for CROPS development either did not have a retrofit ROPS kit available or had a retrofit ROPS kit available that was relatively expensive. The estimated cost for a CROPS was $290 (shipping and installation not included). The five tractor models selected for this study were the Farmall-M, Farmall-H, Ford-3000, Ford-4000, and Ford-8N. CROPS designs were developed for each of these models, and engineering assembly drawings were delivered to FEMCO, Inc.

CROPS designs were developed for the Farmall-M, Farmall-H, Ford-3000, Ford-4000, and Ford-8N. These designs were delivered to FEMCO, Inc. and included all engineering assembly drawings necessary for CROPS fabrication. NIOSH researchers located these tractors in the field or at dealerships to collect relevant tractor dimensions for development of CROPS designs. Tractor owners and dealers provided important information regarding typical attachments or implements used with the various tractor models. NIOSH researchers incorporated this input in

CROPS designs so that typical tractor function would not be hindered by the CROPS. CROPS prototypes for the Ford-3000 and Ford-4000 successfully passed load testing specified in SAE J2194. FEMCO plans to evaluate performance of the remaining three prototypes. In addition to being cost effective, NIOSH researchers observed that CROPS typically can be installed by one person without special lift-assist equipment.

INPUTS: None given

PROJECT ID: HCCB7 9277178 - New Technology to Increase ROPS Use on Tractors

END OUTCOMES: None given

INTERMEDIATE OUTCOMES (IO):
NIOSH, through a partnership with SCAG Power Equipment, a zero turn mower manufacturer, obtained support for the Office of Technology Transfer and Commercialization (OTTC) to develop an AutoROPS design for a zero turn mower. OTTC is a private, nongovernmental office with the mission of promoting the transition of new technologies to the marketplace. As part of this process, OTTC conducted a marketing study for NIOSH for this technology.

With the help of industry, NIOSH successfully introduced a new American Society of Agricultural and Biological Engineers (ASABE) standard for the NIOSH AutoROPS. The new standard, ASABE-X599, Standardized Deployment Performance of an Automatic Telescoping ROPS for Agricultural Equipment, is in draft form and has undergone its first review. This standard, once issued, will give the manufacturers criteria to build, test, and sell AutoROPS to consumers.

FINAL CUSTOMERS: None given

INTERMEDIATE OUTPUTS: None given

INTERMEDIATE CUSTOMERS: None given

TRANSFER ACTIVITIES: None given

OUTPUTS:
Outputs of the project include:

Exhibit Material:
- NIOSH AutoROPS display booth at the State Fair of Ohio (August 2005), State Fair of Virginia (September 2005) and The International Lawn, Garden & Power Equipment Exposition (October 2005)/

Conference Proceedings:
- McKenzie, Jr., E.A., Etherton, J.R., Harris, J.R., Cantis, D.M and Lutz, T.J [2005] “NIOSH AutoROPS Research to Practice: Zero Turn Commercial Mowers” (IMECE2005-81575) Proceedings of 2005 American Society of Mechanical Engineers, Congress and Exposition, {November 11, 2005}: Orlando, FL
- Lutz, T.J. and McKenzie, Jr., E.A.,[2005] “Remote Control on a Zero-turn Commercial Lawn Mower To Conduct SAE J2194 Rollover Test” Proceedings of the 2005 ASAE AutoROPS .Annual International Meeting (#055004), {July 17-20 2005}Tampa, FL
- Etherton JR, McKenzie, Jr., E.A., Powers JR, [2004]. “Commercializing An Automatically Deployable Rollover Protective Structure (AutoROPS) For A Zero-Turn Riding Mower: Initial Product Safety Assessment Criteria” Proceedings of 2004 American Society of Mechanical Engineers, Congress and Exposition IMECE2004-59570 {November 13-20}: Anaheim, California
- McKenzie, Jr., E.A., Etherton JR, Harris JR, Cantis DM, Lutz TJ [2003]. “NIOSH AutoROPS 3rd Generation Static Testing and Human Interaction Element” Proceedings

Article published, professional:

- Etherton JR, McKenzie, Jr., E.A., Lutz TJ, Cantis DM, Kau TY, [2004]. “An Initial Farmer Evaluation of a NIOSH AutoROPS Prototype”, International Journal of Industrial Ergonomics 34:155-165

ACTIVITIES: This was a safety engineering project that was designed to organize similar technical skills, equipment and instrumentation to work on a common problem: too many tractors do not have Rollover Protective Structures (ROPS). Two aspects of ROPS engineering were considered: 1) industry technology transfer of the structure for an automatically deployable ROPS that could provide passive protection for work that includes low overhead clearances; 2) industry technology transfer of a rollover sensor that initiates deployment of a low profile ROPS. This combination of activities was intended to provide an efficient use of personnel and resources to resolve shortcomings in ROPS engineering that lead to ROPS not being used. Field and laboratory testing of prototype structures developed jointly with industrial partners are important elements of this project.

This project was cancelled in fiscal year 2006. However, during the implementation of the project we were contacted by domestic and foreign stakeholders (approximately 25 contacts) regarding design progress. In addition, one new industry standard was being created with (ASABE) titled X599

INPUTS: None given

PROJECT ID: VAJ882 – Hazard Control Evaluation of Cardboard Paper Baler Safety Device Technology

END OUTCOMES:

None to report.

INTERMEDIATE OUTCOMES (IO):

This project investigated current control systems on cardboard baling equipment. The project also investigated the use of strain gauges mounted to the baler to determine how they were affected by normal baling operations. This work ultimately supported a later NIOSH project to develop a new control system for balers that would make the job of clearing a jam safer.

FINAL CUSTOMERS:

Baler Operators, Recycling Centers, Baler Owners

INTERMEDIATE OUTPUTS:

None to report.

INTERMEDIATE CUSTOMERS:

Baler Manufacturers, Baler Control System Manufacturers

TRANSFER ACTIVITIES:

None to report.

OUTPUTS:

Peered Reviewed Articles:

Etherton J.R., Moore P., Harris J.R., Zeng S., “Safety Factors Relating to Monitored Compactor Operating Parameters”, *Safety Engineering and Risk Analysis*, 1998, Vol. 8: 49-56.

Conference Papers

Etherton J.R., Moore P., Harris J.R., Zeng S., “Factors Limiting the Use of Frame Deflection Monitoring to Predict Material Jams in Baling Equipment”, National Occupational Injury Research Symposium (NOIRS), Morgantown, West Virginia, October 15 – 17, 1997, Abstract, p.60.

ACTIVITIES:

This project investigated the use of strain gauges mounted to an integral horizontal compactor container. Readings were taken once a day under normal compactor operations. The goal of this part of the project was to observe the effects of gauge site, gauge length, compactor fill, and gauge orientation. The study concluded that readily available strain gauges produced measurable responses to stresses in a normally filled compactor container that did not jam. Changing conditions inside the container resulted in substantial changes in strain responses. The study also found that signal conditioning is a must due to the somewhat noisy signal pattern.

This project also conducted a fault tree safety analysis (FTA) to examine the feasibility of the proposed monitoring method (strain gauges) for safer baler operations. For this analysis, the fault tree was created to determine what the critical steps are to prevent a person from being injured (top level of tree). In the initial analysis (no strain gauges), the jam buildup did not provide adequate visual or audible early warning that would have permitted reduced exposure for safer clearing. However, strain gauges could have provided this early warning. The FTA concluded with several factors that could affect the viability of strain gauge monitoring, including, location of the gauge, drift of the signal, and vibration or degradation of the gauge.

This project ultimately concluded that, until further research is conducted, mechanical blocking of the platen and proper lockout/tagout should remain the primary control of hazardous energy to prevent bailing equipment related fatalities and injuries.

INPUTS:

None to report.

PROJECT ID: Prevention of Vehicle and Mobile Equipment-Related Injury

END OUTCOMES:

INTERMEDIATE OUTCOMES (IO):

FINAL CUSTOMERS:

Contractors, contracting agencies, policy makers, manufacturers, law enforcement, the research community, labor unions, workers

INTERMEDIATE OUTPUTS:

Building Safer Highway Work Zones has been incorporated into new worker training materials and best work practice guides. For example, the National Safety Council (NSC) and the American Road and Transportation Builders' Association (ARTBA) worked with NIOSH to develop an OSHA 10-hour course specifically for the road construction industry. Modules addressing safety when working around construction vehicles and equipment as well as nighttime road construction were incorporated into this training program. The OSHA 10-hour course for roadway construction is provided to member construction companies by both the NSC and the ARTBA. The course is also a core component of the Northeast Regional Safety Academy's road construction safety training program in Montpelier, Vermont.

The Laborers' Health and Safety Fund of North America incorporated the document in its entirety as an Appendix to their 2003 "Highway Work Zone Safety Manual," and information on internal traffic control plans into their new worker orientation training program, "Roadway Safety."

Other ways that organizations use information from *Building Safer Highway Work Zones* include providing risk management recommendations to clients by both the St. Paul and the CNA insurance companies; supporting development of contract language to require disaster cleanup contractors to use high-visibility clothing during cleanup operations by the Federal Emergency Management Agency; developing two safety training videos, "Flagger Safety" and "Work Zone Safety for Construction and Utility Employees" by J.J. Keller & Associates; incorporating injury prevention measures into a best practices guide by the Dallas Area Road Construction Work Zone Task Force; developing a 3½-hour PowerPoint presentation by the Texas Engineering Extension Service and incorporating safety measures and case examples into tool-box safety talks by roadway construction companies.

A June 2000 article in the Engineering News Record noted the pending release of *Building Safer Highway Work Zones,* and included specific recommendations from the too-be-released report on traffic control, internal traffic control, high visibility clothing and the contracting process. The article also noted that "OSHA officials say they are awaiting the NIOSH report with great interest because the agency is launching its own assault." [Krizan 2000. Construction declares war on highway workzone carnage. Engineering News Record, 244 (23): 36-41.]

INTERMEDIATE CUSTOMERS:

Training organizations, safety consultants, labor unions, trade associations, state and federal agencies

TRANSFER ACTIVITIES:

NIOSH distributed the document, *Building Safer Highway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Equipment*, through targeted mailings, conference and exhibition handouts, and downloads from the NIOSH website. The publication went through 4 printings with approximately 15,000 copies distributed. External organizations that helped distribute the document include Occupational Safety and Health Administration offices in Washington, D.C. and Puerto Rico, the Laborer's International Union of North America, the American Road and Transportation Builders' Association, and the Washington State Department of Labor and Industries.

OUTPUTS:

Pratt SG, Fosbroke DE, Marsh SM [2001]. Building safer highway work zones: measures to prevent worker injuries from vehicles and equipment. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-128.

ACTIVITIES:

A workshop was held in December 1998 to gather input on perceived gaps in work zone safety standards and regulations, as well as input on safe work practices in road construction. The workshop was attended by a broad range of over 50 stakeholders in work zone safety including individuals from government, labor, industry, academia, and state departments of transportation. After a plenary session that included background information on the problem, attendees participated in breakout sessions that addressed four topic areas: safety of workers on foot around traffic vehicles; safe operation of construction vehicles and equipment in highway work zones; planning for safe operations within work zones; and special safety issues associated with night work in highway construction. NIOSH developed a white paper on each topic and provided it to attendees before the workshop, so attendees had time to consider work zone safety needs ahead of time. During the workshop breakout sessions, a series of questions was presented to stimulate discussion about preventing occupational injuries in highway work zones.

The general information, experiences, research results, resources, and suggestions for prevention shared during the four sessions were the starting point for the NIOSH publication, *Building Safer Highway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Equipment*, which contains specific measures that contractors, contracting agencies, policy makers, manufacturers, law enforcement, and the research community can use to reduce occupational injuries in highway work zones. This document also includes an Appendix with descriptions of highway construction fatalities investigated through the NIOSH Fatality Assessment and Control Evaluation (FACE) program. Each fatality description includes case-specific prevention recommendations.

INPUTS:

In 1997, NIOSH organized a series of forums for discussion of research needs with construction industry stakeholders and conducted a series of site visits to construction sites to validate concerns identified in the stakeholder meetings. This pilot project was funded by the NIOSH Construction Steering Committee.

One key area of concern for groups with interest in highway construction was prevention of injuries related to vehicles and equipment. NIOSH determined that a significant risk existed for workers in highway and street construction based on numbers of reported fatalities and injuries. NIOSH also determined that a broad effort to involve interested parties would be helpful in developing guidelines addressing work zone safety. The following year, the Jefferson Group approached NIOSH about sponsoring a workshop to address fatalities that were occurring in highway and street construction. NIOSH agreed to convene a workshop focused on prevention of injuries due to motor vehicles and equipment and undertook a comprehensive review of the scientific literature; data from the Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) and Survey of Occupational Injuries and Illnesses; and relevant investigations conducted by the NIOSH FACE program in preparation for this workshop.

PROJECT ID: 9278313 Workplace Violence Initiative: Research and Implementation

END OUTCOMES: During 1993-2002, the number of workplace homicides decreased from 1,074 in 1993 to 609 in 2002. The greatest declines have been in the retail industry. Late-night retail risk factor analysis conducted by NIOSH TI in the 1990s contributed to the decline of homicides in the retail industry. Although progress has been made in reducing workplace violence, the problem is still significant among police and security workers, late night retail workers, health care workers particularly in psychiatric facilities, teachers, and transportation particularly among truck drivers and taxicab drivers.

INTERMEDIATE OUTCOMES (IO): Using the NIOSH research as a basis for many recommendations, in 1998 OSHA published "Recommendations for Workplace Violence Prevention Programs in Late-Night Retail Establishments". Several states have adopted these recommendations into laws related to prevention of violence against late-night retail staff.

FINAL CUSTOMERS:
Final customers include but are not limited to employers (private industry and government), managers, workers, academics, trade associations, and other organizations.

INTERMEDIATE OUTPUTS:
Throughout the year, many requests for workplace violence materials are directed to NIOSH by employers interested in developing or updating workplace violence prevention programs.

INTERMEDIATE CUSTOMERS:
Intermediate customers include but are not limited to employers (private industry and government), managers, workers, academics, trade associations, and other organizations.

TRANSFER ACTIVITIES:
<u>Workshops and conferences</u>

NIOSH TI sponsored workshop on occupational homicide held in Washington, DC on July 23-24, 1990. A panel of 14 experts from government agencies, academia, private industry, and trade associations participated by discussing limitations of available data, important research issues, areas where further research is needed, and evaluation of known prevention strategies. The discussions were summarized in: *Homicide in the Work place: A Strategy for Prevention and Research.* DHHS (NIOSH) Pub No. 92-103. September 1992.

NIOSH TI sponsored University of Iowa Workshop on Workplace Violence Intervention Research Held in Washington, DC on April 5-7, 2000. A panel of 37 invited participants representing private industry, organized labor, municipal, state, and federal governments, and academia met to examine issues related to all four types of violence in the workplace and to develop recommended research strategies to address this public health problem. A summary of the conference entitled "Workplace Violence: A Report to the Nation" was published by the University of Iowa in February 2001.

NIOSH Workplace Violence Prevention Stakeholder Meetings:

Healthcare industry – May 2003. A diverse group of 38 attendees representing trade associations, federal partners, state agencies, and labor unions participated in discussions concerning strategies for prevention of violence against healthcare workers. Presentations were designed to inform participants about the NIOSH TI and OSHAs efforts in prevention of violence directed towards healthcare workers. After these brief presentations, each person in attendance was given some time to describe their organizations' efforts, successes, and trials in preventing workplace violence directed towards healthcare workers. Attendees were asked to describe ways that NIOSH TI could assist them in preventing workplace violence. A recommendations from this group was that NIOSH TI organize and sponsor a conference designed to share the "best practices" of workplace violence prevention in the healthcare setting.

Domestic Violence in the Workplace – June 2003. A diverse group of 38 attendees representing trade associations, federal partners, state agencies, and labor unions participated in discussions concerning strategies for prevention of domestic violence incidents in the workplace. Presentations were designed to inform participants about the NIOSH TI, CDC, and FBI efforts in prevention of domestic violence in the workplace. After these brief presentations, each person in attendance was given some time to describe their organizations' efforts, successes, and trials in preventing domestic violence in the workplace. Attendees were asked to describe ways that NIOSH TI could assist them in preventing workplace violence. A recommendation from this group was that NIOSH TI organize and sponsor more meetings that address the issue of preventing domestic violence in the workplace.

Retail Industry – August 2003. Seventeen people representing a cross-sector of private industry, trade associations, federal partners interested in preventing retail industry violence participated. Presentations were designed to inform participants about the NIOSH TI and OSHAs efforts in prevention of violence directed towards retail workers. After these brief presentations, each person in attendance was given some time to describe their organizations' efforts, successes, and trials in preventing workplace violence directed towards retail workers. Attendees were asked to describe ways that NIOSH TI could assist them in preventing workplace violence. A recommendation from this group was that NIOSH TI research why the presence of certain risk factors makes an establishment an attractive target to someone intent on committing a crime

Security/Law Enforcement – November 2003. A diverse group of 25 attendees representing trade associations, federal partners, state agencies, and labor unions participated in discussions concerning strategies for prevention of violence against security and law enforcement officers. Presentations were designed to inform participants about the NIOSH TI and OSHAs efforts in prevention of violence directed towards security workers. After these brief presentations, each person in attendance was given some time to describe their organizations' efforts, successes, and trials in preventing workplace violence directed towards security workers. Attendees were asked to describe ways that NIOSH TI could assist them in preventing workplace violence. A recommendations from this group was that NIOSH TI evaluate using community policing as a method of preventing violence against security personnel.

NIOSH Federal Interagency Task Force on Workplace Violence Research and Prevention (Jan. 2003, Sept. 2003, Apr. 2004 and Nov. 2005). Provides an opportunity for all of the agencies that are doing work or who have an interest in workplace violence research to share information and identify opportunities for collaborative efforts.

NIOSH TI conference *Partnering in Workplace Violence Prevention: Translating Research to Practice*. Held in Baltimore, MD on November 17-19, 2004. A diverse group of 182 representatives from a cross-sector of private industry, academics, trade associations, and federal partners participated in this conference. The conference summary document entitled "Workplace Violence Prevention Strategies and Needs" will be published as a NIOSH numbered publication in September 2006.

OUTPUTS:
Four papers were published from four studies conducted to evaluate effectiveness of CPTED elements in reducing robbery and evaluating late night robbery and robbery-related injury risk factors. Results of these papers were presented at two national association of criminology meetings. These meetings were attended by criminologists and convenience store crime prevention experts from academia and industry. These papers have been cited 36 times in peer-reviewed publications from other researchers doing WPV research as well as by OSHA in their 1998 recommendations for workplace violence prevention programs in late night retail establishments.

Results of the OSHA guidelines, research from NIOSH TI and many other investigators which have confirmed the effectiveness of CPTED elements in late night retail culminated in the evaluation of a NIOSH TI funded UCLA administered CPTED program in 400 Los Angeles retail establishments realizing a reduction in all violent crimes of over 30% and in robbery over 50% in comparison to non-intervention comparison groups. Because only 45% of LA retail establishments approached volunteered to participate, future NIOSH TI research will focus on ways to develop community programs to increase participation as well as compliance to adoption of CPTED guidelines.

Four papers were published that presented national surveillance data on the number and risk factors for WPV homicides. These papers have been widely quoted in the literature on WPV and were cited in OSHA guidelines. These papers served to focus intramural and extramural NIOSH TI research priorities toward high risk industries and occupations such as late night retail, health care workers, teachers, truck drivers and taxicab workers.

<u>Alerts, guidelines, and educational materials</u>
The 1993 NIOSH TI ALERT was a ground breaking paper – one of the first to highlight the problem in WPV on the national level. Over 85,000 copies of the alert have been disseminated and it has been quoted frequently in journal articles and by OSHA guidelines.

The 1996 NIOSH TI Current Intelligence Bulletin 57 "Violence in the Workplace: Risk Factors and Prevention Strategies" summarized the information know at the time for fatal and nonfatal workplace violence in an effort to focus prevention and research. Just over 83,000 copies of this document have been distributed.

NIOSH TI contributed to the development, technical content, and production of the "Violence on the job" DVD which has had over 22,000 copies distributed since its 2004 release. Anecdotally the DVD is being used widely as a training mechanism for workplace violence prevention.

NIOSH TI developed a poster for use in the convenience store that participated in the NIOSH field study. The poster entitled “Reduce Your Risk for Robbery and Robbery-Related Injury” provides a concise easy to read outline of what to do in the event that the convenience store is being robbed.

ACTIVITIES:
TI researchers in the Division of Safety Research have taken the lead in the analysis of national statistics on workplace homicides such as in publishing reports on workplace homicides from NIOSH’s TI National Traumatic Occupational Fatality database and from the more current BLS Census of Fatalities from Occupational Injuries. TI has evaluated trends in workplace homicides as a check on the effectiveness of prevention efforts.

Because of the lack of non-fatal workplace violence data, TI researchers in the Division of Safety Research developed the following databases during 2002-2006 to address this gap: 1) a special victims survey of workplace risks conducted for TI by the Bureau of Justice Statistics as part of it National Crime Victimization Survey, 2) a telephone interview survey of workers who were treated for work-related assault injuries in a sample of U.S. hospital emergency departments through the Consumer Product Safety Commission’s National Electronic Injury Surveillance System, 3) a survey of employers with regard to workplace violence policies, training, and related issues conducted in collaboration with the Bureau of Labor Statistics during 2005 and 2006. These surveys will provide needed information on numbers of nonfatal WPV injuries and their risk factors, as well as provide input to guide intervention development and evaluation.

One publication has been submitted to the journals on homicide trends from 1993-2002. Three papers are in draft form on each of these surveys and should be ready for publication by December, 2006.

INPUTS:

PROJECT ID: VLE843 Homicide in Convenience Stores: An Evaluation of Prevention Strategies

END OUTCOMES:
NIOSH is currently working with former project director of the UCLA project to evaluate the effectiveness of disseminating UCLA's workplace violence prevention program through a community policing program. NIOSH and partners are developing protocols for future work to evaluate different models to increase compliance ob late night retail establishments to NIOSH, OSHA, and industry guidelines.

INTERMEDIATE OUTCOMES (IO):

FINAL CUSTOMERS:

INTERMEDIATE OUTPUTS:
In August 2003, seventeen people representing a cross-sector of private industry, trade associations, federal partners interested in preventing retail industry violence participated. Presentations were designed to inform participants about the NIOSH TI and OSHA efforts in prevention of violence directed towards retail workers. After these brief presentations, each person in attendance was given some time to describe their organizations' efforts, successes, and trials in preventing workplace violence directed towards retail workers. Attendees were asked to describe ways that NIOSH TI could assist them in preventing workplace violence. A recommendation from this group was that NIOSH TI research why the presence of certain risk factors makes an establishment an attractive target to someone intent on committing a crime

INTERMEDIATE CUSTOMERS:
National Association of Convenience stores, retail chains, OSHA, and state departments of justice have benefited from findings of study. Results of NIOSH and other studies culminated in OSHA regulations and partner meetings to determine what needs to be done in the future.

TRANSFER ACTIVITIES:
Results were presented at an APHA conference. Posters to promote guidelines for prevention of robbery in late-night retail were developed and distributed to convenience stores. An industry meeting was held in 2003 to engage the industry about future research needs. UCLA used results of the NIOSH project and other studies and developed a workplace violence prevention program. UCLA disseminated this program to 400 retail establishments in LosAngeles and evaluated compliance to the guide lines.

OUTPUTS:
One paper was published from the study:
A Matched Case Control Study of Convenience Store Robbery Risk Factors. Hendricks, S., Landsittal, DP, Amandus, H, Malcan, J., Bell, J., November 1999. JOEM 41(11): 995-1004.

ACTIVITIES:
This study was causation research of robbery risk factors in convenience stores. A matched case-control study of 400 robbed and 1201 non-robbed control stores in areas in and around Richmond, Norfolk, and Fairfax, Virginia were evaluated for robbery risk factors. Crime reports on convenience store robberies were provided to the project team. Using GIS software, robbed stores were then matched to non-robbed stores within a 2 mile radius. Teams of off-duty police officers were then dispensed to visit case and control stores shortly after robbery and the stores were evaluated for environmental designs, staff training in cash handling and nonresistance, security equipment, proximity of the store to high risk areas and other robbery risk factors.

INPUTS:
This study was an epidemiologic case-control study of robberies in counties in and around Richmond, Fairfax, and Norfolk, Va. The purpose was to determine which environmental designs, engineering controls, organizational policies and practices, and other risk factors were associated with convenience store robbery.

Surveillance data: During the early 90's, workplace homicide was the leading cause of work-related traumatic injury. Additionally, the majority of workplace homicides were among late night retail workers and robbery was the primary cause leading to non-fatal and fatal injuries to workers.

Scientific knowledge base: NIOSH conducted studies during 1991-93 to assess the number and rate of fatal and non-fatal injuries in robbery situations among convenience store workers using police department records in approximately 10 major US cities (REF). Higher rates of robbery-related nonfatal injuries were found than reported in previous studies. During that time, approximately xx studies had been conducted by industry and academic groups to evaluate the effectiveness of robbery preventions, and thus, the effectiveness of elements of robbery prevention programs were questioned . None of these studies were well controlled epidemiologically. Thus, this a well designed case-control study of robbery-related risk factors in Virginia convenience stores was initiated and completed to determine the significant elements of robbery prevention and robbery risk factors.

Stakeholder input: (1) A partnership was formed with the State of Virginia Department of Criminal Justice and Statistical Analysis Center. This partnership grew out of partnerships with state Statistical Analysis Centers in approximately 10 states to support and complete previous robbery research in convenience stores injuries. The Virginia partnership opened doors to access of police department records in counties in and around Richmond, Norfolk, and Fairfax. (2) The research protocol was develop with input from the National Association of Convenience Stores, security experts in C-store crime, and with more than 10 convenience store companies including several national chains.

Legislative mandates: During the 1990's OSHA was being petitioned to consider regulating workplace violence under its General Duty Clause. Several state and local ordinances had appeared. There was considerable interest to validate elements of robbery prevention programs which had become part of industry programs.

Public health framework: advocacy groups in Virginia were suing companies for negligence in lack of robbery preventions in the workplace. The importance of knowing what worked and did not work needed to be confirmed.

PROJECT ID: 9277059 - Young Worker Regional Health Education Center

PROJECT OFFICER: Ray Sinclair

END OUTCOMES: A model for community health interventions

INTERMEDIATE OUTCOMES (IO): An intervention model for young worker issues in communities will be developed and described in the literature.

FINAL CUSTOMERS: Youth

INTERMEDIATE OUTPUTS: Interventions capitalize on lessons learned from previous young worker community health training intervention projects.

INTERMEDIATE CUSTOMERS: NS

TRANSFER ACTIVITIES: Analysis of community health education needs and opportunities will guide community-level efforts to raise the issue of young worker health with a variety of target audiences.

OUTPUTS: A draft document that summarizes projects.

ACTIVITIES: A community health education framework is being used to address the problem of high rates of occupational injuries among young workers.

INPUTS: Current Population Survey estimated that 35% of the nation's 7.5 million 16 and 17-year olds were employed. This figure is thought to be underestimated. High school surveys suggest that about 80% of students are employed at some time during their high school years. Data from the 1990 Census shows that 54% of youths worked in retail trades, 25% in services,

PROJECT ID: 9277269 - Injuries and Illnesses Among Farm Youth in the U.S.

Project Officer: Christy Forrester

END OUTCOMES: To provide guidance on future research in child agriculture. The overall objective of this project is reduce fatal and nonfatal injuries of children and adolescents working in the agricultural environment.

INTERMEDIATE OUTCOMES (IO):

FINAL CUSTOMERS: Practitioners responsible for the reducing or eliminating the hazards faced by children and adolescents in the agricultural environment,

INTERMEDIATE OUTPUTS: Project will provide necessary information to develop/refine intervention and educational programs and projects related to the National Occupational Research Agenda under Special Populations at Risk-Children/Adolescents.

INTERMEDIATE CUSTOMERS:

TRANSFER ACTIVITIES:

OUTPUTS:

ACTIVITIES: Evaluate the scientific basis for North American Guidelines for Children's Agricultural Tasks (NAGCAT) through the identification of empirical evidence which supports or refutes the guidelines. Research recommendations will be formulated in the absence of empirical evidence

INPUTS: Data from the National Center for Health Statistics that shows each year 100,000 children under 20 years of age are injured on farms and over 100 killed. A Bureau of Census Current Population Report suggests that approximately 126,900 individuals under the age of 19 lived on U.S. farms and ranches in 1991.

PROJECT ID: Childhood Agricultural Injury Surveillance (CAN 9278953)

END OUTCOMES:

The Childhood Agricultural Injury Surveillance project is one component of the NIOSH Childhood Agricultural Injury Prevention Initiative begun in 1997. Data generated throughout this project has been used by NIOSH and stakeholders to guide research and prevention efforts, and track progress over time. A major focus of the NIOSH Childhood Agricultural Injury Prevention Initiative and stakeholders has been development and promotion of the North American Guidelines for Childhood Agricultural Tasks (NAGCAT) released in 1999. The primary focus of the NAGCAT is to provide guidance to farm families on how to assign work to farm youth to reduce their risk of injury.

1. During the initiative, the total number of youth injured on farms has decreased from 37,800 in 1998 to 27,600 in 2004. For the same time period, the number of farm work-related youth injuries decreased by 51% from 16,695 down to 8,130 (Table 1). (**Source**: NIOSH CAIS). Injury rates for household youth show that farm injury risks have decreased in all regions of the U.S. *(Figure 1)* (**Source**: NIOSH CAIS).

*Table 1. Injuries to youth less than 20 years of age that occurred on U.S farms during 1998, 2001, and 2004, by sex and work status (**Source:** NIOSH CAIS).*

	1998	2001	2004
Injuries‡	37,774	29,207	27,590
Male	29,564	16,526	14,390
Female	8,210	12,641	13,201
Work	16,695	9,481	8,130
Non-work	18,169	19,611	19,439

‡ Total injuries may not add up due to rounding or missing data.

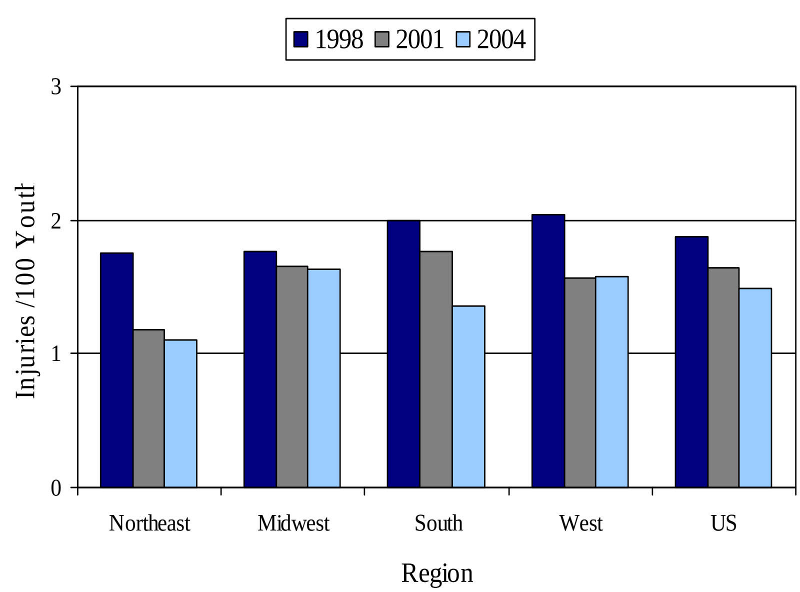

*Figure 1. Farm Injuries Per 100 Household Youth by Region, 1998, 2001, and 2004 (**Source**: NIOSH CAIS).*

2. Since the establishment and promotion of the NAGCATS, work-related farm injuries to youth living on farms have decreased from 11,600 injuries in 1998 down to 6,400 in 2004. The work-related injury rate for household youth decreased from 14.1 to 9.1 injuries per 1000 working household youth for the same period *(Figure 2)* (**Source:** NIOSH CAIS).

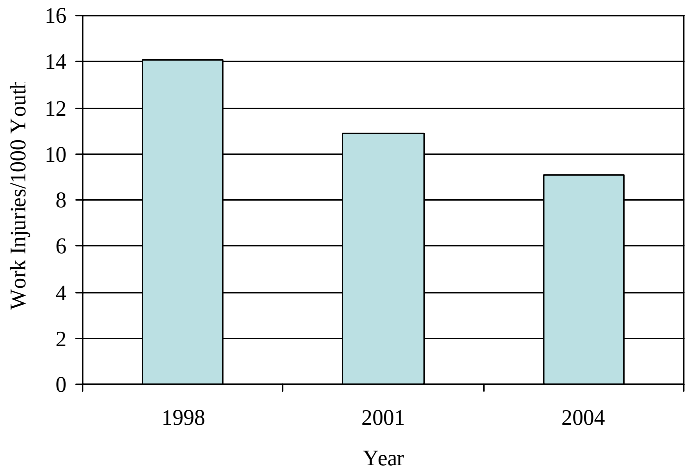

Figure 2. Work Injuries per 1000 Working Farm Household Youth, 1998-2004

3. Males account for 58% of the household youth who work on farms, and have traditionally accounted for most of the work-related youth injuries occurring on farms. Since the introduction of the NAGCATs, farm injuries to young males on farms decreased 50%. A major part of this decrease was seen for work-related farm injuries to males that decreased from 11,800 in 1998 to 5000 in 2004 (**Source**: NIOSH CAIS). The male household youth work-related injury rate decreased from 20.3 to 9.0 injuries per 1000 working household youth during this same time period *(Figure 3)* (**Source**: NIOSH CAIS).

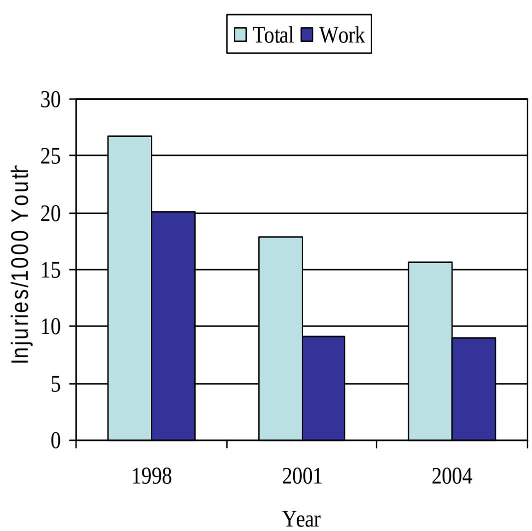

Figure 3. Injuries per 1000 Household Male Youth and Work Injuries per 1000 Working Household Male Youth, 1998-2004

INTERMEDIATE OUTCOMES (IO):

1. The U.S. Department of Labor is currently considering changes to federal child labor laws based on NIOSH recommendations. Data from the 1998 CAIS were used extensively by NIOSH staff in the preparation of recommended changes to the agricultural hazardous orders for the U.S. Department of Labor. The 1998 CAIS provided the most representative and current data on occupational youth farm injuries by covering youth of all ages and farms of all types.

2. One significant finding from the CAIS, Minority-CAIS, and NIOSH death certificate studies has been the importance of non-work injuries and fatalities to youth on farms. These findings led to the development of a new recommendation in the updated 2002 Childhood Agricultural Injury Prevention National Action Plan to address non-work injuries on farms. In response to this new recommendation, the National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS) produced several documents on the importance and design of safe play areas for children on farms. NCCRAHS also maintains a website dedicated to the topic of safe play areas on farms (see http://www.marshfieldclinic.org/nfmc/pages/default.aspx?page=nfmc_nccrahs_safe_play_welcome).

3. NCCRAHS is just one of the national child safety organizations that use the results from the NIOSH youth farm injury surveillance studies. Other organizations, such as Farm Safety for Just Kids and the National Safe Kids Campaign now use the NIOSH injury and injury rate estimates for children on farms as their official numbers.

4. The estimates of youth farm injuries produced by NIOSH have also been cited in proposed congressional legislation. In July 2005, the Children's Act for Responsible Employment of 2005 ('CARE' Act of 2005, HR 3482) was submitted in the House of Representatives by Representative Roybal-Allard. The CARE Act proposed changes to child labor laws in agriculture, and identified the youth farm injury data collected by NIOSH CAIS as one source of data that would be used to develop an annual report on occupational injuries to youth working on farms in the US. At this time, no action has yet been taken on this proposed bill within Congress.

5. As part of a cost-benefit analysis of proposed changes to Child Labor hazardous orders for youth working on farms, a contractor for USDOL requested data from NIOSH in the spring of 2004. The contractor, SiloSmashers, requested information on estimates of youth less than 20 years old working on farms, estimates of working youth who operated farm tractors on farms, work-related injuries occurring to these youth, and non-work injuries occurring to youth on farms. SiloSmashers concluded that the NIOSH CAIS surveillance data were the only source of these data, and were critical to conducting the cost-benefit analysis requested by USDOL. This work is still in progress.

6. In 1999, Dr. Barbara Marlenga of the National Farm Medicine Center in Marshfield, Wisconsin, approached NIOSH to provide assistance on a research project. Dr. Marlenga's research required a national sample of farms with household youth 7 to 16 years of age. NIOSH worked with the National Agricultural Statistics Service (NASS), who is a partner in NIOSH childhood agricultural injury surveillance efforts, to identify farms with household youth in this age range and asked if they would be willing to participate in this study as part of the CAIS data

collection effort. Dr. Marlenga was given access to those farm families who agreed to participate. Results of Dr. Marlenga's study are reported in:

Marlenga BL**,** Pickett W, Berg RL. [2002]. Evaluation of an enhanced approach to the dissemination of the North American Guidelines for Children's Agricultural Tasks: a randomized controlled trial. Preventive Medicine 35:150-159. PubMed ID: 12200100

7. NIOSH has also worked with NASS to provide CAIS data to Dr. Marlenga for two additional research studies. Results from the 1998 CAIS were used by Dr. Marlenga to assess whether guidelines for assigning youth work tasks based on their age would have prevented certain types of farm injuries. Results of this research are reported in:

Marlenga BL**,** Brison RJ, Berg RL, Zentner JL, Linneman JG, Pickett W. [2004]. Evaluation of the North American Guidelines for Children's Agricultural Tasks using a case series of injuries. Injury Prevention 10:350-357. PubMed ID: 15583256

Data from the 1998 CAIS and 2000 Minority-CAIS have also been provided to Dr. Marlenga to assess the potential impact of applying Child Labor hazardous orders for youth working on farms to youth working on their family's farm. This research is still in progress.

8. A search of the literature has identified a minimum of 22 peer reviewed journal articles that have cited surveillance data from the CAIS.

9. Dr. Barbara Lee, Director of the NCCRAHS, recently published an editorial in the Journal of Agromedicine (2005: Vol. 10(4)) entitled 'NIOSH Fills Void with Surveillance of Injuries to Youth Living on U.S. Farms." This editorial commends the work that NIOSH has undertaken in collecting youth farm injury data that was previously unavailable. Additionally, Dr. Lee encourages others to give their support to NIOSH and the continuation of the NIOSH childhood agricultural injury surveillance plan.

10. Based on the 2004 journal article based on an analysis of death certificates (Childhood Agricultural Mortality Surveillance-CAMS), NCCRAHS requested NIOSH to provide additional analyses on suicide cases identified in the CAMS. NCCRAHS is now incorporating the results of these analyses in their suicide prevention programs and presentations (see http://www.marshfieldclinic.org/nfmc/pages/default.aspx?page=nccrahs_presentations).

FINAL CUSTOMERS:

Farm operators
Farm families
Farm resident youth
Hired farm workers

INTERMEDIATE OUTPUTS:

Esser N, Heiberger S, Lee B Eds. [2003]. Creating Safe Play Areas on Farms. Marshfield, WI: Marshfield Clinic.

Hanna C. [2005]. The Clock is Ticking: Rural Adolescent Suicide. http://www.marshfieldclinic.org/ldf/SPRC_presentation.ppt (last accessed September 18, 2006).

Lee B, Gallagher S, Marlenga B, Hard D Eds. [2002]. Childhood Agricultural Injury Prevention: Progress Report and Updated National Action Plan from the 2001 Summit. Marshfield, WI: Marshfield Clinic.

Marlenga BL**,** Brison RJ, Berg RL, Zentner JL, Linneman JG, Pickett W. [2004]. Evaluation of the North American Guidelines for Children's Agricultural Tasks using a case series of injuries. Injury Prevention 10:350-357. PubMed ID: 15583256

Marlenga BL**,** Pickett W, Berg RL. [2002]. Evaluation of an enhanced approach to the dissemination of the North American Guidelines for Children's Agricultural Tasks: a randomized controlled trial. Preventive Medicine 35:150-159. PubMed ID: 12200100

Safe Kids USA. [2005]. Facts About Injuries To Children Who Live In Rural Areas http://www.usa.safekids.org/content_documents/Rural_facts.pdf

INTERMEDIATE CUSTOMERS:

National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS)
Farm Safety for Just Kids
Safe Kids USA
Silo Smashers (contractor for U.S. Department of Labor, Wage and Hour Division)
Agricultural and childhood injury prevention professionals

TRANSFER ACTIVITIES:

Results from the Childhood Agricultural Injury Surveillance project are generally disseminated to our intermediate customers through the mailing of NIOSH numbered documents to a special group of agricultural and childhood injury prevention professionals. Our intermediate customers are also reached through the publication of peer-reviewed journal articles in professional journals, and through the presentation of results at national conferences and symposiums.

We also work with our partners to disseminate the surveillance results directly to farm families and farm operators. Two examples of this approach are:

> 1. NIOSH has also worked extensively with NASS to disseminate survey results and recommendations for keeping youth safe on farms. NASS has distributed more than 100,000 NIOSH pamphlets to farm operators across the U.S., including pamphlets specifically targeting minority farm operators. These pamphlets summarize common causes of childhood farm injury based on NIOSH surveillance data, and steps that farmers can take to foster safe and healthful farm environments for children.

2. National FFA and Department of Labor representatives from the Federal Interagency Working Group on Preventing Childhood Agricultural Injuries have agreed to help disseminate brochures on findings and recommendations of the latest childhood agriculture injury surveillance.

OUTPUTS:

Data Bases:

NIOSH has established four new surveillance systems as part of the childhood agricultural injury surveillance project:

- Childhood Agricultural Injury Survey (CAIS): data available for 1998, 2001, and 2004.
- Minority Childhood Agricultural Injury Survey (M-CAIS): data available for 2000 and 2003.
- National Agricultural Workers Survey (NAWS) Youth Injury Module: data are available for 1999, 2001-2004.
- Childhood Agricultural Mortality System (CAMS): data are available for the years 1995-2003.

Peer reviewed Journal Articles:

Castillo DN, Adekoya N, Myers JR. [1999]. Fatal work-related injuries in the agricultural production and services sectors among youth in the United States, 1992-1996. Journal of Agromedicine, 6(3):27-41.

Goldcamp E, Myers J, Hendricks K, Layne L, Helmkamp J. [2006]. Nonfatal All-Terrain Vehicle-Related Injuries to Youths Living on Farms in the United States, 2001. Journal of Rural Health 22(4):309-313. *(In press).*

Goldcamp EM, Hendricks KJ, Myers JR. [2004]. Farm fatalities to youth 1995-2000: a comparison by age groups. Journal of Safety Research 35(2):151-157.

Hard DL, Myers JR. 2006. Fatal Work-Related Injuries in the Agriculture Production Sector Among Youth in the United States, 1992-2002. *(In press).*

Hard DL, Myers JR, Gerberich SG. 2002. Traumatic injuries in agriculture. Journal of Agricultural Safety and Health 8(1):51-65.

Hard DL, Myers JR, Snyder KA, Casini VJ, Morton LL, Cianfrocco R, Fields J. [1999]. Young workers at risk when working in agricultural production. American Journal of Industrial Medicine 36 Supplement 1:31-33. *(cited 13 times per Google Scholar)*

Hendricks KJ, Layne LA, Goldcamp EM, Myers JR. [2005]. Injuries to Youth Living on U.S. Farms in 2001 with Comparison to 1998. Journal of Agromedicine 10(4):19-26.

Hendricks KJ, Myers JR, Layne LA, Goldcamp EM. [2005]. Household youth on minority operated farms in the United States, 2000: exposures to and injuries from work, horses, ATVs and tractors. Journal of Safety Research 36(2):149-157.

Hendricks KJ, Goldcamp EM, Myers JR. [2004]. On-farm falls among youth less than 20-years old in the U.S. Journal of Agricultural Safety and Health, 10(1):27-38.
Hendricks KJ, Adekoya N. [2001]. Non-fatal animal related injuries to youth occurring on farms in the United States, 1998. Injury Prevention 7(4):307-311.

Myers JR, Adekoya N. [2001]. Fatal on-farm injuries among youth 16 to 19 years of age: 1982-1994. Journal of Agricultural Safety and Health, 7(2):101-112.

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Adekoya N, Pratt SG. [2001]. Fatal unintentional farm injuries among persons less than 20 years of age in the United States: Geographic profiles. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-131.

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Myers JR, Hendricks KJ. [2001]. Injuries among youth on farms in the United States, 1998. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-154.

Myers JR, Hendricks KJ, Goldcamp EM, Layne LA. [2005]. Injuries and asthma among youth less than 20 years of age on Minority farm operations in the United States, 2000 Volume I: Racial minority national data. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005-147.

Myers JR, Hendricks KJ, Layne LA, Goldcamp EM. [2005]. Injuries and asthma among youth less than 20 years of age on Minority farm operations in the United States, 2000 Volume II: Hispanic national data. Cincinnati, OH: U.S. Department of Health and Human Services, Public

Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2006-109.

NIOSH. [2004]. Injuries to youth on minority farm operations. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-117.

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NIOSH. [2004]. Worker Health Chartbook, 2004. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-146 (*Agricultural fatality and non-fatal injury section – pages 195-211).*

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USDA. [2004]. 2001 Childhood agricultural-related injuries. Washington, DC: US Department of Agriculture, National Agricultural Statistics Service, Sp Cr 9 (1-04).

Conference Reports and Papers:

Goldcamp EM, Hendricks KJ, Myers JR. [2002]. Farm fatalities to youth 1995-1997: a comparison by age groups. National Institute for Farm Safety 2002 Annual Meeting, June 23-27, 2002, Ponte Vedra Beach, FL. Columbia, MO: National Institute for Farm Safety.

Goldcamp EM, Myers JR, Hendricks KJ, Layne LA. [2003]. Non-fatal injuries: an overview of injuries to youth on racial minority operated farms in the United States, 2000. National Institute for Farm Safety 2003 Annual Meeting, June 22-26, 2003, Windsor, Ontario, Canada. Columbia, MO: National Institute for Farm Safety.

Goldcamp EM, Myers JR, Hendricks KJ, Layne LA. [2004]. Nonfatal all-terrain vehicle injuries to youth on farms in the U.S., 2001. National Institute for Farm Safety 2004 Annual Meeting, June 20-24, 2004, Keystone, CO. Columbia, MO: National Institute for Farm Safety.

Hendricks KJ, Adekoya N. [2001]. Non-fatal animal-related injuries to youth occurring on farms in the United States- 1998. National Institute for Farm Safety Annual Meeting, June 24-27, 2001, Pittsburgh, PA. Columbia, MO: National Institute for Farm Safety.

Hendricks KJ, Goldcamp EM, Myers JR. [2002]. Fatal and non-fatal falls in United States agricultural production for youth less than 20 years old. National Institute for Farm Safety 2002 Annual Meeting, June 23-27, 2002, Ponte Vedra Beach, FL. Columbia, MO: National Institute for Farm Safety.

Hendricks KJ, Myers JR, Goldcamp EM, Layne LA. [2003]. Farm hazards to household youth on minority operated farms in the United States, 2000: exposures and injuries from work, horses, ATVs and tractors. National Institute for Farm Safety 2003 Annual Meeting, June 22-26, 2003, Windsor, Ontario, Canada. Columbia, MO: National Institute for Farm Safety.

Hendricks KJ, Layne LA, Goldcamp EM, Myers JR. [2004]. Injuries among youth on farms in the United States, 2001. National Institute for Farm Safety 2004 Annual Meeting, June 20-24, 2004, Keystone, CO. Columbia, MO: National Institute for Farm Safety.

Layne LA, Myers JR, Hendricks KJ, Goldcamp EM. [2003]. Demographics and non-fatal injury patterns of youth less than 20 years of age on Hispanic operated farms in the United States, 2000. National Institute for Farm Safety 2003 Annual Meeting, June 22-26, 2003, Windsor, Ontario, Canada. Columbia, MO: National Institute for Farm Safety.

Layne LA. [2006]. Youth Living on Hispanic Operated Farms in the United States: An Examination of Population Growth and Changes in Risk Exposure and Injury Patterns between 2000 and 2003." National Institute for Farm Safety 2006 Annual Meeting, June 25-29, 2006, Sheboygan, Wisconsin. Columbia, MO: National Institute for Farm Safety.

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Hard DL. [2003]. Agricultural Injury Surveillance Conducted by NIOSH. Presented at the 5th International Symposium: Future of Rural People – Rural Economy Health People, Environment, and Rural Communities, October 19-22, 2003, Saskatoon, Saskatchewan, Canada.

Hendricks KJ, Myers JR, Adekoya N. [2000]. Non-fatal childhood agricultural injuries in the U.S.–1998. Agricultural Safety and Health in a New Century, April 28-30, 2000, Cooperstown, New York.

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Myers JR, Hendricks K. [2000]. NIOSH approach to childhood agricultural injury surveillance. Presented at the National Occupational Injury Research Symposium (NOIRS), Pittsburgh, PA, October 17-19, 2000.

Myers JR, Adekoya N. [2000]. Fatal on-farm Injuries to Youth 16 to 19 years of age: 1982-1994 (poster). National Institute for Farm Safety 2000 Conference, June25-29, 2000, Dubuque, Iowa.

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ACTIVITIES:

The purpose of this project, funded through NIOSH's child agriculture injury prevention initiative, is to conduct surveillance of childhood agricultural injuries. NIOSH, in collaboration with the National Agricultural Statistics Service (NASS), is collecting childhood agricultural injury data through farm operator surveys that have a minority-specific component. Information gathered through personal interviews of farm workers in the US Department of Labor's National Agricultural Workers Survey provides additional surveillance data. NIOSH also conducts periodic analyses of the Consumer Products Safety Commission's National Electronic Injury Surveillance System, the National Center for Health Statistics' Vital Statistics Mortality data, death certificates from state vital statistics registrars, and the Bureau of Labor Statistics' Census of Fatal Occupational Injuries. This project provides important information for prioritizing research and intervention programs to reduce childhood agricultural injuries in the future.

INPUTS:

1. In Fiscal Year 1997, Congress appropriated NIOSH $5 million annually to implement the 1996 National Committee for Childhood Agricultural Injury Prevention (NCCAIP) national action for preventing childhood farm injuries: *NCCAIP. [1996]. Children and Agriculture: Opportunities for Safety and Health. A National Action Plan. Marshfield, WI: National Farm Medicine Center.*

2. NIOSH held a public meeting on February 5, 1997, in Washington, DC, to allow stakeholders the opportunity to provide their opinions on the NIOSH plan for implementing the Childhood Agricultural Injury Prevention Initiative. This meeting was attended by 23 individuals representing farm families, a farmworker organization, an insurance agency, an equipment manufacturer, safety advocates and educators, researchers, and key federal agencies, and allowed

NIOSH to obtain diverse perspectives on the draft plan. Many of the comments received at this meeting dealt with the NIOSH plan for establishing a national surveillance program for childhood agricultural injuries. NIOSH received support that surveillance be an internal NIOSH activity, but recommended that NIOSH conduct a peer review of its surveillance plan before proceeding with its surveillance activities. Specifically, the meeting participants wanted to ensure that NIOSH conducted surveillance that would cover as many youth populations as possible, including young migrant and seasonal farm workers, and youth visiting farms in the U.S.

3. In response to comments from the February, 1997 public meeting, NIOSH held a separate peer review meeting to obtain additional input into its surveillance options. This meeting was held in Crystal City, Virginia, in October of 1997. Comments were received from: Dr. Paul Gunderson, National Farm Medicine Center; Dr. Susan Gerberich, University of Minnesota; Dr. Michael Schulman, North Carolina State University; and, Dr. Robert McKnight, University of Kentucky. Written comments were also provided by Dr. Lorann Stallones, Colorado State University, Dr. Frederick Rivara, University of Washington, and Dr. Dennis Murphy, Pennsylvania State University. Representatives were also present from the U.S. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS), and the U.S. Consumer Products Safety Commission (CPSC). These agencies were invited to the meeting because they were potential partners in any surveillance approach pursued by NIOSH.

4. In 2001, the NCCRAHS held a second national conference to assess the progress and priorities of the national childhood agricultural injury prevention action plan. Funding for the conference was provided by NIOSH with funds initiated by Senator Herb Kohl (D-WI). NIOSH staff worked with NCCRAHS in planning the conference, and participated on various special emphasis panels. Results of this conference were released in 2002: *Lee B, Gallagher S, Marlenga B, Hard D Eds. [2002]. Childhood Agricultural Injury Prevention: Progress Report and Updated National Action Plan from the 2001 Summit. Marshfield, WI: Marshfield Clinic.*

PROJECT ID: 9278954, Child Agriculture Injury Prevention

END OUTCOMES: The problem of children being injured while living, working, or visiting agricultural work environments (primarily farms), had been recognized for several decades. Youth deaths on farms during the 1980's averaged over 100 per year (*Figure1)*, while non-fatal injuries during this same time period were estimated to be as high as 100,000 farm youth per year. Although many individuals and groups crusaded for the prevention of childhood agricultural injuries over the years, there was not a national, coordinated effort. This changed in 1991, when the Surgeon General's Conference on Agricultural Safety and Health was held in Des Moines, Iowa. A session at this conference entitled *Intervention: Safe Behaviors Among Adults and Children* highlighted the risks faced by people, both young and adult, involved with production agriculture. The Surgeon General's conference led to a series of other national meetings specifically addressing agricultural youth injuries and diseases, culminating in the document "Children and Agriculture: Opportunities for Safety and Health, A National Action Plan". This document resulted in Congress appropriating funds to NIOSH in 1997 to establish the Childhood Agricultural Injury Prevention Initiative.

Over the course of the project, CAN 9278954 - Child Agriculture Injury Prevention, both the number of youth agricultural fatalities and the number of nonfatal injuries per 100 youth has shown a general decline (Figure 2, Figure 3). While it is impossible to attribute this downward decline solely to the project, it is believed the NIOSH Childhood Agricultural Injury Prevention Initiative, of which this project is a component, has had some influence on these statistics. The nonfatal injury data is available because of CAN 9278952 – Childhood Agricultural Injury Surveillance, another project in the NIOSH Childhood Agricultural Injury Prevention Initiative. This is the only national surveillance system tracking on-farm youth nonfatal injuries.

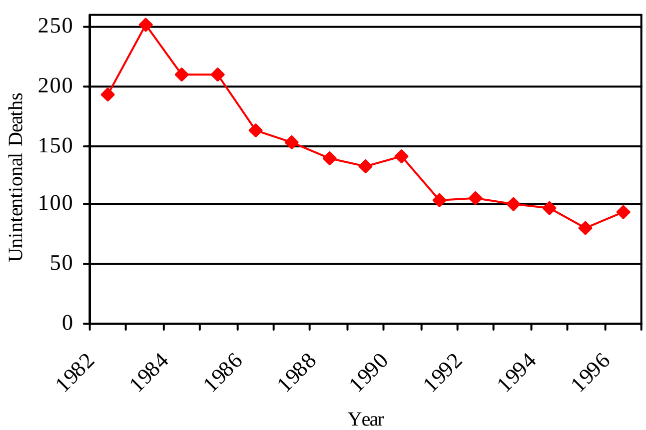


*Figure 1. Unintentional farm deaths to youth less than 20 years of age, 1982-1996 (**Source**: National Center for Health Statistics, National Vital Statistics System).*

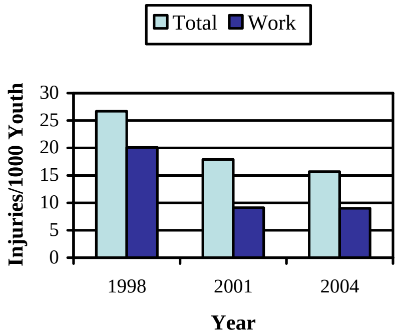


Figure 2. Injuries per 1000 Household Male Youth and Work Injuries per 1000 Working Household Male

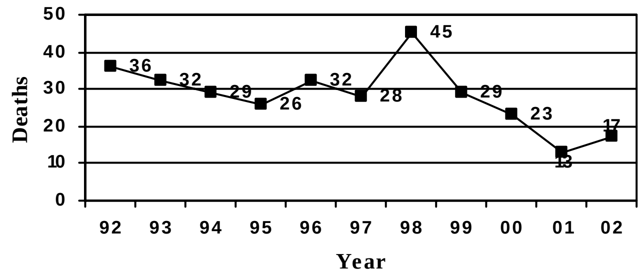


Figure 3. Frequency of Fatalities in Agriculture Production for Workers <20 Years of Age in the US, 1992-2002 from BLS CFOI

INTERMEDIATE OUTCOMES (IO):
Interactions With and Successes of Our Extramural Partners:

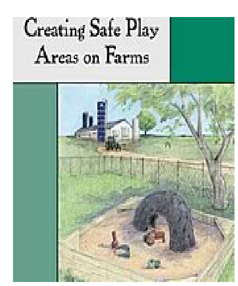
NIOSH has been working with our extramural partners from the beginning of the childhood agricultural injury prevention movement in the early 1990's. Intermediate outcomes from these relationships include:

1. Dr. Hard was an invited member of the Agricultural Engineering/Structural/Environmental working group perspective of the 1992 Childhood Agricultural Injury Prevention Symposium held April 1-3, in Marshfield, Wisconsin. As such, he had input into identifying major issues regarding childhood agricultural injury and proposed recommendations within this subject matter area. This helped develop working relationships with agricultural equipment manufacturer representatives and professional society representatives. Some of the same or similar issues were addressed in the National Action Plan, which was to come later.

2. NIOSH was represented by Dr. Hard as an active participant in the expert panel that developed the 62 North American Guidelines for Children's Agricultural Tasks (NAGCATs) by the NCCRAHS.

3. NIOSH sponsored research has shown that the NAGCATs can be an effective means of reducing injuries to youth on farms. This controlled study found that farm parents who used the NAGCATs reported a 50% reduction in youth farm injuries compared to youth in control farm families.

4. The NCCRAHS published *Creating Safe Play Areas on Farms* in 2003 to provide safety professionals and community leaders guidance on addressing this emerging issue. This document has significantly increased the attention to the development of safe, structured, supervised play areas for children on farms, and has prompted many Safety Day Camps for farm youth to offer parent-oriented programs to promote fenced, supervised play areas for children on farms.



5. NIOSH was represented by Dr. Hard on the National Committee for Childhood Agriculture Injury Prevention (NCCAIP). This committee developed the document Children and Agriculture: Opportunities for Safety and Health: A National Action Plan which was instrumental in obtaining Congressional funding for the NIOSH Childhood Agricultural Injury Prevention Initiative.

6. On September 22, 1999, NIOSH conducted a midcourse review of the Childhood Agricultural Injury Prevention Initiative. A Federal Register Announcement [Federal Register: July 7, 1999 (Volume 64, Number 129), Notices, Page 36693] was made informing the public of this event. Thirty-eight individual comments were received or made at the in-person meeting held in Washington, DC. These individuals represented a wide range of stakeholders, ranging from agricultural center directors, insurance companies, medical doctors, national organizations, and individual researchers. In general, no one disagreed with the course NIOSH had taken with the Childhood Agricultural Injury Prevention Initiative and all believed funding should be continued. This model was similar to the one used by the National Children's Center for Rural and Agricultural Safety and Health for their 2001 Summit review of the childhood agricultural initiative.

FINAL CUSTOMERS: Farm parents and agricultural safety and health professionals who work with farm parents and/or youth.

INTERMEDIATE OUTPUTS:

Dr. Barbara Lee, Director of the NCCRAHS, recently published an editorial in the Journal of Agromedicine (2005: Vol. 10(4)) entitled 'NIOSH Fills Void with Surveillance of Injuries to Youth Living on U.S. Farms." This editorial commends the work that NIOSH has undertaken in their leadership role in the Childhood Agricultural Injury Prevention Initiative. Additionally, Dr. Lee encourages others to give their support to NIOSH and the continuation of the NIOSH childhood agricultural injury surveillance plan.

In 1995, the National Farm Medicine Center sponsored the Child and Adolescent Rural Injury Control Conference. The outcome of this conference was the establishment of the National Committee for Childhood Agricultural Injury Prevention (NCCAIP), which represented a core group of 42 individuals representing various national organizations as well as recognized authorities in the area of childhood agricultural injury or disease prevention. The chair of this committee was Dr. Barbara Lee, National Farm Medicine Center. Over a 16-month period, members of the committee finalized a national action plan to address childhood injuries on farms. NIOSH was represented by two scientists on NCCAIP: Dr. David Hard and Ms. Teri Palermo. Dr. Hard was the chair of the NCCAIP *Research* work group and as such had input into the development and the responsibility of generating the research recommendations for the final report. Ms. Palermo was an active member within the Empowerment working group. The final NCCAIP document was released in the spring 1996 and was entitled *Children and Agriculture: Opportunities for Safety and Health: A National action Plan*. NCCAIP. [1996]. Children and Agriculture: Opportunities for Safety and Health. A National Action Plan. Marshfield, WI: National Farm Medicine Center. As chair of the Research work group of the NCCAIP, Dr. Hard had input into the development of the recommendations and had the responsibility of generating the research recommendations for the NAP. The major areas identified in the report were leadership, surveillance, research, education, and public policy. In addition, the plan specifically recommended that NIOSH serve as the lead federal agency in preventing childhood agricultural injury. As a result of this report, Congress appropriated NIOSH $5 million in Fiscal Year 1997 to implement the NCCAIP plan, resulting in the NIOSH Childhood Agricultural Injury Prevention Initiative.

In 2001, a five year review was held of the activities of the NIOSH Child Ag Injruy Prevention Initiative by extramural partner, NCCRAHS. Lee, B., Gallagher, S., Marlenga, B., Hard, D Eds. [2002]. Childhood Agricultural Injury Prevention: Progress Report and Updated National Action Plan from the 2001 Summit. Marshfield, WI: Marshfield Clinic. *NIOSH was heavily involved in this summit meeting, due to the request of the summit organizers and because it was a cooperative agreement. In recognition of his input and involvement, Dr. Hard was invited to be an author of the final summit report.*

A major activity undertaken by NCCRAHS has been the development of the North America Guidelines for Children's Agricultural Tasks (NAGCAT). The NAGCATs, which are a set of guidelines to assist parents in assigning farm jobs to their children 7 to 16 years of age, were developed in response to farm parent requests for such a resource. NAGCATs allow children and adolescents to gain meaningful work experience with minimal risk of agricultural-related injury. These recommendations were developed using a consensus approach using a panel of agricultural safety and health and child development experts. NIOSH was represented on this expert panel by Dr. David Hard. NAGCAT have been widely cited by both the professional and public press, and has been found to be effective in reducing youth farm injuries in one controlled study.

A major focus of the NIOSH Childhood Agricultural Injury Prevention Initiative has been working with the NCCRAHS on the development and promotion of the North American Guidelines for Childhood Agricultural Tasks (NAGCAT) released in 1999. The primary focus of the NAGCAT is to provide guidance to farm families on how to assign work to farm youth to reduce their risk of injury. The NAGCAT have been widely reported in the popular farm press, and have been shown to be effective in reducing injuries to household youth in one controlled study. Since the establishment and promotion of the NAGCATS, work-related farm injuries to youth living on the farms have decreased from 11,600 injuries in 1998 down to 6,400 in 2004. The work-related injury rate for household youth decreased from 14.1 to 9.1 injuries per 1000 working household youth for the same period (**Source:** NIOSH CAIS).

In fall of 1998, NIOSH, in conjunction with Purdue University, sponsored a workshop entitled "The Childhood Agricultural Injury Prevention Strategy Workshop: A Private Sector Perspective." The purpose of the workshop was to obtain input from the private section on ways they could become active partners in the Childhood Agricultural Injury Prevention Initiative, a stated goals of the NCCAIP action plan. NIOSH contacted more than 250 groups representing the following industrial areas: agricultural chemical manufacturers, agricultural cooperatives, insurance companies, private consultants and legal professionals, farm media, safety equipment manufacturers, feed and grain suppliers, utilities, commodity groups, farm structure providers, suppliers of farm services, medical professionals and lending institutions. As a result of these contacts, forty-three individuals attended and participated in the workshop.

Workshop participants identified corporate image, name recognition, media attention, and increased leverage in future litigation as important justification for involvement in injury prevention programs. Reasons for supporting specific activities included consistency with corporate mission, enhanced public relations, and the potential for successful outcomes. However, budget constraints and a perceived lack of benefits to the organization were identified as primary reasons why requests for support by organizations such as NCCAIP were rejected. Other Internal barriers for organizational support of injury prevention programs were the potential for creating a liability risk, and the lack of support from management. Finally, workshop participants indicated the private sector should be recognized and acknowledged by planners of agricultural childhood injury prevention efforts. Participants felt the private sector commitment to injury prevention was a reflection of concern for families that use their products and services. Participants believed the problem was a community problem which requires a broad-based collaborative effort involving all stakeholders and that additional regulations were not needed. Purdue University produced a final report summarizing the workshop which has been made available through the National Technical Information Service.

In addition to this workshop, NIOSH has organized several special sessions on the topic of childhood agricultural injuries at various conferences. Five such conferences were:

- Fourth International Symposium: Rural Health and Safety in a Changing World, October 18-22, 1998, Saskatoon, Saskatchewan, Canada.
- Agricultural Safety and Health in a New Century, April 28-30, 2000, Cooperstown, New York.
- National Occupational Injury Research Symposium, October 17-19, 2000, Pittsburgh, Pennsylvania.
- National Institute for Farm Safety 2001 Annual Meeting, June 24-27, 2001, Pittsburgh, Pennsylvania.
- National Occupational Injury Research Symposium, October 28-29, 2003, Pittsburgh, Pennsylvania.
- National Injury Prevention and Control Conference, May 9-11, 2005, Denver, Colorado.

INTERMEDIATE CUSTOMERS:

TRANSFER ACTIVITIES: NIOSH established a website (http://www.cdc.gov/niosh/childag/) dedicated to providing current information regarding the NIOSH Childhood Agricultural Injury Prevention Initiative. The National Children’s Center for Rural and Agricultural Safety and Health also established a website for providing current information on farm youth injury statistics (utilizing NIOSH survey information), injury prevention information and translating research findings into useable information for lay people.

OUTPUTS:
Conferences sponsored:

Special Session: Intervention--Safe Behaviors Among Adults and Children, Surgeon General's Conference on Agricultural Safety and Health, April 1991 Des Moines, IA.

The Childhood Agricultural Injury Prevention Strategy Workshop: A Private Sector Perspective, November 90-11, 1997, Indianapolis, IN.

Special Session: Childhood Agricultural Injuries, Fourth International Symposium: Rural Health and Safety in a Changing World, October 18-22, 1998, Saskatoon, Saskatchewan, Canada.

Special Session: Childhood Agricultural Injuries, Agricultural Safety and Health in a New Century, April 28-30, 2000, Cooperstown, NY.

Special Session: Childhood Agricultural Injury Prevention, National Occupational Injury Research Symposium, October 17, 2000, Pittsburgh, PA.

Special Session: Childhood Agricultural Injuries, National Institute for Farm Safety 2001 Annual Meeting, June 24-27, 2001, Pittsburgh, PA.

2001 Summit on Childhood Agricultural Injury Prevention, April 30-May 1, 2001, Brooklyn Park, MN.

Special Session: Childhood Agricultural Injury Prevention, National Occupational Injury Research Symposium, October 28-29, 2003, Pittsburgh, PA.
Special Session: Agricultural Injuries, National Injury Prevention and Control Conference, May 9-11, 2005, Denver, Colorado.

Peer reviewed Journal Articles:

Hard DL, Myers JR. 2006. Fatal Work-Related Injuries in the Agriculture Production Sector Among Youth in the United States, 1992-2002. Accepted by the Journal of Agromedicine, 6-29-06.

Hard DL, Myers JR, Gerberich SG. 2002. Traumatic injuries in agriculture. Journal of Agricultural Safety and Health 8(1):51-65.

Hard DL, Myers JR, Snyder KA, Casini VJ, Morton LL, Cianfrocco R, Fields J. [1999]. Young workers at risk when working in agricultural production. American Journal of Industrial Medicine 36 Supplement 1:31-33. *(cited 13 times per Google Scholar)*

Castillo D, Hard D, Myers J, Pizatella T, Stout N. [1998]. A national childhood agricultural injury prevention initiative. Journal of Agricultural Safety and Health Special Issue 1:183-191.

Landsittel D, Murphy DJ, Kiernan NE, Hard DL, Kassab,C. 2001. An evaluation of the effectiveness of educational interventions in the Pennsylvania Central Region farm safety pilot project. American Journal of Industrial Medicine, 40(2):145-152.

Landsittel D, Hard DL, Murphy DJ, Kiernan NE. [1998]. The Pennsylvania Central Region Farm Safety Pilot project: Part II--Baseline data associations between approach-to-safety and hazard conditions. Journal of Agricultural Safety and Health Special Issue 1: 21-28.

Murphy DJ, Kiernan NE, Hard DL, Landsittel D. [1998]. The Pennsylvania Central Region farm safety pilot project: Part I--Rationale and baseline results. Journal of Agricultural Safety and Health 4(1):25-41.

NIOSH Numbered Documents:

Mason RW, ed.: Report to Congress on workers' home contamination study conducted under the Workers' Family Protection Act [281 pages]. NIOSH, US Dept Health & Human Services, Cincinnati, OH. September, 1995. *(cited 17 times per Google Scholar) Dr. Hard developed a section devoted to caustic farm products. Farms were also highlighted (dealing with caustic substances ingested by children and pesticide exposures) along with sections on caustic farm products and pesticides.*

Myers ML, Herrick RF, Olenchock SA, Myers JR, Parker JE, Hard DL, Wilson K (editors). [1992]. Papers and Proceedings of the Surgeon General's Conference on Agricultural Safety and Health. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Pub. No. 92-105. *(cited 20 times per Google Scholar)*

Fatal work-related injuries in the agriculture production sector among youth in the United States, 1992-2002. Hard-DL; Myers-JR Proceedings of the National Institutefor Farm Safety (NIFS) Annual Conference, June 26-30, 2005, Wintergreen, Virginia. Technical Paper No. 05-07, Columbus, OH: National Institute for Farm Safety, 2005 Jun. (NIOSHTIC Numer:1-1220028967)

Conference Reports and Papers:

Hard DL. [2000 & 2003]. Special Session Moderator–Childhood Agricultural Injury Prevention. National Occupational Injury Research Symposium, October 17, 2000, Pittsburgh, PA.

Lee, B., Gallagher, S., Marlenga, B., Hard, D Eds. [2002]. Childhood Agricultural Injury Prevention: Progress Report and Updated National Action Plan from the 2001 Summit. Marshfield, WI: Marshfield Clinic. *NIOSH was heavily involved in this summit meeting, due to the request of the summit organizers and because it was a cooperative agreement. In recognition of his input and involvement, Dr. Hard was invited to be an author of the final summit report.*

Childhood Agricultural Injury Prevention Strategy Workshop: A Private Sector Perspective. Final Report: A Summary of Strategies and Successes. NTIS Order # PB99147597; Year : 1999.

NCCAIP. [1996]. Children and Agriculture: Opportunities for Safety and Health. A National Action Plan. Marshfield, WI: National Farm Medicine Center. *As chair of the Research work group of the NCCAIP, Dr. Hard had input into the development of the recommendations and had the responsibility of generating the research recommendations for the NAP.*

Presentations:

Hard DL. [2003]. Agricultural Injury Surveillance Conducted by NIOSH. Presented at the 5th International Symposium: Future of Rural People – Rural Economy Health People, Environment, and Rural Communities, October 19-22, 2003, Saskatoon, Saskatchewan, Canada.

Hard DL [2003]. The NIOSH childhood agricultural injury prevention initiative. National Occupational Injury Research Symposium, October 28-29, 2003, Pittsburgh, PA.

Hard D, Castillo D, Myers J, Pizatella T, Olenchock S. [2000]. Overview of the NIOSH childhood agriculture injury prevention initiative. National Occupational Injury Research Symposium, October 17-19, 2000, Pittsburgh, PA.

Hard DL, Layne LA. [1995]. A National Sample of Nonfatal Occupational Injuries Incurred by Youth Presenting to Hospital Emergency Departments: Agriculture Compared to Other Industries. Poster presentation at the Child and Adolescent Rural Injury Control Conference, March 8-9, 1995, Marshfield, WI.

ACTIVITIES:

Project Description:

The Childhood Agricultural Injury Prevention Initiative uses a triad approach of: surveillance, research and information dissemination. This project is designed to encompass non-surveillance components of the NIOSH Childhood Agricultural Injury Prevention Initiative. Activities within this project include: (1) assuming a leadership role in federal efforts to prevent childhood agricultural injuries; (2) assisting in the development of a grant/cooperative agreement program to stimulate research and the use of empirical data to reduce agricultural injuries to children; (3) eliciting feedback from stakeholders on progress of the Initiative and strategies or ideas for improving research and prevention efforts; (4) providing technical and programmatic assistance to the National Children's Center for Rural and Agricultural Health and Safety; and (5) serving as a liaison for NIOSH research activities in order to achieve wide dissemination of research results to childhood agricultural safety and health practitioners.

The leadership role in federal efforts to prevent childhood agricultural injuries is evidenced by NIOSH convening a Federal Interagency Working Group on Preventing Childhood Agricultural Injuries, consisting of 11 agencies or other government organizations with an interest in this area. The Federal Interagency Working Group serves as a mechanism for sharing information and facilitating collaborative efforts in the area of childhood agricultural injury prevention among federal agencies. By convening representatives of federal agencies with knowledge and interest in childhood agricultural safety and health, the Working Group will provide focus and emphasis to the childhood agricultural injury problem.

The research component is primarily R01 extramural grants. NIOSH has funded 31 extramural research projects to-date under the initiative, encompassing a range of areas identified as priorities by external constituents and partners. These research areas include: etiology, outcomes, intervention strategies, and rigorous evaluations of commonly available educational/training programs; evaluate the effectiveness of commonly used educational materials/training; understanding the magnitude and scope of childhood agricultural injuries and illnesses; evaluation of the effectiveness of currently used community-based interventions; develop and evaluate new or existing enhanced control technologies; develop and evaluate incentives which encourage adults to protect youth from farm hazards.

Funding/support for a National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS) is designed to help translate research into commonly understood concepts or terms for lay users and practitioners and provide the latest up-to-date information on childhood agricultural injury prevention to stakeholders. Examples of this are the posting of the latest

NIOSH/USDA surveillance information on the NCCRAHS website, promulgating promising research findings and putting research findings into plain and easy to understand language for practitioners and farm families. This has resulted in the North American Guidelines for Children's Agricultural Tasks (NAGCAT) being developed (a developmental-based guide for work tasks for youth), an action plan for addressing Migrant and Seasonal Adolescent Farmworkers, Creating Safe Play Areas on Farms (to address the majority of youth who are injured on farms that are not working), and the promotion of promising research interventions for agricultural youth injury prevention. This project is best conducted as a coordination project because of the variety of issues that are to be addressed in recommendations from the 2001Childhood Agricultural Injury Prevention Summit and the 1996 National Action Plan along with the large number of internal and external partners that are required to address these recommendations.

The ultimate goal of the project is to facilitate and enhance federal efforts to reduce childhood agricultural injuries.

NIOSH Funded RO1 Childhood Agricultural Injury Prevention Grants between 1997 and 2004.

RO1 Childhood Agricultural Injury Prevention Grant Title	PI
Occupational Injury in Hispanic Farmworker Families	McCurdy, Stephen
Community-based Health & Safety Interventions for Adolescents Working in	Lee, Barbara
Risk Factors for Injury among Migrant and Seasonal Farmworker Children	Amandus, Harlan
Youth Teaching Youth: Are TASK Teens Ready to Teach	Petrea, Robert
Childhood Health Outcomes in a Rural Cohort	Merchant, James
Ag Disability Awareness and Risk Education	Reed, Deborah
Enhancing Agricultural Safety and Health through Education	Parker, David
Evaluating Ohio's Tractor Certification Program: Traditional and Novel	Wilkins, III, J.R.
Childhood Injuries in Washington State Agriculture (paper copy)	Alexander, Bruce
Childhood Agricultural Safety and Health Intervention (paper copy)	Chapman, Larry
Etiology and Consequences of Injuries Among Children in Farm Households	Gerberich, Susan
Work Guidelines: Evaluation of Dissemination Methods	Marlenga, Barbara
Empirical Derivation of Work Guidelines for Youth in Agriculture	Wilkins, III, J.R.
An Evaluation of the North American Guidelines for Children's Agricultural Tasks	Wright, Sue
Evaluation of NAGCAT Using case Series of Injuries	Marlenga, Barbara
Teaching Kids Safety on the Farm: What works	Gadomski, Anne
Childhood Agricultural Safety and Health	Parker, David
Pesticide Training for Adolescent Migrant Farmworkers	McCauley, Linda
Using the ASHBMP Manual as a Tool to Reduce Farm Hazards	Legault, Malcom
Evaluating Teen Farmworker Education	Baker, Robin
Adapting NAGCAT for Ethnic Communities: A Research model	Shutske, John
Childhood Agricultural Trauma Evaluation System	Boyle, Debra

RRIS II: Agricultural Injury Surveillance	Gerberich, Susan
Effectiveness of Farm Safety Day Camps for Children	McCallum, Debra
Evaluation of Farm Safety 4Just Kid Day Camps	Reed, Deborah
Removing the HOOA Family Farm Exemption: Impact On Injury	Marlenga, Barbara
Biomarkers of Pesticide Toxicity Among Teen Farmworkers	McCauley, Linda
Evaluation of Occupational Carrying Tasks for Farm Youth	Schwab, Charles
Adherence to the NAGCAT and Injury Risk Reduction	Wilkins, J. R.
Effect of Work Permits In Protecting Youth Workers	Dal Santo
Work Injury and Young People: A Prospective Survey	Breslin
Farm Family Total Noise Exposure Assessment	Milz

Federal agencies invited to participate in the NIOSH Federal Interagency Working Group on Preventing Childhood Agricultural Injuries during 2006.

Participating Federal Agencies
Consumer Products Safety Commission
HRSA, Maternal Child Health Bureau
US Department of Education, National FFA Advisor
National Center for Injury Prevention and Control
USDA, NASS
US Department of Education, Office of Migrant Education
USDOL, Occupational Safety and Health Administration
Division of Community and Migrant Health Centers
National Institute of Child Health and Human Development
USDA, Cooperative State Research, Education, and Extension Service
USDOL, Employment Standards Administration
USDOL, Employment and Training Administration
Indian Health Service

INPUTS:

PROJECT ID: 927006N - OS&H Asssistance to Vocational/Technical Schools

PROJECT OFFICER: John Palassis

END OUTCOMES: To promote occupational safety and health among vocational and technical schools among the 11 million young workers and teachers in 20,000 schools in the U.S.

INTERMEDIATE OUTCOMES (IO):

FINAL CUSTOMERS: Young workers

INTERMEDIATE OUTPUTS: To produce a NIOSH publication as a result of the site visits to include respirator program for schools in order to prevent young worker/student' exposure to organic chemicals in auto body repair shops.

INTERMEDIATE CUSTOMERS:

TRANSFER ACTIVITIES: This project translates research into practice for safety and health professionals, employers, and workers.

OUTPUTS: collaboration with CPSC and other agencies and organizations for the development of chemical safety guide to students in postsecondary schools.

ACTIVITIES: provide funding and judging assistance for two national competitions in OS&H --one among students, and the other among teachers and provide award

INPUTS:

PROJECT ID: 927008W - Evaluation of OSH Training of Young Workers

PROJECT OFFICER: Carol Stephenson

END OUTCOMES: an evaluation of OSH training materials

INTERMEDIATE OUTCOMES (IO):

FINAL CUSTOMERS: young workers

INTERMEDIATE OUTPUTS:

INTERMEDIATE CUSTOMERS:

TRANSFER ACTIVITIES:

OUTPUTS:

ACTIVITIES: collaborating with partners to implement, evaluate, and institutionalize an occupational safety and health curriculum in high schools nationwide.

INPUTS Information from the National Electronic Injury Surveillance System (ER data) and Survey of Occupational Injuries & Illnesses (annual BLS survey of employees).

PROJECT ID: CAN 9277187R, Young Worker Safety

END OUTCOMES:

The rates of young worker injury deaths have fluctuated over the last decade. Rates since 2000 are generally lower than rates in the 1990s (Figure 1).

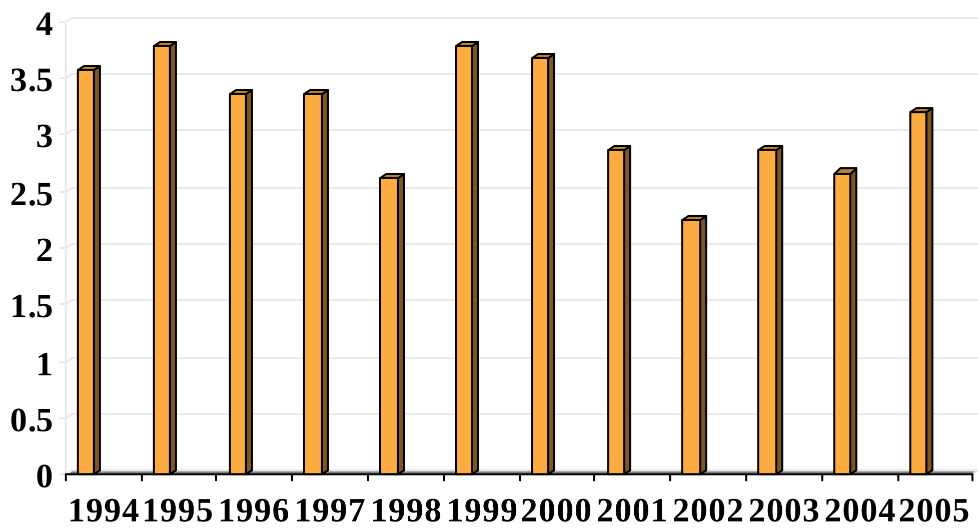


Figure 1. Fatality rates per 100,000 fulltime equivalents, youth 15-17 years of age (Source: Bureau of Labor Statistics, Census of Fatal Occupational Injuries (CFOI))

While there appear to be positive reductions in rates of young worker injury deaths for 16- and 17- year-olds generally since 1996, there has been little change for youth 15 years of age, and apparent increases in fatality rates for 15- and 16-year-olds in agriculture (Table 1). It is important to note that youth less than 14 years of age work, especially in agriculture, but the absence of official statistics for youth employment preclude the ability to calculate comparable fatality rates.

Age (Years)	**All Industries**			Ag Production		
	1992-96 Rate	**1997-02 Rate**	**% Change**	1992-96 Rate	1997-02 Rate	% Change
15	**5.2**	**5.1**	**-1.9**	13.3	24.1	81.2
16	**3.6**	**2.8**	**-22.2**	10.5	15.2	44.8
17	**3.5**	**2.9**	**-17.1**	16.8	12.9	-23.2

Table 1. Fatality rates per 100,000 fulltime equivalents for youth 15-17 years of age for all industries and the agricultural production industry for select time periods. (Source: CFOI. Numbers and rates were calculated by NIOSH and may differ from previously published BLS CFOI numbers and rates. We are currently seeking review by BLS of updated numbers.)

INTERMEDIATE OUTCOMES (IO):

1. Changes to child labor laws based on NIOSH recommendations.

A final rule published by the Department of Labor (DOL) in 2004 incorporated NIOSH recommendations, referring to NIOSH comments and recommendations in the accompanying narrative [69 Fed. Reg. 75382 (2004)]. The new federal child labor regulations went into effect on February 14, 2005. NIOSH research and recommendations were cited among the justifications for the rule changes. NIOSH recommendations were submitted to DOL in response to a public comment period on the proposed rule, and a report that NIOSH developed at the request of DOL recommending changes to Hazardous Orders (those activities deemed to be especially dangerous for youth, and prohibited for youth less than 18 years of age in non-agricultural industries, and youth less than 16 years of age in agriculture). These changes have the potential to reduce young worker deaths and injuries associated with working on roofs, compactors and balers, driving, and the manufacture of explosives.

2. Calls for the Department of Labor (DOL) to implement NIOSH recommendations for changes to Hazardous Orders

Since the release of the NIOSH Hazardous Orders recommendations in May 2002, numerous researchers, standards-setting bodies, legislators, and advocacy groups nationally and internationally have called for implementation of its recommendations or cited them as justification for the need to update child labor laws. Several examples of the many ways in which the report has been used are detailed below.

<u>Action by the International Labour Organization (ILO) Related to U.S. Compliance with Convention No. 182, 2006</u>:
At the 2006 annual meeting of the ILO in Geneva, Switzerland, the Conference Committee on the Application of Standards discussed the U.S. application of Convention No. 182 (Elimination of the Worst Forms of Child Labour) as it relates to children performing hazardous work in agriculture. The Committee of Experts report used as a resource by the ILO Conference Committee mentions the NIOSH recommendations on Hazardous Orders, noting that the U.S. Government has indicated that it is “in the process of determining which recommendations concerning the Hazardous Orders will be presented in a first round of proposed rules” [International Labour Organization 2006, p. 231]. The Conference Committee requested that the U.S. Government provide copies of any new Hazardous Orderss when adopted. In addition, the Conference Committee requested the U.S. government to “indicate, in its next report to the Committee of Experts, the measures taken or envisaged (including but not limited to legislation) to ensure that work performed in particular in the agricultural sector was prohibited for children under 18 years where it was hazardous work within the meaning of the Convention” [International Labour Organization 2006, p. 230].

<u>Letter from Child Labor Coalition to Secretary of Labor Elaine Chao requesting action on child labor regulations for agriculture, June 28, 2006</u>:
The Child Labor Coalition followed the action by the ILO Conference Committee with a letter to Secretary of Labor Elaine Chao requesting that forthcoming proposed changes to child labor laws focus on agriculture. The letter references the 2002 NIOSH report recommending changes to Hazardous Orders (HOs), and the discussions at the 2006 annual ILO meeting questioning

U.S. compliance with ILO Convention No. 182 (Elimination of the Worst Forms of Child Labour) in relation to children working in agriculture:

> **"The Child Labor Coalition strongly urges the Labor Department to make agricultural HOs a top priority within the anticipated child labor regulatory action in 2006.** Given that the lead advocacy group (CLC) and the lead group of health and safety experts on child labor (YWH&S Network); and the government's lead agency on occupational safety and health (NIOSH) recognize the pressing need to strengthen the agricultural HOs, it would be deplorable if the 2006 proposed child labor regulations do not include agriculture in the scope of proposed rulemaking. Furthermore, in light of increased attention by the ILO on the issue of children in hazardous agricultural employment and their request for more information related to measures taken or envisaged, it would certainly not be overlooked if the DOL's regulatory changes in child labor exclude or minimize agriculture." [Child Labor Coalition 2006]

<u>Proposed legislation that references NIOSH Hazardous Orders recommendations</u>:
In 2003 and again in 2005, Representative Tom Lantos (D-California) introduced the Youth Worker Protection Act, which would amend the Fair Labor Standards Act of 1938 (FLSA) to revise requirements relating to child labor and to set forth new requirements for the employment of minors. The Act included a provision directing the Secretary of Labor to promulgate a rule relating to particularly hazardous occupations for children between the ages of 16 and 18, specifying that this rulemaking was justified based on the Hazardous Orders recommendations released by the National Institute for Occupational Safety and Health in 2002 [GovTrack.us 2006a, 2006b].

FINAL CUSTOMERS:

Employers, young workers, parents, and educators.

INTERMEDIATE OUTPUTS:

<u>DOL stakeholder meetings</u>: In response to the release of the NIOSH Hazardous Orders recommendations, the DOL/Employment Standards Administration convened a series of stakeholder meetings to gather input on priorities for future rulemaking in 2003. Authors of the NIOSH recommendations participated in these meetings, segmented by the agricultural and nonagricultural sectors. Organizations with interests in youth work in agriculture that participated in the agricultural meeting included the Farmworker Justice Fund, the U.S. Department of Agriculture, the Pennsylvania State University, and the Tennessee Agricultural Extension Service. Organizations who participated in the nonagricultural meeting included the Center to Protect Workers' Rights, which focuses primarily on the safety and health of workers in the construction industry; the AFL-CIO; the National Consumers League; and the United Food and Commercial Workers Union.

<u>Press release from Farmworker Justice Fund cites NIOSH Hazardous Orders recommendations, 2003</u>:
In 2003, the Farmworker Justice Fund called for DOL to revise the Hazardous Orders for youth in agricultural occupations, citing the NIOSH recommendations as the basis for these revisions [Farmworker Justice Fund, Inc. 2003].

Comments and prioritization of recommendations by Young Worker Health & Safety Network, 2003:
In March 2003, the Young Worker Health and Safety Network (YWH&S) released its report,* NIOSH Recommendations for Changes to the Federal Child Labor Regulations: A Response from Members of the Young Worker Health and Safety Network. *The network is a subcommittee of the Occupational Health and Safety section of the American Public Health Association, comprised of public health professionals, advocates, educators, and government agency staff. More than 25 individuals from a variety of disciplines collaborated to develop the network's response to the NIOSH Hazardous Orders recommendations [Young Worker Health & Safety Network 2003].

The YWH&S Network agreed with all NIOSH recommendations pertaining to the existing Hazardous Orders (HOs) for agriculture, and flagged four agricultural HOs as top priorities for regulatory action. These are: HO 1, Tractors; HO 6, Ladders and Scaffolds; HO 7, Motor Vehicles; and the new NIOSH proposed HO related to respiratory protection (for both agricultural and non-agricultural industries). The YWH&S Network identified four additional HOs for non-agricultural occupations as top priorities for revision per NIOSH recommendations: HO 5, Woodworking Machines; HO 7, Hoisting Apparatus Operations; HO 14, Power-driven Saws; and HO 16, Roofing.

The YWH&S Network comments were also the topic of a peer-review journal article, which further encouraged implementation of the NIOSH recommendations by DOL/ESA [Miller and Bush 2004].

Use of NIOSH Hazardous Orders recommendations in report by Child Labor Coalition, 2005: In 2005, the Child Labor Coalition (CLC) prepared a report entitled *Protecting Working Children in the United States: Is the Government's Indifference to the Safety and Health of Working Children Violating an International Treaty?* [Child Labor Coalition 2005]. The CLC is a group of non-governmental organizations whose mission is to end child labor exploitation in the U.S. and abroad and to protect the health, education, and safety of working minors. The CLC report was submitted in June 2005 to the ILO Committee of Experts, which is an independent body charged with examining the application of ILO conventions in member states. In the report, the CLC questions whether the U.S. is in compliance with ILO Convention No. 182 (Elimination of the Worst Forms of Child Labour), with particular emphasis on Hazardous Orders and children working in agriculture. Several pages of the report are devoted to a discussion of needed revisions to agricultural HOs 1, 6, 7, and 9. Data and rationale from the NIOSH Hazardous Orders report are used as the primary justification for changes. The report urges DOL/ESA to take action on NIOSH recommendations, particularly those which focus on the agricultural HOs.

INTERMEDIATE CUSTOMERS:
- World Health Organization and International Labour Organization who held an expert meeting on the development of guidelines for defining hazardous child labor. The NIOSH recommendations for changes to Hazardous Orders were put forward as one approach.
- U.S. Congress, as evidenced by the use of the NIOSH recommendations to justify introduction of new legislation in 2003 and 2005 to protect working youth.
- The U.S. Department of Labor, Employment Standards Administration, Wage and Hour Division responsible for promulgating and enforcing federal child labor laws.

- Occupational Safety and Health Administration who is involved in educational efforts to protect young worker
- Child Labor Coalition, a non-governmental organization whose mission is to end child labor exploitation in the U.S. and abroad and to protect the health, education, and safety of working minors.
- Young Worker Safety & Health Network, a subcommittee of the Occupational Health and Safety section of the American Public Health Association, comprised of public health professionals, advocates, educators, and government agency staff.
- Interstate Labor Standards Association, an association of state government staff responsible for promulgating and enforcing state labor laws.
- Researchers and public health practitioners

TRANSFER ACTIVITIES:

NIOSH Hazardous Orders Recommendations
NIOSH provided this report to the Department of Labor, Employment Standards Administration, Wage and Hour Division in May, 2002. A presentation was given by request to the Child Labor Coalition in September, 2002. The report was also provided in response to specific requests, including to the World Health Organization and International Labour Organization, and subsequently posted on the NIOSH internet. In 2003, the Department of Labor distributed the report to groups invited to participate in stakeholder meetings to gather input on priorities for future rulemaking.

NIOSH Young Worker Alert
In August 2003, NIOSH published an Alert, *Preventing Deaths, Injuries, and Illnesses of Young Workers*, summarizing current statistics and providing prevention recommendations for employers, parents, educators and youth. Partners such as the Child Labor Coalition, Interstate Labor Standards Association, OSHA and state governmental agencies helped distribute over 31,000 copies. Examples of dissemination of the document by state groups include:

- Maryland Occupational Safety and Health (MOSH) Training and Education -- 100 copies distributed in their Teen Train-the-Trainer program
- Virginia Department of Labor & Industry -- 50 copies used for consultation program
- Massachusetts Fatality Assessment and Control Evaluation program -- 560 copies sent to the Massachusetts Department of Education
- Nebraska Fatality Assessment and Control Evaluation program – distributed at every presentation, briefing, or booth attended by program staff, including “Husker Harvest Days” and “Farm Safety Day Camps”

Fatality Assessment and Control Evaluation (FACE) reports on young worker injury deaths
Finalized reports were provided to the Department of Labor, Employment Standards Administration, Wage and Hour Division, and posted on the NIOSH internet.

In December 2002, NIOSH in collaboration with the Department of Labor, Employment Standards Administration, Wage and Hour Division, mailed a packet on forklift safety to over 10,000 retail warehouses. The packet included FACE reports of young worker fatalities involving forklifts in warehouse-type settings, and stickers provided by the Department of Labor that indicate that persons less than 18 years of age are prohibited from operating forklifts. The mailing resulted in requests for 6,000 additional stickers. A similar mailing was subsequently conducted in conjunction with the Occupational Safety and Health Administration, including OSHA materials in the informational safety packet.

OUTPUTS:

Top-level category:

Castillo DN, Pratt SG, Mardis AL, Hendricks KJ [2002]. National Institute for Occupational Safety and Health (NIOSH) recommendations to the U.S. Department of Labor for changes to Hazardous Orders. Report to the U.S Department of Labor, Employment Standards Administration, Wage and Hour Division. May 3, 2002.

NIOSH [2000]. Comments of the National Institute for Occupational Safety and Health on the Department of Labor Notice of Proposed Rulemaking and Request for Comments on Child Labor Regulations, Orders and Statements of Interpretation; Child Labor Violations – Civil Money Penalties, 29 CFR Parts 570 and 579. January 28, 2000.

NIOSH Publication Sub-category:

Mardis AL, Pratt SG [2003]. NIOSH Alert: Preventing deaths, injuries, and illnesses of young workers. Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Pub. No. 2003-128.

NIOSH [1999]. Youth dies in trench collapse B Arizona. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 99-02.

NIOSH [2000]. 15-year-old campground laborer dies after striking a camper trailer hitch while operating a utility vehicle B Ohio. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 99-05.

NIOSH [2000]. 16-year-old ride attendant dies after being caught and dragged by amusement park ride B Connecticut. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 99-06.

NIOSH [2000]. Three tower painters die after falling 1,200 feet when riding hoist line B North Carolina. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-07.

NIOSH [2000]. 16-year-old farmworker dies in a cotton packing machine after being covered with a load of cotton B Georgia. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-06.

NIOSH [2000]. Youth laborer dies in trench collapse B Michigan. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-03.

NIOSH [2000]. 16-year-old laborer at a building supply center crushed by forklift that tipped over B Ohio. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-09.

NIOSH [2000]. 15-year-old part-time worker at retail grocery store suffers amputation while assembling meat grinder - Utah. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-13.

NIOSH [2000]. Sixteen-year-old mechanic=s assistant died after being run over by the rear wheels of a tub grinder B Connecticut. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-14.

NIOSH [2001]. Sixteen-year-old produce market worker dies from crushing injuries after being caught in a vertical downstroke baler B New York. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-19.

NIOSH [2001]. Seventeen-year-old laborer at salvage lumber operation crushed by forklift that tipped over B New York. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-22.

NIOSH [2001]. Fourteen-year-old youth pulled into operating wood chipper B Florida. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-21.

NIOSH [2001]. A 17-year-old life guard died from injuries sustained after she fell into an empty pool during pre-season maintenance work B Pennsylvania. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-17.

NIOSH [2001]. A sixteen-year-old male died after falling 27 feet at a residential construction site B Alabama. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-16.

NIOSH [2001]. 17-year-old bagger at retail grocery store suffers amputation while operating a meat grinder B Pennsylvania. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2001-05.

NIOSH [2002]. Fourteen-year-old laborer dies after a stored piece of hoisting apparatus fell on him at an automobile repossession yard B Pennsylvania**.** Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-04.

NIOSH [2002]. Seventeen-year-old window washer dies after falling 180 feet due to a rigging anchor failure B PA. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-08.

NIOSH [2002]. A 15-year-old male farm laborer dies after the tractor he was operating overturned into a manure pit B Pennsylvania. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-18.

NIOSH [2002]. A 16-year-old roofer helper dies after 28-foot fall down an unguarded elevator shaft opening B Pennsylvania. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-23.

NIOSH [2002]. A 15-year-old youth fell through a skylight 24 feet while he was helping a repairman on the roof of a stone-casting company B Florida. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2001-04.

NIOSH [2002]. Fourteen-year-old laborer dies after falling through a skylight B Alabama. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2001-07.

NIOSH [2002]. Seventeen-year-old warehouse laborer dies after the forklift he was operating tipped over and crushed him B Arizona. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2002-02.

External Publication Sub-Category:

Hendricks KJ, Layne LA [1999]. Adolescent occupational injuries in fast food restaurants: An examination of the problem from a national perspective. J Occup Environ Med *41*:1146-1153.

Mardis AL, Pratt SG [2003]. Nonfatal injuries to young workers in the retail trades and services industries in 1998. JOEM *45*(3): 316-323.

Publications resulting from Cooperative Agreements, "Research on Young Worker Safety and Health Risks in Construction"

Lipscomb HJ, L Li [2001]. Injuries among teens employed in the homebuilding industry in North Carolina. Inj Prev *7*:205-209.

O'Connor T, Loomis D, Runyan C, Abboud dal Santo J, Schulman M [2005]. Adequacy of health and safety training among young Latino construction workers. J Occup Environ Med *47*:272-277.

Runyan CW, Dal Santo J, Schulman M, Lipscomb HJ, Harris TA [2006]. Work hazards and workplace safety violations experienced by adolescent construction workers. Arch Pediatr Adolesc Med *160*:721-7.

Seixas NS, Goldman B, Sheppard L, Neitzel R, Norton S, Kujawa SG [2005]. Prospective noise induced changes to hearing among construction industry apprentices. Occup Environ Med *62*:309-317.

Suruda A, Philips P, Lillquist D, Sesek R [2003]. Fatal injuries to teenage construction workers in the US. Am J Ind Med *44*:510-514.

ACTIVITIES:

Activity: NIOSH Recommendations to the U.S. Department of Labor for Changes to Child Labor Laws

In response to a recommendation in the National Research Council monograph *Protecting Youth at Work*, the U.S. Department of Labor (DOL) provided funds for NIOSH to develop a report on the adequacy of Hazardous Orders (HOs) based on a review of data and the scientific literature. The report was developed as a deliverable in interagency agreements between NIOSH and the DOL/Employment Standards Administration (ESA) in fiscal years 1999 to 2001. ESA is the agency within DOL that is directly responsible for developing and enforcing child labor laws. Primary data sources used by NIOSH were the Census of Fatal Occupational Injuries, the Survey of Occupational Injuries and Illnesses, the National Electronic Injury Surveillance System, and the Current Population Survey. In addition, hundreds of scientific articles and reports were reviewed. Considerable staff resources in the Division of Safety Research were devoted to the analysis and interpretation of data and preparation of the report. The equivalent of two full-time staff worked on the report between January 2001 and June 2002. Staff in other NIOSH divisions provided supporting data.

This comprehensive report, which was released to the DOL in May 2002, made specific recommendations for each of the HOs that defines prohibited occupations. It did not address statutory issues such as the minimum age for work in HOs and exemptions from the FLSA, such as work on family farms. The development of recommendations was driven by data on high-risk activities for all workers, not just patterns of fatalities and serious injuries among young workers. The general rationale for recommending an HO was that the associated fatality rate had to be at least 10 per 100,000 workers, or about twice the fatality rate for all U.S. workers. The number and severity of nonfatal injuries were also considered, as well as research on health effects of workplace exposures.

NIOSH found justification for all of the existing HOs. Review of available data and scientific evidence found that work currently prohibited by HOs continued to pose risks for death, serious injuries, and disabling health conditions. NIOSH proposed several types of revisions to HOs: better definition of prohibited activities, incorporation of associated legislative provisions, and in some cases, removal of current exemptions. In addition, NIOSH made recommendations to expand several HOs to include similar work with comparable or greater risk. Table 2 below summarizes NIOSH recommendations for changes to the 17 existing HOs for nonagricultural occupations, and Table 3 provides the same information for the 11 existing HOs for agricultural occupations.

NIOSH recommended the development of several new HOs to protect youth from especially hazardous work not adequately addressed in the existing regulations. The recommended HOs encompassed work associated with deaths and severe injuries of youth, work with especially high fatality rates, and work associated with disabling health conditions. In several instances, NIOSH recommended extending prohibitions now in place for agricultural occupations to similar tasks in nonagricultural occupations, e.g. pesticide handling, work in confined spaces, and tractor operation. Recommended new HOs are detailed in Table 4.

<u>Activity:</u>
Fund Cooperative Agreements, “Research on Young Worker Safety and Health Risks in Construction”

The interagency agreements with ESA also provided funds for NIOSH to administer an extramural research program to provide empirical data to guide future rulemaking to protect young workers in construction. NIOSH developed a Request for Applications and funded three extramural research projects focusing on health and safety hazards to youth working in the construction industry. The first project, at the University of North Carolina, examined work patterns, practices, and injury experiences among young construction workers in North Carolina, with special emphasis on Latino workers. The objective of the second project, at the University of Utah, was to calculate and compare fatality rates among young (< age 18) and older construction workers according to injury circumstances, establishment size, union affiliation, and employer gross income, using 15 years of OSHA investigation data and employment data. Partial funding was also provided for a third project at the University of Washington that was a prospective study of noise-induced hearing loss in newly hired construction workers.

<u>Activity</u>: Updated NIOSH Alert on Young Worker Safety and Health

NIOSH scientists involved in research on child labor saw the need to update the NIOSH Alert on adolescent workers published in 1995. The updated Alert built on the 1995 NIOSH Alert on the same topic, adding updated statistics, illustrative case studies, a discussion of health risks to young workers, and detailed information on child labor laws. Particular effort was made to ensure that the Alert would appeal to the widest possible audience by including information for parents, educators, employers, and youth.

INPUTS:

Funds for the “Young Worker Safety” project were provided through an interagency agreement with the U.S. Department of Labor, Employment Standards Administration, Wage and Hour Division in fiscal years 1999 through 2001. In part, impetus for this agreement was the recommendation in the National Research Council monograph *Protecting Youth at Work*, that U.S. Department of Labor (DOL) provide funds for NIOSH to develop a report on the adequacy of Hazardous Orders based on a review of data and the scientific literature. The interagency agreement provided for development of such a report, supported Fatality Assessment and Control Evaluation (FACE) investigations of young worker fatalities, and supported intramural and extramural research on injuries and fatalities of young workers.

EXTERNAL FACTORS:

The scope of the NIOSH recommendations on changes to Hazardous Orders was delineated in interagency agreements between NIOSH and DOL/ESA in fiscal years 1999, 2000, and 2001. However, as the NIOSH report neared completion, the change in Administration in January 2001 led to changes in leadership at DOL and at DOL/ESA. New leadership had no investment in the NIOSH report, reacting somewhat defensively to the efforts of NIOSH and other stakeholders to promote it as an important tool for guiding future rulemaking.

In general, regulatory actions by DOL agencies have become increasingly difficult to initiate, as Federal agencies that wish to propose new rules are now required to evaluate the economic impact of these proposals. It is possible that the increased complexity of the rulemaking process has contributed to inaction by DOL/ESA on rulemaking related to the HOs for young workers.

Statutory provisions of the Fair Labor Standards Act (FLSA) also limit the potential impact of regulatory changes. Large numbers of working youth are not covered by the FLSA, including youth who work on their parents' farms, and youth 16- and 17- years of age who work on any farm.

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Table 2. Summary of NIOSH Recommendations Pertaining to Existing Nonagricultural Occupation HOs

Existing Nonagricultural HO	**Retain**	**Revise**	**Training exemption**	**Specific recommendations**
HO 1: Manufacturing or Storage Occupations Involving Explosives		X	n/a	Revise the definition to include the current ATF list of explosive materials.
HO 2: Motor Vehicle Occupations		X	n/a	1) Incorporate provisions of the Drive for Teen Employment Act; 2) Provide guidance on Aurgent, time-sensitive deliveries@ and Aincidental and occasional driving@; 3) Delete exemption for school bus driving.
HO 3: Coal Mine Occupations	X		n/a	
HO 4: Logging and Sawmilling Occupations		X	n/a	1) Expand to cover similar work in operation of timber tracts, tree farms and forestry services; 2) Remove the current exemptions for construction work for living or administrative quarters.
HO 5: Power-Driven Woodworking Machines		X	Retain	Expand to include similar power-driven machines used to operate on materials other than wood.
HO 6: Occupations Involving Exposure to Radioactive Substances and to Ionizing Radiation		X	n/a	Revise to reflect current risks to youths for occupational radiation exposures.
HO 7: Power-driven Hoisting		X	n/a	1) Expand to cover repairing, servicing, disassembling and

Existing Nonagricultural HO	Retain	Revise	Training exemption	Specific recommendations
Apparatus Operations				assisting in tasks being performed by the machine; 2) Expand to prohibit youth from riding on any part of a forklift as a passenger, and from working from forks, platforms, buckets, or cages attached to a moving or stationary forklift; 3) Expand to prohibit work from truck-mounted bucket or basket hoists, commonly termed Abucket trucks@ or Acherry pickers@; 4) Expand to include commonly used manlifts that do not meet the current definition, specifically aerial platforms.
HO 8: Power-driven Metal Forming, Punching, and Shearing Machine Operations		X	Retain	Expand to include several types of metalworking machinery currently excluded from this HO, including milling, turning, grinding, and boring machines.
HO 9: Occupations in Connection with Mining, Other than Coal		X	n/a	1) Expand to include all work performed in connection with petroleum and natural gas extraction; 2) Remove exemptions permitting repair and maintenance of roads, and work on track crews.
HO 10: Occupations in the Operation of Power-driven Meat-Processing Machines and Occupations Involving Slaughtering, Meat Packing or Processing, or Rendering		X	Add partial exemption	1) Expand to prohibit work in all meats products manufacturing industries, including poultry slaughtering and processing; 2) Consider a revision* to allow use of meat and food slicers in retail, wholesale and service industries; 3) Allow apprentice/student learner exemptions in retail, wholesale or service industries.
HO 11: Power-driven Bakery Machine Occupations		X	n/a	Consider a revision* to allow the use of Acounter-top models@ of power-driven bakery machines.
HO 12: Power-driven Paper-Products Machine Occupations		X	Retain	1) Incorporate provisions of the Compactor and Baler Act; 2) Expand to include similar power-driven machines used to operate on materials other than paper products.
HO 13: Occupations Involved in the Manufacture of Brick, Tile, and Kindred Products	X		n/a	

Existing Nonagricultural HO	Retain	Revise	Training exemption	Specific recommendations
HO 14: Occupations in the Operation of Power-Driven Circular Saws, Band Saws, and Guillotine Shears		X	Retain partial exemption	Consider revising definition to include other machines which perform cutting and sawing functions through direct contact between the cutting surface and the material (the current definition is based on the presence of a continuous series of notches or jagged teeth).
HO 15: Occupations Involved in Wrecking, Demolition, and Shipbreaking Operations	X		n/a	
HO 16: Occupations in Roofing Operations		X	Remove	1) Expand to include all work performed on roofs; 2) Remove the exemption for apprentices/student learners.
HO 17: Occupations in Excavation Operations	X		Remove	Remove the exemption for apprentices/student learners.

* Any revisions of HOs that would allow work that was previously prohibited should be accompanied by a mandatory reporting period in which all serious youth injuries and deaths resulting from previously prohibited activities are promptly reported to the U.S. Department of Labor. This would allow an assessment as to whether the revision should be rescinded or further refined to best protect working youth, while not unnecessarily limiting job opportunities.

Table 3. Summary of NIOSH Recommendations Pertaining to Existing Agricultural Occupation HOs

Existing Agricultural HO	**Retain**	**Revise**	**Specific Recommendations**
HO 1: Operating a Tractor Over 20 PTO Horsepower or Connecting or Disconnecting an Implement or Any of Its Parts To or from Such a Tractor		X	1) Revise to remove the 20 PTO (power take-off) horsepower threshold; 2) Revise exemption for 14- and 15-year olds with tractor certification to require tractors to be equipped with a rollover protective structure (ROPS) and mandate the use of seatbelts.
HO 2: Operating or Assisting to Operate (including starting, stopping, adjusting, feeding or any other activity involving physical contact associated with the operation) any of the following machines: corn picker, cotton picker, grain combine, hay mower, forage harvester, hay baler, potato digger, or mobile pea viner; feed grinder, crop dryer, forage blower, auger conveyor, or the unloading mechanism of a nongravity-type self-unloading wagon or trailer, or power post-hole digger, power post driver, or nonwalking-type rotary tiller		X	Combine HO 2 and HO 3, and expand prohibition from lists of specific machines to machines that perform general functions (e.g. harvesting and threshing machinery; mowing machinery; plowing, planting and fertilizing machinery; other agricultural and garden machinery; excavating machinery; loaders; wood processing machinery, such as wood chippers and debarkers; sawing machinery, including chain saws; powered conveyors; and, mobile equipment, including forklifts).
HO 3: Operating or assisting to operate (including starting, stopping, adjusting, feeding, or any other activity involving physical contact associated with the operation) any of the following machines: trencher or earthmoving equipment; fork lift; potato combine; power-driven circular, band, or chain saw		X	See comments above pertaining to agricultural HO 2.
HO 4: Working on a Farm in a Yard, Pen, or Stall Occupied By a: (i) Bull, boar, or stud horse maintained for breeding purposes; or (ii) Sow with suckling pigs, or cow with newborn calf (with umbilical cord present)	X		
HO 5: Felling, Bucking, Skidding, Loading or Unloading Timber with Butt Diameter of More than 6 Inches.		X	Remove 6 inch diameter threshold.

Existing Agricultural HO	Retain	Revise	Specific Recommendations
HO 6: Working from a Ladder or Scaffold (Painting, Repairing, or Building Structures, Pruning Trees, Picking Fruit, etc) at a Height of Over 20 Feet		X	1) Expand to include work on roofs, on farm structures including silos, grain bins, windmills, and towers; and, on vehicles, machines, and implements; 2) Reduce the maximum height at which youth may work in these settings from 20 feet to 6 feet.
HO 7: Driving a Bus, Truck, or Automobile When Transporting Passengers, or Riding on a Tractor as a Passenger or Helper		X	1) Expand to prohibit driving of all motor vehicles and off-road vehicles (including all-terrain vehicles), with or without passengers, on or off the highway; 2) Expand to prohibit work as an outside helper on a motor vehicle; 3) Retain the provision prohibiting riding on a tractor as a passenger or helper, but move it under Agricultural HO 1.
HO 8: Working Inside: A fruit, forage, or grain storage designed to retain an oxygen deficient or toxic atmosphere; an upright silo within 2 weeks after silage has been added or when a top unloading device is in operating position; a manure pit; a horizontal silo while operating a tractor for packing purposes		X	Expand to prohibit *all* work inside (i) a fruit, forage, or grain storage, such as a silo or bin; (ii) a manure pit.
HO 9: Handling or Applying (including cleaning or decontaminating equipment, disposal or return of empty containers, or serving as a flagman for aircraft applying) Agricultural Chemicals Classified Under the Federal Insecticide, Fungicide, and Rodenticide Act (as amended by Federal Environmental Pesticide Control Act of 1972, 7 U.S.C. 136 et seq.) as Toxicity Category I, Identified by the Word ADanger@ and/or APoison@ with Skull and Crossbones; or Toxicity Category II, Identified by the Word AWarning@ on the Label		X	Expand to be consistent with EPA Worker Protection Standard for pesticides, encompassing prohibitions against pesticides with chronic health effects as well as pesticides with recognized acute toxicity.
HO10: Handling or Using a Blasting, Including but Not Limited to Dynamite, Black Powder, Sensitized Ammonium Nitrate, Blasting Caps, and Primer Cord	X		
HO 11: Transporting, Transferring, or Applying Anhydrous Ammonia	X		

Table 4. New Hazardous Orders Recommended by NIOSH

$ Commercial Fishing Operations
$ Construction Occupations
$ Work in Refuse Occupations
$ Water Transportation Industries
$ Work in Scrap and Waste Materials Industry
$ Farm Product Raw Materials Wholesale Trade Industry
$ Railroad Industry
$ Work at Heights
$ Tractors (in nonagricultural occupations)
$ Heavy Machinery
$ Welding
$ Confined Spaces (in nonagricultural occupations)
$ Work Involving Powered Conveyors (in manufacturing industries)
$ Pesticide Handling (in nonagricultural occupations)
$ Exposure to Lead
$ Exposure to Silica
$ Work Requiring the Use of Respiratory Protection

PROJECT ID: National Traumatic Occupational Fatalities (NTOF) Surveillance System

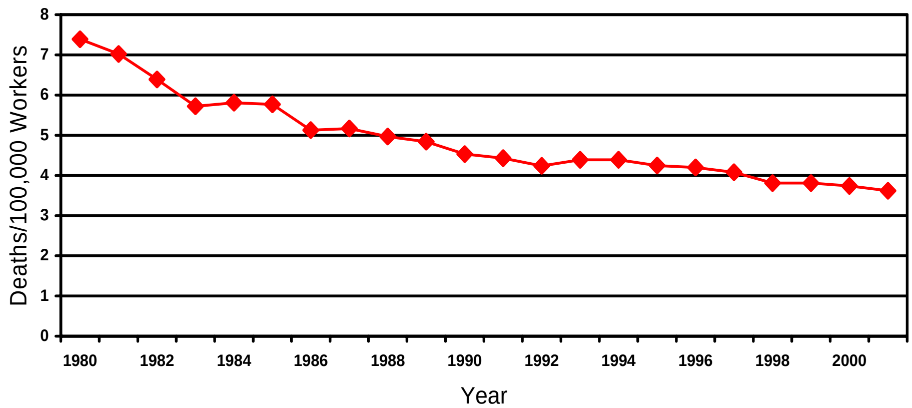
END OUTCOMES:

OVERALL FATALITIES

In the mid 1980s, NIOSH initiated a systematic national collection of workplace fatalities through the National Traumatic Occupational Fatalities (NTOF) surveillance system. For the first time, NTOF provided a uniform surveillance system of work-related fatal injuries for all industries. NTOF successfully filled a critical data need by providing a measurement system for tracking outcomes and important data that many in NIOSH and elsewhere used to direct more detailed projects to address specific causes of death or high-risk worker groups.

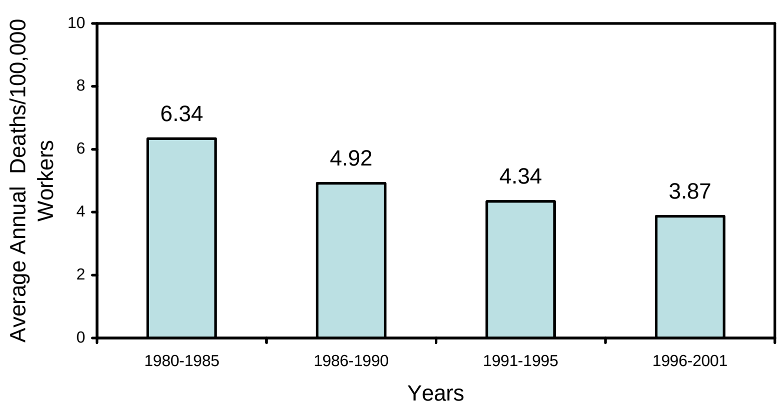
Work-related fatality rates in the U.S. have decreased 51% from 1980 through 2001 based on data from the NTOF surveillance system *(Figure 1).* The 6-year average fatality rate for the period 1996-2001 decreased 39% compared to the 6-year time period 1980-1985 *(Figure 2).*

*Figure 1. Occupational Fatality Rates by Year**
(Source: NIOSH NTOF 1980-2001)



**Data for 2001 exclude deaths associated with September 11.*

Figure 2. Annual Average Fatality Rates for Four Time Periods Between 1980 and 2001 (Source: NIOSH NTOF)*



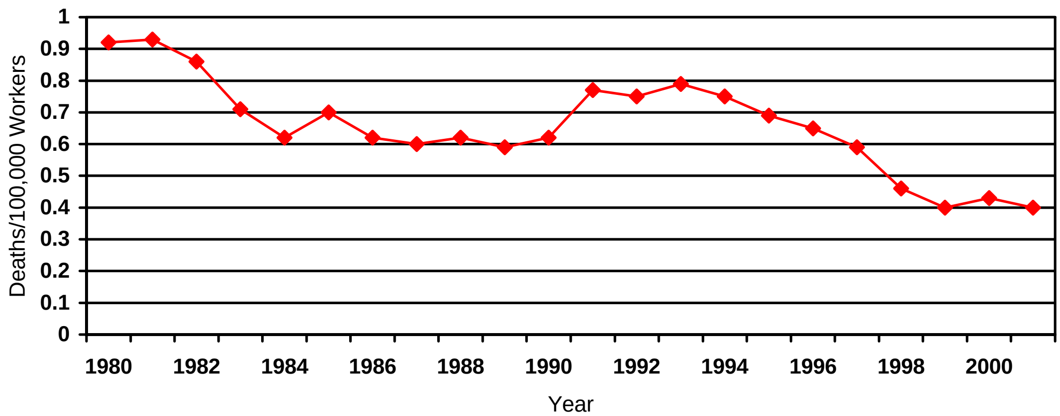
**Data for 2001 exclude deaths associated with September 11.*

HOMICIDES

In the late 1980s, NIOSH's NTOF surveillance system identified homicides as a leading cause of work-related injury death in the U.S. This national recognition formed the basis of NIOSH's efforts that began in the early 1990s to address this serious public health problem. The NTOF data have supported and directed further research into the characteristics of homicides and provided an index for tracking improvements.

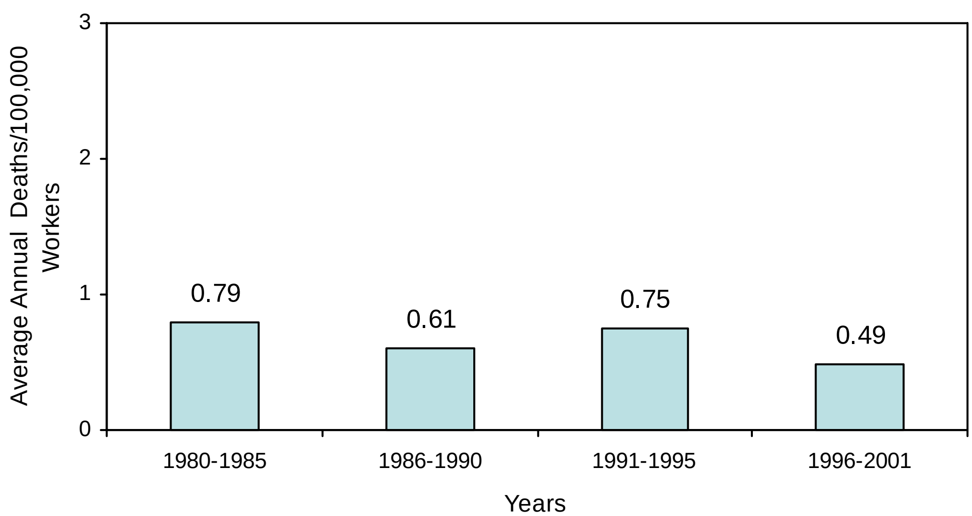
Work-related fatality rates for homicides have decreased 130% from 1980 through 2001 based on data from the NTOF surveillance system *(Figure 3).* The 6-year average fatality rate for the period after NIOSH began its focus on workplace homicides decreased 37% compared to the rate for the 6-year time period 1980-1985 *(Figure 4).*

*Figure 3. Occupational Fatality Rates for Homicide-related Deaths**
(Source: NIOSH NTOF 1980-2001)



**Data for 2001 exclude deaths associated with September 11.*

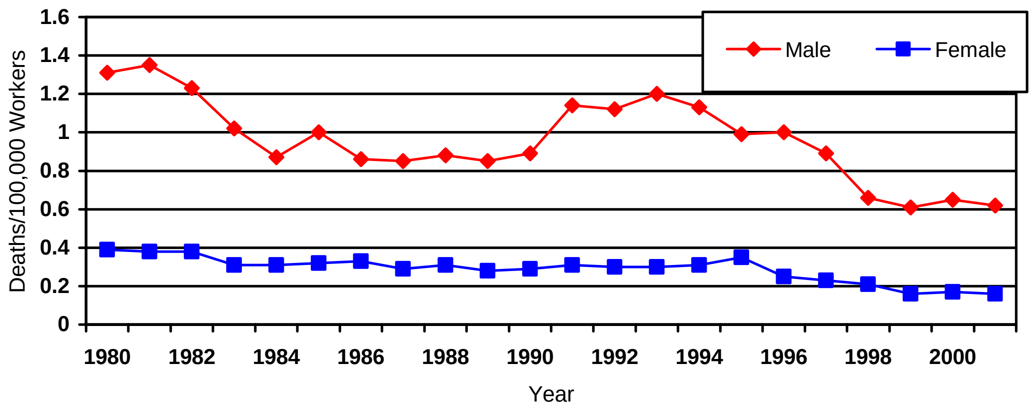
Figure 4. Annual Average Homicide Fatality Rates for Four Time Periods Between 1980 and 2001 (Source: NIOSH NTOF)*



**Data for 2001 exclude deaths associated with September 11.*

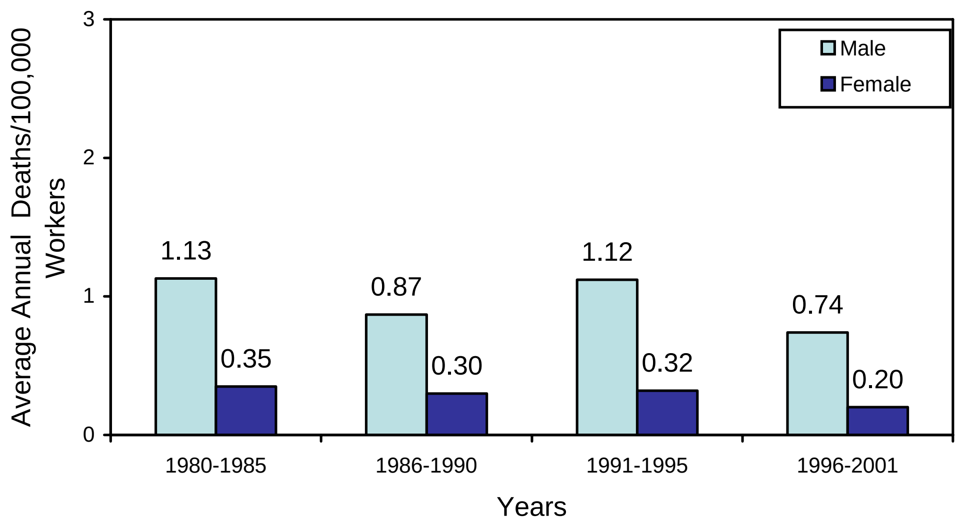
Although the majority of workplace homicides occurred to men, homicides were the leading cause of death among women. Fatality rates for homicides among women decreased 59% from 1980 through 2001 compared to a 53% decrease for men for the same period *(Figure 5).* The 6-year average fatality rate for the period after NIOSH began its focus on workplace homicides decreased 43% for women and 35% for men compared to the rates for the 6-year time period 1980-1985 *(Figure 6).*

*Figure 5. Occupational Fatality Rates for Homicide-related Deaths by Sex**
(Source: NIOSH NTOF 1980-2001)



**Data for 2001 exclude deaths associated with September 11.*

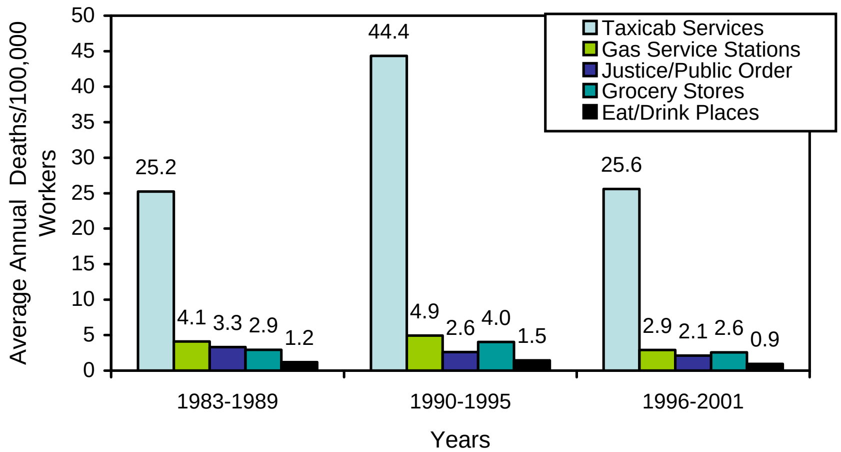
Figure 6. Annual Average Homicide Fatality Rates by Gender for Four Time Periods Between 1980 and 2001 (Source: NIOSH NTOF)



**Data for 2001 exclude deaths associated with September 11.*

NIOSH researchers identified five primary industries as having either a high number of workplace homicides or a high rate of homicides. The number and rate of fatality in all five industries (Taxicab Services, Gas Service Stations, Justice/Public Order Establishments, Grocery Stores, and Eating/Drinking Places) decreased for the period after NIOSH began its focus on work place homicides *(Figure 7).*

Figure 7. Annual Average Homicide Fatality Rates by Selected Industries for Three Time Periods Between 1983 and 2001 (Source: NIOSH NTOF)*

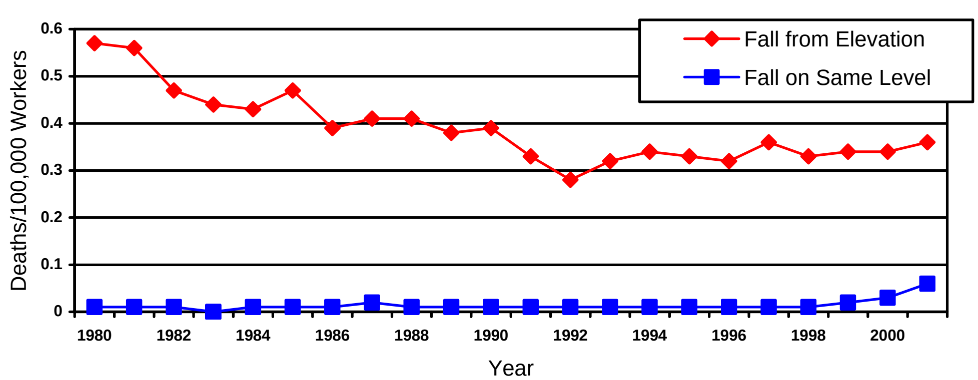


**Data for 2001 exclude deaths associated with September 11.*

FALLS FROM ELEVATION

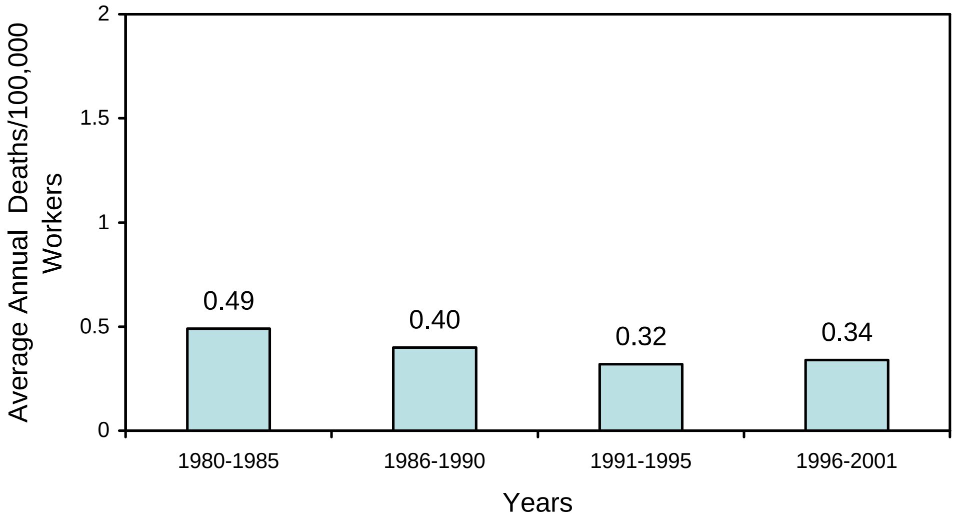
In the late 1980s, through the NTOF surveillance system, NIOSH identified falls as the fourth leading cause of work-related injury death in the U.S. The majority of work-related falls were from an elevation (e.g., ladders, scaffolding, or stairs or steps) *(Figure 8).* Fatality rates for falls from elevation have decreased 37% from 1980 through 2001 based on data from the NTOF surveillance system *(Figure 8).* The average fatality rate for falls from elevation for the period 1996-2001 decreased 31% compared to the rate for the time period 1980-1985 *(Figure 9).*

Figure 8. Occupational Fatality Rates for Fall-related Deaths by Fall Type (Source: NIOSH NTOF 1980-2001)*



**Data for 2001 exclude deaths associated with September 11.*

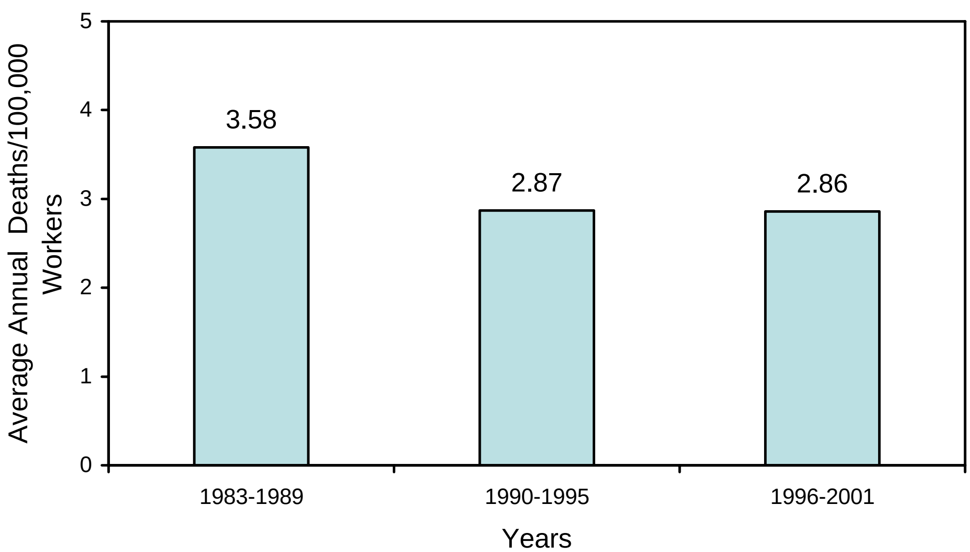
Figure 9. Annual Average Fatality Rates for Falls from Elevation for Four Time Periods Between 1980 and 2001 (Source: NIOSH NTOF)*



**Data for 2001 exclude deaths associated with September 11.*

NIOSH researchers identified workers in construction as having the highest risk of fatal falls from elevation. The rate of fatal falls from elevation in construction has decreased 20% since NIOSH began collecting NTOF data *(Figure 10).*

Figure 10. Annual Average Fatality Rates for Falls from Elevation by in Construction for Three Time Periods Between 1983 and 2001 (Source: NIOSH NTOF)*



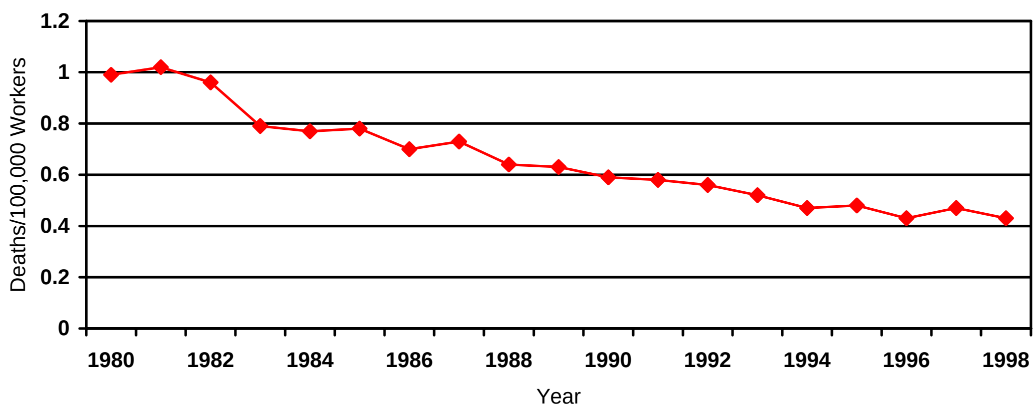
**Data for 2001 exclude deaths associated with September 11.*

MACHINES

NIOSH has been conducting research on machine safety since the early 1970s. With the introduction of the NTOF surveillance system, NIOSH was able to quantify the number of machine-related fatalities and the characteristics of the machines that caused many of the reported fatalities. These results helped stimulate and direct NIOSH's research on machine safety, especially in the agriculture industry.

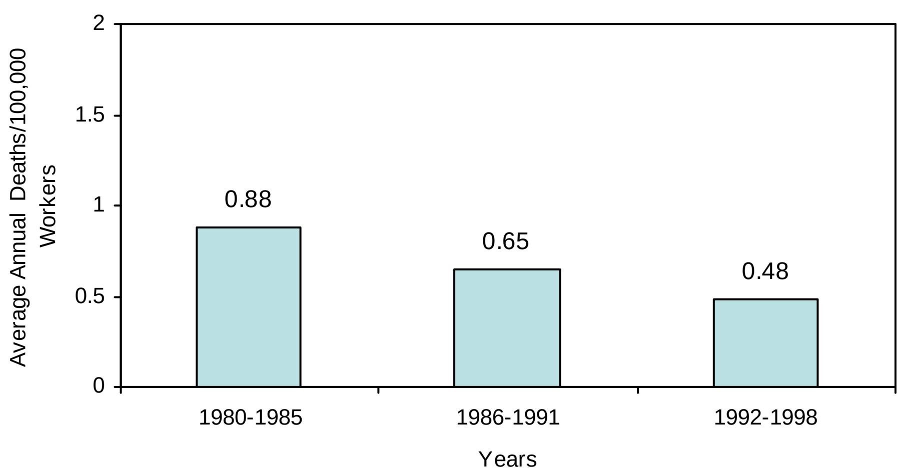
Work-related fatality rates for all machines have decreased 57% from 1980 through 1998 based on data from the NTOF surveillance system *(Figure 11).* The average fatality rate for machine-related deaths for the 7-year period 1992-1998 decreased 45% compared to the fatality rate for the time period 1980-1985 *(Figure 12).*

Figure 11. Occupational Fatality Rates for Machine-related Deaths (Source: NIOSH NTOF 1980-1998)*



**Because of significant inconsistencies in machinery codes assigned to the 1980-1998 and 1999-2001 data, data for the later years of NTOF are not presented.*

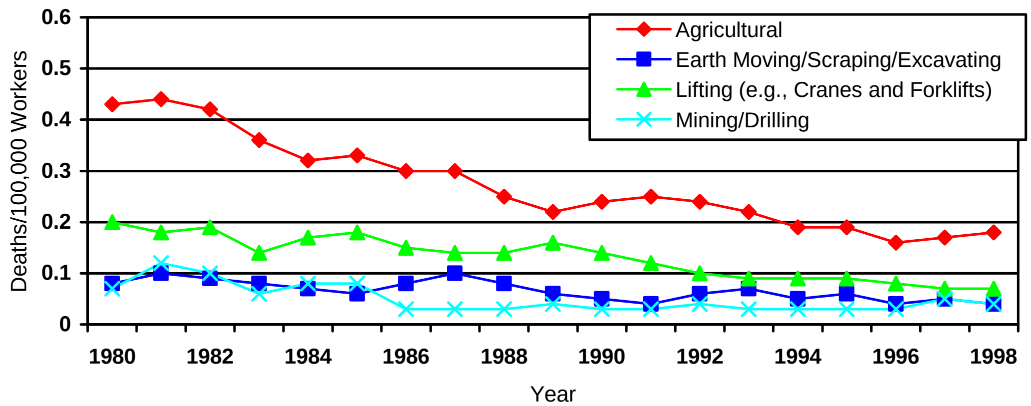
Figure 12. Annual Average Machine-related Fatality Rates for Three Time Periods Between 1980 and 1998 (Source: NIOSH NTOF)*



**Because of significant inconsistencies in machinery codes assigned to the 1980-1998 and 1999-2001 data, data for the later years of NTOF are not presented.*

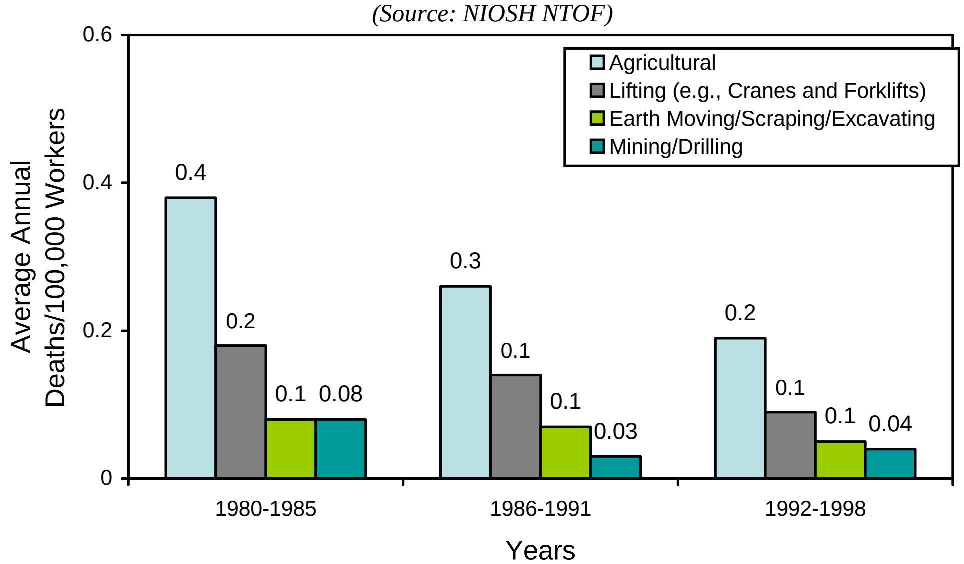
NTOF surveillance data enabled NIOSH researchers and others to establish research priorities for projects targeting specific machine types (e.g., tractors). From 1980 through 1998, rates for agricultural machinery-related fatalities decreased 58% *(Figure 13)*. The fatality rates for selected machine types for the 7-year time period 1992-1998 decreased 38-50% compared to the rates for the 6-year time period 1980-1985 *(Figure 14)*.

Figure 13. Occupational Fatality Rates for Machine-related Deaths by Selected Machine Types (Source: NIOSH NTOF 1980-1998)*



**Because of significant inconsistencies in machinery codes assigned to the 1980-1998 and 1999-2001 data, data for the later years of NTOF are not presented.*

Figure 14. Changes in Annual Average Machine-related Fatality Rates by Selected Machine Types for Three Time Periods Between 1980 and 1998 (Source: NIOSH NTOF)*

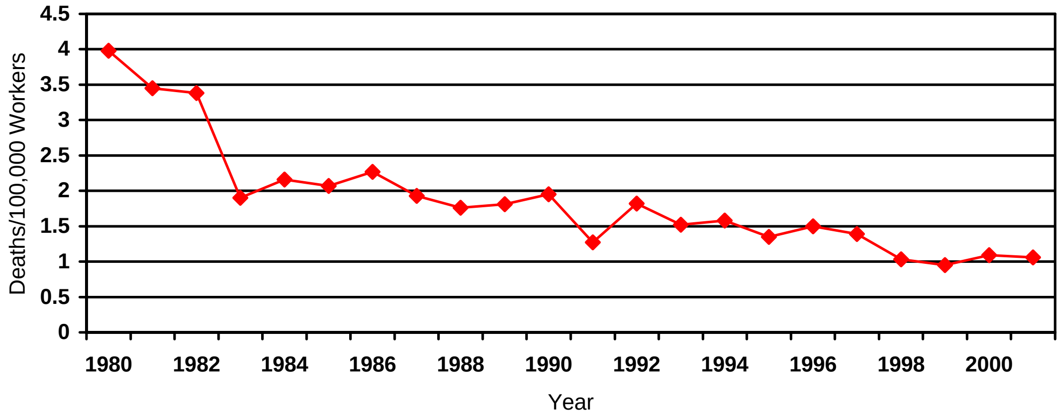


**Because of significant inconsistencies in machinery codes assigned to the 1980-1998 and 1999-2001 data, data for the later years of NTOF are not presented.*

YOUTH

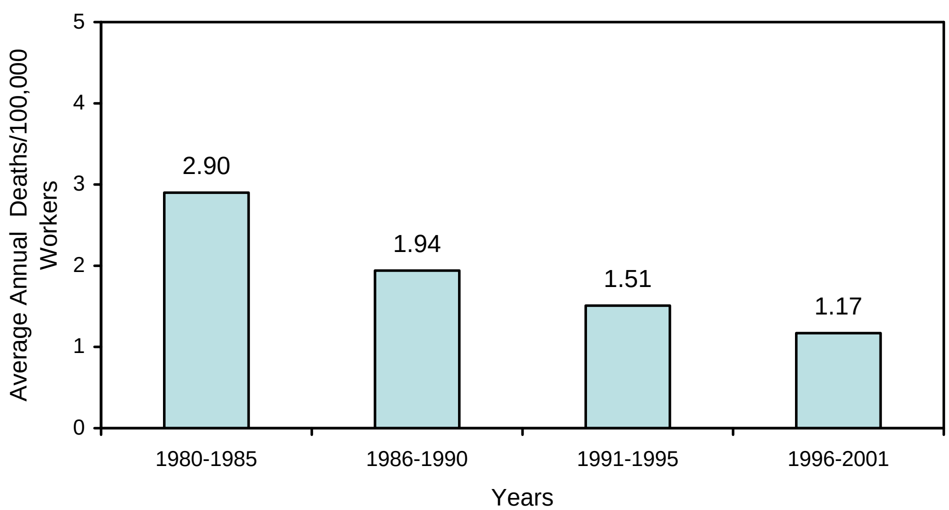
In the early 1990s, NIOSH researchers found that the risk of injury death for workers 16 and 17 was similar to that of adult workers aged 18 and older when comparing rates based on full-time equivalency. Because young workers are less likely to be employed in especially hazardous jobs, this finding raised concern within NIOSH and throughout the occupational safety and health community. NIOSH has worked closely with safety and health officials, researchers and advocacy groups to improve the safety of these young workers. Since 1980, work-related fatality rates for youth aged 16-17 years old have decreased 73% *(Figure 15)*. The average fatality rate for workers aged 16-17 years old for the 6-year period 1996-2001 decreased 60% compared to the rate for the time period 1980-1985 *(Figure 16)*.

*Figure 15. Occupational Fatality Rates for Workers Aged 16-17 Years Old**
(Source: NIOSH NTOF 1980-2001)



**Data for 2001 exclude deaths associated with September 11.*

Figure 16. Annual Average Fatality Rates for Workers Aged 16-17 Years Old for Four Time Periods Between 1980 and 2001 (Source: NIOSH NTOF)*



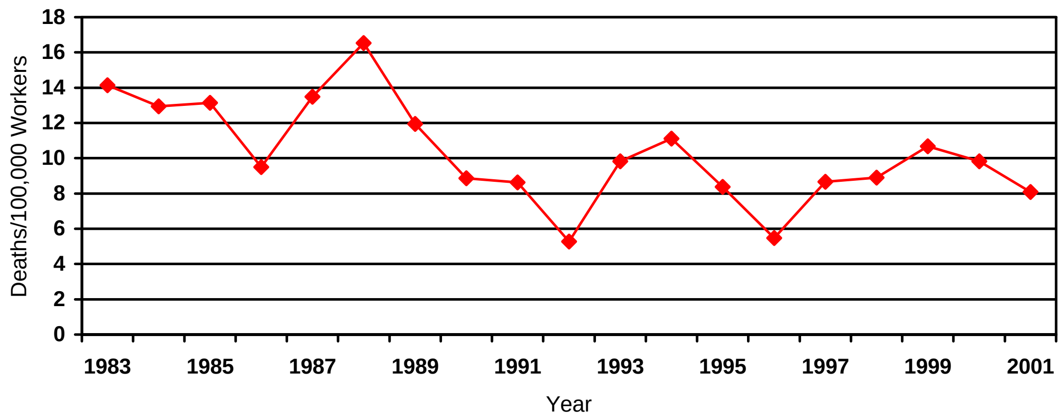
**Data for 2001 exclude deaths associated with September 11.*

FIRE FIGHTERS

Investigations conducted through NIOSH's Fatality Assessment and Control Evaluation (FACE) program in the mid 1990s drew attention to the number of fire fighters that lose their life in the line-of-duty. In FY 1998, Congress began funding NIOSH to formally conduct fire fighter fatality investigations as a means to address this national problem. The NTOF data provided an index for tracking improvements through 2001.

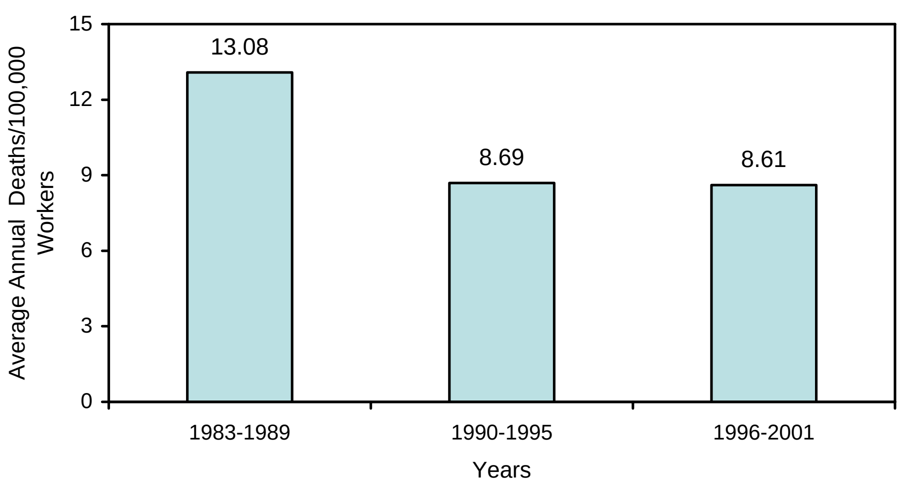
Although fatality rates have fluctuated considerably since 1983, in general, work-related fatality rates for fire fighters have decreased 43% *(Figure 17)*. The 6-year average fatality rate for the period during which funding for NIOSH's fire fighter fatality investigation program began was 34% lower compared to the fatality rate for the 7-year time period 1983-1989 *(Figure 18).*

*Figure 17. Occupational Fatality Rates for Fire Fighters and Supervisors**
(Source: NIOSH NTOF 1983-2001)



**Data for 2001 exclude deaths associated with September 11.*

Figure 18. Annual Average Fatality Rates for Fire Fighters and Supervisors for Three Time Periods Between 1983 and 2001 (Source: NIOSH NTOF)*

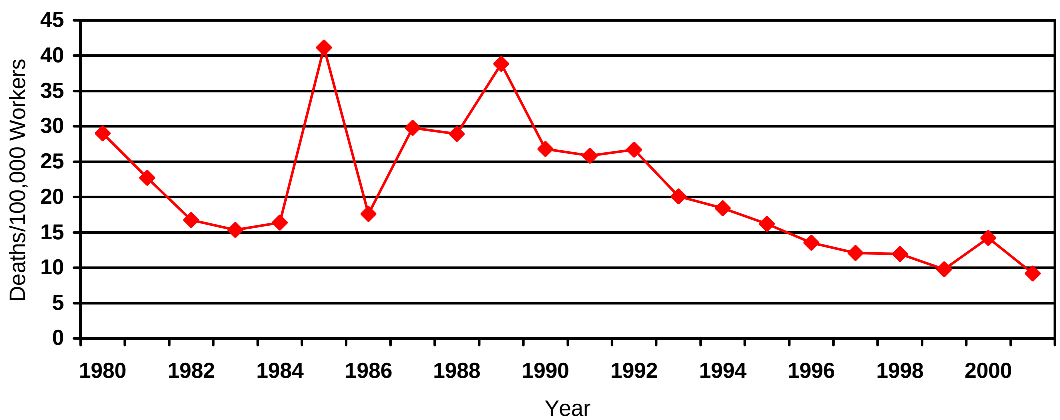


**Data for 2001 exclude deaths associated with September 11.*

ALASKA

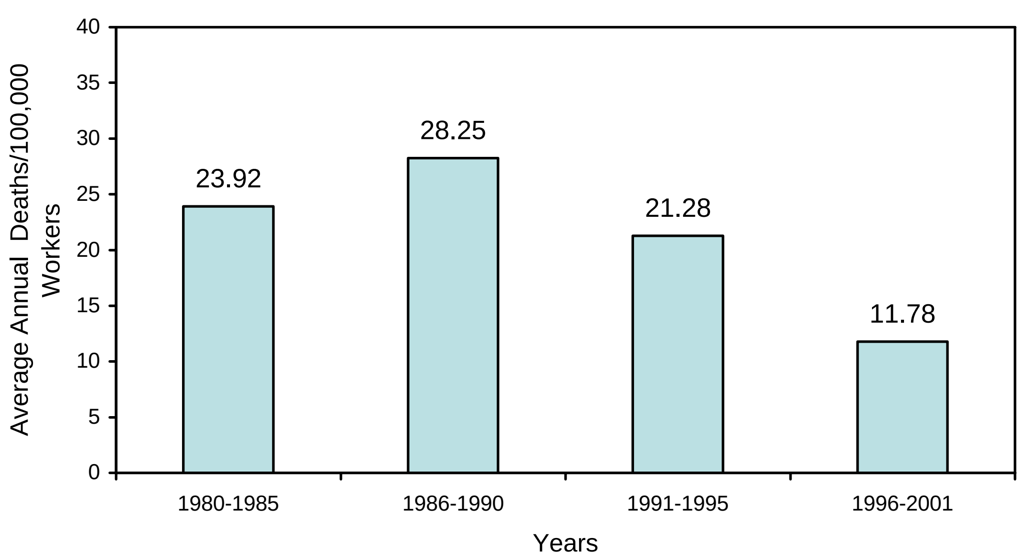
Through NTOF, NIOSH found that the State of Alaska had, by far, the highest occupational fatality rate of any state (NIOSH, 2002). To address this serious problem, the Alaska Field Station was created in 1991. The NTOF data were used to identify high-risk worker populations in Alaska and to track overall improvements in workplace fatalities. Since 1980, work-related fatality rates for the State of Alaska have decreased 68% *(Figure 19)* largely due to the increased attention from NIOSH. The 6-year average fatality rate for the period after the Alaska Field Station was established decreased 51% compared to the fatality rate for the 6-year time period 1980-1985 *(Figure 20).*

*Figure 19. Occupational Fatality Rates for the State of Alaska**
(Source: NIOSH NTOF 1980-2001)



**Data for 2001 exclude deaths associated with September 11.*

Figure 20. Annual Average Fatality Rates for the State of Alaska for Four Time Periods Between 1980 and 2001 (Source: NIOSH NTOF)*



**Data for 2001 exclude deaths associated with September 11.*

INTERMEDIATE OUTCOMES (IO):

Since NIOSH began collecting data through the NTOF surveillance system in the mid 1980s, NIOSH has been a leader in improving knowledge on characteristics of occupational fatalities such as those described previously. Within NIOSH, the FACE program has relied heavily on NTOF data to select investigation priorities and support program recommendations. NTOF has also been frequently cited by many NIOSH researchers as evidence to support or influence more detailed analyses or direct specific safety research projects. NIOSH's fatality surveillance efforts have led to a greater understanding of the industries and occupations at high risk and a greater public awareness of the causes and circumstances surrounding workplace fatalities.

The utility of NTOF fatality surveillance data also influenced the National Academy of Science Panel on Occupational Safety and Health Statistics' recommendation for development of a more comprehensive national fatality census (Pollack & Keimig, 1987). This led directly to the development of the Bureau of Labor Statistics' Census of Fatal Occupational Injuries (CFOI) system that NIOSH continues to use for fatality surveillance.

FINAL CUSTOMERS:

- Employers;
- Supervisors;
- Safety Managers;
- Workers; and
- Manufacturers.

INTERMEDIATE OUTPUTS:

Since NIOSH began collecting data through the NTOF surveillance system, NTOF statistics have been routinely cited through newspaper articles, press releases, and on news and radio shows.

INTERMEDIATE CUSTOMERS:

- Bureau of Labor Statistics;
- National Center for Health Statistics;
- The Occupational Safety and Health Administration; and
- Members of the academic and public health research communities.

TRANSFER ACTIVITIES:

Findings from the NTOF surveillance data were routinely distributed through presentations to scientific conferences, research working groups, professional associations, and other audiences. Examples of groups or conferences to which NTOF data were presented include:

- American Public Health Association;
- Homicide Research Working Group;
- American Medical Association;

- Injury Prevention and Control World Conferences;
- National Occupational Injury Research Symposium;
- National Safety Council;
- Safe USA; and
- American Society of Safety Engineers.

OUTPUTS:

The primary output from this project is the NTOF database that is accessible by researchers within NIOSH. Results from these data have been disseminated per specific requests for NTOF analyses and through NIOSH publications and scientific journals.

NIOSH Publication Sub-category:

Overall Fatalities

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ACTIVITIES:

Accurate reporting of workplace fatalities is a critical component for determining prevention priorities. Prior to the 1980s, however, no systematic national data collection of traumatic occupational fatalities existed. Recognizing this gap and the disparity in existing estimates, NIOSH began collecting fatality surveillance data through the NTOF surveillance system in the mid 1980s to gain a better understanding of the most severe work-related injuries. NIOSH developed NTOF by collecting death certificates from state vital registrars in all 50 states, New York City, and the District of Columbia. Demographic, industry, occupation, and circumstances of death were abstracted for fatalities occurring from 1980 through 2001. Through the NTOF, NIOSH provided for the first time a uniform surveillance system of work-related injuries for all industries and for all traumatic injury-related causes of death. This collection of death certificates filled a critical data need in identifying and understanding workplace fatalities. Through the identification of leading causes of death (e.g., homicides and machines) and high-risk worker groups (e.g., youth), NIOSH has created new or directed existing projects. NTOF fatality data have been disseminated in the scientific literature, NIOSH publications, and presentations to occupational safety and health, public health, and other audiences. These data have also been used by NIOSH and OSHA as a quantitative basis to guide national research priorities, in the development of recommendations for preventing occupational injury deaths, and to set occupational safety standards.

NTOF successfully filled a critical data need to drive occupational fatality research. However, the limitations inherent in conducting surveillance solely based on death certificates were well recognized. Based on the recommendations of the National Academy of Science Panel on Occupational Safety and Health Statistics (Pollack & Keimig, 1987), the BLS began collecting occupational fatality information from multiple sources. In 1992, the BLS CFOI was fully operational and continues through today. The use of multiple fatality data sources with improved case capture (~20% increase in fatalities vs. NTOF) and dual confirmation of work-relatedness by an agency dedicated to statistical data collection has provided an exceptional system for more detailed industry wide surveillance. After a decade of overlap, NIOSH discontinued the NTOF data collection at the end of 2001 and now uses the CFOI data for occupational fatality surveillance. NIOSH and BLS have a mutually beneficial relationship that expands the utility of the CFOI data. NTOF provided an important data source as efforts to address occupational safety were growing. NIOSH continues to maintain these data as a resource for examination of trends over a 22 year period.

INPUTS:

Two publications influenced the direction of the NTOF surveillance system: recommendations of the National Academy of Science Panel on Occupational Safety and Health Statistics published in *Counting Injuries and Illness in the Workplace: Proposals for a Better System* (Pollack & Keimig, 1987) and the NIOSH strategic plan entitled *Tracking Occupational Injuries, Illnesses, and Hazards: The NIOSH Surveillance Strategic Plan* (NIOSH, 2001).

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PROJECT ID: CAN 8870, State-based Fatality Surveillance Using FACE Model

END OUTCOMES:
Data analysis has not been conducted on the impact of State-based Fatality Assessment and Control Evaluation (FACE) programs. Such an analysis has numerous complexities, including a dynamic set of states participating in the program over the years. Additionally, while State-based FACE programs make concerted efforts to reduce worker fatalities based on findings from fatality investigations, they rely on preventative actions taken by others, such as employers and regulators. Given numerous examples of intermediate outputs, it is likely that State-based FACE has contributed to reductions in worker injury deaths.

INTERMEDIATE OUTCOMES (IO):

- In February 2003, the Michigan (MI) FACE program investigated the death of a store manager who died of acute respiratory failure after suffering an acute asthmatic reaction due to inhalation of chemicals after spraying the floor and sides of a van with an isocyanate-based truck bed liner (TBL). This investigation identified a serious chemical exposure hazard not widely recognized by companies and workers involved with TBL applications. The MI FACE program contacted the Alliance for the Polyurethane Industry (API) for assistance in getting information to those at risk. The API formed a Truck Bed Lining Task Group to address the issues involved in the TBL application. Because API found very little public information on the truck bed liner application process, they decided to develop and disseminate an informational pamphlet to all member company franchises, to non-member franchises, and to all operators of companies offering truck bed liner services as identified through the business pages of the telephone book. The API Task Group is currently working on best practices and standardized training programs.

- After seeing a copy of the Michigan (MI) FACE report 04MI223, *19 Year-Old Female Waitress Died From an Asthma Attack While Working in a Bar*, Michigan State Senator Raymond Basham wrote an e-mail to the Michigan State University, Occupation and Environmental Medicine employee who had informed him about the report, saying he had used the report to make a very compelling argument in support of his legislation, Michigan Senate Bill 394 and its companion bill SB 395, that together prohibit smoking in all Michigan workplaces including restaurants and bars. These bills were introduced into the Michigan Senate on April 19, 2005. They were referred to Committees and have not been voted upon.

- The Oklahoma (OK) FACE program investigated the January 2003 death of an equipment operator who died from head injuries when another employee attempted to pull the road grader he was operating out of a ditch. The tow rope was attached to a “ripper tooth” on another grader that was being used to tow the victim’s machine out of a ditch. OK FACE disseminated the investigation report to a technical career center safety coordinator, who used the report in a training of Latimer County road worker employees. During the training, workers reported that it had been a common practice for years to use the ripper teeth to pull things with road graders. This practice was discontinued by the county following the dissemination of the report.

- The West Virginia (WV) FACE program developed a safety video entitled *Some Mistakes Last Forever* and a field guide entitled *West Virginia Logger's Safety Field Guide* based on findings from fatality investigations. From April 2002 through October 2003, the WV Department of Forestry incorporated both the video and safety guide into 80 logger safety training sessions (required for certification) attended by 1,197 loggers. Post-training surveys found statistically significant improvements in safety knowledge after viewing the video. Many loggers contacted at follow-up said they related to the real-life victim stories portrayed in the video, and that the field guide served as a quick and easy reference and taught them valuable tips on safe cutting and felling. Based on a survey conducted six months after training, 57% of loggers reported changing work site practices as a result of the training. Many loggers reported that the field guide was an excellent reference for safe cutting and felling techniques, was used in safety meetings, and was kept in work vehicles.

- The Washington (WA) FACE program has received feedback on intermediate outcomes through anonymous mail-back surveys following distribution of fatality investigation reports. Examples follow:
  - *Lineman Killed After Being Struck by a Car in Washington State* (00WA040) was mailed to 769 recipients on June 14, 2004. Evaluation surveys with postage-paid return envelopes were mailed to all recipients on August 30, 2004. One-hundred and twenty-seven (17%) surveys were returned by October 21st. The respondents reported that 37% had made changes as a result of the materials. Of those reporting changes, 84% reported that it was too early to tell if the changes had been effective, 7% stated that the changes had been effective, and 9% did not respond.
  - *City Worker Killed When Struck by a Dump Truck in Washington State* (00WA041) was mailed to 1,092 recipients in August 2004. One hundred and forty (13%) recipients responded to the survey, with 44% of respondents reporting changes as a result of the materials. Of those reporting changes, 84% reported that it was too early to tell if the changes had been effective, 12% reported that the changes had been effective, and 5% reported that the changes were not effective.

- In February 2004, the New York (NY) FACE program distributed a fatality investigation report and related fact sheet, *Truck Driver Run Over by Trash Compactor at Municipal Landfill (FACE FACTS02NY007),* to 48 landfill employers in New York. On June 5, 2004, the Albany Times Union published a story, *And now, a dump with a dress code of sort,* reporting that a town landfill in NY instituted new policies requiring all people who visit the landfill (e.g. to dispose of trash) to wear orange safety vests on site. This new policy was prompted, in part, by recommendations and outreach made by the NY FACE program following the investigation of the truck driver fatality.

- The Boston Globe Newspaper company printed an article entitled *Panel Targets Floor Finishing* on May 17, 2006. Massachusetts (MA) FACE is on this panel, along with contactors, public health and environmental activists, and Vietnamese community leaders. Information from MA FACE investigations, *04MA032: Two Vietnamese Floor Sanders Die When Floor Product Ignites* and *MA044: Floor Sander Dies When Wood Floor Refinish Product Ignites,* have been used to highlight hazards. A Vietnamese language cable series focused on occupational safety and health topics will address hazards of floor finishing in the first three shows, the first of which will be shown in September 2006. State Representative

Martin J. Walsh of Dorchester, MA has filed a bill that will require contractors and employees in Massachusetts to become trained and certified, and to use a safety checklist when refinishing wood floors. This bill is currently in the Rules Committee and will be re-filed during the next Massachusetts House Session.

- In 1994, MA FACE investigated the death of petroleum plant operator who was fatally injured by a fall when he was knocked off the top of a tanker truck while loading oil into the truck. A bubble of compressed air in the fuel caused the loading arm to recoil, striking the worker in the chest, and knocking him to a concrete floor 12 feet below. On September 7, 2000, the Boston Globe published an article, "Fuel tanker suit prompts changes," describing changes made by the industry subsequent to this death. Though the MA FACE investigation and report were not mentioned in the article, preventive measures recommended by the MA FACE report were included in those described in the article, including, making fuel trucks with bottom loading charge ports and stabilizing load arm tubes when purging air from supply lines. The Boston Globe article made the following statement, "Overall fuel truck loading is becoming less hazardous due to advances in technology. Many newer trucks are now loaded from a pipe on the bottom of the tank rather through a hatch on the top, allowing the operator to stand safely on the ground."

- The Nebraska (NE) FACE program widely distributed, NE 03-04 *Cattleman Dies Due to Accidental Injection*, including to all 720 registered veterinarians in Nebraska. The cattleman had died from an injection of Micotil 300®. Micotil 300® is typically dispensed by veterinarians to farmers, who in turn administer it or have their employees administer it to cattle or sheep. Veterinarians were also sent a survey on their use and practices related to Micotil 300®. Two-hundred and twenty-eight (32%) surveys were returned, with 107 (47%) of the responding veterinarians currently prescribing Micotil300®. All except one warned their customers each time about the dangers. Fourteen (12%) veterinarians prescribed an alternative drug and 15 (12%) stopped prescribing Micotil® based on the associated dangers. Seven that did not prescribe Micotil® still warned their customers.

- The Oregon (OR) FACE program communicated findings from an investigation OR2003-20-01, *Youth camp counselor killed when cannon burst into pieces,* to the Oregon Bureau of Labor and Industries, Wage and Hour Commission. Recommendations in the report were used to propose a child labor rules change that restricts minors under the age of 18 years old from using explosives in non-agricultural jobs. On January 3, 2005 a new rule addressing occupations involving the use of explosives by minors was passed (Stat. Auth.: ORS 653.305 & 653.525.)

- In 1994, the New Jersey Fatality Assessment and Control Evaluation (NJ FACE) program investigated a work-related fatality that involved a 20 year old lifeguard who was electrocuted when he touched a water pump that was energized due to an electrical fault in the pump motor. Recognizing that similar conditions might exist at other public pools within the state, NJFACE published a hazard alert bulletin entitled "Electrocution Hazard for Employees at Public Swimming Pools." NJ FACE sent 3,200 bulletins to local health departments for distribution during their bi-annual swimming pool health inspections. As a follow-up, NJFACE sent surveys to 270 swimming pool directors to inquire whether their pools had been inspected and if electrical hazards were identified. Seventy three percent of the responders who had received the hazard alert indicated that they had their swimming pools inspected. Thirty seven percent reported finding electrical problems. In response to the lifeguard electrocution, Old Bridge New Jersey passed an ordinance in October 1994 requiring periodic inspections of swimming pools to help prevent electrocutions. During 1995, 15 of the town's 21 pools (71%) failed their initial inspection because they did not meet electrical requirements. In 1996, members of the New Jersey State Assembly and Senate introduced bills modeled on the Old Bridge swimming pool ordinance. The New Jersey FACE hazard alert bulletin was cited in the bill's narrative to justify the new law. After several years of discussion and modification, New Jersey Pool Law, PL1998c137 was signed into law by Governor Whitman in December 1999. As of January, 2004 the NJ FACE program has not identified any additional work-related electrocutions at NJ swimming pools

FINAL CUSTOMERS:
Employers, safety managers, supervisors, workers, and health care professionals.

INTERMEDIATE OUTPUTS:
State-based FACE investigation findings, reports, and recommendations have been cited and used in trade journals and newsletters, occupational safety and health publications, public health media, and in the lay press. They have also been used by other states in safety alerts. The following are examples, and not an exhaustive list.

- The California (CA) FACE program was mentioned in an article, *Do your Hispanic Workers Understand You?*, published in the April 2006 edition of the Professional Landcare Network's (PLANET) newsletter *Safety Solutions*. This article went out to all PLANET members, approximately 4,300 companies. Reference to the NIOSH and CA FACE Websites were included in the article which can be found at www.landcaenwewtwork.org.

- A trade journal mentioned the Iowa (IA) FACE report that dealt with a farm boy's death. *Rollover Fatality Mars Family Legacy*, authored by Cheryl Tevis. This article was published on the Special Bonus page in Successful Farming in March, 2005.

- The summary and recommendations section of the Kentucky (KY) FACE report, *Equine Farm Manager Dies From Accidental Overdose of Xylazine*, was published by the Kentucky Department of Agriculture in *Kentucky Proud*, in the column "From the Front Desk of the State Veterinarian" Volume 2, Issue 2 in April, 2005.

- A sticker developed by the MA FACE program conveying that workers less than 18 years of age are prohibited from operating forklifts was modified by the U.S. Department of Labor, Wage and Hour Division (WHD), and subsequently distributed broadly by WHD, OSHA, and NIOSH.

- The North Carolina Department of Labor issued an Alert entitled *Department of Public Works Employee Electrocuted Attempting to Read a Water Meter Located Behind an Apartment* (http://nclabor.com/boiler/alerts/alert_electrocution.htm which cited MI FACE Investigation Report 03MI079.

- The MI FACE program was cited or mentioned in the following articles/websites:
    - *Breathing Better, Living Well*, has a link to MI FACE Investigation #04MI223: *19-year-old female waitress died from an asthma attack while working in a bar at* http://www.breathingbetterlivingwell.com/archive/articles/faceindoorairdeath.pdf;
    - Bed Liner Product Spray Resources: cites MI FACE Investigation #03MI018: *Manager of after-market truck bed liner store dies of asthma attack after spraying van with isocyanate-based truck bed liner* at http://bedliners.aboutrapid.info/bed-liner-product-spray.html;
    - Safety Lines from Minnesota OSHA, *Truck Bed Lining Industry No Breath of Fresh Air*, cites MI FACE Investigation #03MI018: *Manager of after-market truck bed liner store dies of asthma attack after spraying van with isocyanate-based truck bed liner* at http://www.doli.state.mn.us/pdf/5006sl.pdf;
    - Occupational Hazards, *Hammering Away at Construction Hazards* – 5/12/06 used information from the MI FACE Investigation #04MI160, *Carpenter dies when 8-foot trench wall collapses during sewer pipe replacement*, as part of an article that informs readers about the most common causes of injury in construction and measures to prevent injury.

- Minnesota (MN) FACE supplied information used in an article on farm safety entitled: *Stored Grain-Hazardous Situations that Can Quickly Turn Deadly*, published in the Southwest Minnesota Farmer, November 19, 2004.

- The Nebraska Tribune used information from NE 03-04, *Cattleman Dies Due to Accidental Injection*, in a three-part article published in October, 2003: *Breaking the Silence*, *Haunted*, and *Under a Microscope*. Dialogue between NE FACE, Elanco (the manufacturer of Micotil®- the pharmaceutical involved in NE 03-04) and the Food and Drug Administration has resulted in the following:
    - The potentially fatal consequences of human injection are now more clearly noted by the manufacturer on prescription pads and the product label, and
    - New safety materials have been developed and distributed to veterinarians who distribute the antibiotic to farmers.

- Two investigations conducted by the NE FACE program, one worker killed and one injured in separate incidents due to an accidental injection of Micotil 300®, an animal antibiotic, were cited in an article entitled *NIOSH Report Details Exposure Risks of Exposure to Drugs Meant for Animals* which was published by Occupational Safety and Health in Volume 35, No 14, pages 314-315 on April 7, 2005.

- NE FACE supplied information used in an article entitled: *U.S. Mexican Agencies Team Up on Job Safety*, published January 20, 2006 in the Omaha World Herald.

- NY FACE supplied information used in an article about baler safety entitled, *Baler Safety a Must*, published in the New York State Retailer, Vol.3, Number 7, 2005.

- WA FACE supplied information used in an article on construction fall fatalities that ran on the front page of the Tacoma News Tribune on 12/5/04, *Construction workers' safety net full of holes.*

- The NIOSH FACE website address was included in Annex D of the draft ANSI Z133 Standard -The American National Standard for Tree Care Operations.

- A trade journal mentioned FACE reports that dealt with roadway work zone fatalities. *Roadway Work Zone Tragedies Can Be Prevented, American Society of Safety Engineers Say, Especially This Memorial Day.* Published at http://www.asse.org on May 26, 2005.

- Professional nursing journal coverage of *NIOSH Alert, Preventing Falls of Workers through Skylights and Roof and Floor Openings.* Summary information was published March, 2005 in the American Association of Occupational Health Nurses (AAOHN) Newsletter.

- Trade Journal coverage of NIOSH Alert, *Preventing Falls of Workers Through Skylights and Roof and Floor Openings:* December 13, 2004 Reed Business Information, Division of Elsevier, Inc-New England Construction Headline: New Literature; December 16, 2004: Business News Publishing company 2656-Best or e-mail bestsafe@capital.net to request a copy. Headline: Temporary skylight guarding.

INTERMEDIATE CUSTOMERS:
U.D. Department of Labor, Occupational Safety and Health Administration (OSHA) and State-plan OSH States
U.S. Department of Labor, Wage and Hour Division
U.S. Food and Drug Administration
Health and safety professionals
Academic professionals
Safety and health consultants
Trade groups, e.g. American Polyurethane Industry (API)

TRANSFER ACTIVITIES:
The NIOSH FACE program posts all state-based fatality investigation reports on the NIOSH FACE webpage, and includes links to each state-based FACE program where additional State-based FACE publications such as Alerts, FACE Fact sheets, fatality narratives and journal articles are located. (www.cdc.gov/niosh/face). NIOSH provides support to states in communicating findings amongst states, including helping to coordinate annual meetings. This helps foster the use of findings and products across states. NIOSH also incorporates findings from state-based fatality investigations into NIOSH Publications and other products, including NIOSH comments on proposed regulations.

State-based FACE programs share findings at national, state, and regional conferences; trade shows; county fairs; and employer sponsored tool box meetings. State-based programs also work with other state agencies, such as regulatory agencies, and state and community task forces and working groups. For example, Massachusetts FACE continues to coordinate the Preventing Falls in Construction Working Group, which met on February 15, 2006. This meeting included a presentation by an occupational medicine resident working with the FACE project, *Fall Protection in Residential Construction: Should the Massachusetts Building Code Be Changed to Include Built-in Anchoring Systems (BIAS)?* A written report on which the presentation was based was disseminated at the meeting to 18 representatives of OSHA, BLS, Liberty Mutual Insurance Company, CPWR, University of Massachusetts, Harvard University, The Construction Institute, Massachusetts Division of Occupational Safety, Massachusetts Department of Public Health, and immigrant community organizations. Copies were also distributed at the Annual FACE Meeting on March 8, 2006.

OUTPUTS:
Top level category:
The NIOSH webpage http:www.cdc.gov/niosh/face/ contains links to each State–based FACE program where additional State-based FACE publications such as Alerts, FACE Fact sheets, fatality narratives and journal articles are located.

States have produced state-based publications, such as videos, alerts, safety information packets, brochures, fact sheets, fatality narratives, news bulletins, and press releases. States have also produced training videos and programs. Select examples follow:

AK FACE [2004]. Faller Safety Interactive Video. Anchorage, AK: Alaska Fatality Assessment and Control Evaluation Program.

CA FACE [2005]. FACE FACTS: Crane Operator Crushed! Unsecured Load Falls During Riggings. Richmond, CA: California Fatality Assessment and Control Evaluation Program.

KY FACE [2004]. FACE the Facts: Fatal Occupational Motor Vehicle Collisions and Work Fatigue/Inattention in Kentucky. Lexington, KY: Kentucky Fatality Assessment and Control Evaluation Program.

MA FACE [2002]. FACE Facts: 16-year-old Massachusetts youth was fatally injured at work while operating a forklift. Boston, MA: Massachusetts Fatality Assessment and Control Evaluation Program.

MA FACE [2002]. FACE Facts: Massachusetts welders killed in explosions caused by torch cutting operations. Boston, MA: Massachusetts Fatality Assessment and Control Evaluation Program.

MA FACE [2003]. FACE Facts: Massachusetts police officers killed in highway and street work zones. Boston, MA: Massachusetts Fatality Assessment and Control Evaluation Program.

MA FACE [2006]. MA FACE and State Fire Marshall Fire Safety Alert. Boston, MA: Massachusetts Fatality Assessment and Control Evaluation Program.

MA FACE [1997]. Falls: The leading killer on construction sites. Boston, MA: Massachusetts Fatality Assessment and Control Evaluation Program.

MI FACE [2004]. MI Hazard Alert: Electrocuted While Welding. Lansing, MI: Michigan Fatality Assessment and Control Evaluation Program.

NE FACE [2003]. FACE FACTS: Energy—Friend or Foe? Omaha, NE: Nebraska Fatality Assessment and Control Evaluation Program.

NJ FACE [2004]. NJ Hazard Alert Bulletin: Warning! Dangers to Teens Working at Pizza Restaurants. Trenton, NJ: New Jersey Fatality Assessment and Control Evaluation Program.

NY FACE [2006]. FACE Facts: Truck driver run over by a trash compactor at a municipal landfill. Troy, NY: New York Fatality Assessment and Control Evaluation Program.

NY FACE [2006]. A NY FACE Training Guide for Safety and Health Professional Module 1: Preventing Deaths and Injuries to Public Workers While Working Around Mobile Equipment. Troy, NY: New York Fatality Assessment and Control Evaluation Program.

OK FACE [2003}. Injury Update: Construction-Related Fatalities in Oklahoma. Oklahoma City OK: Oklahoma Fatality Assessment and Control Evaluation Program.

OR FACE [2003]. OR FACE Fatality Alert: Truck-Mounted Pile Driver presents Fatal Electrocution Hazard. Portland, OR: Oregon Fatality Assessment and Control Evaluation Program.

WA FACE {2005]. Fatal Facts: Electrocution Hazards Working Near Overhead Power Lines. Olympia, WA: Washington Fatality Assessment and Control Evaluation Program.

WI FACE [2001]. Fact Sheet: Youth Farm Worker Pinned Under Overturned Horse-Drawn Manure Sled. Madison, WI: Wisconsin Fatality Assessment and Control Evaluation Program.

WV FACE [2002]. Video: Some Mistakes Last Forever. Morgantown, WV: West Virginia Fatality Assessment and Control Evaluation Program.

WV FACE [2002]. West Virginia Logger's Safety Field Guide. Morgantown, West Virginia Fatality Assessment and Control Evaluation Program.

NIOSH Publication Sub Category:

Fatality reports—974 finalized State-based FACE reports between 1996 through 2005. Of these, 407 were machine related and 149 were falls. These reports are available at **http://www.cdc.gov/niosh/face/**

Higgins DN [2004]. NIOSH Alert: Preventing Falls of Workers through Skylights and Roof and Floor Openings. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-156.

Higgins D, Parker DK, Wahl G [2001]. Hazards associated with using farm tractors to move large bales, Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Hazard ID 13.

Higgins DN, Hendricks K, Struttman T, Tierney J [1999]. Deaths among children aged _< 5 years from farm machinery runovers--Iowa, Kentucky, and Wisconsin, 1995-1998, and United States, 1990-1995. MMWR 48(28):605-608.

Burkhart J, Moore PH [2003]. Preventing deaths and injuries while compacting or baling refuse material, Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2003-124.

Casini V, Castillo DN, Lentz TJ, Ray TD [2001]. NIOSH Alert: Preventing injuries and deaths from falls during construction and maintenance of telecommunications towers, Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-156.

Moore, PH, Merinar TR [2006]. NIOSH Alert: Preventing worker injuries and deaths from mobile crane tip-over, boom collapse, and uncontrolled hoisted loads, Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2006-142.

External Publication Sub-Category:

<u>NIOSH authors or co-authors:</u>

Styles L, Cierpich H, Rogge J, Higgins D, Harrison R [2005]. To live and die in Los Angeles: the California Fatality Assessment and Control Evaluation (FACE) program: 1992 - 2002, 2005 National Injury Prevention and Control Conference, Denver, Colorado, May 9-11, 2005 Atlanta, GA: Centers for Disease Control and Prevention.

Helmkamp JC, Bell JL, Lundstrom WJ, Ramprasad J, Haque A [2004]. Assessing safety awareness and knowledge and behavioral change among West Virginia loggers, Inj Prev *10(4):*233-238.

Higgins DN, Tierney J, Lins M, Hanrahan L [2004]. School Nurses: A Resource for Young Worker Safety, J Sch Nur 20(6):317-323. *(The Editor's publication notification letter indicates that the article was sent to the 12,000 members of the National Association of School Nurses.)*

Tierney JM, Higgins DN, Hanrahan LP, Washburn MJ [2003]. Preventing Youth Worker Fatalities [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

Higgins D, Tierney J, Hanrahan L [2002]. Preventing youth worker fatalities: the Fatality Assessment and Control Evaluation (FACE) Program, AAOHN *50*(11):508-514.

Higgins DN, Casini VJ, Bost P, Johnson W, Rautiainen R [2001]. The Fatality Assessment and Control Evaluation program's role in the prevention of occupational disease, Injury Prevention 7(Suppl I):i27-i33.

State-based authors-examples of external articles:

Hallman EM, Gelberg KH, and Hallisey JL. A NY FACE Case Study: Dairy Farm Owner Dies during Manure Pump PTO Entanglement, Journal of Agromedicine, 2005; Vol 10(3).

Chester DA, Hanna EA, Pickelman BG, Rosenman KD. Asthma death after spraying polyurethane, American Journal of Industrial Medicine, Volume 48, Issue 1, Date: July 2005, Pages: 78-84.

MN FACE [2004]. Summertime Baling: A Time of Increased Risk on Minnesota Farms. Southwest Minnesota Farmer, Vol 1 (15), 2004.

IA FACE [2003]. Investigating a Fatal Tree Shear Incident. Arbor Age, April 2003.

Parker D, Wahl G [1998]. Fatalities associated with large round hay bales -- Minnesota, 1994-1996. MMWR 47(2):27-30.

Targeted dissemination efforts:

OK FACE report 03OK 016-01, “Waste disposal worker was crushed between a waste disposal truck and a dumpster in Oklahoma,” along with a cover letter and a copy of the NIOSH Alert “Preventing workers injuries and death from moving refuse collection vehicles” was distributed to 210 waste hauling companies and to 812 persons on the OK FACE mailing list which included vocational school instructors, medical examiners, high school teachers, and others. OK FACE developed a survey to measure reader response. Seventy-two surveys were returned, a 7% response rate. In response to the question how will you use the enclosed materials? (responders could check all that applied): 35 responded that they would use the materials in training and safety meetings; 23 said they would distribute it to employees; 22 said they would post the material on the bulletin board; 21 responded that they would file it for future use; 14 responded that they would not use it as they did not operate waste disposal trucks; and, 14 had a variety of additional narrative responses. No-one checked the response that they would not use the material because the information was not helpful. One of the additional responses was “Thanks for the packet. The City of Nicholas Hills now contracts out our commercial accounts with dumpsters. Safety concerns were part of that decision. The NIOSH Alert I ordered over the Internet. I used it in training and incorporated it into our safety manual. Any and all additional information in the future is welcome.”

MA FACE disseminated a work zone FACE Facts packet to all MA Police Chiefs (348). The packets consisted of the MA FACE Facts, a letter explaining the mailing, a MA FACE Brochure, and a FAX request sheet for ordering additional copies of the work zone FACE Facts work zone fact sheet. Thirty police departments requested an additional 1,972 copies.

MA FACE and the MA teens at Work Project mailed 199 packets to all employers in the Department of Industrial Accidents database that had an injured teen worker file a workers compensation claim. These packets consisted of a letter explaining the mailing, a copy of the MA employers guide to child labor laws, the young worker forklift safety FACE Facts and sticker, and a FAX request form for additional copies of the materials. Eleven requests were made for additional copies.

MA FACE developed a database of 28 Spanish community organizations. Informational packets which consisted of a letter explaining the mailing, Spanish and English versions of the MA FACE young worker forklift safety FACE Facts and sticker, Torch Cutting FACE Facts, MA FACE Fall Prevention Brochures, and a fax form for additional copies of the materials. Fifty requests were received for the forklift safety FACE Facts; 40 for the torch cutting FACE Facts, 60 for the falls brochures, and 50 for forklift warning stickers.

In October 2003, 3,354 copies of the NIOSH Alert, "Preventing Worker Deaths from Uncontrolled Release of Electrical, Mechanical, and Other Types of Hazardous Energy," published in August 1999, were mailed to companies in Nebraska and California as part of a state-based dissemination effort. These mailings included cover letters from the Nebraska Department of Labor and the California Department of Public Health, respectively. One-thousand, five-hundred and fifty-four Alerts were distributed in Nebraska, and 1,800 in California. Sixty-six readers returned reader response cards, 25 from Nebraska and 41 from California Summaries of these responses follow:

- Forty-seven (71%) responders identified themselves as managers, 10 (15%) as safety professionals, 8 (12%) as employees, and 1 as other.
- Forty-nine (74%) responders reported that they worked in private industry, 14 (21%) owned their own business, and 4 (6%) of the respondents reported that they worked in a government agency.
- Seventeen (26%) respondents reported that they used the document to change the work environment or procedure, 16 (24%) used it to assist in ongoing or new research, 16 (24%) reported that they used the document to change training or course curriculum, and 9 (14%) reported that the document was not used.

The WI FACE program sent the article, *School Nurses: A Resource for Young Worker Safety*, to 530 school nurses in WI along with a survey to assess the utility of the article. One-hundred fifty-eight nurses responded to the survey. Summaries of responses follow:

- 31% reported that they used information in the article to promote young worker safety;
- 85% reported that the article increased their understanding of child labor laws;
- 78% reported that that the article increased their understanding of safety training.
- When asked to report how they would use the materials to promote young work safety, the majority reported that they would share the information with colleagues.

ACTIVITIES:
State-based FACE is a continuing extramural program of identification and epidemiologic investigation of selected occupational fatalities. The objective of the FACE project is to prevent fatal work-related injuries through an integrated program of surveillance, on-site investigation, and dissemination and prevention activities. The project is implemented through cooperative agreements with State health and labor departments.

The purpose of State-based Fatality Assessment and Control Evaluation (FACE) is to identify work environments that place workers at high risk for fatal injury, identify potential risk factors, and formulate and disseminate prevention strategies to those who can intervene in the workplace. State-based FACE identifies work-related deaths and investigates selected cases through a network of cooperative agreements with states using the NIOSH FACE model. Investigative findings and prevention recommendations are broadly disseminated through health communication documents at state and national levels, and are used by employers and manufacturers to increase worker safety, and by OSHA and other organizations to support promulgation of safety standards and compliance directives. Numerous fact sheets, alerts, hazard IDs, Workplace Solutions, journal articles, posters, and presentations are made based on information gained through investigations.

INPUTS:
Until recently, NIOSH identified specific types of deaths that all state-based FACE programs would investigate, and states identified additional targets based on surveillance data in their states, and opportunities for prevention. NIOSH has used both the NIOSH National Traumatic Occupational Fatality (NTOF) database and Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI) data system to identify targets for the FACE project. Other inputs have also been used to identify targeted areas for investigation. Specifically, the 1998 Research Council report, “Protecting Youth at Work,” as well as input from the U.S. Department of Labor, Wage and Hour Division, influenced the FACE program targeting young worker deaths. OSHA interest and focused prevention activities in falls from telecommunication towers and Hispanic worker fatalities influenced the FACE program targeting Hispanic worker deaths. In the future, targets for investigation by all states will likely be identified by the State-based FACE Coordination Consortium, which includes voting representatives from all states, and nonvoting representatives from NIOSH.

PROJECT ID: CAN 9278807, Fatality Assessment and Control Evaluation Project-TA

END OUTCOMES:

None to report specific to this project.

INTERMEDIATE OUTCOMES (IO):

- NIOSH data analysis, information from fatality investigations, and FACE investigative reports were used in the development of the North Carolina Telecommunication Tower Standard, the first in the nation, promulgated by the North Carolina Department of Labor.

- NIOSH researchers provided information to Mr. Jake Verkerk, who is with the Safety and Environmental Compliance office of the Federal Aviation Administration (FAA) in Miami. This information led to the successful development of a scope of work involving the retrofitting of a damaged antenna tower at Great Inagua in the Bahamas. In a letter to NIOSH, Mr. Verkerk stated "Dear NIOSH Division of Safety Research: The Safety and Environmental Compliance office of the FAA in Miami, want to thank Mr. Virgil Casini for providing vital information to the successful development of a scope of work involving the retrofitting of a damaged NDB antenna tower at Great Inagua, the Bahamas. Mr. Casini's insight and his close working relationships with the task members of the National Association of Tower Erectors (NATE) have lead to the dramatic improvement of the FAA's regional perception of safe working at antenna tower structures, and Mr. Casini's ability to provide contact leads with industry professionals and regulators has proven paramount in the identification of the lack of proper safe guards in our local Elevated Work Surfaces program. Once again, we appreciate your West Virginia counterpart for his contributions to the well being of the local Federal employee safety program managed in Miami for South Florida and the Caribbean."

- NIOSH researchers assisted OSHA and NATE in the development of a three-day train-the-trainer course designed for OSHA compliance officers, contractors, tower erectors, tower owners, wireless service carriers, and tower component manufacturers. At one training course held in Stowe, Ohio, 173 participants from 37 states were present. All course evaluations from participants were positive.

- A packet containing a sample of four crane-related FACE reports and a page from the NIOSH Alert, "Preventing Electrocutions of Crane Operators and Crew Members Working Near Overhead Powerlines" was mailed to approximately 4,600 crane rental and crane service establishments across the nation. The packet described crane-related injury risks and steps employers can take to prevent worker death and injury. Recipients were encouraged to use these materials for training purposes, toolbox talks, and as support for safety program development. A crane rental company requested over 100 copies to issue with each crane rented. A construction contractor who requested multiple copies praised the packet as the most useful safety tool he ever received from the government. "I had heard about the accidents, but didn't know the causes. I will circulate the publication among my employees who work with cranes. It will give us an opportunity to discuss crane safety using real life examples. I am sure my employees will find it as fascinating as I did."

- The Agricultural Health Nurse Program of New York State, funded by NIOSH, identified an incident that resulted in the scalping of a woman in New York when her hair became entangled in the driveline of a hay bale thrower on a hay baling machine. Subsequent investigation by NIOSH personnel identified four additional cases. The same model machine was involved in all the incidents. NIOSH investigations indicated that when the women leaned under the driveline to adjust the tension on the hay bales, their hair became entangled in the driveline. The drivelines were covered by a U-shaped tunnel guard that left the bottom of the rotating driveline exposed. In response to these incidents, NIOSH developed an Alert entitled *Preventing Scalping and Other Severe Injuries From Farm Machinery*. Although only one model of machinery was involved in this incident, the hazards and recommendations identified in the document apply to many manufacturers and types of agricultural equipment. When contacted, the manufacturer informed NIOSH that a retrofit guard had been developed for the machine that would entirely enclose the rotating driveline. Dissemination of the NIOSH Alert to equipment dealers and county agricultural extension agents impacted end users; requests for the retrofit guard exhausted the manufacturer's inventory and resulted in additional production to fill orders.

- NIOSH, through its Community Partners for Healthy Farming program in New York, received two separate reports of farm workers who were injured while attempting to drill holes into sealed plow frames in order to mount a hitch or a "slow-moving vehicle" sign. These workers received serious skin burns and other injuries when the drill bits penetrated the frames releasing and igniting flammable gases. Subsequent NIOSH investigations indicated that hydrogen and methane gas may be produced within sealed frames that are filled during manufacture with scrap metal ballast. It was determined that the un-cleaned, assorted, machine shop metal scrap ballast apparently reacts electrochemically with water and emulsion-type cutting oils to liberate flammable gases. After NIOSH discussions with the manufacturer, the manufacturer ceased using the scrap for fill in their equipment frames and began using stainless steel punch-out scrap.

FINAL CUSTOMERS:

Employers, safety professionals, workers, and manufacturers.

INTERMEDIATE OUTPUTS:

- Sarah Sanders Smith, Assistant Professor of Organizational Leadership & Supervision, Purdue University North Central contacted the In-house FACE project officer and said that she is developing for Purdue University an Occupational Safety and Health training program that will establish Purdue University as the educational center for Occupational Safety and Health in the state of Indiana. She is using the NIOSH page in general and the FACE program in particular in the development of this program. The FACE program and the FACE reports and other FACE materials such as Workplace Solutions and Alerts will be used as a basis for training modules and in the development and establishment of prevention strategies for this program.

- Ms. Ellen Parson, contributing Editor for *American Reconstruction* Magazine, a new periodical aimed at contractors performing reconstruction after demolition efforts and/or after natural disasters, interviewed the FACE project officer. A discussion was held on the use of portable generators (electrical and CO hazards), the use of rough-duty extension cords, and the importance of treating all conductors as energized unless they have been verified as de-energized. Ms. Ayrd also wanted information on the FACE program, and liked the FACE reports written after the electrocutions investigated in Puerto Rico following Hurricane Hugo. Ms. Ayrd said she would reprint these reports in the magazine along with other relevant reports. The first few issues of the magazine will contain information from the NIOSH and FACE web pages. The first article entitled "The Shocking Truth—Beware of Electrical Hazards" was published in the July 2006 issue (http://www.ecmweb.com/).

- As part of a collaboration between NIOSH, OSHA, and the National Association of Tower Erectors (NATE), NIOSH provided technical assistance to OSHA in the development of a safety checklist for telecommunication tower construction safety and in the development and revision of a compliance directive (CPL 2-1.36- Interim Inspection Procedures During Communication Tower Construction Activities), both of which provide guidance on safe work practices in the construction and maintenance of telecommunication towers. The 100% fall protection and personnel hoisting requirements contained in the initial and revised directive were supported by NIOSH investigative findings and data input and, when used correctly, decrease worker exposure to fall hazards.

- OSHA and NATE developed, with technical assistance from NIOSH staff, a three-day train-the-trainer course designed for OSHA compliance officers, contractors, tower erectors, tower owners, wireless service carriers, and tower component manufacturers.

- NIOSH researchers provided OSHA with data, investigative findings, and preventive recommendations that were used in the development of the OSHA Training Institute's *Course 350—Tower Safety*.

- NIOSH researchers provided NATE technical assistance in the development of their comprehensive safety manual. Additionally, NIOSH researchers provided the Advisory Committee for Construction Safety and Health (ACCSH) telecommunication tower subcommittee with technical assistance in the development of a *Recommended Best Practices Site Safety Manual.*

- NATE provides a direct link to the NIOSH homepage and to relevant NIOSH publications in their monthly association journal *Tower Times.*

- Mr. Craig Lekutis, President, Wireless estimator.com developed an article on the use of NIOSH telecommunication tower-related FACE reports as training aids for the wireless industry. Wireless Estimator.com is a free internet service for the wireless industry. The article provided links to the FACE reports and can be found at: http://www.wirelessestimator.com/breaking_news.cfm.

- While NIOSH was investigating the hazard of drilling into sealed frames of agricultural equipment, *Successful Farming* magazine ran a cover story detailing a project by the Future Farmers of America (FFA) in Kansas to replace slow moving vehicle signs on all agricultural machinery in the state. The cover picture was of two youth drilling into a sealed frame. Following NIOSH contact, the FFA issued a nationwide bulletin to all FFA chapters describing the hazard, and *Successful Farming* ran an article on the NIOSH Hazard ID summarizing the hazard and steps to reduce injury, *Ignition Hazard From Drilling Into Sealed Frames of Agricultural Equipment.*

- NIOSH has received feedback on a number of ways in which stakeholders use FACE findings and recommendations to educate employers, workers and the public about work hazards and prevention measures. For example, the Occupational Safety and Health Administration, the American Bureau of Crane Inspection, Inc., West Virginia University, North Carolina State University, and trade associations report using the materials for training. Publications such as *Technical Rescue*, based in the United Kingdom, reprint FACE reports.

- In a study funded by CPWR using NIOSH grant funding, Michael Behm from East Carolina University analyzed fatality reports from FACE investigations and linked them back to the design-for-safety concept (Linking construction fatalities to the design for construction safety concept, Behm M, SAFETY SCIENCE , 43 (8): 589-611 OCT 2005). FACE cases were used to assess the potential of designing safety into construction projects.

- In a Construction Bulletin entitled “How Much Do You Know About Forklift Safety,” Copyright 2005 Reed Business Information, US, a Division of Reed Elsevier Inc., information and cases from the NIOSH Forklift Alert were cited.

- Mr. Josh Cable, writer for Occupational Hazards magazine, wrote an article entitled “Hammering Away at Construction Hazards” that referenced the NIOSH FACE report 2005-11.

- FACE report 2005-06, Hispanic Worker Dies After Falling From a Pile of Construction Debris in the Bed of a Trash-Style Body Truck to a Paved Driveway Below—North Carolina, was printed in its entirety in the Spring 2006 issue of Blueprints, the American Society of Safety Engineers’ construction practice specialty newsletter. The Editor’s note gave an excellent description of both the in-house and state-based FACE program.

INTERMEDIATE CUSTOMERS:

- OSHA
- State Departments of Labor
- Researchers
- Journalists
- Trade and labor associations
- Trainers and training organizations

TRANSFER ACTIVITIES:

NIOSH uses multiple avenues to foster FACE findings and recommendations being put into action in the workplace. All FACE reports are posted on the internet: www.cdc.gov/niosh/face. An electronic communication link has been established on the FACE website that will alert key stakeholders when new FACE reports are available. The FACE dissemination list is being refined to ensure that FACE reports are reaching all key stakeholders. All FACE reports from FY2001 through the present have been linked to an electronic evaluation mechanism that will allow users to provide instant feedback on the reports. FACE personnel will receive quarterly reports of the feedback from EID that will be evaluated and will allow FACE personnel to improve the quality and usefulness of the reports as necessary

NIOSH has established routine mechanisms whereby FACE reports and products are disseminated to groups who use them in training and outreach to employers, such as the nine OSHA Consultation Programs, an OSHA Regional Training and Educational Center, and the American Society of Safety Engineers. Through the past fiscal year, over 12,000 NIOSH-numbered publications have been disseminated through these avenues. Additionally, seven trade publications with subscribers numbering over 360,000 have agreed to work with FACE personnel to disseminate FACE products.

NIOSH frequently undertakes targeted outreach (independently and with partners such as OSHA and the Wage and Hour Division, Department of Labor) to specific employer and worker groups and intermediaries. Examples include NIOSH outreach on crane-related injury risks, joint outreach with the Department of Labor on young worker deaths associated with forklifts, assistance from the Association of Equipment Manufacturers (AEM) in disseminating a Workplace Solution on hazards associated with excavators (provided an international mailing list), and assistance from the National Association of Tower Erectors in disseminating an Alert on preventing falls from telecommunication towers.

NIOSH also provides technical assistance and participates on working groups addressing specific hazards. Two examples are NIOSH working with OSHA, the National Association of Tower Erectors and state level regulators to improve safety for workers who erect and maintain telecommunication towers, and NIOSH working with the Association of Equipment Manufacturers, the International Union of Operating Engineers (IUOE), and OSHA to update OSHA regulations for ROPS on ride-on rollers.

Presentations are given to researchers and at professional conferences. Examples include:

“Ignition Hazard From Drilling Into Sealed Frames of Agricultural Equipment” presented to NIOSH staff in Pittsburgh, PA.

“Communication Towers: A Rising Injury Risk” presented to the Board of Scientific Counselors in 2000.

“Communication Towers: A Rising Injury Risk” presented as part of the OSHA train the trainer Telecommunication Tower course in Cleveland, Ohio 1999.

“Communication Towers: A Rising Injury Risk” presented at the NATE annual conference in Dallas, Texas 2001.

“NIOSH, OSHA, NATE Efforts for the Prevention of Injury to Telecommunication Tower Construction and Maintenance Workers” presented at the National Safety Council in Atlanta 2001.

“Communication Towers: A Rising Injury Risk” presented as part of the OSHA Telecommunication Tower course in Philadelphia, PA. 2001.

“The NIOSH Fatality Assessment and Control Evaluation (FACE) Program” presented to the IMHOTEP students in Atlanta, Georgia.

“Communication Towers: A Rising Injury Risk” presented to North Carolina stakeholders meeting in Raleigh, NC.

“Communication Towers: A Rising Injury Risk” presented at NOIRS 2000.

“The NIOSH Fatality Assessment and Control Evaluation (FACE) Program” presented at the National Safety Council in New Orleans, LA.

“The NIOSH, OSHA, NATE Partnership for the Prevention of Injury to Telecommunication Tower Construction and Maintenance Workers” presented to DSR staff and Dr. Linda Rosenstock.

“NIOSH, OSHA, NATE Efforts for the Prevention of Injury to Telecommunication Tower Construction and Maintenance Workers” presented at the 2000 NATE annual conference.

“Efforts to Prevent Crane-Related Fatalities” poster presentation for the ASSE conference in Las Vegas, Nevada 2004.

“Investigation of Hispanic Worker Fatalities to Identify Factors That Contribute to High Fatality Rates” poster presentation for the World Safety Congress Orlando, FL 2005.

“Communication Towers: A Case Study” presentation given at NATE 2003 annual conference.

“Efforts for the Prevention of Injury to Telecommunication Tower Construction and Maintenance Workers” presented at the NATE 2005 annual conference by OSHA personnel. Author could not attend due to weather.

“The NIOSH Fatality Assessment Control Evaluation (FACE) Project” presented via envision to Roger Rosa and the Department of Transportation 2005.

“NIOSH FACE Program: Hispanic Worker Fatalities” presented at the 2003 annual FACE meeting in Washington state.

“The NIOSH Fatality Assessment and Control Evaluation (FACE) Program for the Investigation and Prevention of Occupational Fatalities” presented at the OSHA Training Institute Des Plaines, Il. 1998.

OUTPUTS:

FACE findings are summarized in narrative reports for each fatality investigation (FACE reports), and are featured in NIOSH Alerts, Workplace Solutions, and journal articles. FACE findings are also included in NIOSH comments on proposed worker safety and health legislation (e.g. lockout/tagout, trenching and excavations, electrical safety and child labor laws).

Six hundred and forty-three FACE investigations have been conducted and 630 FACE reports have been completed and posted on the NIOSH FACE webpage. Since 1996, NIOSH personnel have conducted 145 FACE investigations. Of these, fifteen involved falls from elevation and seventy involved machinery. These reports can all be accessed at: http://www.cdc.gov/niosh/face/default.html .

Twenty NIOSH Alerts on a variety of subjects including forklifts, balers, cranes, scalping, falls from telecommunication towers, falls through skylights, and falls from scaffolds have been developed using FACE findings and prevention recommendations. Eleven of these Alerts have been translated into Spanish. Three monographs (confined space, electrocution, and falls) have been published. Three NIOSH Hazard IDs have been developed pertaining to wood chippers, moving large hay bales, and ignitions during the penetration of sealed frames of agricultural machinery. Two Workplace Solutions involving backhoes/excavators and ride-on roller compactors were developed and disseminated internationally. These products may all be accessed at: http://www.cdc.gov/niosh/face/othpubs.html. Two new NIOSH Workplace Solutions based on FACE findings will be published in 2007, one addressing backovers in roadway work zones, and another that will be translated into Spanish addressing aluminum ladder/overhead powerline contact.

Citations for journal articles:

CDC [1996]. Skid-steer loader-related fatalities in the workplace--United States, 1992-1995. MMWR 45(29):624-628.

Moore P, Burkhart J [2001]. Baler and compactor-related deaths in the workplace--United States, 1992-2000, MMWR 50(16):309-313.

Higgins DN, Casini VJ, Bost P, Johnson W, Rautiainen [2001]. The fatality assessment and control evaluation program’s role in the prevention of occupational fatalities. Inj Prev 7 (Suppl 1): i27-33.

ACTIVITIES:

The goals/objectives of this project are to prevent fatal work injuries by identifying work situations at high risk of fatal injury and developing prevention strategies for those who can intervene in the workplace.

NIOSH is voluntarily notified of selected occupational fatalities (currently machine-related, workers under 18 years of age, highway construction work zones, and Hispanic workers) by the Departments of Labor in the states of Maryland, North Carolina, South Carolina, Tennessee, and Virginia, Federal OSHA Area Offices in Ohio and Pennsylvania, and the Allegheny County Coroner's Office in Pittsburgh, Pennsylvania. NIOSH is notified of work-related deaths of youth under 18 years of age across the nation by the Wage and Hour Division, U.S. Department of Labor. Through on-site fatality investigations, FACE personnel collect agent, host, and environmental information from the pre-event, event, and post-event phases of the fatal incident via a case series design to facilitate descriptive analysis of the incidents. These investigations are not conducted to find fault or place blame, but to better understand the chain of events and contributing factors and develop recommendations for preventing similar deaths. Findings from FACE investigations are frequently combined with surveillance data to describe specific injury problems and develop broad-based prevention recommendations. The results of FACE investigations are disseminated through narrative reports for each fatality, NIOSH Alerts, Workplace Solutions, technical reports, targeted mass mailings, journal articles, MMWRs, and presentations. NIOSH Alerts and Hazard IDs have covered the topics of forklifts, skid steer loaders, telecommunication towers, skylights, moving large hay bales, and wood chippers among others. The results of the FACE program have the unique capability to reach workers at risk and provide timely intervention strategies to targeted areas.

All FACE products are available on the internet. Additionally, NIOSH frequently undertakes targeted dissemination efforts to provide prevention information to specific audiences. For example, in FY04 NIOSH mailed a packet documenting crane-related injury risks and steps that can be taken to prevent worker death and injury to approximately 4,600 crane rental and crane service establishments across the nation.

NIOSH also partners with other federal agencies and private sector groups to communicate prevention information from the FACE program. For example, NIOSH has worked for several years with OSHA and the National Association of Tower Erectors (NATE) to reduce extremely high fatality rates for workers who erect and maintain telecommunication towers. NIOSH data analysis, information from FACE investigations, and recommendations are used by OSHA and NATE as training materials. To address shared concerns about the incidence of young workers being fatally injured while operating forklifts, NIOSH and the Department of Labor's Wage and Hour Division (WHD) collaborated in December 2002 to send an information packet on forklift safety and young workers to more than 10,000 retail warehouses and storage facilities. NIOSH, WHD, and OSHA all participated in additional outreach efforts in January 2004 to distribute 5,000 copies of this same packet, along with an OSHA bulletin, in a broader mailing that included OSHA alliance partners such as the Industrial Truck Association (ITA).

The State-Based FACE Program and Fire Firefighter Fatality Investigation and Prevention Program were spawned from the In-House FACE Program and use the original FACE methodology in the implementation of their respective programs.

INPUTS:

Initially, the NIOSH National Traumatic Occupational Fatality (NTOF) database was utilized to identify targeted areas of investigation. These targets included confined spaces, electrocutions, falls, logging, agriculture, youth, and machines. Today, the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI) data system is used to identify targets for the FACE project. For example, BLS CFOI analyses demonstrating high occupational injury fatality rates among Hispanics were used to support the addition of Hispanics as a target for FACE investigations.

Other inputs have also been used to identify targeted areas for investigation. Specifically, the 1998 Research Council report, "Protecting Youth at Work," as well as input from the U.S. Department of Labor, Wage and Hour Division influenced the FACE program targeting young worker deaths. OSHA interest and focused prevention activities in falls from telecommunication towers and Hispanic worker fatalities influenced the FACE program targeting Hispanic worker deaths.

Appendix 2: Traumatic Injury Intramural and Extramural Projects

Extramural

More information is available for selected listed extramural projects. Follow the links to access additional detail on the goals, activities, outputs and outcomes of these studies.

Acute Back Injury

3380	System for Safe Patient Handling
3703	Predictors of Low-Back Injury and Disability in the U.S. Army
3746	A New Training Intervention to Prevent Back Injuries;
3749	Getting to Zero in Nursing Homes: Intervention Effectiveness
7708	Lift Aid Use in Reducing Injuries in Nursing Personnel
8375	Effectiveness of Patient Lift Equipment
VCE8875-03	Back Injury Interventions for Small Contractors

Emergency Responders

7960	Downed Fire Fighter Location System
03559FF	Leadership Intervention for Fire Service Personnel
03802D	Impact of Time and SCBA Tank Utiliz. on Injury Prev. in Fire Fighters;
04173R	SCBA Oximetry for Fire Fighter Physiologic Monitoring
07673R	Bioelectric Telemetry System for Fire Fighter Safety
07869 BT	Hazardous Substance Training for Emerg Responders

Machines

3612	ROPS Design and Testing for Agricultural Tractors;
8108	Audiovisual Method-ROPS Traumatic Injury Prevention
8542	National Agricultural Tractor Safety Initiative
08562R	A PC Based Virtual Reality Simulator for Forklift Safety Training
VEA8132	Prevention Effectiveness Analysis for Preventing Ag Tractor Roll-over Fatalities

Motor Vehicles

3419	Work-Related Motor Vehicle Crashes: Reducing the Burden
3804	Trucking Firm Characteristics, Driver Injury and Outcome
7699	Auditory Motion and Pedestrial-Motor Vehicle Collisions
217559	Effect of Active Speed Cntrls in Hwy Wk Zones

Workers in Alaska

4073	Occ Injuries Among Commercial Fishers

Workplace Violence

3407	Personal Safety for Social Services Providers
3412	Worksite Intervention to Reduce Wk-Related Assault Injury
3438	A Study of Risk Factors for Violence Among Nurses
3897	Homicide During Robbery: A Case Control Study
4037	Reducing Violence Against Nursing Home Caregivers
4051	Effects of OSHA Guidelines on Violence Prevention in Mental Health

7373	Wk-Related Assault: Impact of Trng & Policy
7374	Management Practices as a Factor in Workplace Violence
7754	Workplace Violence Risk in Home Hlth Wk Place
7816	Violence Against Teachers: Etiology & Consequences
7931	Risk for Violence in Long-Haul Truckers
7934	Evaluation of California Initiatives to Reduce Violence
7946	Organizational Factors Affecting Police Victimization
7947	Spokane Workplace Domestic Violence Initiative
7948	Evaluation of Workplace Violence Prevention Intervention
7953	Workplace Violence Nursing Health and Employment Outcomes
04051Prev	Eff of OSHA Guidelines on Violence Prev in Mental Hlth

Youth

3530	Safety of Youth Employment: A Nat'l Study of Parents & Teens
3786	On the Job Injury in South Texas Middle School Children
3796	Adolescent Toxic Exposures in the Workplace
3924	Children's Injuries on Kentucky Beef Cattle Farms
4205	Evaluation of NAGCAT Using Case Series of Injuries
4210	Using the ASHBMPManual as a Tool to Reduce Farm Hazards
4215	Adapting NAGCAT for Ethnic Communities: Aresearch Mode
4216	Teaching Kids Safety on the Farm: What Works
4220	Childhood Agricultural Safety and Health
4220	Evaluation of A School-Based Ag Health and Safety Curriculum
4222	Evaluating Teen Farmworker Education
4257	Evaluation of North American Guidelines for Children's Ag Tasks
4265	Childhood Ag Trauma Eval System
7298	The Youth Employment Training Pilot Program (Enhanced)
7301	Enhanced Surv of Occ Injuries to Youth
7534	Evaluation of Farm Safety 4 Just Kids Day Camps
7536	Effectiveness of Farm Safety Day Camps for Children
7744	Adolescent Farm Work, Fatigue, and Injuries in CO
7850	Evaluation of the NAGCAT Tractor Guidelines
7908	Effect of Work Permits in Protecting Youth Workers
8046	Removing the HOOA Family Farm Exemption: Impact on Injury
8058	Evaluation of Occupational Carrying Tasks for Farm Youth
8070	Adherence to the NAGCAT and Injury Risk Reduction
8126	Work Injury and Young People: A Prospective Survey
14357	Wisconsin Childhood Agricultural Safety and Health Intervention (513257)
14375	Etiology and Consequences of Injuries Among Children in Farm Households
16767	Childhood Injuries in Washington State Agriculture
514436	National Center for the Prevention of childhood Agricultural Injury
08107a	National Children's Center for Rural & Ag Health & Safety
VEA8067	Agriculture Child Labor

Title: **ROPS Design and Testing for Agricultural Tractors**

Submitted by Paul Ayers, University of Tennessee

1. Definition of the problem being addressed (e.g., number of workers affected; rates of injury, illness, or fatality; hazards)

Agriculture is considered one of the nation's most hazardous occupations with an estimated death rate of 21 per 100,000 workers in 1996 (National Safety Council, 1997). The National Safety Council estimated 800 agricultural work deaths in 1995. Also in 1995, the National Safety Council estimated 431 on-farm tractor-related deaths, of which 237 were due to tractor overturns. Although not all the tractor overturn fatalities are considered agricultural work deaths, it represents a considerable percentage. In fact, in 1994 agricultural work deaths were estimated at 890, while tractor overturns resulted in 188 on-farm fatalities. In these two years (1994 and 1995), the ratio of on-farm tractor overturn fatalities to agricultural work deaths rose from 20.6 percent to 29.6 percent.

In a review of the National Institute for Occupational Safety and Health (NIOSH) Fatality Assessment and Control Evaluation (FACE) program, 454 agricultural production fatalities were reported by the State FACE programs from 1990-1994 (Olenchock, 1997). Of these, 178 were tractor-related, with half resulting from tractor overturns. Here the ratio of tractor overturn fatalities to agricultural production fatalities is about 20 percent. A review of agricultural fatalities conducted by Myers and Snyder (1995) concluded, "tractor overturns (are) the leading cause of occupational traumatic death in the U.S. agricultural industry."

Tractor rollovers have been called an "occupational obscenity" by NIOSH (National Institute for Occupational Safety and Health) Director J. Donald Millar (NIOSH, 1993). NIOSH recommends National and community-based programs retrofit farm tractors with rollover protective structures (ROPS) and develop guidelines for the design of ROPS for tractors manufactured before 1971 (NIOSH, 1993).

2. Aims of the project (major objectives for the period of the work)

The overall objective of this project is to investigate and evaluate rollover protective structure (ROPS) designs for agricultural tractors in the United States to provide operator protection on tractors and in operating conditions not currently available. This objective includes both analysis of tractor ROPS inventory, and testing of ROPS designs and supporting structures.

3. Partners (participants in the project and the roles they served)

The author acknowledges the support of the National Institute for Occupational Safety and Health (NIOSH) safety engineers, Dr. John Etherton and Mr. James Harris for providing technical expertise. In addition, the author acknowledges the assistance of Doug Whitt, Laboratory Coordinator at the Agricultural Engineering Research Center (AERC) at Colorado State University (shop services), Dr. Juhua Liu (preparing and conducting field tests), and the following students: Sarah Legoza, Achai Broner, Chad Jackson, Nate Erickson, Jeremy

Pankonin, Luke Marriner, Travis Hertneky, Phillip Bacon, Ross Ballard, Ty Fickensher and Mike Olander (field test support).

4. Customers (intended users or beneficiaries of the results)

The customers of this research are primarily tractor and ROPS manufactures. These include Deere and Company, CNH, AGCO, Saf-T-Cab and Femco Mfg. The final beneficiary would be tractor operators involved in a tractor rollover with a certified ROPS.

5. Approach (tasks involved in conducting the project)

The specific tasks include:

1) Continued examination and inventory of agricultural tractor ROPS availability (specifically for older tractors) to determine the population of tractors for which ROPS are not available,

2) Prioritizing the agricultural tractor population for ROPS design feasibility based on population numbers and ROPS design and mounting feasibility,

3) Design, construction and testing of ROPS for the two highest prioritized pre-ROPS tractors (tractors not originally designed with the intent to mount a ROPS) in accordance with ASAE S519 (Rollover Protective Structures (ROPS) for Wheeled Agricultural Tractors, ISO Compatible). This includes conducting both lateral and longitudinal tests in static and field upset conditions,

4) Conducting a minimum of four axle housing strength tests for each pre-ROPS tractor to evaluate the torsional strength and design margins,

5) Conducting, in accordance with ASAE S519, lateral and longitudinal field upset tests on the NIOSH auto-ROPS (frame only) to evaluate elastic and plastic deformations and dynamic stresses,

6) Conducting, in accordance with ASAE S519, lateral and longitudinal field upset tests on the NIOSH auto-ROPS (frame and deployment sensor) to evaluate deployment timing. Video technology will be used to evaluate timing and operator protection. A field-upset test will also be conducted in a high-speed hillside roll condition,

7) Evaluating false deployment possibilities in lateral and longitudinal conditions at 45 degree slopes and high speed hill-side test conditions, and

8) Presenting pre-ROPS tractor ROPS and auto-ROPS design and test results to commercial ROPS manufacturer for commercial construction and follow-up field testing.

6. Results/Findings (preliminary or final observations and conclusions)

Analysis was conducted that indicates of the 70 most popular tractor models in the United State (Myers and Snyder, 1995), 50.4% were pre-ROPS tractors. Of these tractors, 73% are included in this ROPS design study (includes previous R01 grant involving Ford and Farmall tractors). With the completion of this ROPS design research project, 89.6% of the Pre-ROPS tractors (in the top 70) will have a ROPS design.

ROPS can be successfully designed for the John Deere A and Allis Chalmers pre-ROPS tractors. These ROPS meet ASAE S519 (SAE J2194) standards. Axle housing tests conducted demonstrate the ability of the axle housings to attain the stresses produced during the static longitudinal tests without failure. Factors of safety of 1.6 were attained. The ROPS are able to withstand the forces produced during the field upset tests. The method of measuring ROPS dynamic deflection was developed by using a LVDT. Dynamic deflection occurred during about 0.155-0.2 seconds period. Body rotation velocity could be as high as 200-350 degrees/second when ROPS touched ground. The velocity of the deflection was 63 cm/s. The duration of tractor rollover is about 0.7 to1.0 seconds.

Maximum dynamic deflection is less than the static deflection at the required energy. Longitudinal static deflection is 22 cm and longitudinal dynamic deflection is 11 cm; lateral static deflection is 25 cm; lateral dynamic deflection is 12 cm. Dynamic deflection provides more effective information for development of engineering control strategies for deployable ROPS.

7. Outputs (reports, publications, products, methods, etc.)

Ayers, P. D., J. B. Conger, R. Comer and P. Trout. 2002. ROPS Design and Testing for Off-Road Utility Vehicles and Lawnmowers. Proceeding of the 2002 NIFS Conference, Ponte Vedra Beach, Florida, 24-27 June 2002.

Ayers, P. D. and J. Liu. 2001. ROPS design and testing for agricultural tractors. ASAE Paper No. 01-8034. ASAE, St. Joseph MI 49085.

Liu, J., P. D. Ayers, S. Legoza and A. Broner. 2000. Dynamic deflection of ROPS and prevention effectiveness evaluation. Proceedings of the NIFS Conference, Dubuque, IA.

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Liu, J. and P. D. Ayers. 1999. Off-road vehicle rollover and field-testing of stability index. Journal of Agricultural Safety and Health 5(1): 59-71.

Liu, J. and P. D. Ayers. 1998. Applications of tractor stability index in development of control strategies for protective structures. Journal of Agricultural Safety and Health. Special Issue (1): 171-181.

8. Outcomes (how outputs have been used, e.g. change in behaviors, processes, technologies, guidelines, etc. that have made a difference in measurable endpoints related to exposures or health and safety indicators)

The findings of this study reveal the opportunity and approach for mounting ROPS on agricultural tractors. Tractor ROPS manufacturers can understand the opportunities and problems associated with mounting ROPS on pre-ROPS tractors (John Deere A and Allis Chalmers D17). This study also reveals the ROPS designs used to successfully mount ROPS to pre-ROPS tractors. The measurable endpoints include successful ROPS designs for pre-ROPS tractors, that may save lives of tractor operators involved in tractor rollovers.

Title: **Audiovisual Approach to Train WV Farmers on Prevention Effectiveness of ROPS in Reducing Traumatic Injury**

Definition of the Problem:
From 1997 through 2002, 37 tractor-related fatalities were identified in West Virginia. All but two of these involved males, and over one-third (13/37) were determined to be work-related (WR). The mean age at death was 58 with a range of 31 to 85 years. Thirty percent (11/37) of the victims were ≥65 years of age and 16% (6/37) were ≥75.

Tractor-related deaths occurred in 26 of West Virginia's 55 counties with nearly 80% (29/37) of the total in the north-central, northern and eastern panhandles regions of the state. Seventy-eight percent (29/37) of the incidents involved tractor overturns or rollovers, and 5% (2/37) involved power takeoffs. West Virginia's rugged terrain and generally mountainous environment increases the risk of rollovers and resulting injuries to tractor operators.

Field investigators for WV FACE conducted comprehensive investigations of 6 of the 13 WR deaths. None of the tractors were equipped with a rollover protective structure (ROPS) and seat belts. The average age of the tractors at the time of their respective crashes was 31 years (range 8 to 63 years). The type of farming specialty of the farmers killed on-the-job included beef cattle (4), general livestock (3), dairy (2), and crops (1). Four farmers were transporting round hay bales and four others were conducting mowing operations at the time of their deaths.

Aims of the Project:
The overall goal of the project was to use a locally developed video to inform West Virginia farmers about the risks associated with tractor rollovers and the effectiveness of ROPS in reducing traumatic injuries and determine whether the video influences change in tractor safety. Specific aims include:

1. Create a tractor safety video based on feedback gathered from farmer focus groups.

2. Distribute the video to West Virginia farmers.

3. Evaluate the video to determine changes in farmers' knowledge and actions concerning rollover risks, causal factors, and ROPS as a means of injury prevention.

Partners:
The Great Lakes Center for Agricultural Safety and Health (GLCASH) provided 2-year (10/03 – 9/05) funding for this project. The West Virginia Farm Bureau (WVFB) provided names and addresses of member farmers in WV. West Virginia University (WVU) Agricultural Extension agents helped conduct focus group meetings. The WVU Radio and Television Services (RTS) directed and filmed the video. The WV Fatality Assessment and Control Evaluation (FACE) Program provided background information and overall coordination of the project.

Customers:
The approximately 6,000 farmers in WV belonging to the WVFB during the period 2004-2005. Of these, the specific population-of-interest were farmers who operated tractors without ROPS.

Approach:
Key milestones of the project included:

1) October 2003 – January 2004: Select sites for multiple focus group meetings and identify farmers willing to participate through the WVFB and WVU County Agricultural Extension Agent network. Conduct focus group meetings.

2) February 2004 – April 2004: Work with the WVU RTS to develop an appropriate story line based on focus group feedback. With assistance from the WVFB and WVU County Agricultural Extension Agents, identify potential video participants.

3) May 2004 – August 2004: Film video in varying locales throughout West Virginia. Use farmer input to assist WVU RTS staff in editing video. Prepare project annual report to GLCASH.

4) September 2004 – November 2004: Distribute video to all farmers on the WVFB mailing list as well as to WVU County Agricultural Extension Agents.

5) December 2004 – September 2005: Develop, conduct pre-and post video mail surveys (Surveys 1 and 2) and follow-up telephone surveys (Surveys 3 and 4). Set up survey computerization system and appropriate data files. Enter survey data. Conduct quality assurance probes, as appropriate. Begin data analysis.

6) April 2005 – February 2006: Complete data entry and analysis. Prepare abstracts and manuscripts. Prepare project final report.

Results:

<u>Survey 1</u> - mailed to 5,786 farmers belonging to the WV Farm Bureau – PRE VIDEO

2,203 surveys returned → 38.1% response rate

For the tractor most often operated by the respondent (N=2,203): 68% were equipped with ROPS and a seatbelt; 28% used their seat belt always or most of the time and 36% rarely or never used it.

For those tractors not equipped with ROPS and a seat belt (N=717): 74% had no plans to equip their tractors with ROPS; 24% were considering installing ROPS someday**;** 2% were taking action to install ROPS now.

If not installing ROPS and a seat belt, the most important reason why (N=574): 33% said ROPS was too expensive; 37% said ROPS was not available for their tractor model; and 30% said a rollover was unlikely.

For respondents without ROPS-equipped tractors, how often they would use a seat belt on <u>any</u> tractor that has a ROPS and seat belt (N=775); 32% would always use**;** 47% would sometimes use; and 21% would never use.

<u>Survey 2 and Video</u> - *"A Tractor Accident can Happen to Anyone"* mailed to 5,632 farmers* belonging to the WV Farm Bureau - POST VIDEO

**154 farmers/next of kin responding to Survey 1 indicated that they did not own a tractor, had retired or the farmer had died. These individuals were not sent a video or Survey 2.*

779 surveys returned after farmer viewed video → 13.8 % response rate

Did video increase awareness about risks associated with fatal tractor rollovers (N=748): 85% of respondents indicated yes.

Did video increase knowledge of ways to decrease risk of rollovers (N=750): 83% of respondents indicated yes.

Does the tractor you most often use have ROPS and a seal belt (N=736): 67% yes.

After viewing video, how often would respondents use a seat belt on <u>any</u> tractor that has a ROPS and seat belt (N=739): 45% would always use; 49% would sometimes use; and 6% would never use.

After viewing the video, opinion about installing ROPS and seat belt on their tractor that they use most often that does not have ROPS and a seat belt (N=286): 32% had no plans to equip their tractors with ROPS**;** 53% were considering installing ROPS someday**;**15% were taking action to install ROPS now.

If not installing ROPS and a seat belt, the most important reason why (N=125): 43% said ROPS was too expensive; 35% said ROPS was not available for their tractor model; and 22% said a rollover was unlikely.

<u>Survey 3</u> - Telephone calls made to farmers who indicated during Survey 2 that they were considering or taking action to install ROPS and a seat belt and who provided their telephone numbers for future contact – POST VIDEO

107 of 244 farmers answered this question and provided their phone number

Multiple attempts to call 107 farmers → successful contact with 82 (77%)

Segments of video which were most important (N=55): Testimonials by farmer's widow/rollover survivor – 31%; Comments/instructions by narrator – 2%**;** Demonstrations – 25%**;** and Other – 42%.

Video shared with others (N=52) – 58% yes.

Shared video with: Family – 53%**;** Other farmers – 17%; and Others – 30%.

Contacted someone in past several months to install ROPS and seatbelt on tractor not so equipped (N=56) – Yes 50%

Have installed ROPS and seatbelt on most used tractor not equipped with ROPS and seat belt (N=23)– None

Reasons why ROPS and seat belt not installed (N=32): 19% too expensive**;** 12% not available for their tractor; and 69% other.

Survey 4 - Telephone calls made to farmers who indicated during Survey1 that they never wore their seat belts on the tractor they used most of the time that is equipped with ROPS and a seat belt and who provided a telephone number for future contact -- POST VIDEO

314 of 377 farmers answered this question and provided their telephone number

Multiple attempts to call 314 farmers → successful contact with 200 (64%)

Segments of video which were most important (N=63): Testimonials by farmer's widow/rollover survivor – 35%; Comments/instructions by narrator – 7%**;** Demonstrations – 25%**;** and Other – 33%.

Video shared with others (N=68) – 53% yes

Shared video with (N=36): Family – 64%**;** Other farmers – 3%**;** Dealers – 3%**;** and Others – 30%

How often do you use the seat belt on the tractor you indicted in an earlier survey that you used most often and was equipped with ROPS and seat belt (N=77): Always or most of the time – 10%; Sometimes – 19%**;** Rarely or never – 71%.

Outputs:

1. Two annual reports and final project report to GLCASH.

2. Video, "A Tractor Accident can Happen to Anyone." Separate versions prepared for WV and national release.

3. Poster presentation at 2002 annual meeting of the American College of Epidemiology. *Ann Epi* 2002; 12(7):510.

4. Poster presentation at the National Symposium on Agricultural Safety and Health, June 2004.

5. Poster and oral presentation at the GLCASH Symposium, September 2006.

6. Invited presentation at the WVU Institute for Occupational and Environmental Health Grand Rounds, October 24, 2006.

7. Invited lecture during WVU Department of Community Medicine course PUBH 704, November 2, 2006.

Outcomes:

1. Nearly 6,000 videos were distributed by the WV Farm Bureau in May 2005.

2. Twenty-one farmers who called the 1-800 number displayed on the video requested information on ROPS for their model tractor. ROPS was located for 18 of these. Forty-three other farmers, who had not originally received the video, were sent a video after learning of its existence from a statewide press release.

3. Several WV- and nationally-based corporations, organizations, governmental agencies including Dupont Corporation, the Veteran's Administration and Indiana State University were sent multiple copies of the video for internal training programs and inclusion in their lending libraries.

4. At the GLCASH's request, this video was adapted for national use and over 1,000 VHS and DVDs have been distributed in 33 states and 4 countries: 373 academics; 35 hospitals/health centers; 231 farm industry; 14 state and federal agencies; 85 safety organizations; and 6 insurance companies.

5. The video was highlighted in a GLCASH newsletter and in Gempler's Alert, June 2006 Volume 13(6).

Title: **A PC Based Virtual Reality Simulator for Forklift Safety Training**
Grant 1 R43 OH008562-01
PI: Kevin Chugh

1) Definition of the problem being addressed

The problem being addressed is forklift safety. There are over 1 million forklifts in operation in the United States and upwards of 6 million operators. Annually, there are 100-200 fatalities, and over 100,000 reported injuries (and perhaps countless unreported injuries as well).

2) Aims of the project

The aim of the project is to help reduce injury and fatality caused by improper forklift operation through superior training. Superior training can be achieved by replacing traditional hands off, passive technqiues, such as watching video tapes and completing workbooks, to an active hands-on technique, namely using a low cost virtual reality forklift safety trainer, being developed in this project.

3) Partners

This is a two phase SBIR project, and Phase I is complete, while Phase II is currently being reviewed for funding. In Phase I, the following partners were consulted:

Partner	Role
Erie Insurance	Review prototype, give feedback
Wal-mart	Review prototype, give feedback
Nissan Forklift	Review prototype, give feedback
Mitsubishi Caterpillar Forklift of America	Review prototype, give feedback

In Phase II, the following partners have committed to participate:

Partner	Role
Erie Insurance	Periodically provide feedback and guidance
Wal-mart	Periodically provide feedback and guidance
Nissan Forklift	Periodically provide feedback and guidance
Mitsubishi Caterpillar Forklift of America	Periodically provide feedback and guidance
Emedco	Will work to become distributor of product
High Peaks Ventures	Will consider financing commercialization
Niagara County Community College	Will run formal testing on forklift students with our simulator
Empire State Development Corporation	Will work to help with financing for commercialization

4) Customers

There are three target customers- forklift operators and small businesses who employ them, big businesses who have formal training programs and budgets, and forklift training schools.

5) Approach

The basic approach is to build 3D models of forklifts, cargo, warehouses, pedestrians, etc., then build the algorithms to model the physical interactions between these objects. A curriculum engine is then built and incorporated into the system so that the user can drive the forklift (using an actual PC game steering wheel) around a variety of environments.

6) Results/Findings

As this was a Phase I/feasibility project only, the results are largely annecdotal. We received unanimous support for the potential product in training forklift operators. Every company, operator, and insurance carrier we showed the product to was enthusiastic about the prospects, and confirmed that there is nothing like it on the market currently, and that there is tremendous potential to affect the safety of forklift operation with such hands on virtual reality based training.

7) Outputs

There is a working prototype, where a user can drive a forklift through a series of scenarios, as well as a video of such an interaction, available at http://www.tactustech.com/videos/forklift_tiny.wmv

8) Outcomes

Since this was a prototype development project only, the only outcomes are increased awareness of the potential for high fidelity, realistic training for forklift safety and enthusiasm for potential marketing opportunities with distributors, OEMs, and training facilities.

Title: **Work Site Intervention to Reduce Work Related Assault**

Submitted by: Corinne Peek-Asa, PhD
10/14/06

1. Definition of the problem being addressed (e.g., number of workers affected; rates of injury, illness, or fatality; hazards)

Crime and violence are the leading causes of occupational death in a number of retail and service businesses. In addition to affecting the health and well being of employees, these events affect customers and the business. Small business owners are at high risk for crime and violent events, and also have fewer resources to develop prevention programs.

2. Aims of the project (major objectives for the period of the work)

The major objective of this study was to determine the effectiveness of a community based, business-site educational intervention to reduce work-related assault injury in high risk business populations. The focus was on small retail establishments that included gas stations/convenience stores, restaurants, bars, motels, and grocery stores. Other objectives included identifying risk factors for workplace assaults, describing the incidence of workplace assaults in selected communities, and identifying specific environmental changes or groups of changes which decrease workplace violence.

The Workplace Violence Prevention Program had two sets of specific aims. The first were specified in the original grant, and the second in a competitive renewal. The original specific aims were:

1. Based on prior studies and existing state data, identify specific risk factors for work-related assaults in high risk businesses in two Southern California OSHA Regions.

2. Establish a comprehensive and on-going surveillance system to identify workplace assault incidence in these CalOSHA Regions from multiple reporting sources.

3. Develop, test, and introduce an educational intervention which addresses environmental, behavioral, and social risk factors for workplace assault.

4. Apply the educational intervention to selected businesses in the city of Los Angeles.

5. Measure the effectiveness of the intervention in reducing fatal and non-fatal assault injuries in the workplace by comparing differential work-place assault incidence by intervention status.

The second set of specific aims was developed based on trends identified during the first three years of the workplace violence project. These specific aims had two purposes. The first was to expand the original project to include additional information and to extend the follow-up period. The second purpose was to examine some emerging trends in workplace violence. These specific aims were:

1. Determine long-term compliance to the intervention program. Establish if intervention programs were upgraded, downgraded, or unchanged. Identify which program components were maintained long-term and which were not. Determine which business characteristics influence the level of compliance to the program.

2. Extend the follow-up period to determine if original program effectiveness is sustained beyond the initial three-month assessment. Determine the proportion of the expected decrease in workplace violence events attributable to the program by controlling for overall decreases in crime rates.

- Partners (participants in the project and the roles they served)

Project Personnel

Project Participant	Role on Project
Jess F. Kraus, MPH, PhD	Principal Investigator
Corinne Peek-Asa, MPH, PhD	Co-Principal Investigator
Carri Casteel, MPH, PhD	Project Director
Rosemary Erickson, PhD	Intervention Program Design
Lawrence Chu, MPH, PhD	Crime Data Supervisor
James Grayson, CPP	Safety Specialist
Phillip Smith, CPP	Safety Specialist
Dawn Gregory, CPP	Safety Specialist
Lisa Meneshian, MPH	Data Coordinator
Myduc Ta, MPH	Data Coordinator
William Kaufold, MPH	Field Data Collector
Caroline Lacsamana, MPH	Data Management Assistant

Interagency Collaborators

The Workplace Violence Prevention Project was a large undertaking that involved participation and input from a wide variety of professional backgrounds. We would like to acknowledge partners in other agencies that provided their time and resources to this project. Without their dedication we could never have completed this intervention project.

Cal/OSHA Consultation Services Program (WVPP Project Development)
John Howard
Bob Barish

Los Angeles Police Department
Chief Bernard Parks (signed final Memorandum of Understanding for access to crime reports)
Assistant Chief Jim McDonnell (established collaboration between UCLA and LAPD)

Records and Identification Division (Crime Report Abstraction)
Barbara Taylor
Jim Lee
Olivia Flores
Beverly Pippin

Information Technology Division (PACMIS Data)
Commanding Officer Troy Hart
D.C. Dasari

Crime Analysis Section (Memorandum of Understanding Approval)
Lieutenant Paul Geggie
Sergeant Dennis Ballas
Officer Arturo Gomez

Korean American Grocers Association (KAGRO) (Community Partner)
Yong Sun Kim, Chairman
Ellis Cha, President

KAGRO "Project Build-Up" Partners (Community Partners)
Twin Huynh, Customer Service Representative, Nabisco
Myn Min Kim, Customer Service Representative, Southern California Edison
Dan Holland, President, Mission Beverage Company
John S. Yoo, Community Outreach Director, Korean American Coalition

Corporate Partners
Jose Jacobo Orellana, Security and Safety Director, New Otani Hotel, Los Angeles
Pam Gray, California Loss Prevention Operations Manager, Whole Foods Market
John Ragsdale, Loss Prevention Manager, 7-11 Stores
John Christenson, Senior Loss Prevention Specialist, ARCO
Bert Blender, Owner, Grinder Restaurants
Gordon Rose, Vice President Operations, Acapulco Restaurants
Lisa Shavitz, Operations Director, Dominos Pizza
Ted McCaskey, Owner, Erewhon Natural Foods
Sergio Preciado, Public Relations Manager, King Taco
Larry Wright, Security Director, Mobil
Danny Glover, Safety Director, Motel 6
Mike Schlicte, Security Director, Shell
John Halvin, Security Director, Unocal
Keith Shiozaki, Senior Vice President, Yoshinoya Restaurants

Oxnard Police Department (WVPP Extension)
Commander Tom Chronister
Assistant Chief John Cronbach
Chief Art Lopez
Community Affairs Manager David Keith

Agency / Government Contacts (Consultants)
Mark Gleckman, American Society of Industrial Security
Special Agent William Rehder, Federal Bureau of Investigations (Takeover Robberies)

1. Customers (intended users or beneficiaries of the results)

Intended beneficiaries include retail and service businesses, law enforcement, security consultants such as ASIS, and community agencies that serve these businesses.

2. Approach (tasks involved in conducting the project)

INTERVENTION PROGRAM DEVELOPMENT AND COMPONENTS

The WVPP was developed to meet the individual needs of each business. The first step in developing the intervention plan for each business was a baseline security program assessment. This assessment identified and evaluated existing elements of a security program. Using this assessment, a specific set of action items were created for each store. The action items were specific recommendations on how to implement each element of the comprehensive security plan. Once the store's individual action plan was created, an individual consultation was conducted. This consultation was conducted by trained security professionals hired by the study. The individual consultation ensured that the business owner was introduced to all of the components of the safety program, that each action item was individually discussed, and that the owner had time to ask questions. The Security specialists were available to answer questions throughout the study period.

The WVPP focused on two types of workplace violence. The most prevalent type of violence in the eligible business types is related to robbery and similar criminal activity, and this type of violence is the primary focus of the prevention program. Because many of these businesses must work with potentially violent and intoxicated customers, a portion of the program also focused on recognizing and intervening early when a customer could become violent.

Crime Prevention Through Environmental Design (CPTED) was the basic model for the program. This model recognizes that much of the risk for crime can be modified through controlling the business environment. The focus was on controlling the environment prior to a crime taking place rather than on the individual criminal after the commission of an offense. The model emphasizes the integration of security and behavioral concepts into the normal and routine use of the environment, while treating labor- and hardware- intensive security devices as secondary.

The WVPP program was comprised of environmental controls including a comprehensive cash control program, ensuring good visibility into and outside of the business, maintaining good interior and exterior lighting, and limiting access and escape routes. The program also incorporates an employee training component which encourages safety awareness, how to respond to criminal activity to reduce the risk of violence, and how to present the business as a well-managed environment. These components constitute the "Basic Program" because they are appropriate for all businesses and emphasize procedures that can be implemented with relative ease and without significant cost. Although the "basic" robbery and violence prevention program is emphasized, safety and surveillance equipment (e.g., alarms, cameras) are recommended to businesses at particularly high risk of violence. These components are deemed "Additional Recommendations" because they are more expensive and timely to implement and maintain and are secondary to the CPTED model.

Intervention program materials

Participating businesses received a wide range of informational and training materials. These were provided in the forms of interpersonal verbal communication, written materials, a video, and safety signage. Additional funding was secured from the California Occupational Safety and Health Administration to produce a WVPP video for employee training. This video was created in collaboration with the UCLA Department of Film and Television and was age-appropriate for the average small business staff worker. The video was named the "Best Prevention Video" at the World Injury Congress in New Delhi, India in 2000.

Each participating intervention business received:

- An individual Action Plan which detailed each specific recommendation for the business. The Action Plan was presented in the written form of a checklist with rationale for each action item following. Each element of the checklist was carefully reviewed in an on-site consultation with one of the study's Safety Specialists and the business owner.

- A management manual describing all intervention program components and the rational behind each specific component.

- An Equipment Guide that described all types of security equipment, their functions, and different types of products on the market with price ranges (such as different types of safes)

- Colorful brochures for employees on how to prevent robbery, what to do during and after a robbery, and how to detect and de-escalate potential violence.

- A prevention kit containing cash handling and educational materials which included a safety poster, placards for the door, cash registers and safes, and forms to document events.

- A violence prevention training video

- A certificate of participation

The program was prepared and presented in such a way that employees could be trained by the owner/manager and the recommendations easily enforced, which is especially beneficial in many of the businesses where employee turnover was high.

To improve language barriers between business operators and the security consultants, the management manual and a generalized Action Plan were translated into the following languages.

- Korean
- Mandarin
- Spanish

Individual, on-site consultations were conducted in English or Spanish, and a Korean translator was available upon request.

3. Results/Findings (preliminary or final observations and conclusions)

VERY ABBRIEVIATED FINDINGS (more provided at request)

By the second follow-up visit, compliance to the intervention program was significant for each program component. Employee training was the most frequently implemented intervention component. Neighborhood crime level, primary language spoken by the business owner, and the number of employees were all related to level of implementation. While crime rates generally increased for all businesses from the pre- to post- intervention periods, businesses with high compliance to the program experienced a decrease in overall violent crime and robbery.

4. Outputs (reports, publications, products, methods, etc.)

PRESENTATIONS, PUBLICATIONS AND REPORTS

Community Presentations

“Workplace Intervention to Reduce Workplace Assault Injury, Pilot Study”. California Occupational Safety and Health Administration Workplace Security Task Force, Anaheim, California, 1996.

“Workplace Violence Prevention Project”. Los Angeles Restaurant Association Annual Conference, Los Angeles Convention Center, California, 1997.

“Workplace Violence Prevention Project”. Alcohol Beverage Control and Security Seminar - Southwest Division, North Hollywood, California, 1999.

“Workplace Violence Prevention Project”. Business Watch Meeting, Korean American Grocers Association and Los Angeles Police Department, 77th Los Angeles Division, California, 1999.

“Workplace Violence Prevention Project”. California Beverage Merchants Board of Directors Meeting, Korea Town, Los Angeles, California, 1999.

"Epidemiology of Workplace Violence and Injury". American Society of Safety Engineers, Orange County Chapter, Costa Mesa, California, 2000.

"The Value of a Community-Based Crime Prevention Program for Law Enforcement". Oxnard Police Department, Oxnard, California, 2000.

"Workplace Violence Prevention Project". Business Watch Meeting, Korean American Grocers Association and Los Angeles Police Department, Southwest Los Angeles Division, California, 2000.

"Workplace Violence Prevention Project". Business Watch Meeting, Korean American Grocers Association and Los Angeles Police Department, Southeast Los Angeles Division, California, 2000.

"Workplace Violence Prevention Project". Business Watch Meeting, Korean American Grocers Association and Los Angeles Police Department, Newton Los Angeles Division, California, 2000.

"Workplace Violence Prevention Project". California Crime Prevention Through Environmental Design Association Meeting, Irvine, California, 2000.

"Workplace Violence Prevention Project". American Society for Industrial Security, Santa Barbara Chapter, California, 2000.

"Workplace Violence Prevention Project". American Society for Industrial Security, Inland Empire Chapter, California, 2000.

"Workplace Violence Prevention Project". Retail Special Agents Association, Los Angeles, California, 2000.

"Field Evaluation of the Workplace Violence Prevention Project: Gas/Convenience Stores". British Petroleum Security (ARCO), Torrance, California, 2000.

"Field Evaluation of the Workplace Violence Prevention Project: Gas/Convenience Stores". TOSCO – Unocal, Orange, California, 2000.

"Workplace Violence Prevention Project". Korean American Grocers Association Meeting with Councilman Mark Ridley-Thomas, Los Angeles, California, 2001.

"Crime Prevention Through Public Partnership". Ventura County Law Enforcement and Security Summit, Oxnard, California, 2001.

"Violence Prevention Techniques for the Workplace". American Society for Industrial Security, Inland Empire Chapter, California, 2001.

"Violence Prevention Techniques for the Workplace". American Society for Industrial Security, Santa Barbara Chapter, California, 2001.

"Workplace Violence Prevention Project". Central Coast Police-Security Summit, Oxnard, California, 2002.

"Crime Prevention Through Public Partnership". Law Enforcement/Private Security Conference, Inland Empire, California, 2002.

"Crime Prevention Through Public Partnership". Los Angeles Police Department/American Society of Industrial Security – Valley Chapter Security Symposium, California, 2002.

"Workplace Violence Prevention Project". The Flair Park Security Manager's Round Table, Rosemead, California, 2002.

"Workplace Violence Management Techniques: Prevention, Rage Management, and Customer Service". American Society of Threat Assessment Professionals, Glendale, California, 2002.

"Workplace Violence Management Techniques: Prevention, Rage Management, and Customer Service". Retail Special Agents Association, Los Angeles, California, 2003.

"Workplace Violence Management Techniques: Prevention, Rage Management, and Customer Service". American Society for Industrial Security, Inland Empire Chapter, California, 2003.

"Workplace Violence Management Techniques: Prevention, Rage Management, and Customer Service". American Society for Industrial Security, Orange County Chapter, California, 2003.

"Workplace Violence Management Techniques: Prevention, Rage Management, and Customer Service". Flair Park Retail Special Agents Association, Rosemead, California 2003.

"Workplace Violence Management Techniques: Prevention, Rage Management, and Customer Service". St. John's Hospital, Oxnard, California 2003.

Presentations with Published Abstracts

Peek-Asa C. Reducing Violence in the Workplace - Experience of the United States. International Commission on Occupational Health, Stockholm, Sweden, 1996.

Peek-Asa C. Inappropriateness of the Capture-Recapture Method to Determine Incidence of Workplace Assault Injury from two Reporting Sources. Society for Epidemiologic Review Annual Meeting, Edmonton, Canada, 1997.

Peek-Asa C, Erickson R. Fatal Occupational Injuries in the Retail Industry, United States, 1992 - 1995. National Symposium on Occupational Safety and Health, Morgantown, West Virginia, 1997.

Hartman C, Peek-Asa C, Howard J, Erickson R. Prevention of Workplace Violence in Liquor Stores, Santa Monica, California, National Symposium on Occupational Safety and Health, Morgantown, West Virginia, 1997.

Casteel C, Peek-Asa C, Kraus JF. Evaluation of Risk Factors for Violence in Liquor Stores. 125th Annual Meeting of the American Public Health Association, Indianapolis, Indiana, 1997.

Peek-Asa C. An Intervention Program to Reduce Workplace Violence in Retail Liquor Stores. 4th World Congress on Injury Control, Amsterdam, Netherlands, 1998.

Peek-Asa C, Howard J. Effectiveness of OSHA Compliance Inspections in Reducing Workplace Violence. American Public Health Association Annual Meeting, Washington, DC, 1998.

Grayson J, Vargas P, Peek-Asa C. Community Factors in Predicting Business-Level Crime. Violence Prevention Coalition of Greater Los Angeles Bi-Annual Meeting, Long Beach, California, 1999.

Smith P, Peek-Asa C. Take-over Robberies: A Changing Paradigm of Adolescent Crime Perpetration and Victimization. Violence Prevention Coalition of Greater Los Angeles Bi-Annual Meeting, Long Beach, California, 1999.

Peek-Asa C. Injury Prevention in the Occupational Setting. American Public Health Association Annual Meeting, Chicago, Illinois, 1999.

Casteel C, Peek-Asa C, Kraus JF. Evaluation of a Crime Prevention Through Environmental Design (CPTED) Intervention in Reducing Violence in Liquor Stores: Preliminary Findings. 33rd Annual Meeting of the Society for Epidemiologic Research, Seattle, Washington, 2000.

Casteel C, Peek-Asa C. Evaluation of Risk factors for Robbery and Employee Injury and Compliance to a Workplace Violence Intervention in High-Risk Business Settings. National Occupational Injury Research Symposium, Pittsburgh, Pennsylvania, 2000.

Peek-Asa C, Casteel C. Evaluation of a Workplace Violence Intervention in Small Businesses. SafeUSA Conference, Atlanta, Georgia, 2001.

Casteel C, Peek-Asa C. Crime and Injury: An Environmental Design Application in the Retail Sector. 46th Annual Human Factors and Ergonomics Society Meeting, Baltimore, Maryland, 2002.

<u>Publications</u>

Peek-Asa C, Schaffer K, Kraus J, Howard J. Surveillance of nonfatal workplace assault injuries using police and employers reports. J Occup Environ Med 40:707-713, 1998.

Peek-Asa C, Erickson R, Kraus J. Traumatic occupational fatalities in the retail industry, United States, 1992 - 1996. Am J Ind Med 35(2):186-191, 1999.

Peek-Asa C, Howard J. Workplace violence investigations by the California Division of Occupational Safety and Health. J Occup Environ Med 41(8):647-653, 1999.

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Casteel CH, Peek-Asa C, Howard J, Kraus JF. Effectiveness of crime prevention through environmental design in reducing criminal activity in liquor stores. J Occup Environ Med. May;46(5):450-8, May 2004

Peek-Asa C, Casteel CH, Mineschian L, Erickson R, Kraus JF. Implementation of a workplace robbery and violence prevention program in small retail businesses. Am J Prev Med. 26(4):276-283, May 2004.

Peek-Asa C, Casteel C, Whitten P, Kraus JF. Employee and customer injury during violent crimes in retail and service businesses. Am J Pub Health. November, 2006.

<u>Reports</u>

Grayson JL. Enhanced community policing through public/private partnerships.

Grayson JL. Workplace violence prevention project: service station security review.

5. Outcomes (how outputs have been used, e.g. change in behaviors, processes, technologies, guidelines, etc. that have made a difference in measurable endpoints related to exposures or health and safety indicators)

   1. The Oxnard Police Department integrated the WVPP into their crime prevention program. This effort is currently being evaluated by Dr. Carri Casteel and Dr. Corinne Peek-Asa.
   2. The Korean-American Grocer's Association offered the WVPP as a membership incentive for several years after the end of the project.

3. Dr. Harlan Amandus is currently developing an internal NIOSH project, working with Drs. Peek-Asa and Casteel, to develop sustainable models for the WVPP in law enforcement agencies.
4. Two stories of participants demonstrate the programs impact:

TWO WORKPLACE VIOLENCE PREVENTION PROGRAM STORIES

Although the development, implementation, and evaluation of the intervention program are the main components of this research project, some of the project's value can be demonstrated through individual experiences. The following two stories clearly illustrate the impact such intervention programs can have.

When considering these stories, it is important to note that the project focused on very small businesses. Some of the participating businesses had only two employees, and often these were family members. These businesses were frequently operating on very small profit margins and with very restricted personnel. In addition, many owners were foreign born, and as such may be less familiar with patterns of violence in the United States. A violent event in these small businesses thus has important implications for the victims physical, emotional, and family well-being.

A WVPP success story.

The UCLA research team was introduced by a collaborating Los Angeles Police Department detective to the owner of a restaurant chain after a violent event had occurred. The businessman owned nine local family restaurants comprising a chain. The event involved a homicide/rape/robbery in which two employees were killed and one raped. The event was highly publicized and led to the closure of the restaurant after revenue fell 80%. The owner had not believed that such a thing could happen and had taken no security precautions. He was eager to enroll his eight remaining restaurants in the WVPP, and he implemented each recommendation of the program.

Seven months after implementation of the program, a man entered one of the restaurants. He took a seat at the counter next to the register. When asked what he wanted to order, he held up the menu, pulled out a handgun, and told the waitress that "this is a robbery." The waitress could see that the robber was nervous and told him "calm down, I will get you the money." After she gave the money to the robber, he walked out of the restaurant. The manager reported to the police and the UCLA research team that due to the UCLA WVPP, the store had implemented employee training, cash control policies, and had installed a video recorder and CCTV system. The robber was captured on video coming into the store, sitting down, pulling the gun, and then leaving with the money. An interview with the waitress indicated that she knew what to expect and how to respond because of the UCLA video and training. She returned to work two days later and felt good about the experience. The robber, who was later arrested, absconded with only $57.00 because of new policies to reduce available cash.

Although being robbed is a strange success story, we believe the WVPP helped not only reduce potential injuries and psychological trauma associated with such events, but gave the employee a sense of control over the event.

A WVPP Missed Opportunity.

The owner of a small corner liquor store was invited to participate in the study. The store served a range of clients and included an inventory of wine, beer and hard liquor. The windows of the business were covered with advertising posters, and the internal visibility was poor. When asked to participate, the owner said that robberies were part of the business, that he knew how to handle them, and that he did not have time to participate in the program. He and his wife were the only employees of the business. His business was included as "declined participation."

Six months after he had been invited to participate, a robber entered his store and was able to leave with a large sum of cash. The owner, who was the only employee on duty at the time of the robbery, chased the robber out into the street in front of the store. The fleeing robber then turned and shot the owner, hitting him in the face. Luckily, the owner survived his injuries. However, the business never re-opened and remained vacant for several years. The robber was never caught. We do not know if the owner has re-established a business elsewhere.

Although we cannot know if participation in our prevention program would have prevented this event, there were many characteristics of the business and of the event that could have been easily altered to reduce risk. For example, the intervention program would have recommended that the visibility of the store be improved, making it a less attractive target for robbery. The program would also have recommended a cash control policy that would have reduced the amount of money available. Perhaps if the robber had not gotten away with so much money, the owner would not have chased him into the street. In addition, the training materials strongly emphasized appropriate actions to take during a robbery. One specific element instructed employees not to confront or chase the robber.

Title: **Reducing Violence Against Nursing Home Caregivers**

Investigators: Donna Gates, Evelyn Fitzwater, Paul Succop and Marilyn Sommers

Problem

Growing violence against health care workers prompted the Occupational Safety and Health Administration in 1996 to publish employer guidelines. Certified nursing assistants (CNAs) working in long term care represent the occupation most at risk of workplace assault. These caregivers receive minimal education regarding the care of some of the most challenging and aggressive patients. As the number of nursing home residents and CNAs increases in the near future, efforts are needed to improve the nursing home environment for both CNAs and residents (patients). Previous studies indicate that CNAs, who daily experience verbal and physical violence, lack the knowledge and skills to prevent violence. However, there have been very few studies designed to identify the most effective approaches for decreasing violence against CNAs.

Aims

The aims of the study were to: 1) describe the context in which assaults occur, 2) increase CNAs' skills to prevent assaults, and 3) decrease the incidence of assaults against CNAs

Partners

- College of Nursing, University of Cincinnati (office space; resources including financial expertise, secretarial support; computers, and printers; graduate students)
- National Institute for Nursing Research (R15 funding)
- National Institute for Occupational Safety and Health (R01 funding)
- 6 nursing homes in Cincinnati Ohio (provided access to workers during work time, assisted with organizing the project, provided patient room to conduct simulations, and assisted with recruitment of participants).

Customers

Customers of this project included nursing home employers and administrators, nursing assistants, professional nurses, and residents (patients) in nursing homes.

Approach

Investigators conducted a quasi-experimental study with 138 NAs in 3 intervention and 3 comparison homes. A baseline questionnaire was used to obtain information on demographics, employment, and past violence experience. At pre-, post- and six months after the intervention all subjects completed the State Trait Anger Inventory (STAXI), the Occupational Stress Inventory (OSI), the Knowledge and Self-efficacy Survey, carried an Assault Log for 80 hours of work, and participated in a simulation exercise to assess violence prevention skills. Tabulations, ANOVA and Poisson regression were used to analyze the data.

Results/Findings

The intervention was successful in increasing self-efficacy, knowledge and skills one week after completion. Although the intervention was successful in increasing knowledge six months after intervention completion, the significant increases in self-efficacy and skills were not sustained.

Although the intervention had no significant main effect on the incidence of assaults, there was an interaction effect between the intervention and number of pre-intervention assaults. The intervention had a significant effect on those NAs who had less than 8 assaults pre-intervention ($p<0.001$) and no significant effect ($p>0.05$) on those who had more than 7 assaults on pre-intervention. Additional findings include the following:

- The incidence of assaults against CNAs from patients was very high. During an 80-hour work period (baseline measure), 94 CNAs (71% of subjects) reported 624 assaults from patients and 31 injuries. The mean number of assaults for an 80-hour work period was 4.5 (range 0 - 64).
- The following variables were found to be positively related to the number of reported assaults: state anger, trait anger, role insufficiency, role ambiguity, and number of assigned residents. The CNA's age was negatively related to the number of assaults. Duration of employment and previous training were not related to the number of assaults.
- 59% of CNAs responded on a survey that they are assaulted by patients once a week and 16% responded that they are assaulted by residents every day.
- 51% of CNAs responded on a survey that they had been injured by a patient while working as a CNA during their lifetime and 38% responded that they had received medical treatment for an injury.
- 10% of CNAs responded on a survey that they had been assaulted by a co-worker while working as a CNA during their lifetime.
- 4.3% of CNAs responded on a survey that they had been assaulted by a patient's family member while working as a CNA during their lifetime.
- 56% of CNAs responded on a survey that they always report assaults to supervisors, while 15% seldom report assaults.

Conclusions: The results of this study have implications for practice, policy, and research. Although the incidence of violence cannot be eliminated, it can be decreased and it should never be viewed as "part of the job". To do so devalues the NA which in turn has devastating implications for our growing, elderly population.

Outputs (reports, publications, products, methods etc.)

Publications

Gates, D., Fitzwater, E., Telintelo, S. (2001). Using simulations to assess skill performance. *Clinical Nursing Research 10(4),* 387-400

Gates, D (2002). *Violence Against Nurses: The Silent Epidemic*. Ohio's Nurses Association Continuing Education

Gates, D. (2002) Violence against caregivers in nursing homes in the U.S.A, in *Violence in Nursing: An International Perspective* (eds.Haberman & Uys). J. Lang Publishers: Hamburg, Germany.

Gates, D., Fitzwater, E., Telintelo, S., Succop, P. & Sommers, M.L (2002) Preventing assaults by nursing home residents: Caregivers' knowledge and confidence – A Pilot Study. *Journal of the American Medical Directors' Association 3,* 366-370.

Gates, D., Fitzwater, E., & Deets, C. (2003). Testing the reliability and validity of the assault log and violence prevention checklist. *Journal of Gerontological Nursing* 29, 18-23.

Gates, D., Fitzwater, E. & Succop, P. (2003). Predicting assaults against caregivers in nursing homes*. Issues in Mental Health Nursing, 24(8),* 775-793*.*

Gates, D., Fitzwater, E. & Salazar, M. (2003). Dealing with workplace violence: Strategies for prevention. *AAOHN Journal 51, 243-5.*

Fitzwater, E. & Gates, D. (2004). Clinical consultation. How do you manage the aggressive behavior of cognitively impaired patients. *Rehabilitation Nursing* 29, 5, 13

Gates, D., Fitzwater, E. & Succop, P. (2005) Reducing assaults against nursing home caregivers, *Nursing Research, 54(2),119*

Gates, D.M. (2004). The Epidemic of violence against healthcare workers: No longer silent. *Occupational and Environmental Medicine Journal*, 61, 649-650. Invited editorial

Gates, D (2004). Burgers or bruises? *American Journal of Nursing*. 104(9), 13.

Gates, D., Fitzwater, E. & Succop, P. (2005) Reducing assaults against nursing home caregivers, *Nursing Research, 54(2),119.*

<u>*Additional products*</u>

1. The Knowledge and Self-Efficacy Survey: measures NAs' beliefs about their knowledge and self-efficacy to prevent aggression and assaults.

Gates, D., Fitzwater, E., Telintelo, S., Succop, P. & Sommers, M.L (2002) Preventing assaults by nursing home residents: Caregivers' knowledge and confidence – A Pilot Study. *Journal of the American Medical Directors' Association 3,* 366-370.

2. Assault Log: tracks assaults

Gates, D., Fitzwater, E., & Deets, C. (2003). Testing the reliability and validity of the assault log and violence prevention checklist. *Journal of Gerontological Nursing* 29, 18-23.

3. Violence Prevention Checklist: used with observation to evaluate violence prevention skills

Gates, D., Fitzwater, E., Telintelo, S. (2001). Using simulations to assess skill performance *Clinical Nursing Research 10(4),* 387-400.

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Gates, D., Fitzwater, E., & Deets, C. (2003). Testing the reliability and validity of the assault l log and violence prevention checklist. *Journal of Gerontological Nursing* 29, 18-23.

4. Intervention program that includes educational materials for classroom sessions and for problem-solving sessions (unpublished)

5. Over 25 poster and paper presentations were given at local, national, and international professional conferences.

Outcomes

Intermediate outcomes.

Our work has been cited by many other authors. In addition, our work was cited in the following reports:

- Guidelines for Preventing Workplace Violence for Healthcare Workers and Social Service Workers
  OSHA 3148-01R 2004
  http://www.osh.govt.nz/order/catalogue/drafts/ViolenceDiscussionPaper15Oct04.pdf
- The Risk of violence in Mental Health Work and Health Research Center
  University of Maryland
  Sept. 2006
  http://www.seiu1199nw.org/docUploads/UM%20Safety%20Report.pdf
- Preventing Violence to Employees In Health and Social Servers
  Discussion Paper
  October 24
  New Zealand Occupational Safety and Health
  http://www.osh.govt.nz/order/catalogue/drafts/ViolenceDiscussionPaper15Oct04.pdf

Dr. Gates and Dr. Fitzwater were invited to present at five in-services and workshops for nurses, nurse aides, and long-term care managers. Currently, Drs. Gates and Fitzwater are assisting Dr. Blair Irvine at the Oregon Center for Applied Science to develop a web-based approach to teach nurse aides how to prevent assaults from nursing home residents. They are serving as consultants to develop the program and in the near future will assist him to test the newly developed media in 6-8 nursing homes. Dr. Gates was asked to write an editorial for *American Journal of Nursing* (2004) about the problem; this journal's readers include registered nurses who supervise CNAs.

End outcomes.
Our research did find that assaults against nurse aides can be reduced with our intervention program.

Potential outcomes.
Although researchers have been studying the disruptive behavior of nursing home residents for several years, our research was the first in the literature to examine the aggression as violence from the viewpoint of the worker. In fact, when we were planning the research and in conversation with nursing home personnel, several administrators and managers stated that this type of violence would not be upsetting to nurse aides due to the fact that many of the offenders (residents) have dementia. Our research demonstrated that not only is the violence a concern to many workers, but that the violence also results in injuries, and is related to decreased job satisfaction and turnover. One of the conclusions from our work is that violence in the healthcare setting should never be expected, tolerated or accepted. The nurse aide turnover in the long-term

care industry is traditionally very high. We believe our work has encouraged many nursing homes to view their nurse aides as valuable assets to their facility and to develop interventions to decrease work stressors, including violence.

Title: **Effects of OSHA Guidelines on Violence Prevention in Mental Health**

1. **Definition of the problem being addressed (e.g., number of workers affected; rates of injury, illness, or fatality; hazards)**

Workplace violence is recognized as a significant occupational hazard in the healthcare and service sectors, in particular in the mental health setting. According to data collected annually between 1993 and 1999, the Department of Justice National Crime Victimization Survey (NCVS) reported that 1.7 million victimizations occur at work annually, on average, during this period. The victimization rate for mental health professionals and custodial workers was 68.2 per 1,000 compared to a rate of 12.6 per 1,000 workers across all occupations (Duhart, 2001).

2. **Aims of the project**

- To document and describe a process for implementing OSHA violence prevention guidelines within the in-patient mental health setting;
- To compare assault rates, risk factors for assault and job satisfaction one year prior to and one year following implementation of a comprehensive OSHA guideline-based violence prevention program; and
- To assess the cost and benefits of implementing a comprehensive violence prevention program.

3. **Partners**

The following partners (their representatives) served as co-investigators and members of the statewide project advisory group that was charged with facilitating the overall project including data collection, intervention development and implementation and impact evaluation.

- OMH Multi-Union Health and Safety Committee
- New York State Office of Mental Health (OMH)
- Civil Service Employees Association (CSEA)
- New York State Public Employees Federation (PEF)
- New York State Corrections Officers and Police Benevolent Association (NYSCOPBA)

4. **Customers**

- 26 NYS OMH facilities and 20,000 staff
- Other mental health settings
- VA system

5. **Approach**

Study sites - Early in this 4-year project, a Request for Applications was sent to all in-patient mental health facilities in New York State inviting them to serve as intervention sites (*n* = 26). Criteria for selection as a study site included management commitment, as measured by willingness to commit the resources necessary to develop and implement a program and labour/management cooperation demonstrated by the presence of an active health and safety committee. Seven applications were received and three psychiatric facilities (two for adults and one for children) were selected to receive the interventions. Later, three facilities similar to the intervention sites in terms of the type of facility (i.e., for adults or for children) and location (i.e., upstate, downstate), as well as having established labour and management cooperation, were selected for comparison. Within each intervention and comparison facility, three wards were selected as the focus of the intervention and evaluation so that the study team could concentrate our efforts and resources on a feasible number of study units.

***The intervention* - The OSHA *Guidelines for Preventing Workplace Violence for Healthcare and Social Service Workers* served as a framework for the study. The study used a participatory action research approach, with management, labour, and direct-care staff representatives working closely with researchers in the design and implementation of the project (Israel, Eng, Schulz, Parker, & Satcher, 2005). A Project Advisory Group (PAG) made up of labour, OMH, and academic partners provided guidance and oversight for the overall project. The intervention had three main components: (1) developing and supporting a facility-level PAG to design and implement a facility-specific program, (2) conducting a comprehensive risk assessment, and (3) designing and implementing feasible recommendations evolving from the risk assessment.**

Focus Groups - Purposive sampling of direct-care workers at each of the three intervention facilities was conducted in such a way that non-supervisory direct-care workers were recruited to participate in focus groups on work time prior to the commencement of the intervention. Two focus groups at each intervention facility were conducted, allowing for participation across shifts and non-supervisory job titles. The pre-intervention focus groups launched the intervention in the sense that, by discussing the issue, the workers became sensitized and engaged in violence-prevention efforts. The post-intervention focus group was conducted with members of the Facility Project Advisory Groups (FPAGs) from each of the three intervention facilities and observed by the PAG members. Instead of being a confidential forum for staff to discuss violence, the post-intervention group represented an opportunity to share best practices and what worked for each facility.

Focus groups were conducted with direct-care staff to inform survey development and to provide qualitative data on staff perceptions of risk factors for violence on their wards and proposed solutions. Sixty staff members participated in one of six focus groups (two per intervention facility) conducted across all shifts at the three sites. Each 90-minute discussion was led by a trained facilitator, external to the OMH.

Staff Survey - A representative staff survey was conducted prior to full implementation of the participatory intervention and 1 year post-intervention. In each of the six facilities (three intervention and three comparison), all staff, including supervisors and administrators, were invited to participate in the survey. Staff were provided release time to complete the survey during work hours. The study coordinator visited the facilities and administered the survey on all three shifts.

Identical direct-care staff surveys were conducted in 2001 and 2003. The survey was adapted from a Washington State survey developed for assessing assaults in state mental hospitals (Bensley et al., 1997). It included sections on risk factors for violence, violence-prevention measures, threats and assaults, and staff perceptions of the quality of the OSHA elements on their ward. The self-administered survey took approximately 20 minutes to complete and was completed on work time.

The survey analysis consisted of the change in staff perceptions of the quality of the OSHA elements on their ward, as well as their change in frequency of assault experience over the preceding 12 months. Staff were asked to evaluate the quality of (1) management commitment to violence prevention, (2) employee involvement in violence-prevention efforts, (3) environmental design of ward (environmental controls), and (4) staff teamwork and cooperation (administrative and work practice controls) on their ward over the preceding 12 months (1 = *poor,* 2 = *fair,* 3 = *good,* 4 = *excellent*). Staff were also asked if they had participated in PMCS training during the previous year (yes/no).

Staff assaults were assessed by asking the number of times in the preceding 12 months the worker experienced patient aggression while assigned to duties on their current ward. There were six levels of violence: (1) threat but no physical contact, (2) physical assault but no physical injury, (3) physical assault resulting in mild injury, (4) physical assault resulting in moderate injury, (5) physical assaults resulting in major injuries, and (6) physical assault resulting in permanent/partial physical disability.

Frequencies were examined by facility and also by intervention and comparison group. Analysis of variance was used to test the change in scores, using an alpha of .05 to evaluate level of significance. All analyses were conducted using SPSS Version 11.0.

6. Results/Findings

Findings from the focus group discussions including the following themes: the changing patient populations, inadequate staffing and deployment of staff, hierarchical management style, low management commitment to staff safety, ineffective patient programming and problems such as long wait times in food lines.

Between May 2001 and January 2002 the pre-intervention survey was completed by 406 direct-care staff (90% response rate) from three intervention and three comparison facilities. The post-intervention survey was conducted in the spring of 2003 and was completed by 319 direct-care staff (70% response rate). The number of respondents from individual facilities ranged from 43 to 117 for the pre-intervention survey and 36 to 69 for the post-intervention survey. Responses from staff in intervention and comparison facilities were compared to examine changes in their perception of the quality of the OSHA elements (mean value on a scale of 1–4) pre- and post-intervention. Staff in both intervention and comparison facilities reported statistically significant (or borderline) improvements in the first four elements, while the intervention facilities also reported significant improvement in the fifth element.

Overall, nearly 90% of staff reported threats of assault in the preceding 12 months (data not shown), with the mean number ranging from 35 to 70 threats for the two time periods and two groups. By comparison, less than 40% of staff reported a physical assault with moderate injury, with the mean number ranging from 0.8 to 1.76 per staff member. When the difference (or change) in reported threats and physical assaults during the preceding 12 months was calculated for the pre- and post-intervention periods, a slight reduction in the mean change in physical assaults with any level of injury among intervention facility staff and among severe and permanent injury among comparison facility staff was noted. An increase was observed in threats of assault among the staff of both intervention and comparison facilities. Possible interpretations for this finding include: a greater tendency to report these less severe events; a shift of some physical assaults to threats of assault (an averted physical assault); or a real increase in threats of assault.

7. Outputs (reports, publications, products, methods, etc.)

All published outputs (item 7) should be provided in citation format.

Grants:

"Evaluation of Workplace Violence Prevention Intervention" National Institute for Occupational Safety and Health. October 1, 2002 - September 30, 2007, PI: Jane Lipscomb; Co-investigators: Kate McPhaul, Jeff Johnson, Jeanne Geiger Brown, Dawn Foster.

R01 OH009072-01, Lipscomb (PI), 8/31/06-8/30/11, CDC/NIOSH
Evaluation of Organizational Justice Intervention to Alleviate Type III Violence
This study develops, implements, and evaluates effective intervention strategies for preventing Type III (worker on worker) violence in a state government workforce.

Publications:

Lipscomb J, Silverstein B, Slavin TJ, Cody E, Jenkins L. Perspectives on legal strategies to prevent workplace violence. *J of Law, Med & Ethics* 2002;30:166-72.

McPhaul K, Lipscomb J. Workplace violence in health care: recognized but not regulated. *Online J Issues in Nursing* 2004;30:7.

Lipscomb, J.A. Homicide and assault. In Levy BS, Wegman DH, Rest K, Weeks J (Eds.). *Preventing Occupational Disease and Injury* (2nd edition) 2005;253-6. Washington, DC: American Public Health Association.

Lipscomb, J., McPhaul, K., Rosen, J., Geiger-Brown, J., Choi, M., Soeken, K., Vignola, V., Wagoner, D., Foley, J., Porter, P. (Dec. 2006). Violence prevention in the mental health setting: The New York State experience. *Canadian Journal of Nursing Research*.

Presentations:

McPhaul, K.M., Lipscomb, J.A. A focus group assessment of work organization risk factors for workplace violence in mental health. APHA, Washington DC, 2002.

Lipscomb, J.A., “Perspectives on legal strategies to prevent workplace violence.” Centers for Disease Control and Prevention Public Health Law Conference, Atlanta, GA., 2002.

Lipscomb, J.A., “How OSHA’s Violence Prevention Guidelines Reduce Violence Risk and Assault Injuries: Report from a Study Evaluating OSHA Guidelines in Mental Health.” Maryland Occupational Safety and Health Conference, 2002.

Lipscomb, J.A., “OSHA Violence Prevention Guidelines: An Effective Strategy for Preventing Workplace Violence.” New York State Public Employees Federation Health and Safety Conference, Albany NY, 2003.

Lipscomb, J.A., “Violence Prevention in the Mental Health and Social Services Workplace: Intervention Effectiveness Research In-Progress.” University of California San Francisco, Occupational and Environmental Research Grand Rounds, 2003.

Lipscomb, J.A., “Workplace Violence Prevention in the Mental Health Setting.” National Occupational Injury Research Symposium, Pittsburgh, PA, 2003.

London, M., Rosen, J., Lipscomb, J.A., Bain, E. “Workplace Violence Prevention: Responding to the Lack of an OSHA Standard.” APHA, Boston, 2006.

Geiger-Brown, J., Muntaner, C., Lipscomb, J.A., Trinkoff, A. “Musculoskeletal Disorders and Demanding Work among Home Care Workers.” APHA, Boston, 2006.

8.Outcomes

Intermediate outcomes: The study team was contacted by several employer and or worker organization to provide violence prevention program consultation as an outcome of this grant. Organizations requesting assistance include: Department of Idaho Department of Health and Welfare (2005), VHA (ongoing), SEIU Local 1199NW (2006) Dimensions Health Care (2006) and Sibley Hospital (2006).

*End outcomes***:** In the final year of the project, representatives of the three intervention PAGs met with the research staff to discuss lessons learned and the project’s successes. This discussion was conducted as a focus group, with one member of the project staff serving as facilitator. Individuals representing the three facilities were asked to discuss what worked and did not work throughout the project. The discussion was recorded on flip charts, summarized in a report, and shared with participants for review, validation, and revision. In January 2005, the P.I. was invited to present the findings of this report (including following recommendations) at a meeting of the Directors of all 26 in-patient facilities.

Potential outcomes: Upon completion of the NIOSH funded project, the following recommendations were presented to the 26 OMH Directors and the OMH Multi-Union Health and Safety Committee

Management commitment to the violence-prevention program

- management communication of its intentions to reduce violence on the wards
- regular participation of senior leadership in violence-prevention meetings
- senior staff presence at all PMCS training sessions and a requirement for management to comply with annual PMCS training
- participation of upper-level administrators in ward rounds and morning report
- ongoing data collection, data sharing, and discussion of injury data with staff
- use of the courts for medication over-resistance and pressing assault charges

- management responsiveness to staff solutions for reducing violence
- allocation of resources for staff training and overtime related to violence prevention
- strong program for post-assault response staff

Employee involvement in the violence-prevention program

- regular communication via the committee process: rounds, shift-to-shift communication
- multidisciplinary STEP committee membership
- team approach to identifying needs and solutions and consensus decision-making on implementation of project recommendations

Hazard-assessment activities

- use of staff focus groups and staff surveys
- periodic environmental audit/assessment and mapping of high-risk areas with staff input
- encouragement of accurate and timely reporting of injuries
- data collection and analysis and review of reporting practices

Hazard-control activities

Infrastructural/organizational

- creation of violence-prevention infrastructure (STEP/PAG committee)
- documentation of the hazard controls implemented or a timetable for implementation
- assessment of hazard-control effectiveness via the committee infrastructure using ongoing data collection and review

Environmental

- assessment of ward movement to avoid prolonged standing in line
- installation of locks wherever necessary
- installation of staff personal alarm system and alarms in all nursing stations and medicine and treatment rooms
- removal of wire glass

Administrative

- ongoing assessment of data collection and data use
- ongoing assessment of PMCS training and management of psychiatric emergencies

Behavioural

- improvement of the shift-to-shift reporting process
- senior staff rounds of treatment units
- clinical/treatment rounds across disciplines, including treatment aides

Title: **Work-Related Assault: Impact of Training and Policy**

Definition of Problem Being Addressed:
In the United States, occupational violence is frequently one of the top three leading causes of work-related death, and it has been estimated that over 1.7 million non-fatal violent acts occur at work annually; nurses, particularly, appear to be at increased risk of work-related violence. Policy and training on work-related violence are often recommended as part of a comprehensive approach to address this problem; however, evaluation of the impact of these recommendations has been lacking.

Aims:
Specific Aim 1: to examine the relation between work-related violence prevention training and the outcome of work-related assault against nurses.
Specific Aim 2: to examine the relation between work-related violence prevention policies and the outcome of work-related assault against nurses.

Partners in the Project:

Names	**Role:**
1. Susan Goodwin Gerberich, Ph.D.	Co-investigator
2. Patricia M. McGovern, Ph.D.	Co-investigator
3. Timothy R. Church, Ph.D.	Co-investigator
4. Helen E. Hansen, Ph.D.	Co-investigator

Customers:
The intended users of these results include: facilities that employ nurses; nurses; occupational health professionals; researchers interested in work-related violence; and those interested in effective management of nurses.

Approach:
This study is based on data collected for the case-control phase of the Minnesota Nurses' Study. Case participants were surveyed about the month prior to the first assault reported during the previous year; controls were randomly selected, based on months worked, from either 1) months worked by nurses who did not report assaults, or 2) months worked prior to the first assault for cases. A comprehensive causal model, using a directed acyclic graph, served as a basis for survey design, analyses, and interpretation. Multivariate logistic regression was used to assess the impact of policies and training on the outcome of physical assault. Sensitivity analyses were also incorporated to address unmeasured confounders and exposure misclassification.

Results:
Over 40% of cases and controls reported having ever received training about occupational violence. Most often, nurses indicated being trained about reporting violence and managing violent patients. Results of multivariate logistic regression analyses varied by training topic; three types of training appeared to decrease the risk of violence, four types appeared to increase the risk of violence, but none were found to be statistically distinct from one. Results of multiple regression analyses, regarding written work-related violence policies indicated that the odds of physical assault decreased for having a zero tolerance policy (OR=0.5, 95% CI: 0.3, 0.8) and for having policies regarding types of prohibited violent behaviors (OR=0.5, 95% CI: 0.3, 0.9). Sensitivity analyses were conducted for exposure misclassification and the presence of an

unmeasured confounder, providing further confidence that some work-related violence policies may be protective.

Outputs:
Results of this study have been presented at: the American Public Health Association conferences in 2002 and 2003; the Minnesota Health Services Research Conference in 2003; the National Occupational Injury Research Symposium in 2003; the National Occupational Research Agenda Symposium 2004; and the American Association of Occupational Health Nurses conference in 2005.

In addition, two peer-reviewed papers have been published:

Nachreiner, N., Gerberich, S.G., McGovern, P., Church, T., Hansen, H., Geisser, M., and Ryan, A. (2005). Impact of Training on Work-related assault. Research in Nursing and Health, 28(1): 67-78.

Nachreiner, N., Gerberich, S.G., McGovern, P., Church, T., Hansen, H., Geisser, M., Ryan, A. (2005). Relation between policies and work related assault: Minnesota Nurses' Study. Occupational and Environmental Medicine. 62(10): 675-81.

Outcomes:
This research has served as a model for additional work-related violence studies. For example, doctoral students at the University of Minnesota are now assessing the impact of policies on violence against Minnesota educators. The published studies have been cited in other publications, and conference attendees have had great interest in these presentations.

Title: **Risks for Workplace Violence in Long-Haul Truckers**

Debra G. Anderson, PI, Deborah B. Reed, Co-I, Steve Browning, Co-I

1. Definition of Problem: The U.S. truck driving industry employs nearly nine million Americans. A significant subset (3.16) million) of these workers consists of long-haul truck drivers (U.S. Bureau of Labor Statistics, 2001). The Bureau of Labor Statistics (BLS) rates truck driving as the third largest growth occupation (tied with Registered Nurses), with a projected growth of 561,000 jobs from 2000-2010 (Eisenburg, 2002). Only teachers and computer software engineers are estimated to be growing more quickly in numbers than truck drivers. This growth is affecting not only the number of long-haul drivers but also the gender make-up of the driver workforce. The number of women truckers has increased from an estimated 513 drivers in 1970 (Lembright, 1982) to between 174,000 and 290,000 (6-10%) currently (American Trucking Association, 1999; Renner, 1998). The overall size of this sector of the economy, and projections for its growth, coupled with the non-traditional aspects of long haul truckers' workplace environments and employment arrangements, underscores the importance of assessing this population in terms of workplace violence and the specific risk factors associated with long-haul truck driving.

Several studies have examined health risks of truckers (Bolster, 1989; Korelitz et al., 1993; Magnusson et al., 1996; Reed et al., 2000). One of the key issues revealed by these studies is the finding that truck drivers have more heart disease that any other occupations (Leigh & Miller, 1998). Stress is an identified risk factor for heart disease, however few studies have investigated violence and stress related to long-haul truckers. The existing research is further limited by the fact that the majority of studies among long-haul truck driving have used exclusively male samples (Gruber, 1976; Hakkanen, 2001; Ho et al., 1993; Korelitz et al., 1993; Patenaude et al., 2001). In light of the rapidly increasing number of female long-haul truckers, it is important to address their specific needs in addition to the needs of truck drivers in general.

From 1992-1996, the number of injuries and illnesses for all occupations decreased 20% while increasing 5% in truck drivers. In 1999, truck drivers had more workplace injuries and illnesses involving time away from work than any other occupation (Bureau of Labor Statistics, 2001) and heavy truck driving is one of the occupations with the most costs related to job-related injuries and illnesses (Leigh & Miller, 1997). It is important to determine the nature of these injuries and illnesses to enable the development of appropriate interventions to prevent them. Rates of workplace violence specifically for long-haul truckers are not available in the existing literature or from national surveys and agencies. One reason cited for the lack of national data is that, although truck hijackings are investigated by the federal bureau of investigation, personal crimes against truckers are generally handled by local authorities and are therefore not always reported to federal authorities (Strah, 1994). A crime bill signed by then President Clinton, in 1994, instructed federal authorities to work closely with state and local authorities (Strah, 1994). It also specified that prosecutors should aggressively prosecute crimes against truckers and that penalties for crimes against truckers should be more than the maximum set by law. Truck driving is listed as one of the occupations that loses work time due to violence at the worksite (Toscano & Weber, 1995). A review of news articles also provides evidence of the dangers of truck driving (Campbell, 2000; Lockridge, 1994; Magner, 1999; Spencer, 2000; Strah, 1994). The National Crime Victimization Survey uses the occupational category of transportation workers, which includes taxi drivers, bus drivers, truckers, and other transportation industry workers. Based on data from this survey, workers in the transportation industry experienced average annual rates of aggravated assaults (3.5 per 1,000 persons) and simple assaults (10.2 per 1,000 persons) that ranked this industry fourth and sixth, respectively, in comparison to the other surveyed industries (Duhart, 2001). The transportation industry, in general, has the highest average annual rate of robberies in the workplace, as reported for the years 1993-1999 by the Bureau of Justice Statistics. Further, in comparison to other industries, the transportation industry has the largest percentage (31.7%) of workplace victims who were victimized by the offender with a weapon. Data from this survey suggest that a substantial proportion (63%) of the workplace victimization crimes for employees in the transportation field were not reported to the police. In general, rapes/sexual assaults and simple assaults tended to be severely underreported in the study population.

2. Aims of the project:

Aim 1: Identify the types of violence that women and men experience while working as long-haul truck drivers.

Aim 2: Identify risk factors that contribute to violence against truckers and between truckers.

Aim 3: Differentiate the risks of work-related stress among distinct socio-demographic groups of truckers as they relate to specific exposures experienced by long-haul truck drivers.

Aim 4: Determine the prevalence of domestic violence experienced by long-haul truck drivers when their driving partner is also their intimate partner.

Aim 5: Identify work environment factors that place truck drivers' safety at risk.

The aims of this project are consistent with the Healthy People 2010 objectives that address the reduction of work-related homicides (Objective 20-5) and work-related assaults (Objective 20-60) and with the National Institute for Occupational Safety and Health National Occupational Research Agenda (NORA) objectives. It also addresses the types of violence identified by the Iowa Report to the Nation on Workplace Violence (Loveless, 2001). The project specifically focuses on types of workplace violence and risk factors related to that violence in the long-haul trucking profession.

3. Partners: Various truck shows and truck stops across the U.S. were used as sites for the collection of data.

4. Customers: Truck drivers, truck stops, trucking companies, delivery sites, and the justice system are potential users and beneficiaries of this project.

5. Approach: A cross-sectional design using both quantitative (Phase I) and qualitative methods (Phase II) were used to collect data from long-haul truck drivers. This multi-method approach should allow for the development of a strong conceptual understanding of violence at the workplace not available from the use of one method (Miles & Huberman, 1994). The qualitative data should be useful in validating, interpreting, clarifying and illustrating quantitative findings from the truckers. The different methods may yield different results because they are sensitive to

different nuances (Patton, 2002). Combining quantitative and qualitative approaches in a process of methodological triangulation, will strengthen the data collection process (Patton, 2002) by allowing for the fullest possible descriptions of risks for violence in long-haul truckers.

A written survey was administered to a non-probability volunteer sample (N = 987) recruited at truck shows and truck stops to assess episodes of workplace violence and the circumstances surrounding the episodes of violence. Qualitative data was collected via phone interviews with a small sample of female and male participants who have completed the written survey and have identified themselves as having been a victim of workplace violence. The phone interview was conducted to assess in more detail the episodes of violence identified in the written surveys and to evaluate the context of those violent episodes. Unfortunately, the target of 60 interviews was not met as the truckers selected often were not available when contacted for follow up.

The target population for this study was female and male long-haul truck drivers. The inclusion criteria were: (a) commercial drivers who spend the majority of their work hours in long-haul trucking; (b) age 21 or older; and (c) ability to speak English. For the purpose of this study, long-haul trucking was limited to truckers who spend one or more nights per week away from home while driving. The age of 21 was used because many states require truckers to be at least 21 years of age to obtain a commercial driver's license. Length of time on the job was collected to assess potential differences in novice and experienced drivers. Because the measures in the study were not available in other languages, only English speaking truck drivers were included.

6. Results/Findings (Preliminary): The funding for this project concluded on September 29, 2006. Data analysis is ongoing, thus the findings discussed in this section are preliminary and may change based on more in-depth analysis.

- The participants (N = 987) had been long-haul truckers an average of 14 years; 64% were married;
- 38% had children under the age of 18 (of those, 37% had children who traveled with them);
- 87% had a high school education;
- 46% attended college;
- 91% were Caucasian;
- 12% (n = 119) did not have a residence outside of their truck;
- mean BMI for male truckers (n = 797) was 31.6;
- mean BMI for female truckers (n = 174) was 31.2;
- 34% of male truckers were overweight and 52% were obese;

- 26% of female truckers were overweight and 49% were obese;
- 73% of truckers feared for their personal safety at work;
- 88% had had their safety threatened while driving; and
- 44% carried weapons (Gun = 23.5%; Knife = 56.8%)

7. Outputs:

Heaton, K., Browning, S. and **Anderson, D.** (under review). Variables predicting falling asleep at the wheel in long-haul truckers. Accident Analysis and Prevention.

Heaton, K., Browning, S., & **Anderson, D. G.,** (under review). Epworth Sleepiness Scale. Journal of Nursing Measurement.

Anderson, D. G., Westneat, S., & Reed, D. (2005). Violence and stress in female long-haul truck drivers. Security Journal, 18 (2), 31-38. *(Pilot Study for NIOSH study – funded by NIOSH ERC).*

Anderson, D. G. (2004). Workplace violence in long-haul trucking: A review of the literature. AAOHN Journal, 52 (1), 23-27.

Conference Proceedings:

Anderson, D.G. and Reed, D.R. (2006). Risks for workplace violence in long-haul truckers. National Occupational Research Agenda (biennial meeting), Washington DC.

Allen-Bryant, K., Westneat, S., **Anderson, D.G.** (2006). Disparities in the Prevalence of Workplace Violence Among Long-Haul Truck Drivers, Southern Nursing Research Society, Memphis, TN.

Anderson, D.G., Reed, D.R., Lennie, T. & Westneat, S. (2006). Truckers and Nutrition. Southern Nursing Research Society, Memphis, TN.

Allen-Bryant, K., Westneat, S., **Anderson, D.G.** (2005). Disparities in the Prevalence of Workplace Violence Among Long-Haul Truck Drivers, American Public Health Association, Washington, DC.

Anderson, D. G., Westneat, S., & Kenworthy, E. (2005). Workplace violence in vulnerable occupations. Midwest Nursing Research Society, Cincinnati, OH.

Anderson, D. G., Westneat, S., Reed, D. (2005). Risks for Workplace Violence in Long-haul Truckers: Preliminary Data. NCIPC, Denver, CO.

Anderson, D. G., Westneat, S., & Reed, D., (2004). "Workplace Violence,”for the 15th International Nursing Research Congress, Dublin, Ireland.

Riley, P. & **Anderson, D. G.** (2004). Data collection methods for workplace violence in long-haul truck drivers. Western Institute of Nursing, Portland, OR.

Anderson, D. G. (2004). Workplace violence in female long-haul truckers. Southern Nursing Research Society, Louisville, KY.

Anderson, D. G. (2004). Workplace violence in long-haul truckers. Southern Nursing Research Society, Louisville, KY.

Anderson, D. G., Allen, K., & Riley, P. (2003). Risks for workplace violence in long-haul truckers. American Public Health Association Annual Meeting. San Francisco, CA.

8. Outcomes: This project provides information that should be useful in improving safety at the worksites of truckers related to the design of truck stops, rest areas, delivery sites, and training of employees. In addition, findings unrelated to violence are also important, and include nutrition and housing status. We have submitted a proposal that focuses on the nutrition and injury of truckers partially due to our findings that 85% or truckers are obese or overweight – and other studies that indicate that overweight and obese lead to injury. Over 12 percent of truckers responded that they have no residence outside of their truck – this has implications for health care access, stability, and support systems.

Title: **Evaluation of California Initiatives to Reduce Violence**

Submitted by: Corinne Peek-Asa, PhD
10/14/06

1. Definition of the problem being addressed (e.g., number of workers affected; rates of injury, illness, or fatality; hazards)

Health care workers, especially those providing emergency and psychiatric care, have long been recognized as having a high risk of work-related assault. This study evaluated state policies to reduce violence against health care workers. In response to a growing awareness of violence against health care workers, the State of California has implemented two initiatives to reduce workplace violence in health care facilities. The first initiative was Cal/OSHA's "Guidelines for Security and Safety of Health Care and Community Service Workers," released in 1993. The Cal/OSHA Guidelines provide a comprehensive list of intervention approaches to reduce workplace violence and offer a strategy to design and implement a comprehensive security program. The second state-based initiative was the passage of the California Hospital Safety and Security Act (Assembly Bill 508) in 1993. The Hospital Security Act required licensed acute care and psychiatric facilities to implement a comprehensive security program by July, 1995.

2. Aims of the project (major objectives for the period of the work)

Objective 1: Impact Evaluation

Specific Aim 1: Evaluate the level of compliance in hospital security plans pursuant to the Cal/OSHA Guidelines and the Hospital Security Act and identify characteristics of hospitals that are related to level of compliance.

Specific Aim 2: Determine if hospital security programs are more comprehensive in California compared to hospital security programs in New Jersey, where no state-based initiatives have been implemented.

Objective 2: Outcome Evaluation

Specific Aim 3: Using interrupted times-series analysis, determine if rates of reported violent events in all California hospitals decreased from the pre-initiative to the post-initiative period compared to hospitals in New Jersey.

Specific Aim 4: Identify individual components of hospital security programs that are associated with decreased rates of violence. Individual components will be divided according to the Cal/OSHA Guidelines into the categories of: environmental modifications, work practice changes, policies and practices implemented, training, use of security and law enforcement, management commitment, risk assessments and integration with the security program, and surveillance of violent events.

3. Partners (participants in the project and the roles they served)

    1. California Department of Health Services, Occupational Health Branch conducted the field work for the California hospitals.

2. New Jersey Department of Health and Senior Services conducted the field work for the New Jersey hospitals.
3. University of North Carolina, Chapel Hill, participated as part of the research team
4. University of California, San Francisco, participated as part of the research team

4. Customers (intended users or beneficiaries of the results)

Health care administrators, security directors and risk managers, health care providers, public health officials, state hospital administrations, patients

5. Approach (tasks involved in conducting the project)

Using a quasi-experimental design with a nonequivalent control group, this evaluation compared hospital security programs and violence rates in a similar sample of intervention and comparison hospitals. Hospitals in the State of California were considered the intervention hospitals that have been “exposed” to the two California hospital security initiatives. Hospitals in the State of New Jersey were the comparison hospitals, in which general guidelines are available but no specific state-based interventions have been implemented.

Nearly 150 licensed hospitals in California and 50 in New Jersey were recruited to participate. Hospitals were chosen through a stratified random sampling process, with the strata based on hospital size and urban influence of the county. Acute Care and Psychiatric Hospitals were eligible; in the acute care hospitals the security assessment will include the Emergency Department and the Psychiatric Unit.

We conducted a comprehensive assessment of each hospital’s overall security program as it related to the Cal/OSHA Guidelines and the Hospital Security Act. This included environmental modifications, work practice changes, policies and practices implemented, training, use of security and law enforcement, management commitment, risk assessments and integration with the security program, and surveillance of violent events. Information about the security program was collected through interviews of the Emergency Department Nurse Manager, the Psychiatric Unit Nurse Manager, the Risk Manager/Director of Security, and an average of three staff in each unit. In addition to the interviews, existing printed materials that described the training program and hospital security policies were requested.

Information about events in each hospital was obtained through several sources. Statewide trends in hospital violence and events in each facility were identified through the Worker’s Compensation Information System, a statewide electronic database of Worker’s Compensation Claims. Events in individual hospitals were evaluated through OSHA 200 logs, employer’s reports, and security logs. Information about the employee population will be obtained from the personnel office and will be used to derive rates of violent events.

6. Results/Findings (preliminary or final observations and conclusions)

Data for this project are still being analyzed. Some of our basic findings:

- Hospitals in California had all responded to some extent to the California Hospital Security Act, although there was a broad range of programs in place. While some hospitals had organized and integrated programs, others were piecemeal and disorganized.
- New Jersey hospitals had all implemented some types of workplace violence strategies. California had significantly more workplace violence program elements in training and in policies/procedures, but there was no significant difference between the states in security and environmental approaches.
- The majority of hospitals had ongoing workplace violence training programs, and although none were comprehensive enough to comply to the letter of the legislation, most were thorough. All hospitals had implemented some types of environmental approaches to prevention, which was usually in the form of security equipment. The environmental approach, however, was often the least developed aspect of the security program.
- Workplace violence program components of training, administrative policies/procedures, security, and environmental measures were not highly correlated, which indicates that having a strong program in one component (such as training) is not related to having a strong program in another component (such as administrative policies and procedures). In fact, many of these different program elements were negatively correlated.

7. Outputs (reports, publications, products, methods, etc.)

Manuscripts in progress:

Peek-Asa C, Casteel C, Allareddy V, et. al.. Impact of the California Hospital Safety Act on Workplace Violence Prevention Programs in Hospital Emergency Departments. In Progress.

Peek-Asa C, Casteel C, Allareddy V, et. al.. Impact of the California Hospital Safety Act on Workplace Violence Prevention Programs in Psychiatric Facilities. In Progress.

Casteel C, Peek-Asa C, Nocera M, et al., The effects of the California Hospital Security Act on Workplace Violence Events in Health Care Facilities. In progress.

Peek-Asa C, Casteel C, Nocera M, Allareddy V. Reporting sources for violence events in hospitals: can we do it better for fewer resources? In progress.

Casteel C, Peek-Asa C, Nocera M, et al., Epidemiology of workplace violence in health care facilities. In progress.

Blando J, OHagan E, Valiante D, McPherson K, Peek-Asa, C. Community crime rates and their influence on hospital violence. In progress.

Umbarger-Mackey M, Peek-Asa C, Allareddy V. Under-reporting of violent events in health care facilities. In progress.

8. Outcomes (how outputs have been used, e.g. change in behaviors, processes, technologies, guidelines, etc. that have made a difference in measurable endpoints related to exposures or health and safety indicators)

Most participating hospitals have asked for results from this study, and these were provided to them. These results are being used by hospitals to benchmark their programs in relation to like hospitals (Note: no results were produced to identify individual hospitals, which was a condition of our IRB approval). The CADHS conducted a symposium with participating hospitals to discuss approaches to prevention. The NJDSS research team met with members of the New Jersey Hospital Association to help improve training programs for hospital staff.

Title: **On-the-Job Injury in South Texas Middle School Children**

September 30, 1998 – September 29, 2000

Sharon P. Cooper, PhD, Principal Investigator

Nancy F. Weller, DrPH, Co-Principal Investigator and Project Director

Susan R. Tortolero, PhD, Co-Investigator
Steven H. Kelder, PhD, Co-Investigator
Sponsored by the National Institute for Occupational Safety and Health
Grant Number 1R03 OH03786-01

1. Definition of the problem being addressed

State and national child labor laws prohibit the employment of children younger than 14 years of age. Despite these proscriptions against work in young children, emerging evidence suggests that some unknown proportion of young people work during their middle school years (6th through 8th grades or about 11-14 years old), probably in the informal sector, but possibly during the school year and in formal sector positions. Although early adolescents commonly relate working during their 6th-8th grade years, documentation of these work experiences in the scientific literature is largely unconfirmed. Information on the extent and nature of employment during the middle school years is also deficient. Like their older adolescent counterparts, middle school youngsters may also be at risk for various occupational hazards, including work-related injury, already documented as a substantial public health problem in high school students. Additionally, these youngsters may be susceptible, especially as hours of weekly work increase, to the negative academic, social, behavioral, and health effects that older adolescents have experienced as a result of working long hours weekly.

Finally, no information is available on the social variation in work patterns among lower-income and minority middle school youth, youngsters who may work more hours weekly due to their socioeconomic circumstances. The purpose of this study was to describe the prevalence and patterns of work and work-related injury among mostly low-income and minority 6th, 7th, and 8th graders from South Texas, and the associations of school-year employment with quality of life issues, and environmental and behavioral factors among these students.

2. Aims of the project

Anecdotal data from the popular literature and other limited, scientific data indicate that as many as one-third of youth have been employed during their middle school years, some in occupations that have been documented to be hazardous.. Interventions are needed to address occupational safety and health concerns among these employed children, their parents and employers, and other concerned professionals. Toward this objective, a one-year grant under multiple National Occupational Research Agenda priority research areas (Special Populations at Risk – young, minority, low-income workers – and Traumatic Injuries) was awarded by NIOSH in September 1998. Specific aims included the following:

1. To determine the prevalence of employment and weekly work intensity levels among middle school youth;

2. To describe the prevalence of reported work-related injuries in middle school students;

3. To describe the demographic characteristics of middle school students who work and who report work-related injuries;

4. To describe quality of life issues (sleep, leisure time, stress) associated with working and work-related injuries;

5. To determine environmental factors (i.e., number of hours worked weekly, type of job) and behavioral factors (i.e., substance use, violence-related behaviors) associated with employment and work-related injuries.

3. Partners (participants in the project and the roles they served)

Partners included Texas Education Agency who helped recruit schools and school teachers and students who made the survey possible.

4. Customers (intended users or beneficiaries of the results)

Potential customers include researchers, other public health professions, school personnel, parents, legislators.

5. Approach (tasks involved in conducting the project)

During May 1995, data in this descriptive, cross-sectional study were collected as part of the Safe and Drug Free Schools Program's (SDFS) regular assessment of the prevalence of substance use among Texas Education Agency Region Two students who represented 27 junior high schools in 11 contiguous counties in South Texas. The SDFS's data collection provided an opportunity to examine issues of employment in relation to health and other behaviors.

The SFDS program coordinator recruited all 42 school districts in these counties. Thirteen districts declined participation due primarily to time constraints. Participating and nonparticipating districts were located in small towns and rural areas except for a single, small urban area in the nonparticipating group. The total student population in the participating middle schools was 11,523. At the larger schools, classes were randomly selected by grade from a master list of second period classes using a random number table. In schools with fewer than 200 students, all students were surveyed. The number of students eligible to complete the survey was 8,757. A total of 7,420 6^{th}, 7^{th}, and 8^{th} graders, representing 85% of the eligible, was surveyed. The number of 6^{th} graders who responded was 2,365, 7^{th} graders 2,487, and 8th graders 2,450. The study protocol was approved by The University of Texas Health Science Center Institutional Review Board (HSC-SPH-95-018). During the week prior to survey administration, parents received a passive informed consent form explaining the study and providing an opportunity to decline participation. Following the Center for Disease Control and Prevention's (CDC) Youth Risk Behavior Study (YRBS) protocol, teachers received instruction packets and administered the survey during student's regular classes. The survey was anonymous; students recorded their responses directly on a computer-scannable answer sheet.

6. Results/Findings

Data on the work experiences of children and early adolescents are scarce. Preliminary evidence suggests, however, that very young workers – especially poor, minority youth – may be at risk for adverse work-related effects, including on-the-job injuries. Pre-existing work-related data from 7,420 South Texas middle school students, were analyzed according to the specific aims of the study: to determine the prevalence of employment among middle school youth; to document the prevalence of work-related injury in middle schoolers; to describe the demographic characteristics of working middle school students and injured workers; to describe quality of life issues associated with working and work-related injuries; and to determine environmental factors and behavioral factors associated with work-related injuries. Results indicate that 25% of employed students reported having ever experienced an occupational injury. Of the injured, 30% required medical help. A dose response effect was observed where increasing weekly work hours were significantly related to work injury. Types of jobs associated with work-related injury were restaurant work, agriculture, construction, and retail work. Restaurant work was associated with injury requiring medical help. The overall prevalence of employment was 56%. Three-quarters of workers were employed 1-10 hours weekly. Employed students worked an average of 8 hours weekly. Middle school students were more likely to work in childcare and yardwork than in other types of jobs. About half of students reported working to earn spending money. Working longer hours weekly was associated with using several substances, decreased sleep, increased stress and frequency of having headaches, and dissatisfaction with amounts of leisure time. Working more than 10 hours weekly was also correlated with poorer school performance and school disengagement. We found that students from families of migrant farmworkers are particularly vulnerable to sleep deprivation, decreased academic performance, and an increase in the likelihood of work-related injury. Further investigation is needed to examine the impact of school-year work on youth functioning and to develop interventions to reduce work-related injuries in this population. Parents and professionals should monitor the number of hours of weekly work of middle school children.

7. Outputs (reports, publications, products, methods, etc.)

Weller NF, Cooper SP, Kelder SH, Basen-Engquist K, Tortolero S. Work-related injury among South Texas Middle School Students: prevalence and patterns. South Med J 2003; 96: 1213-1220.

Weller NF, Basen-Engquist K, Cooper SP, Kelder SH, Tortolero SR, Hassan S. School-year employment among middle school students in South Texas: prevalence and patterns. Journal of Children's Health 2004; 2:87-102.

Weller NF, Tortolero SR, Cooper SP, Kelder SH, Hassan S. School-year employment among South Texas middle school students: effects on academic, social, and physical functioning. Journal of Children's Health 2004;2:103-117.

COOPER SP, Weller NF, Fox EE, Cooper SR, Shipp EM. Comparative description of migrant farmworkers vs. other students attending south Texas schools: demographic, employment, and health indicators. Texas Medicine 2005; 101:58-62.

Cooper SP, Weller NF, Fox EE, Cooper SR. Comparative description of migrant farmworkers vs. other students attending South Texas schools: substance use, work and injuries. J Rural Health 2005;21:361-366.

8. Outcomes

This was research that was intended to shed light on the work, injury, academic and psychosocial experiences of middle school students. Since there is a paucity of data in these young workers, its full contribution remains to be seen. In addition to being cited in the peer-reviewed literature, this research could be used to educate legislators on such pending legislation as the CARE Act (The Children's Act for Responsible Employment) or by researchers or public health practitioners to develop interventions.

Title: **Adolescent Occupational Toxic Exposures**

NORA R03 NIOSH PROJECT
P.I. – Alan Woolf MD, MPH
Children's Hospital Boston
Harvard Medical School
Boston, Massachusetts

1. DEFINITION OF PROBLEM

There was scant national data on the frequency or characteristics of toxic exposures occurring in workplace settings that involve adolescents 12-17 years old as victims. Databases usually used to obtain such information (e.g. workmen's compensation claims, Medicaid claims, emergency department visits) did not reliably include the age spectrum of interest and/or were not national in scope.

2. PROJECT AIMS

Project aims included:

- description of occupational toxic exposures among adolescents in the U.S.
- analysis of trends over time
- comparison with such exposures occurring among adult workers and contained in the same database

3. PROJECT PARTNERS

The project was based at Children's Hospital Boston, and the Harvard Medical School. Partners included the regional Massachusetts Poison Control System, based in Boston. Partners included epidemiologists (Dr. Sam Lesko) at the Slone Epidemiology Unit at Boston University School of Public Health, Boston, Massachusetts and Dr. Hillel Alpert, a statistician at the Harvard School of Public Health.

4. CUSTOMERS

Users of such data included academic-based health professionals, public health officials, and those responsible for public health policy and public education outreach programs.

5. APPROACH

Secondary retrospective analysis of the Toxic Exposure Surveillance System (TESS) database maintained by the American Association of Poison Control Centers (AAPCC), comprised of poisoning exposure calls received by all 62 poison control centers in the United States. The analytical plan included descriptive epidemiology, trend analysis, and inferential comparison of rates internal to the database.

6. RESULTS

Of 2,200,000 potential poisonings reported annually to U.S. poison control centers, over 300,000 occupational toxic exposures were reported during the 5 years of interest, 1993-97. Of these, there were 8,779 (3%) exposures occurring among adolescents younger than 18 years old: including 35% inhalations, 27% ocular splashes, and 24% dermal exposures. The most frequent toxic agents involved in these adolescent exposures included caustics, gases and fumes, cleaning agents, bleaches, drugs, and hydrocarbons. Of the total reported adolescent exposures, 14.5% were coded as resulting in moderate or severe medical outcomes, and there were 2 adolescent occupational deaths reported to poison centers during this time period.

Fractional monthly incidence rates were comparatively higher than those of adults in trend analysis over the five years of interest. Such findings suggest (speculatively) adolescents are recruited to entry level jobs where there is exposure to hazardous chemicals, where there is less training and orientation to the hazards of such chemicals and the need for barrier precautions, and where adolescents take fewer precautions and routinely engage in more risk-taking activities than adults.

7. OUTPUTS

Woolf AD, Flynn B: Workplace toxic exposures involving adolescents 14-19 years old- one poison center's experience. Arch Pediatr Adolesc Med 2000; 154: 234-239.

Woolf AD, Garg A, Hillel AR, Lesko S. National variations in the types and severity of adolescent workplace toxic exposures. Presented at the annual national congress of the American Academy of Pediatrics, Chicago IL, October, 2000.

Woolf AD. Studies in adolescent occupational toxic injuries in the United States. Seminar, Int'l Labor Office (ILO), Geneva, Switzerland, October 27, 2000.

Woolf AD. Symposium Organizer and Moderator; also Presenter: Child Labor and Toxic Exposures. in WHO/AAPCC Symposium on Children's Environmental Health. North American Congress of Clinical Toxicology, Montreal, Quebec, Canada, October 1, 2001.

Woolf AD, Garg A, Hillel AR, Lesko S. Adolescent toxic exposures in the workplace: trends in the United States and comparisons to adults. Pediatric Res 2001; 49 (Part 2): A7.

Woolf AD, Alpert HR, Garg A, Lesko S. Poison control center surveillance of adolescent toxic exposures in the workplace: trends in the United States from 1993-97. J Toxicol Clin Toxicol 2001; 39: 272.

Woolf A, Alpert HR, Garg A, Lesko S. Adolescent occupational toxic exposures – a national study. Arch Pediatr Adolesc Med 2001; 155: 704-710.

Woolf AD. Health hazards for children at work. J Toxicol Clin Toxicol 2002; 40: 477-482.

8. OUTCOMES

Project aided in the informing of public health officials nationally and internationally to a new focus for health prevention and education activities. Project recommendations for increased efforts at orientation and on-the-job training of adolescents to the potential toxic effects of workplace chemicals has led to enhancements of such activities. Internationally both WHO and ILO officials were interested in these results. Recommendations for simple measures to avert toxic exposure events – such as wearing eye guards and gloves – should be implemented and considered as routine barriers to injury by employers of adolescents. It is unknown how extensively such recommendations have been implemented.

Title: **Childhood Agricultural Trauma Evaluation System**
NIOSH Grant: R01 OH004265-4
PI (2002-2005): Allan N. Williams, MPH, PhD
PI (2001-2002): Debora J. Boyle, DVM, PhD

1. Definition of the problem being addressed (e.g., number of workers affected; rates of injury, illness, or fatality; hazards)

Agriculture is one of the most hazardous industries in Minnesota and rural Minnesota adolescents are frequently employed in both agricultural and non-agricultural jobs. Previous surveillance studies of agricultural work and injury have generally been limited to emergency room data, surveys of only farm families, or inclusion of only paid work activities. Consequently, the broader scope of work experiences, injuries and illness among adolescents in rural or agricultural communities has been less well characterized. The purpose of this study was to develop and implement surveillance methods to more broadly characterize injury, work, and asthma occurrence among rural Minnesota adolescents.

2. Aims of the project (major objectives for the period of the work)

The specific aims of this study were: (1) determine the magnitude and scope of agricultural injury and asthma among adolescents in 9^{th} - 12^{th} grades in rural Minnesota; (2) describe the change in work hours between 9^{th} and 12^{th} grades in terms of total work hours, and the shift in work hours between agribusiness, traditional family farm work, and non-farm work; (3) evaluate the reliability of adolescent self-reported information about agricultural and non-agricultural work hours and injury experiences; and (4) use a cohort analysis to calculate rate ratios for risk factors for injury and to facilitate planning for future prevention and intervention activities.

3. Partners (participants in the project and the roles they served)

This study involved four categories of partners and/or participants:

a. University of Minnesota faculty and researchers – these researchers had key roles in the design and implementation of this study:
Peter Hannan, MA, M.Stat, M.Ed, Epidemiology, University of Minnesota
Susan Gerberich, PhD, Environmental Health Sciences, University of Minnesota
Bruce Alexander, PhD, Environmental Health Sciences, University of Minnesota
John Shutske, PhD, Biosystems & Agricultural Engineering, University of Minnesota
b. Youth at Work Advisory Group – This group was comprised of current and former high school educators, representatives from the state department of education, county public health, and University of Minnesota researchers.
c. Administrators and teachers from 41 rural Minnesota high schools who agreed to participate
d. The approx. 14,000 students from 41 rural Minnesota high schools who completed up to 5 surveys over two successive school years.

4. Customers (intended users or beneficiaries of the results)

Customers include (a) rural high schools that were provided with data about their students (injuries, work hours, sleep hours, homework hours, tobacco and alcohol use, seat belt use, patterns of school commuting, asthma, and other survey data); (b) state and local public health professionals; (c) University of Minnesota agricultural and occupational health researchers; and (d) other researchers.

5. Approach (tasks involved in conducting the project)

Self-completed in-school questionnaires were developed and used to ascertain injuries, work experiences, asthma, and potential risk factors among adolescents attending a stratified random sample of 41 rural Minnesota high schools from four agricultural regions and three categories of school size. Questionnaires were administered to students four times over two consecutive school years. Fall surveys ascertained events from the previous summer while spring surveys ascertained events during the school year. All 9^{th}, 10^{th}, and 11^{th} grade students were asked to complete the questionnaires during the first year, and all 10^{th}, 11^{th}, and 12^{th} grade students were asked to complete the questionnaires the second year. Participation declined with each survey; the initial survey included 13,869 participants from 41 high schools, while the fourth and final survey included 7,802 participants from 35 schools. A brief midyear work and injury survey was administered to a sample of students during the second year to evaluate differing periods of recall.

6. Results/Findings (preliminary or final observations and conclusions)

Using a very broad definition of work (paid or unpaid work or chores), this study found that the vast majority of rural Minnesota adolescents are engaged in work or chores. Data from the most complete surveys (first year) showed that just over 80% of 9^{th}-11^{th} grade students reported some work during the summer, while 65% worked at some point during the school year. More girls reported working than boys both during the summer and school year, and the proportion of adolescents working, as well as their work hours, increased with grade level and age. About one out of ten reported jobs were related to agriculture. The majority of agricultural jobs were with traditional farms and there appeared to be no shift toward agribusiness work versus traditional farm work. Among students who completed all four surveys, 23% reported at least one agricultural job over the two-year period. About 9% of adolescents reported one or more injuries both during the summer and during the school year. About one in five injuries occurred at work during the summer and about one in eight injuries occurred at work during the school year. Agricultural injuries were reported by 0.5% of students during the summer and by 0.3% of students during the school year. In a multivariate analysis, age, current smoking, agricultural work, farm residence, obesity, and increased work hours were significantly associated with work-related injury during both the summer and school year. Male gender and reduced sleep hours were also significantly associated with work-related injury during the summer. Among students who completed all four surveys, about 4.5% of working students reported at least one agricultural injury. Ever-diagnosed asthma was reported in 12.6% of students during the initial survey and smoking, female gender, and obesity were significantly associated with risk of asthma, while farm residence was protective. There was inconsistent evidence of a recall bias for injury and work.

This survey confirms that the great majority of rural Minnesota adolescents participate in work or chores, both during the summer and school year. Many rural youth are engaged in agricultural work activities, regardless of whether they reside on a farm. About one in ten jobs were related to agriculture and there was no evidence of a shift in patterns of agricultural work over the span of this study. Work-related injuries comprised only a small portion of total injuries, and agricultural injuries represented a small proportion of total work-related injuries. Nearly one in eight students reported ever-diagnosed asthma. Falling participation rates and a sharp decline in reported rates of multiple-item survey questions (injury, work, asthma) on the second year surveys limited their usefulness and suggest that fewer or shorter surveys are warranted. Survey data should be useful in targeting intervention and prevention activities.

7. Outputs (reports, publications, products, methods, etc.)

Report: Williams AN, Langner DM, Lindgren PG, Brunner W, Hickman C, Hill D, Boyle D. Childhood Agricultural Trauma Evaluation System, Final NIOSH Technical Report, February 2006. 198p.

Publication: Brunner WM, Lindgren PG, Langner DM, Williams AN, Yawn BP. Asthma among rural Minnesota adolescents. Journal of Asthma 42(9):787-792, 2005.

Presentation: Brunner W, Langner D, Williams A. Keysser J. Asthma in Rural Minnesota Adolescents, CDC 4th National Asthma Conference: Winning with Asthma, Atlanta, GA, April 14-16, 2004.

Presentation: Williams AN, Langner DM, Lindgren PG. Childhood Agricultural Trauma Evaluation System, NIOSH Childhood Agricultural Safety and Health PI Research Conference, Pittsburgh, Pennsylvania, September 2004.

Minnesota Department of Health Fact Sheet and Press Release: Asthma in Rural Minnesota Adolescents. May, 2004
http://www.health.state.mn.us/divs/hpcd/cdee/asthma/documents/RuralAdolescents.pdf

Report: Asthma in Minnesota – 2005 Epidemiology Report. Asthma Program, Minnesota Department of Health, Minneapolis, MN. September 2005.

PhD Dissertation, University of Minnesota. (Pending as of 10/31/06).

8. Outcomes (how outputs have been used, e.g. change in behaviors, processes, technologies, guidelines, etc. that have made a difference in measurable endpoints related to exposures or health and safety indicators)

This project was funded under the NIOSH program area, "Research to Strengthen Occupational Safety and Health Surveillance." This study was designed to evaluate a surveillance strategy to identify work experiences, injuries, asthma, demographic data, and other possible risk factors for those outcomes in a representative rural population of Minnesota adolescents. Study outcomes can be characterized in terms of surveillance methodology and surveillance data.
Surveillance Methods. By using broad definitions of work and injury and in-school questionnaires, this study provides a broader look at youth work, injury, and asthma than studies of only farm families or only emergency department admissions. Students were surveyed four times over two consecutive school years. While in-school surveys and a stratified random sample design proved to be a cost-effective method to obtain work, injury, asthma, and other data from

adolescents, interpretable data were largely limited to the initial two surveys. For the final two surveys, a sharp decline in participation at both the school level and individual level were evident. In addition to the declining participation, even among those students completing the final two surveys, a significant decline was noted in positive responses to the key multi-part questions involving injury, work, and asthma (declines not supported by other concurrent data sets).

Surveillance data. Key findings from the two initial surveys have been disseminated in two separate communications to all participating high schools. Unfortunately, the study protocol did not include time or resources for follow-up to determine how schools may have utilized these findings to address issues related to occupational health and safety among their students. Work and injury data have not been more broadly disseminated or published pending completion of a doctoral thesis. However, asthma prevalence and risk factor data have been widely disseminated and utilized by the Minnesota Department of Health (MDH) CDC-funded program, “Addressing Asthma from a Public Health Perspective.” Asthma data from this study represent the best estimates to date of asthma prevalence in rural Minnesota adolescents and prevalence and risk factor data have been disseminated through a published paper, an MDH press release, and inclusion in the MDH Asthma Program’s 2006 asthma burden report, “Asthma in Minnesota.” These data continue to be utilized by the MDH Asthma Program and its partners in program planning and will inform the 2007 update of the state’s “Strategic Plan for Addressing Asthma in Minnesota.”

Title: **The Wisconsin Youth Employment Training Pilot Program**

Abstract

This project will develop and implement a new model for youth occupational injury surveillance in Wisconsin. This model will link injury surveillance with the Wisconsin youth work permit system. Within the next two to three years, the Wisconsin Department of Workforce Development (DWD) plans to computerize the current child work permit system. Now, during the initial computerization planning process, is an opportune time to develop a surveillance component that can be incorporated into the work permit application system. Upon successful completion, the proposed pilot study could affect the statewide implementation of the DWD program and expand the linked injury surveillance and the work permit application system to all of the public high schools in Wisconsin.

There have been no youth surveys to determine the incidence of occupational injuries in Wisconsin. Existing data comes from Workers' Compensation Claims. Currently there is no comprehensive occupational safety training program for working Wisconsin youth nor is there easy youth access to safety information or a mechanism for getting questions answered.

The project will:

- Develop a computerized youth work permit application.
- Develop and maintain a computerized work permit database in order to make sure that jobs applied for are not prohibited by State or Federal rules, or individuals whose permits have been revoked do not receive another.
- Develop a computerized safety training program for working minors.
- Develop a computerized survey for minors who are working that can be administered during school.
- Create a website/hotline to address any student work safety concerns.

Data from the anonymous school based surveys will be used to determine whether youth who have obtained a work permit are less likely to experience a work related injury.

a. Specific Aims

This research project will develop and implement a new model for childhood occupational injury surveillance. This model will link injury surveillance with the childhood work permit system. Within the next two to three years, the Wisconsin Department of Workforce Development (DWD) plans to computerize the current child work permit system. Now, during the initial computerization process, is an opportune time to develop a surveillance component that can be incorporated into the work permit system. Upon successful completion, the proposed pilot study could affect the statewide implementation of the DWD program and expand the linked injury surveillance and the work permit system to all of the public high schools in Wisconsin.

Program goals:

- Reduce the incidence of injury and death for Wisconsin working children.
- Provide an educational program for children so they become knowledgeable about basic occupational health and safety principles.
- Identify and remove youths who are working in hazardous situations and prevent them from working in jobs prohibited by State or Federal rules.
- Educate employers who are attempting to employ youths in prohibited jobs, who are having higher rates of injury, or who have an unsafe work environment. Companies that have fewer than 250 employees would be given information about OSHA Consultation services and how those free services could benefit them and their employees. Because OSHA Consultation is totally voluntary, the company would need to call and invite the consultants to their facility to assist them with any problem they may be experiencing. A referral to an OSHA Enforcement agency would also be done when the situation warranted.

It is our goal that this pilot program will not end once the program has been completed. By working with the Department of Workforce Development, this program eventually could be implemented in every public school in the State of Wisconsin. The Bureau of Occupational Health and the Department of Workforce Development want all of our children educated about occupational hazards so they are less likely to become injured while working.

We also want to create a program that could be easily implemented by other states that would like to create a similar program for their children. Wisconsin would be able to work with individual states to provide information about the best ways to start their own educational program.

This program will be completed in coordination with the Department of Workforce Development and the Department of Public Instruction and would be tested in four public high schools: two rural and two urban schools. This would allow us to see how the program would work with students who are working primarily in the private sector as well as students who are working on farms and the informal working sectors. The program will be comprised of four components:

1. Computerize work permit applications so that Federal or State rules (copies of these rules can be found in Appendices B and C) do not prohibit the jobs applied for. This component will be done in conjunction with the Department of Workforce Development, the department which currently oversees the work permit system. In the new computerized work permit system, if a child enters a job description that is in violation of State or Federal rules, the work permit will not print out and would not be issued. The denied permit will be flagged. This will allow us to intervene and make sure that the child does not work at all in those hazardous sites and therefore reduce the risk of injury or death for the children involved. The system will also determine if the child has had a revoked permit or other violations that will disqualify the child from receiving a (new) permit.

2. An anonymous cross sectional computer survey at each of the participating pilot schools will be developed and administered to all working minors (regardless of whether they have been issued a work permit). The survey will be completed every six months. All students during a particular class (for example, a mandatory English, Math, or computer class) will complete this questionnaire by accessing a secure computer system or website. Paper forms could be used as well to complete it. The survey will ask specific questions to determine if the student is being asked to do tasks that are prohibited by State or Federal rules and if tasks they are currently performing are different from those stated on the work permit. The survey will also determine if the student is being asked to do tasks

that he/she feels are unsafe, why they feel it is unsafe. We will also learn if they had been injured on the job that quarter and how the injury occurred. This will allow us to get more accurate data regarding the types of injuries the children have had during the quarter. The survey would also ask the students with work permits if they are still working and if the job listed on the work permit is the same as what he/she is presently doing. Although anonomous, this information will allow us to focus intervention programs toward industries that seem to have the higher rates of injury for children and to quickly intervene for the children who voice concerns about working in an unsafe environment, before they become injured. We will also be able to work with individual companies to educate them about the tasks children are able to legally perform if it is shown that a company is placing children in work activities that are hazardous. If necessary, other referrals to OSHA Consultation or OSHA Enforcement would be made in order to ensure the safety of the working children.

3. A computerized training program for students will be developed so that they can receive accurate information regarding how to work safely and what jobs they are able to perform in the State of Wisconsin. Currently, there is no formal training program in Wisconsin to train working minors about occupational safety and health issues. A computerized training program will allow the students to complete the training program at their own pace and would give all students a basic understanding about safety in the workplace and the importance of working safely. By computerizing the data, it will also ensure uniformity of the data being taught throughout the school systems of the pilot schools.

4. A website/hotline for students to ask questions or voice concerns regarding unsafe work practices or other work related questions will be developed. This communication method will allow students to express concerns that might otherwise not be discussed with parents, teachers, or others. This will allow us, if necessary, to quickly refer the situation to the Department of Workforce Development or other regulatory agency so that the Department of Workforce Development (DWD) or other agency could intervene on behalf of the student so that they will not be injured on the job. This will also give the student a sense of empowerment so that they will also be less likely to allow unsafe working conditions to occur when they are working adults.

b. Background and Significance

At the State and Federal levels, we hear speeches delivered expressing how our children are a priority and how they are the future of our country and society. Programs have been created to promote the physical and cognitive development of children so that they can achieve their maximum potential. Our country has taken pride with its health promotion and hazard reduction activities, but often overlooked are the hazards a child may encounter while on the jobsite. More than 75 years ago, the U.S. Children's Bureau in the Department of Labor was developed to end the exploitation and hazardous conditions working children were subjected to. Unfortunately, unsafe conditions still continue to exist. Even today in Wisconsin, we recently read about the illegal working conditions an employer subjected Wisconsin children to and how those conditions led to injury and deaths.

A review of the Wisconsin Worker's Compensation data for 1997 was done to specifically look at children who were injured while working. The results showed that there were 550 non-fatal injury claims for children aged 10 through 17 years old. One farming fatality of a 12 year old child was also noted by the Wisconsin Fatality Assessment and Control Evaluation (FACE) Program. During 1997, there were 26 Worker's Compensation claims filed on behalf of Wisconsin children aged 10 (5), 12 (3), 13 (4), and 14 (14). Their injuries included 8 lacerations;

4 contusions; 3 fractures; 3 strains; and 1 each of inflammation, sprain, crushing, and puncture injuries; as well as 4 other unspecified injuries. The industrial sectors in which these children were predominately employed were newspaper publishing (7), eating/drinking places (6), timber tracts (2), and construction (2).

During 1997, 524 Wisconsin children aged 15 to 17 years of age filed Worker's Compensation claims for non-fatal injuries. There were 43 (8.2%) 15 year olds, 183 (34.9%) 16 year olds, and 298 (56.9%) 17 year olds. For the children aged 15 – 17, the leading type of injury claims were strains (124), lacerations (109), contusions (60), burns (40), and fractures (31). Thirty-percent (158) worked in eating, and/or drinking places, 9% (49) in grocery stores, and 3% (17) each in department stores and skilled nursing facilities. The types of injuries that predominated in eating and drinking places were lacerations (52), burns (30), strains (21), and other specific injuries (16). In grocery stores, most injuries involved strains (15), lacerations (10), or contusions (9). In department stores, strains (6), other specific injuries (5), and contusions (4) predominated; however one electrical shock was reported. In skilled nursing care facilities, strains (9), and other specific injuries (3) accounted for the majority of reported claims. In the miscellaneous amusement and recreation sector, 2 fractures were noted in addition to lacerations (3), strains (3), and other specific injuries (3).

When looking at all children aged 10 to 17 who were Worker's Compensation claimants in 1997, about three fourths were clustered in the retail trade or service industries. An additional 70 young claimants were employed in agriculture/forestry, construction, and manufacturing, which are high risk industrial sectors. Because Worker's Compensation only records injuries that are severe enough to cause the employee to be unable to work at least three consecutive days due to the injury, it is unknown how many Wisconsin children are injured and do not have those injuries reported as a Worker's Compensation claim. Some other problems using only Worker's Compensation data for calculating injury rates for children are that we know many children work on family farms and in the informal sector, which we do not have reporting or claimant mechanisms for non-fatal injuries. We must also acknowledge the incompleteness of Worker's Compensation data that results from eligibility requirements, as well as the fact that employees must seek out this form of compensation. With the review of injuries in 1997, it has been shown that many children were injured on the job in Wisconsin severely enough to file for a Worker's Compensation claim and some of the children were engaged in hazardous work contrary to child labor laws in Wisconsin. Copies of 1997 and 1998 Worker's Compensation data for youths can be found in Appendix I.

According to the Wisconsin Department of Workforce Development (DWD), there are on average 130,000 work permits issued annually to Wisconsin youths. (A copy of a Wisconsin work permit can be found in Appendix A.) According to the DWD, the issuing of work permits began around 1916 in the State of Wisconsin and the process has not changed since it was first created. Paper work permits are completed at a designated work permit issuing site and then are mailed back to the DWD. The problems that the DWD is encountering are that the work permits are being sent to their agency anywhere from one to four months or more after they have been issued. This leaves the children at risk if they are working in a prohibited work area for a length of time before the work permit is revoked.

c. Research Designs and Methods

This research project will develop a new model for childhood injury surveillance. This model would create an opportunity to link surveillance with the work permit system. Since the Department of Workforce Development (DWD) plans to computerize the work permit system for the State of Wisconsin, the augmentation of surveillance with the work permit system could be done during the initial computerization process. The pilot study could also affect the statewide implementation of this program by expanding the linkage of surveillance and the work permit system to all of the public high schools in Wisconsin.

Analysis of the surveillance data from this youth injury surveillance model will address the following hypothesis.

Hypothesis: Does obtaining a work permit reduce the incidence and severity of injuries and diseases for employed minors?

Definitions

A minor is an individual under 18 years of age. This definition may be subject to change due to discussions and input from DWD and the Department of Public Instruction (DPI). The case definitions of injuries and disease will be defined during year one of the study prior to any implementation of the program. The case definitions will be reviewed by the State Occupational Surveillance Consortium (SOSC) to ensure that the study designs and data collection protocols will be uniform so that other states could use them.

The surveillance study will enroll a cohort of students from four Wisconsin public high schools. Two urban public high schools of approximately 3,000 students each and two rural public high schools of approximately 250 students each will be selected, creating an estimated cohort size of 6,500 students. Parental consent would be obtained prior to performing the student surveys. This consent will be either a formal written consent or a passive consent. With passive consent, the principal (or other person such as the superintendent or school board) would give information to each parent explaining what the survey is and how the information is to be used. The parent must contact the school if the parent didn't want the student to participate in the survey. With a formal consent, the parent will be given information and then must sign the written consent to allow their child to participate in the survey. The Department of Public Instruction (DPI) has indicated that each school district is independent and most have adopted methods of obtaining consents. DPI reports that consent would be either formal or passive depending on the school and that many of the schools already have consent forms for formal parental consents. DPI said we would need to ask if their forms would be required if that school district felt that formal consents were necessary.

Wisconsin is a good choice for this type of study because both the Department of Workforce Development and Department of Public Instruction are highly supportive (see letters of support). They support a pilot program and have offered their assistance to ensure that the pilot program will succeed. Both Departments have voiced their concerns regarding youth related injury and disease and feel this program would be a viable method to reduce those conditions.

Title: **Work injuries among young people: A prospective study**

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List of abbreviations

National Occupational Research Agenda (NORA)
Survey of Labour and Income Dynamics (SLID)
Work Disability Absence (WDA)
Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST)
CEGEP (a French acronym meaning College of General and Vocational Education)

Abstract

Issue addressed: This study examined the relative contribution of individual factors and job characteristics to the risk of lost days of work due to a work-related disability among Canadians 16 to 24 years old.

Approach: Our analyses used a representative sample of young workers from a longitudinal survey. Our regression analysis of work-related disability included the following predictors: age, gender, physical demands of the job (manual, non-manual, and mixed), hours worked, highest education achieved, multiple concurrent job, job tenure, school activity, and living in a rural or urban area.

Key findings: Young workers holding manual jobs were at increased risk for a work disability absence compared to young workers with non-manual jobs. Low education level was associated with the increased likelihood of a work disability absence. Other demographic factors such as gender were not independently associated with work disability absences.

Implications: This is the first longitudinal study on young workers that found that job characteristics are the predominant risk factors for work disability absences for young workers, and individual factors such as gender were not independently associated with the outcome. Young workers with less education appear to be particularly vulnerable, possibly due to inadequate job skills or particularly dangerous jobs.

Definition of problem being addressed

Work injuries and illnesses among American and Canadian young people 15 to 24 years old are a public health concern. In developed countries, both teenagers and young adults have consistently higher rates of work injury than older workers (8-10). For U.S. teenagers alone, the economic cost of work injuries was estimated at $5 billion in 1993 (11). The purpose of the current study was to examine the relative contribution of individual and job factors to injury risk in a prospective study.

Among young workers, the risk of work injuries is often attributed to individual characteristics. For example, young males sustain work injuries at about twice the rate of young females (12). Also, cognitive and physical developmental factors of teenagers are widely believed to increase injury risk, leading to the current emphasis on school- and community-based educational programs in North America (13;14).

The job characteristics can also influence injury risk. Young workers in manual jobs (e.g., stockhandlers, janitors/cleaners), jobs in the goods-producing sectors (e.g., agriculture, manufacturing, and construction) and food service jobs have higher work injury rates than youth in sales jobs or administrative/clerical jobs (12;15;16). In particular, the physical demands of the job have been shown to be associated with the chance of a work injury (17).

With regard to temporal factors, working longer hours is sometimes associated with injury risk (18), possibly due to fatigue or simply a function of increased exposure time (19). Some studies of work injury records find that new young workers are at increased risk of work injury compared to their more experienced counterparts (20-22). However, self-report studies find the opposite relationship (19) or no association between experience and work injury risk (23). These mixed findings may be due to self-report studies not pinpointing when the injury occurred during each worker's job tenure. Had the studies done so, it would have been possible to track the specific risk of injury for each phase of job tenure. Without this detailed analysis, such job tenure findings address cumulative injury risk versus phase-specific risk.

Several methodological limits complicate the risk estimates provided in previous studies. First, most studies of young workers are descriptive and do not adjust for the fact that males are more likely to hold hazardous jobs (e.g., manual work, jobs in industries with higher injury rates) than young females.

Second, for studies using administrative data sources, underreporting may be an issue. For example, studies which rely on workers' compensation claims could fail to capture all work injuries ((24)), especially if filing a claim might affect a firm's insurance premium or increase their risk of being inspected. Underreporting of claims could bias risk factor estimates if the likelihood of reporting injuries to the compensation system differs by industry or by young worker characteristics. Relying on health records (i.e., health care visits) as a data source can also be problematic and lead to reporting bias, since not all injured workers seek health care services. Research shows that only 34 percent of occupational injuries are treated in emergency departments (25).

Finally, virtually no studies have utilized longitudinal data to examine risk of work injury. An exception is Feldman and colleagues' one-year follow-up of high school students on incidence of musculoskeletal pain (26). In this study, jobs such as baby sitting or non-manual work led to more neck/upper limb pain and back pain (respectively) than those not working at all.

Aims of the project

One of the key aims of this project was to better define the nature and magnitude of injury risk experienced by young workers. In particular, the proposed multivariate analysis of longitudinal data will overcome the threats to causal inference associated. Specifically, we used longitudinal data from a nationally representative sample of teenagers and young adults to examine the relationship between individual, job, and temporal factors and self-reported work absence due to a work-related illness or disability.

Partners

The federal agency Statistics Canada is the custodian of the data that we used for these secondary data analyses and was a partner in making these secondary data analyses possible.

Customers

These findings are relevant to employers who employ young workers, occupational health and safety practitioners, and public policy decision makers who develop and finance youth work injury prevention programs.

Approach

Data and sample

The Survey of Labour and Income Dynamics (SLID) consists of a series of six-year overlapping panels (each of the six years is considered a wave within a panel), with a new panel being introduced every three years to replace the oldest panel (27). Available data from these panels cover the time period from 1993 to 2003 inclusive.

Respondents are interviewed annually about their work experiences over the previous calendar year in up to six jobs and report monthly on the characteristics of each job. These secondary data analyses were approved by the Health Sciences I ethics committee at the University of Toronto.

Population

The target population for SLID is all persons living in Canada, excluding people in the Yukon or Northwest Territories, residents of institutions, persons living on Reserves, and full-time members of the Canadian Armed Forces living in barracks. The initial representative sample of each panel is drawn from respondents of Statistics Canada's Labour Force Survey. For each panel, the sample is approximately 15,000 households, comprising about 31,000 persons aged 16 years and over.

This analysis focused on respondents who were between the ages of 16 and 24 years old and were employed at some point during the observation period.

Outcome, Work Disability Absence

The outcome measure (event) was the first observed occurrence of a work disability absence (WDA) for a person in a given job. A WDA was defined as any absence for one week or greater due to a work related illness or disability. Providing evidence of concurrent validity, this WDA measure showed similar time trends as workers' compensation claim rates in a Canadian province (28).

For each respondent, every job start over the six waves of the panel provided a new person-job episode to be used for the analysis. However, person-job episodes that started prior to the respondent entering the panel were not included in the analysis due to difficulties in determining exposure time and because a WDA could have occurred prior to panel entry.

WDAs were not linked to a specific job when multiple concurrent jobs were being held. Given this, we attributed the work accident of respondents who held multiple concurrent jobs and experienced a WDA to the job identified as the main-job for that month (the job with highest usual hours for that month). A sensitivity analysis was undertaken to assess the impact of assigning the WDA to the respondent's main-job.

For person-job episodes with a WDA, all months of observation after the month of the WDA were excluded. For respondents who held multiple concurrent jobs at the time of a WDA, observed months in all concurrent jobs after the month of the WDA were excluded.

Covariates

Covariates for each person-job episode included in the model were age, gender, job type, hours worked, highest education achieved, having multiple, concurrent jobs, job tenure, school activity, living in an urban versus rural area, and a flag indicating what panel the person-job episode arose.

Age was considered a time-varying covariate, calculated in months and updated each month.

Jobs were classified into three categories of physical demands: manual, mixed, non-manual using the Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST) occupation coding system (29). The coding system is based on observations in workplaces and agreement among experts in the occupational health and safety field on the typical frequency of handling loads and the weight of the load.

Hours worked in a given month for a particular job were assessed by multiplying the average number of paid hours in weeks by the number of weeks worked in that month. Total hours were categorized into four groups (0 to 60, 61 to 120, 121 to 160 and 161 or more hours per month).

Highest education achievement was identified with a three category variable (no secondary degree, secondary degree, post secondary degree) in December of each year of observation.

Job tenure was calculated as the number of months between the start date of the person-job and the current month of observation.

A flag indicating current full time school activity in a given month of observation was used to assess the differences between those respondents who were balancing work and school commitments compared to those who were not.

Given the potential differences in employment patterns and the varying types of jobs held by youth living in urban environments compared to living in rural environments, a flag indicating urban residence was used in the model.

An indicator of the panel (1-4) from which the data arose was also used in the model to control for any difference that may exist between the different cohorts.

Analysis

The complementary log-log model for continuous time processes, as described by Allison (30), was employed. This model is based on the assumption that events are generated by a proportional hazards model with an exponential hazard within a particular time period, but makes no assumptions are made about the overall shape of the hazard across time periods. The analysis was undertaken on a month by month basis. Therefore, a single person-job episode could contribute a maximum of 72 months of observation over the six year observation period. This modelling framework allows for time-dependent covariates.

A list-wise deletion was employed, deleting any observation that did not provide complete responses to all covariates. All covariates were entered in the analysis model simultaneously.

Given the complex nature of the survey and the non-independence that arises due to the clustering of person-job episodes within individuals (respondents may hold more than one job over the six-year period of observation either consecutively, concurrently or both) we calculated robust variance estimates using a weighted bootstrap method with 1000 replicates to adjust variance estimates. The bootstrap technique assumes independence across respondents when estimating the coefficients but accounts for the true non-independence of respondents when estimating the variance of coefficients (31). The weights take into account sampling probabilities and non-response. The weight from the first wave of each panel was used for all subsequent waves of data.

Potential for bias due to sample selection and proxy responses

To assess the potential impact of a person-job episode due to exclusion or non-response, an analysis of those jobs selected for analysis compared to those jobs not selected for analysis was undertaken. A job-based logistic regression model was developed where the outcome was whether or not the job was included in the analysis with the independent variables being the job holder's age (at the start of the job) and gender.

The SLID allows one household member to answer questions on behalf of any or all other members of the household, provided he or she is willing and able to do so (i.e., proxy response). Given this study examines 16 to 24 year old respondents (and that the younger a respondent the greater the potential to have responses through proxy) an estimate of the impact of proxy reporting was undertaken. A logistic regression model was estimated with the job holder's age (at the start of the job) and gender as predictors and whether or not the job was reported through proxy response as the outcome.

Results

Background characteristics

The 16 to 24 year old respondents who had complete covariate information and met the study inclusion criteria provided 360,808 person months of observation from 45,125 jobs. During the observation period there were a total of 281 WDAs observed. The number of jobs, person-months of observation, number of WDAs and the WDA rate per 1000 person-months is provided in Table 1 for each covariate.

Table 1. Number of Jobs, Person Months of Observation and Work Disability Absence Rate for SLID respondents aged 16 to 24 years old. Weighted.

	Jobs	Person Months		Work Disability Absence	
	N	N	%	N	Rate per 1000 PY
Total	45125	360808	100.00	281	0.78
Gender					
Female	22452	184879	51.24	122	0.66
Male	22673	175929	48.76	159	0.91
IRSST Job Type					
Manual	21621	149119	41.33	177	1.19
Mixed	13273	110144	30.53	66	0.60
Non-Manual	10231	101546	28.14	39	0.38
Total Hours Worked (month)					
0-60	9623	86995	24.11	22	0.25
61-120	11525	94391	26.16	40	0.42
120-160	18837	145518	40.33	158	1.09
161+	5140	33904	9.40	61	1.81
Highest Education					
Less than High school	11383	65773	18.23	98	1.49
High school	22711	182894	50.69	126	0.69
Post-Secondary	11031	112141	31.08	57	0.51
Multiple Concurrent Job					
No	36348	293000	81.21	252	0.86
Yes	8777	67808	18.79	30	0.44
Tenure (months)					
0-2	13094	24730	6.85	43	1.75
3-4	10290	37597	10.42	56	1.50
5-6	4624	25254	7.00	43	1.70
7-12	8347	18538	5.14	58	3.11
13+	8770	194689	53.96	81	0.42
School Activity					
No	29702	223634	61.98	236	1.06
Yes	15423	137174	38.02	45	0.33
Living in Urban Area					
No	11805	60139	16.67	66	1.09
Yes	33320	300669	83.33	216	0.72

Multivariate regression results

Results of the fully-adjusted multivariate regression analysis examining the antecedents to WDA are presented in Table 2 including the hazard ratio (HR) and the corresponding 95 percent confidence interval (CI). The final column of the table represents the percentage deviation of the hazard ratio from the null value (1.00).

Manual occupations were 165 percent more likely to experience a WDA compared to non-manual occupations (HR: 2.65, CI: 1.59, 4.41) while mixed occupations had only a 70 percent increase (HR: 1.70, CI: 0.78, 3.68).

Total hours worked per month showed a dose response relationship with increasing hours and increasing risk. Jobs with monthly hours between 61 and 120 hours had a 86 percent increase in the likelihood of a WDA compared to jobs with hours between 0 and 60 (HR: 1.86, CI: 0.89, 3.89). A 381 percent increase was seen for jobs in the 120 to 160 hour range (HR: 4.81, CI: 2.15, 10.76) with a 623 percent increase for jobs working greater than 160 hours per month (HR: 7.23, CI: 3.22, 16.22) compared to jobs with hours between 0 and 60.

Respondents who had completed high school or post-secondary education were seen to decrease their risk of a WDA by 51 to 65 percent (HR: 0.49, CI: 0.27, 0.92 and HR: 0.35, CI: 0.17, 0.73 respectively). Little difference in risk was noted between those who finish high school and those that have finished some sort of post-secondary education.

As noted, when a respondent had multiple concurrent jobs and a WDA, the WDA was assigned to the main-job. In a sensitivity analysis for this treatment of the WDA, the WDA was not re-assigned to the main-job. The full multivariate model was then regenerated with no differences in the direction or relative relationship between the original hazards and the hazards from the sensitivity analysis noted. Given the small number of WDAs that are re-assigned this outcome was expected and demonstrates the minimal effect this decision has on the hazard estimates.

Potential for bias due to sample selection and proxy responses results

The three reasons for not being selected for analysis were examined (job started before the period of observation, missing covariate information and non-response during the first wave of the survey). Overall, gender did not vary greatly between those jobs selected for analysis compared to those jobs not selected for analysis. And, as age increased, the likelihood for selection into the final model decreased.

Proxy responses were 1.47 times more likely to be provided for jobs held by male respondents compared to jobs held by females respondents independent of age (CI: 1.34, 1.60). The likelihood of a proxy response was decreased as age increased. For example, proxy responses were 9.72 times more likely to be provided by jobs held by 16 year old respondents compared to jobs held by 24 year old respondents (CI: 6.32, 14.93), independent of gender. By the time respondents were 20 years old, the likelihood decreases to 2.10 (CI: 1.36, 3.24).

Table 2. Estimates of Hazard Ratios for Work Disability Absence

	Paramete r Estimate	Standard Error	Hazard Ratio	95 % CI	Percent Change
Intercept	-9.08157	0.97277			
Gender					
Females			1.00		
Males	-0.27592	0.24384	0.76	0.47 , 1.22	-24.11
Age (years)	0.06010	0.04276	1.06	0.98 , 1.15	6.19
IRSST Job Type					
Non-Manual			1.00		
Manual	0.97449	0.25944	2.65	1.59 , 4.41	164.98
Mixed	0.52963	0.39504	1.70	0.78 , 3.68	69.83
Total Hours Worked					
0-60			1.00		
61-120	0.62170	0.37648	1.86	0.89 , 3.89	86.21
120-160	1.57010	0.41127	4.81	2.15 , 10.76	380.71
161+	1.97772	0.41239	7.23	3.22 , 16.22	622.63
Highest Education					
Less than High school			1.00		
High school	-0.70533	0.31746	0.49	0.27 , 0.92	-50.61
Post-Secondary	-1.04555	0.37235	0.35	0.17 , 0.73	-64.85
Multiple Concurrent Job					
No			1.00		
Yes	-0.17401	0.31059	0.84	0.46 , 1.54	-15.97
Tenure (months)					
0-2	-0.55565	0.38290	0.57	0.27 , 1.22	-42.63
3-4	0.19342	0.27224	1.21	0.71 , 2.07	21.34
5-6	0.32052	0.28554	1.38	0.79 , 2.41	37.79
7-12	-0.02507	0.20636	0.98	0.65 , 1.46	-2.48
13+			1.00		
School Activity					
No			1.00		
Yes	-0.48234	0.26869	0.62	0.36 , 1.05	-38.27
Living in Urban Area					
No			1.00		
Yes	-0.15220	0.19831	0.86	0.58 , 1.27	-14.12
Panel					
1			1.00		
2	-0.22443	0.24427	0.80	0.50 , 1.29	-20.10
3	-0.22754	0.26295	0.80	0.48 , 1.33	-20.35
4	-0.67751	0.38777	0.51	0.24 , 1.09	-49.21

Discussion

Findings and limitations

This is the first prospective study of the predictors of work-related disability among young workers. We found young males had a higher work disability absence rate compared to young females. However, the adjusted odds of a work disability absence showed no significant gender differences. The lack of significance in the multivariate model may suggest that gender differences are due to differential work exposures of young males and female workers.

Job characteristics were the strongest predictors of work disability absence. Factors such as the physical demands and hazards of the job have been identified in previous cross-sectional studies as important variables mediating the risk of work injury in this age group (17;19;23). As would be expected, we observed a positive linear association between hours worked and work disability absence, with over time work (> 40 hours / week) showing more than a 600 percent increase in risk.

We found that independent of individual and job factors, a higher education level was associated with a decreased risk of WDA. Studies of adult workers have found higher education levels to be associated with lower risk of work injury (32). Future research might investigate the role of residual confounding since we controlled for only work hours and one of several job characteristics that may be associated with both injury risk and level of education. In addition, understanding the influence of different educational experiences (e.g., high school drop out, work experience programs) on job quality and during the school-to-work transition period may be a fruitful research direction.

Our findings need to be interpreted in the light of certain methodological limitations. Error could have been introduced into the reporting of WDAs by respondents' different definitions of work disability, different recovery times from sustained injuries and different financial pressures to remain at work. Also the type of work and the employers' policies and practices bear on whether a worker needs to take time off work when injured, or whether the worker can be accommodated on the job. These measurement biases would have generally reduced our ability to detect associations with the outcome. In addition, we cannot rule out the possibility that a WDA was a recurrence of a condition that arose in a previous job prior to entry into the panel.

The panel design led to a portion of the jobs held by youth to be excluded because we did not observe part of the work episode and therefore we did not know if a WDA occurred in the job prior to entering the panel. Therefore these findings may not generalize to young people's jobs with longer tenures. The information provided by proxy may be subject to recall biases that may further affect accuracy. Finally, we were not able to include other factors that may also have influenced the likelihood of a work disability absence such as previous work experience.

Implications and summary

Our findings support the notion that an important supplement to current school- and community-based education programs on work safety would be reducing the physical hazards youth encounter at work, potentially through technical safety improvements in the equipment and work environment.

In terms of work hours, U.S. Federal laws have restrictions on hours of work for youth 16 and under (6). However, our findings raise the question of whether work hour restrictions should be considered for older teenagers as a method of decreasing work disability.

Finally, young workers with less education appear to be a particularly vulnerable population, possibly due to inadequate job skills or particularly dangerous jobs (i.e., residual confounding of hazard exposures). Consequently, job training and injury prevention programs targeting this subgroup of workers may be warranted.

In summary, this prospective study indicates that job characteristics are a key risk factor in determining occupational health among young people. This study also contributes methodologically to the young worker literature by modelling the complex work patterns during the school-to-work transition.

Outputs

Breslin FC, Pole JD, Tompa E, Amick III BC, Smith P, Hogg-Johnson S. Antecedents of Work Disability Absence Among Young People: A Prospective Study. Annals of Epidemiology, submitted.

Outcomes

Our findings on the etiology of young worker injuries fit well into the public health approach to prevention (1)). Etiological research can help occupational health and safety practioners to identify modifiable risk factors and guide intervention development. Accordingly, our findings suggest that an important supplement to current school- and community-based education programs on work safety would be reducing the physical hazards youth encounter at work, potentially through technical safety improvements in the equipment and work environment. The practical implications of finding that young workers with low education are at risk is that job training and injury prevention programs targeting this subgroup of workers may be warranted.

Our findings on the consequences of work injuries also figure into a public health approach to prevention in that it is important to document the burden of work injury on young workers. Our finding of substantial earnings losses among injured young workers can raise awareness among employers, workers, OHS practitioners and policy makers that injuries potentially can have more than a health cost for the individual.

This finding is also relevant to workers' compensation systems. If such earnings losses are found to be persistent among injured young workers, this information can be used to revise compensation policies so that they are more equitable to those injured while their earnings trajectories are still increasing.

In addition to dissemination of the findings through the scientific literature, the Institute for Work & Health has had a dedicated department for knowledge transfer and exchange since 1999. With assistance from the Institute for Work & Health knowledge exchange specialists, dissemination opportunities for the research will include web-based and print newsletters, media releases, research summaries, and stakeholder meetings. These dissemination strategies will allow us to network with interested researchers, stakeholder organizations, and labour/employer groups in North America.

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Appendix 3: Curriculum Vitae – Traumatic Injury Research Staff

Name: Harlan E. Amandus

Title: Chief, Analysis and Field Evaluations Branch

Discipline: Epidemiology

Division/Office: Division of Safety Research/Analysis and Field Evaluations Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road, Morgantown, WV 26505

Telephone: 304-285-6000

NIOSH Employment: 1970-1996; March 2006-present

Education:

University of California at Los Angeles: BS in Mathematics - 1969
University of California at Los Angeles, MS in Biostatistics - 1970
University of North Carolina at Chapel Hill: Ph.D. in Epidemiology - 1982.

Professional Certifications: None

Research Interests: Workplace Violence, injury intervention evaluation

Memberships:

National Committee Assignments:

Honors:

Recent Publications:

H. E. Amandus, R.D. Hunter, E. James S. Hendricks (1995): Reevaluation of the effectiveness of environmental designs to reduce robbery risk in Florida convenience stores. J. Occup. Environ. Med. 37: 711-717.

H.E. Amandus (1995): Status of NIOSH research on Prevention of robbery-related international injuries to convenience store workers (Overview of the evidence). "Questions and Answers in Lethal and Nonlethal Violence". Edited by C.R. Block and R. Block. National Institute of Justice-Research Report: Proceedings of the Homicide Research Working Group, Atlanta, Georgia, January 18, 1995, Washington, DC.

H.E. Amandus, D. Zahm, R. Friedmann, R.B. Ruback, C. Block, C. Wellford, T. Bynum, et.al. (1996): Employee injuries and convenience store robberies in selected metropolitan areas. JOEM, 38(7), 714-720.

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Boyles, Gerberich, S., Amandus, H.E. et al (1997): Cattle Injuries on Dairy Farms, J. Epidemiology.

Hendricks SA, Landsittel DP, Amandus HA, Malcan J, and Bell J (1999). A Case-Control Study of Convenience Store Robbery, *Journal of Occupational and Environmental Medicine*, 41, 995-1004.

Name: Alfred A. Amendola

Title: Chief, Safety Controls Team

Discipline: Safety Engineering

Division/Office: Division of Safety Research/Protective Technology Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road, Morgantown, WV 26505

Telephone: 304-285-6386

NIOSH Employment: September 8, 2002

Education:

Ph.D., Industrial Engineering (Human Factors/Ergonomics), Texas A&M University, 1989

Professional Certifications:

Certified Professional Ergonomist Board of Certification in Professional Ergonomics Number 490

Research Interests: Safety Engineering, Ergonomics

Memberships:

Member of the Human Factors and Ergonomics Society
Member of the American Industrial Hygiene Association
Member of the American Conference of Governmental Industrial Hygienists

National Committee Assignments:

American Industrial Hygiene Association--(Engineering Committee Member, Committee Secretary 1983-1984, Committee Vice-Chairman 1984-85, Ergonomics Committee Member 1995-1997 and 2003-2006, Member of the Safety Committee 2003-2006)

American Conference of Governmental Industrial Hygienists--(Member of the Engineering Control Technology Committee 1985-1988)

Honors:

Public Health Service Awards:

Citation - 1978
Unit Commendation - 1989, 1995
Commendation Medal - 1991
Outstanding Service Medal - 1992
Outstanding Unit Citation - 1993
The Special Assignment Service Ribbon – 1993

Military Awards:

Air Medal (eight oak leaf clusters)
Vietnam Service Medal
Vietnam Campaign Medal

NIOSH:

Bullard-Sherwood Award for Research2Practice (Honorable Mention) - 2005

Recent Publications:

Al-Eisawi, K. W., Kerk, C. J., Congleton, J. J., Amendola, A. A., Jenkins, O. C., and Gaines, W.G., Jr. "Factors affecting minimum push and pull forces of manual carts", Applied Ergonomics, 30(3), 235-245, 1999.

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Name: Douglas E. Ammons

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Telephone: 304-285-6223

NIOSH Employment: December 20, 1998

Education:

B.S., Computer Engineering, West Virginia University, 1999
B.S., Electronics Engineering Technology, Fairmont State University, 1995

Professional Certifications: None

Research Interests: Applying virtual reality to study falls from elevation, and other situations that are too dangerous to study in a real environment; the application of digital human modeling in human factors research; the application of electronic systems to improve machine safety.

Memberships: None

National Committee Assignments: None

Honors: None

Recent Publications:

Hsiao H, Simeonov P, Dotson B, Ammons D, Kau T, Chiou S [2005]. "Human responses to augmented virtual scaffolding models," *Ergonomics* 48 (10) 1223-1242.

Simeonov P, Hsiao H, Dotson B, Ammons D [2005]. "Height Effects in Real and Virtual Environments," *Hum Factors* 47(2):Jun-Aug 430-438

Newbraugh B, Pratt S, Ammons D, Beaupre J, Fosbroke D, Fox J, Griffin C, Hammer R, Markovich S, Hause M, Merinar T, Powers J, Hendricks S [2005]. "Evaluating Roadway Construction Work Zone Interventions," *Lifesavers Conference*, March 13-15.Charlotte, NC

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Ammons D, Powers J, Newbraugh B [2003]. "Caught-In Injury Protection System For Wood Chippers," *National Occupational Injury Research Symposium [NOIRS]-2003* {October 28-30}Pittsburgh, Pennsylvania p. H3.3

Simeonov P, Hsiao H, Ammons D [2003]. "Postural Adaptation at Elevated and Sloped Surfaces," *NOIRS 2003 Abstracts of the National Occupational Injury Research Symposium* {October}Pittsburgh, Pennsylvania p. 84

Simeonov P, Hsiao H, Dotson B, Ammons D [2003]. "Control and Perception of Balance at Elevated and Sloped Surfaces," *Human Factors* 45(1):{Spring} 136-147

Guan J, Hsiao H, Current R, Powers J, Ammons D [2003]. "Traumatic Injury Potential to Seat Belted Operator during a Rearward Overturn of a ROPS Equipped Farm Tractor," *NORA 2003 National Occupational Research Agenda* {June 23-24}:Arlington, Virginia p. 51

Name: Jennifer Beaupre

Title: Health Scientist

Discipline: General science

Division/Office: Division of Safety Research/Surveillance and Field Investigations Branch

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NIOSH Employment: May 18, 2003

Education:

BSF, Wood Science, West Virginia University, Morgantown, WV 1998
MS, Safety Management, West Virginia University, Morgantown, WV 2003

Professional Certifications:

40 hour Hazwoper, OSHA 500 (Construction Train-the-Trainer), Emergency Training and Response

Research Interests: Roadway Construction Injuries, Transportation-Related Injuries

Recent Publications:

NIOSH [2005]. Making highway work zones safer for you and your workers. Pittsburgh, PA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, unnumbered NIOSH document.

NIOSH [2005]. Finding ways to make highway work zones safer for you. Pittsburgh, PA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, unnumbered NIOSH document.

Name: Jennifer L. Bell

Title: Research Epidemiologist

Discipline: Epidemiology

Division/Office: Division of Safety Research/Analysis and Field Evaluations Branch

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NIOSH Employment: February 1998

Education:

Ph.D. in Wildlife Biology, West Virginia University, Morgantown, WV, December 1997

M.S. in Wildlife and Fisheries Resources, West Virginia University, Morgantown, WV, August 1994

B.S. in Biology, Ursinus College, Collegeville, PA, May 1992

Research Interests: Slips, trips, and falls; logging injuries; traumatic injury

Honors:

Forest Resources Association Technical Writing Award, 2006, for "Mechanized felling reduces West Virginia WCI claims"

2006 National Occupational Research Agenda (NORA) Partnering Award for Worker Safety and Health for "Slips, trips, and falls prevention in healthcare workers", group award.

2005 Alice B. Hamilton Science Award - Human Studies Category, for Collins, J., Wolf, L., Bell, J., Evanoff, B. 2004. An evaluation of a best practices musculoskeletal injury prevention program in nursing homes. Injury Prevention 10:206-211.

2003 National Occupational Research Agenda (NORA) Partnering Award for Worker Safety and Health for "An Evaluation of a “Best Practices” Musculoskeletal Injury Prevention Program in Nursing Homes" by Collins, J., Wolf, L., Bell, J., Evanoff, B.

2000 Alice Hamilton Science Award - Honorable Mention, Human Studies Category, for Hendricks et al. 1999

Recent Publications:

Mujuru, P., Singla, L., Helmkamp, J., Bell, J.L., and Hu, W. 2006, *in press*. Evaluation of the burden of logging injuries using West Virginia workers' compensation claims data from 1996-2001. American Journal of Industrial Medicine.

Bell, JL, and Grushecky, ST. 2006. Evaluating the effectiveness of a logger safety training program. Journal of Safety Research. 37:53-61.

Bell, JL. 2005. Mechanized felling reduces West Virginia WCI claims. Forest Operations Review. 7(3):26-27.

Fact Sheet: Mechanical timber harvesting reduces workers' compensation injury claims in West Virginia. April 2005. DHHS (NIOSH) Publication No. 2005-19.

Helmkamp JC, Bell JL, Lundstrom WJ, Ramprasad J, Haque A. 2004. Assessing safety awareness and knowledge and behavioral change among West Virginia loggers. Injury Prevention 10:233-238.

Collins JW, Wolf L, Bell J, Evanoff B. 2004. An Evaluation of a "Best Practices" Back Injury Prevention Program in Nursing Homes. Injury Prevention 10:206-211.

Bell, JL, Helmkamp JC. 2003. Non-fatal injuries in the West Virginia logging industry: Using workers' compensation claims to assess risk from 1995 through 2001. American Journal of Industrial Medicine 44(5):502-509.

Wang J, Bell JL, Grushecky ST. 2003. Logging injuries for a 10-year period in Jilin Province, People's Republic of China. Journal of Safety Research 34(3):273-279.

Bell, JL, MacDonald, LA. 2003. Hand Lacerations and Job Design Characteristics in Line-Paced Assembly. Occupational and Environmental Medicine 45(8):848-856.

Bell, JL. 2002. Changes in logging injury rates associated with use of feller-bunchers in West Virginia. Journal of Safety Research 33(4): 463-471.

Bell JL, Gardner LI, Landsittel DP. 2000. Slip and fall injuries in relation to environmental cold and work location in above-ground coal mining operations American Journal of Industrial Medicine 38:40-48.

Hassi J, Gardner LI, Hendricks SA, Bell JL. 2000. Occupational injuries in the mining industry and their association with statewide cold ambient temperatures in the USA. American Journal of Industrial Medicine 38:49-48.

Hendricks SA, Landsittel DP, Amandus HE, Malcan J, Bell JL. 1999. A matched case-control study of convenience store robbery risk factors. Journal of Occupational and Environmental Medicine 41: 995-1004.

Name: Stephen Berardinelli

Title: Safety and Occupational Health Specialist

Discipline: Safety/Industrial Hygiene

Division/Office: Division of Safety Research/Surveillance and Field Investigations Branch

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NIOSH Employment: 1991

Education:

BS, Chemistry, West Virginia University, 1987
MS, Occupational Safety and Health Engineering, West Virginia University, 1991

Professional Certifications:

Certified Industrial Hygienist (CIH) by American Board of Industrial Hygiene, 1999
Indoor Environmental Quality (IEQ) by American Board of Industrial Hygiene, 2000

Research Interests: To expedite the National Institute for Occupational Safety and Health goals to identify and help correct occupational safety and health issues for the Nation's workers and emergency responders.

Memberships:

American Board of Industrial Hygiene
American Industrial Hygiene Association
American Conference of Governmental Industrial Hygienists

National Committee Assignments:

Honors:

Recent Publications:

Moyer ES, Berardinelli S [2006]. Performance of selected N-, R-, and P-series filters against exposure to diesel exhaust particulate. Journal of Occupational & Environmental Hygiene. *In journal review*

Moyer ES, Fotta S, Hayes J, Commadore, Berardinelli S [2006]. Real-time evaluation of ventilation filter-bank systems. Journal of Occupational & Environmental Hygiene. *In press*

Berardinelli S; Guglielmo C [2006]. Silo explosion at a lumbar company - a case study on extinguishing a fire in an oxygen-limiting silo [Abstract]. American Industrial Hygiene Conference and Expo, May 13-16, 2006, Chicago, Illinois. American Industrial Hygiene Association: Fairfax, Virginia. http://www.aiha.org/abs06/ps401.htm

NIOSH [2006]. Career Battalion Chief and Career Master Fire Fighter Die and Twenty-Nine Career Fire Fighters are Injured during a Five Alarm Church Fire – Pennsylvania. By Berardinelli S, Oerter B, Tarley J, Merinar T. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2004-17.

Berardinelli S, McFall M, Merinar T, Baldwin [2006]. NIOSH Line-of-duty death report: career fire chief dies & two career firefighters are injured in Ohio house fire flashover. FireRescue 24(4).

NIOSH [2005]. Career Fire Fighter Dies and Two Career Fire Fighters Injured in a Flashover During a House Fire – Ohio. By Berardinelli S, McFall M, Merinar T, Baldwin T. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2003-12.

NIOSH [2004]. Two fire fighters die and eight are injured from a silo explosion - Ohio. By Berardinelli S, Guglielmo C, McFall M. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2003-32.

Berardinelli S, Guglielmo C, Tarley J [2004]. NIOSH reports on collapse, vehicle deaths. Fire Chief 48(9):12.

Berardinelli S, Lutz V, Farmer A [2004]. NIOSH reports on rollover, collapse deaths. Fire Chief 48(7):10.

NIOSH [2004]. Partial roof collapse in commercial structure fire claims the lives of two career fire fighters – Tennessee. By Tarley J, Berardinelli S, McFall M, Merinar-T. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2003-18.

NIOSH [2004]. Career fire fighter dies searching for fire in a restaurant/lounge - Missouri. By Oerter B, McFall M, Berardinelli S. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2004-10.

NIOSH [2004]. Career fire fighter dies from injuries received during a chimney and structural collapse after a house fire - Pennsylvania. By Berardinelli S, Guglielmo C, Tarley J. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2003-04.

NIOSH [2004]. Off-duty career fire fighter dies and another off-duty career fire fighter is injured after being struck by a truck while assisting at a highway traffic incident - Florida. By Berardinelli S, Romano N, Tarley J. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-35.

NIOSH [2004]. Career fire fighter/emergency medical technician dies from injuries sustained in fall from apparatus - California. By Lutz V, Berardinelli S. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2003-07.

NIOSH [2004]. A summary of health hazard evaluations: issues related to occupational exposure to fire fighters, 1990 to 2001. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Publication No. 2004-115.

NIOSH [2003]. Volunteer lieutenant dies following structure collapse at residential house fire - Pennsylvania. By Tarley J, Lutz V, Berardinelli S. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-49.

NIOSH [2003]. Volunteer Assistant Chief Dies in Tanker Rollover - New Mexico. By Berardinelli S, Lutz V, Farmer A. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2003-23.

NIOSH [2003]. Career lieutenant and fire fighter die in a flashover during a live-fire training evolution - Florida. By Romano N, Tarley J, Berardinelli S. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-34.

NIOSH [2003]. Career fire fighter dies after roof collapse following roof ventilation - Iowa. By Tarley J, Frederick L, Berardinelli S. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-40.

Duling M, Berardinelli S; Calvert C; Lawrence R; Coffey C [2003]. Microbiological contamination of HVAC filters [Abstract]. American Industrial Hygiene Conference and Expo, Dallas, TX. American Industrial Hygiene Association: Fairfax, VA. http://www.aiha.org/aihce03/handouts.htm

Ortega HG, Daroowalla F, Petsonk EL, Lewis D, Berardinelli S, Jones W, Kreiss K, Weissman D [2001]. Respiratory symptoms among crab processing workers in Alaska: epidemiological and environmental assessment. Am J Ind Med 39:598–607.

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NIOSH Employment: July 1996

Education:

PhD, Occupational Safety and Health, West Virginia University, Morgantown, WV, 2004

MS, Agricultural and Resource Economics, West Virginia University, Morgantown, WV, 2001

MBA, Business Administration (Economics), University of New Mexico, Albuquerque, NM, (35 of 42 hours completed in the "3/2" program), 1985

BA, Economics University of New Mexico, Albuquerque, NM: (Summa Cum Laude), 1985

Professional Certifications: None

Research Interests: Cost of Injury; Employer Costs; Determinants of Demand; Management Systems

Memberships:

International Health Economics Association
American Society of Safety Engineers
Western Economic Association
Eastern Economic Association
International Society for Quality of Life Studies
Economic Educators Association

National Committee Assignments:

National Institute for Occupational Safety and Health, NORA 2, Public and Private Services Team

National Institute for Occupational Safety and Health, NORA, Social and Economic Consequences of Workplace Injury and Illnesses, Co-Team Leader

International Association of Industrial Accident Boards and Commissions, Accident Prevention, Benefits and Cost Containment Committee

Centers for Disease Control and Prevention, Health Economics Research Group, Elected Member of Steering Committee

Center to Protect Workers' Rights, Economic Research Network, National Institute for

Occupational Safety and Health Representative

American National Standards Institute (ANSI) Z-16 Committee Member

Honors:

Federal Interagency Review Group operating at the behest of John Graham, OMB charged with providing review and guidance on Circular A-4, Regulatory Analysis, invited member

Recent Publications:

Biddle, E. [2006], Feasibility of Collecting Workers' Compensation Administrative Records, IAIABC Journal in press.

Biddle, E. [2006] Is the Occupational Fatal Injury Experience in the United States Really Improving?, Fatal Workplace Injuries: A Collection of Data and Analysis, in press.

Owusu-Edusei K, Biddle, E [2006]. A Stable Dynamic Cohort Analysis of Installing Cost-Effective Roll-Over Protective Structures (CROPS), American Journal of Agricultural Safety and Health in press.

NIOSH [2006]. Industry Sector Cost Profiles By Biddle E, Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publications No. 2006-151 to 160.

Biddle E, Hartley D [2005]. Economic Costs: Another Alternative for Measuring Workplace Fatalities, IAIABC Journal 42(1):173-192.

Biddle E, Hartley D, Starkey S, Febrega V, Richardson S. Deriving Occupational Fatal Injury Costs: A State Pilot Study, compensation and working conditions. Washington, DC: U.S.

Department of Labor, Bureau of Labor Statistics, Compensation and Working Conditions Online; 2004. Posted on http://www.bls.gov/opub/cwc/sh20050216ar01p1.htm.

Biddle E, Tapas R, Owusu-Edusei K, Camm T [2005]. Synthesis and recommendations of the economic evaluation of OHS interventions at the company level conference, J Safety Res 36(3):261-267.

Husting EL, Biddle E [2005]. Truck Safety in the Age of Information. In: Trucking in the Age of Information. Burlington, VT: Ashgate Publishing Company, 2005:247-268.

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Schulte PA, Stephenson CM, Okun AH, Palassis J, Biddle E [2005]. Integrating occupational safety and health information into vocational and technical education and other workforce preparation programs Am J Public Health 95(3):404-411.

Biddle EA [2004]. The Economic Cost of Fatal Occupational Injuries in the United States, 1980-97, Contemporary Economic Policy *22*(3):370-381.

Anderson KR, Biddle EA [2003]. Assessing the Feasibility of Evaluating the Washington State Apprenticeship and Training Program [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

Biddle EA [2003]. Measuring the Economic Burden of Fatal Occupational Injuries [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

Biddle EA, Marsh S [2003]. Comparing Costs of Fatalities from Two Fatal Occupational Injury Surveillance Systems in the United States [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

Chen GX, Jenkins EL, Biddle EA [2003]. Relationships Between Work-Related Injury Costs and Individual Risk Factors [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

Hartley D, Biddle E, Starkey S, Fabrega V [2003]. Economic Cost Model: Transferring Innovative Technology to the States [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

Husting EL, Biddle EA [2003]. The Cost to Society of Fatal Occupational Injury to Truck Drivers [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

Biddle EA, Hartley D [2002]. Fire and flame related events with multiple occupational injury fatalities in the United States, 1980-1995. Injury Control and Safety Promotion *9*(1):9-18.

Biddle EA, Marsh SM [2002]. Comparison of the National Traumatic Occupational Fatalities and Census of Fatal Occupational Injuries Surveillance System. Safety Research 33:337-354.

Hartley D, Biddle E, Grosch J, Marsh S [2002]. The burden of occupational fatal injury for older workers in the United States, Injury Insights June/July (2002):1-2, 11.

Boden LI, Biddle EA, Speiler EA [2001]. Social and economic impacts of workplace illness and injury: Current and future directions for research. Am J Ind Med 40:398-402.

Hartley D, Biddle E [2001]. Will risks to older workers change in the 21st century? Human and Ecological Risk Assessment 7(7):1885-1894.

Biddle E [2000]. Development and application of an occupational injury and illness classification system, in Encyclopedia of Occupational Health and Safety, Geneva: International Labour Office.

Biddle EA Hartley D [2000]. Fire- and flame- related occupational fatalities in the United States, 1980-1994, Journal of Occupational and Environmental Medicine 42(4):430-437.

Biddle E, Kisner SM [1998]. Denominator effects on traumatic occupational fatality incidence rates. Statistical Bulletin 79(1):28-36.

Name: Thomas G. Bobick

Title: Research Safety Engineer

Discipline: Construction safety; Industrial ergonomics

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NIOSH Employment): March 13, 1989

Education:

B.S., Mining Engineering, The Pennsylvania State University, 1970
M.S., Industrial Hygiene, University of Pittsburgh, 1988
Ph.D., Industrial Engineering, West Virginia University, 1997

Professional Certifications:

Professional Engineer (P.E.), Pennsylvania, License No. PE-025435E, 1977
Certified Safety Professional (CSP), Certification No. 10901, 1991
Certified Professional Ergonomist (CPE), Certification No. 052, 1993

Research Interests:

Construction Safety Issues – Preventing Falls from Elevation;
Emergency Medical Services Issues – Patient Compartment Safety;
Ergonomic Issues – Back Injury Prevention; Musculoskeletal-related Problems; Job and Task Analyses; Noise Control and Abatement; Whole-body Vibration; and Hand-arm Vibration.

Memberships:

Member, American Society of Safety Engineers
Member, Pittsburgh Chapter, American Industrial Hygiene Society
Former Long-term Member, Human Factors and Ergonomics Society
Former Long-term Member, American Conference of Governmental Industrial Hygienists (ACGIH)

National Committee Assignments:

NIOSH Representative to the American National Standards Institute (ANSI) A-10 Committee on Safety in Construction and Demolition Operations

DSR Representative to the NIOSH Construction Steering Committee for Safety and Health Research

DSR Representative to the NIOSH Human Subjects Review Board (Subject Protection during Research Investigations)

Honors:

Selected to attend school full-time as part of the NIOSH Long-Term Training Program, 1995-1997 (Advanced Training)

Alice Hamilton Science Award for Leadership in Occupational Safety and Health, Honorable Mention, for Their Outstanding NIOSH Document, "Safe Grain and Silage Handling," DHHS (NIOSH) Publication No. 95-109, 1995

Exceptional Effort Award for Superior Performance on "Special Assignment Related to Transfer of Whole-body Vibration Equipment," October 2002

Cash Award for Outstanding Performance for Years 2005, 2004, 2003, and 2002

Cash Award for Excellent Performance for Yrs 2001, 2000, 1999, 1998, & 1997

Patents:

"Mobile Lifting Jack," RL Unger and TG Bobick, U.S. Patent No. 4,756,509, July 12, 1988 (U.S. Bureau of Mines, Department of Interior).

"Adjustable Roof Bracket and Safety Rail Assembly," DM Cantis, EA McKenzie Jr, TG Bobick, and HD Edgell, Employee Invention Report – CDC No. I-016-04, submitted March 11, 2004, Utility Patent Application No. 11/257,472, Application Filed October 24, 2005.

Recent Publications:

Bobick TG, EA McKenzie Jr, DM Cantis, 2006. "NIOSH-Designed Adjustable Roof Bracket and Safety Rail Assembly," Abstract in: Proceedings of NORA Sym-posium 2006 – *Research Makes a Difference,* April 18-20, 2006, Wash., D.C., p 141.

Bobick TG, EA McKenzie Jr, DM Cantis, T-Y Kau, 2005. "Using Guardrail Sys-tems to Prevent Falls through Roof and Floor Holes," Paper in: Proceedings of 17th World Congress on Safety & Health at Work, Orlando, FL, Sep 18-22, 2005, 4p.

Bobick TG, EA McKenzie Jr, 2005. "Using Guardrail Systems to Prevent Falls through Roof and Floor Holes," Paper in: Safety 2005, Proceedings of American Society of Safety Engineers Conf, New Orleans, LA, June 13-15, Session 601, 18p.

Bobick TG, 2004. "Falls through Roof and Floor Openings and Surfaces, Including Skylights: 1992-2000," *Journal of Construction Engineering and Management*, (Dec 1 issue), 130(6): 895-907.

Bobick TG, PR Keane, EA Biddle, JS Spahr, 2003. "Estimated Costs of Injuries Caused by Falling through Roof Openings, Surfaces, and Skylights," Abstract in: NOIRS 2003, Proceedings of the National Occupational Injury Research Symposium 2003, Pittsburgh PA, October 28-30, Abstract No. C3.3, pp 78-79.

Bobick TG, SL Proudfoot, NT Romano, PH Moore, RS Current, JD Green, 2003. "Ambulance Crash-Related Injuries among EMS Workers," Abstract in: NOIRS 2003, Proceedings of the National Occupational Injury Research Symposium 2003, Pittsburgh PA, October 28-30, Abstract No. E3.3, pp 96-97.

Bobick TG, 2003. Summary of Doctoral Dissertation, 1997: "Effects of Lifting Height and Asymmetry on Maximum Acceptable Weight of Lift, Average Heart Rate, and Estimated Biomechanical Loading to the Lumbar Spine," *Kinesiology Abstracts*, 16(1) (April), p. 13.

Proudfoot SL, NT Romano, TG Bobick, PH Moore, 2003. "Ambulance Crash-Related Injuries among Emergency Medical Service Workers-United States, 1991-2002," The CDC *Morbidity and Mortality Weekly Report*, (Feb 28), 52(8): 154-156.

Bobick TG, DJ Long, 2002. "Overview of Deaths and Injuries Caused by Falls through Roof and Floor Openings and Surfaces, Including Skylight: 1992-1998," Paper in: Power Through Partnerships, Proceedings of the 12th Annual Con-struction Safety & Health Conference, Chicago IL, May 21-23, 2002, pp. 369-374.

Bobick TG, J-L Belard, H Hsiao, JT Wassell, 2001. "Physiological Effects of Back Belt Wearing During Asymmetric Lifting," *Applied Ergonomics*, 32(6): 541-547.

Name: Matt Bowyer

Title: General Engineer

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NIOSH Employment: April 16, 1995

Education:

Bachelor of Science Electrical Engineering, West Virginia University, May 1983

Professional Certifications: none

Research Interests:

Fire Fighter and Construction Safety, Workplace Violence, and Interventions using Electronics

Memberships:

National Committee Assignments:

Honors:

Department of Health and Human Services Secretary Award - 2001

Recent Publications:

NIOSH [2006]. Career fire fighter killed while riding manlift to assess a silo fire - Missouri. By Bowyer M, Braddee R, Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. 2005-34.

NIOSH [2006]. A volunteer fire fighter and volunteer assistant lieutenant die after smoke explosion at a town house complex – Wyoming. By Merinar T, Bowyer M, Tarley J, Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. 2005-13.

NIOSH [2005]. Career fire captain dies when trapped by partial roof collapse in a vacant house fire - Texas. By Merinar T, McFall M, Bowyer M, Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. 2005-09.

NIOSH [2005]. Career captain dies after running out of air at a residential structure fire – Michigan. By Tarley J, Merinar T, Bowyer M, Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. 2005-05.

NIOSH [2005]. One Probationary Career Firefighter dies and Four Career Firefighters are Injured at a Two-Alarm Residential Structure Fire - Texas. By Koedam RE, Merinar T, Bowyer M, Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. 2005-02.

Linn H, Bowyer M, Hartley D, Jenkins EL, [2006]. Workplace Violence Prevention Strategies and Research Needs. NIOSH DHHS (NIOSH) Publication No. 2006-144.

Bowyer M, Jenkins EL [2006]. Building a Research and Prevention Initiative for Workplace Violence [Abstract], 2006 American Psychological Association, the National Institute for Occupational Safety and Health, the National Institute of Justice, the National Institute on Disability and Rehabilitation Research, and the U.S. Department of Labor International Conference "Work, Stress, and Health," Miami, FL, March 2-4, 2006.

Bowyer M, Hartley D, Jenkins EL [2005]. NIOSH's Initiative for Workplace Violence and National Conference [Abstract], 2005 National Injury Prevention and Control Conference "Injury and Violence in America," Denver, CO, May 9-11, 2005.

Jenkins L, Hartley D, Bowyer M, Anderson K [2004]. Building a research and prevention initiative for workplace violence [Abstract] In: The 7th World Conference on Injury Prevention and Safety Promotion, Vienna, Austria, June 6th-9th 2004. Vienna, Austria, Vienna, Austria: Kuratorium fur Schutz und Sicherheit/Institut Sicher Leben , NN: 20025711.

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Bowyer ME, Frazer JA [2003]. State-Based Approaches to Workplace Violence Prevention [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

Jenkins EL, Hartley D, Bowyer ME, Anderson KR [2003]. The NIOSH Workplace Violence Research Prevention Initiative [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

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NIOSH Employment: August 1985

Education:

M.S. Safety Management, West Virginia University, 1999
B.A. Liberal Arts, West Virginia University, August, 1988
A.S. Computer Science Technology, California University of Pennsylvania, 1984
A.S. Letters, Arts, and Sciences, Penn State University, 1980

Professional Certifications: N/A

Research Interests: Safety and Environmental Health

Memberships: N/A

National Committee Assignments: N/A

Honors:

Recent Publications:

NIOSH [1995]. NIOSH ALERT Preventing Injuries and Deaths of Loggers. By Braddee RW, Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 95-101.

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NIOSH [2001]. Residential fire claims the lives of two volunteer fire fighters and seriously injures an assistant chief – Missouri. By Tarley J, Braddee RW., Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2001-15.

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NIOSH [2003]. Parapet Wall Collapse at Auto Body Shop Claims Life of Career Captain and Injures Career Lieutenant and Emergency Medical Technician-Indiana. By McFall M, Braddee R., Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-44.

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Hodous TK, Pizatella TJ, Braddee RW, Castillo DN [2004]. Fire Fighters 1998-2001: overview with an emphasis on structure related traumatic fatalities, Inj Prev *10*(4):222-226.

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Discipline: Mechanical / Construction

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Fairmont State College, 2 yrs. Engineering Technology, 1976

Professional Certifications: None

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Memberships: None

National Committee Assignments: None

Honors:

2005 Bullard-Sherwood Award for Research 2 Practice, Honorable Mention

DHHS-Employee of the Month-June 2003

On The Spot Awards: 07/2006, 07/2001, 07/1999

Invention Award: 10/2005

Outstanding Performance Ratings: 2005, 2004, 2003, 2002, 2001, 2000, 1999,

Recent Publications:

McKenzie T., Abukhadra SM., Etherton JR., Cantis DM., Lutz TJ., Means KH., "Impact Testing of a Hybrid ROPS made from FRP Composite and Steel Components" In the Proceedings of the ASME, Orlando, FL. Nov. 5-11, 2005, Abstract.

McKenzie Jr. EA., Etherton JR., Harris JR., Cantis DM., Lutz TJ., "NIOSH AutoROPS Research to Practice: Zero Turn Commercial Mowers", In the Proceedings of 2005 American Society of Mechanical Engineers, Congress and Exposition, Source: IMECE2005-81575, Orlando, FL. Nov. 11, 2005, Abstract.

Bobick TG., McKenzie Jr. EA., Cantis DM., Kau T., "Using Guardrail Systems to Prevent Falls through Roof and Floor Holes", In the Proceedings of The XVllth World Congress on Safety and Health at Work, Source No. 046, Orlando, FL. Sept. 16-20, 2005, Abstract.

Harris JR., Cantis DM., McKenzie Jr. EA., Etherton JR., Ronaghi M., "Commercialization of cost-effective rollover protective structures (CROPS): research in progress", research-in-progress, In the Proceedings of the National Institute for Farm Safety (NIFS) Annual Conference, Source 1-19, Wintergreen, VA. June 26-30, 2005, Abstract.

Pan CS., Chiou S., Kau Y., Ammons D., Cantis DM., " Biomechanical Evaluations of foot placement for construction workers on stilts", In the Proceedings of American Industrial Hygiene Conference and Exposition (AIHCE) Source 48, Anaheim, CA. May 21-26, 2005, Abstract.

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Memberships: None

National Committee Assignments:

OSHA Telecommunication Tower Task Force

Advisory Committee for Construction Safety and Health (ACCSH) Telecommunication Tower Subcommittee

Honors:

Recent Publications:

Casini V, Burkhart, J [2005]. Truck driver dies after the off-highway truck he was operating rolled over an embankment and came to rest on its top—Pennsylvania. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 2000-05.

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Burkhart J, Casini V [2002]. Roadway construction worker dies from crushing injuries when backed over by a dump truck—Virginia. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 2002-06.

Casini V [2002]. Hispanic forklift operator dies after being caught between mast and cage of forklift—North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 2002-09.

Casini V [2002]. Hispanic construction laborer dies after portable silo collapse—North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 2002-11.

Casini V, Castillo D [2001]. NIOSH Alert: Preventing injuries and deaths from falls during construction and maintenance of telecommunication towers. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-156.

Casini V, Werntz C, Mardis A [2001]. Fourteen-year-old rental equipment worker dies from asphyxiation after becoming entangled in an electric chain hoist—Colorado. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 2001-13.

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Casini V [2000]. Seventeen-year-old window washer dies after falling 180 feet due to a rigging anchor failure—Pennsylvania. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 2000-08.

Casini V [2000]. A 16-year-old died after falling 27 feet at a residential construction site—Alabama. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No.2000-16.

Casini V, Smith G [2000]. A 15-year-old male farm laborer dies after the tractor he was operating overturned into a manure pit—Pennsylvania. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 2000-18.

Casini V [2000]. A 16-year-old roofer helper dies after 28-foot fall down an unguarded elevator shaft opening—Pennsylvania. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 2000-23.

Casini V [2000]. Temporary service worker dies after mower rolls over on him—North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 2000-25.

Casini V [2000]. Construction laborer dies after being struck in the head by backhoe bucket—North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 2000-26.

Moore P, Casini V [1999]. Hazard ID: Injury Associated with Working Near or Operating Wood Chippers. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 99-145.

Casini V [1999]. Tower erector dies after falling 240 feet from a telecommunications tower--North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 99-01.

Casini V, Zlochkower, I [1998]. Hazard ID: Ignition Hazard from Drilling into Sealed Frames of Agricultural Equipment. By Zlochower IA, Sapko MJ, Casini VC, Flesch J, Boyd J: Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 99-145.

Casini V, Kisner S, Stout N [1998]. Worker deaths by electrocution: A summary of surveillance findings and investigative reports. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 98-131.

Casini V [1998]. Maintenance manager dies after falling 7 feet from an elevated forklift safety platform—North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 98-01.

Casini V [1998]. Tower erector dies after falling 130 feet from hoist cable to ground--Pennsylvania. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 98-05.

Casini V [1998]. Tower erector dies after falling 125 feet from cellular phone tower—South Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 98-07.

Casini V [1998]. Scaffold erector dies after falling 60 feet from scaffold inside boiler—South Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 98-08.

Casini V [1998]. Roofer helper dies after falling 16½ feet from roof to concrete basement way—Kansas. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 98-16.

Casini V [1998]. Tower erector dies after falling 200 feet from telecommunication tower--North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 98-20.

Casini V [1998]. Tower painter dies and a second painter injured after falling 900 feet while inside a man basket—South Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 98-21.

Casini V [1997]. Order picker dies after falling from a lift truck-suspended pallet—North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 97-07.

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Casini V [1997]. Construction laborer dies after being struck by a front end loader at a construction site— Pennsylvania. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 97-11.

Casini V [1997]. Tree trimmer dies after 40-foot fall in aerial bucket—Virginia. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 97-12.

Casini V, Pratt S [1997]. Maintenance electrician dies from crush injuries when caught between nip barrier and upper frame of paper rewinder—Virginia. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 97-17.

Casini V [1996]. Area Operator falls 60 feet from manlift--North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 96-06.

Casini V [1996]. Welder/Ironworker dies after becoming entangled in a beltline driveshaft--South Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 96-07

Casini V [1996]. Logger dies after falling from log skidder--South Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 96-10.

Casini V [1996]. Welder dies after being struck by a three-ton steel roof truss-South Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 96-11.

Casini V [1996]. Logger dies after falling from tractor--South Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 96-13.

Casini V, Moore P [1996]. Tree feller killed by a piece of wood from a falling tree – Pennsylvania. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 96-14.

Casini V, Hause M, Castillo D [1996]. Sixteen-year-old electrical-contractor laborer electrocuted—Texas. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 96-19.

Casini V [1996]. Steel Rack Installer dies after being struck by 3,000 pound bundle of rack end pieces—South Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 96-24.

Casini V [1996]. Cement finisher dies after being crushed against doorway by cement truck chute—North Carolina. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report No. 96-25.

Name: Dawn N. Castillo

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NIOSH Employment: December 12, 1991

Education

M.P.H Epidemiology, University of California, Los Angeles, 1986
B.S. Biology, University of California, Irvine, 1985

Professional Certifications: None

Research Interests: Young workers, surveillance methods

Memberships: American Society of Safety Engineers

National Committee Assignments: None

Honors:

James P. Keogh Award for Outstanding Service in Occupational Safety and Health, April 28, 2004

CDC Honor Award, 1999 (Group award: For spirit of leadership and collaboration to provide a vision for CDC/ATSDR activities on behalf of children and health)

Special Act or Service Award, US Department of Health and Human Services, 1998 (Work in the implementation of NORA)

Alice Hamilton Award for Occupational Safety and Health, Honorable Mention, 1996 (Preventing Deaths and Injuries of Adolescent Workers)

Recent Publications:

<u>Peer-reviewed journal articles</u>

Hodous TK, Pizatella T, Braddee R, Castillo DN [2004]. Fire fighter fatalities 1998-2001: Overview with an emphasis on structure related traumatic fatalities. Inj Prev 2004, Vol. 10, pages 222-226.

Castillo DN, Adekoya N, Myers JR [1999]. Fatal work-related injuries in the agricultural production and services sectors among youth in the United States, 1992-1996. J Agromedicine 1999; Vol. 6, pages 27-41.

Castillo DN, Hard D, Myers J, Pizatella T, Stout N [1998]. A national childhood agricultural injury prevention initiative. J Ag Safety Health 1998, Special Issue, Vol. 1, pages 183-191.

Castillo DN, Malit BD [1997]. Occupational injury deaths of 16- and 17-year-olds in the United States: trends and comparisons to older workers. Inj Prev 1997, Vol. 3, pages 277-281.

Castillo DN, Rodriguez RL [1997]. Follow-back study of oldest workers with emergency department treated injuries. Am J Ind Med 1997, Vol. 31, pages 609-618.

Knight EB, Castillo DN, Layne LA [1995]. A detailed analysis of work-related injury among youth treated in emergency departments. Am J Ind Med 1995, Vol. 27, pages 793-805.

Layne LA, Castillo DN, Stout N, Cutlip P [1994]. Adolescent occupational injuries requiring hospital emergency department treatment: a nationally representative sample. Am J Public Health 1994, Vol. 84, pages 657-660.

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Castillo DN, Jenkins EL [1994]. Industries and occupations at high risk for work-related homicide. J Occ Med 1994, Vol. 36, pages 125-132.

<u>Other publications (e.g. book chapters, MMWR articles and NIOSH publications/reports)</u>

Castillo DN, Pizatella TJ, Stout NA [2006]. Injuries. In, Levy B, Wegman DH, Baron SL, Sokas RK (Eds), Occupational and Environmental Health: Recognizing and Preventing Disease and Injury, 5th Edition. Philadelphia, PA: Lippincott Williams & Wilkins.
NIOSH (Castillo DN, Pratt SG, Mardis A, Hendricks K)[2002]. National Institute for Occupational Safety and Health (NIOSH) Recommendations to the U.S. Department of Labor for Changes to Hazardous Orders. May 3, 2002.

Casini V, Castillo DN, Lentz TJ, Ray TD [2001]. NIOSH Alert: Preventing injuries and deaths from falls during construction and maintenance of telecommunications towers, Cincinnati, OH:

Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-156.

Davis L, Castillo DN, Wegman DH [2000]. Child and Adolescent Workers. In, Levy B, Wegman D (Eds), Occupational Health: Recognizing and Preventing Work-Related Disease, 4th Edition. Philadelphia, PA: Lippincott Williams & Wilkins, pp: 689-699, 2000.

NIOSH (Pratt SG, Hendricks KH, Fosbroke DE, Moore PH, Castillo DN) [2000]. Comments of the National Institute for Occupational Safety and Health on the Department of Labor Notice of Proposed Rulemaking and Request for Comments on Child Labor Regulations, Orders, and Statements of Interpretation. Child Labor ViolationsC Civil Money Penalties: 29 CFR Parts 570 and 579. January 8, 2000.

Castillo DN, Davis L, Wegman DH [1999] Young Workers. Frumkin H, Pransky G (Eds), Special Populations in Occupational Health. Occupational Medicine: State of the Art Reviews 14 (3), pp: 519-536.

Castillo DN [1998]. Occupational Safety and Health in Young People. Barling J, Kelloway K (Eds), Young Workers: Varieties of Experience. Washington, D.C.: American Psychological Association, pp: 254-309, 1998.

Adekoya N, Castillo DN, Myers JR [1998]. Youth agricultural work-related injuries treated in emergency departmentsB United States, October 1995B September 1997. MMWR 47:733-737.

NIOSH Child Labor Working Team (Castillo DN- Leader) [1997]. Special Hazard Review: Child Labor Research Needs: Recommendations from the NIOSH Child Labor Working Team. NIOSH Publication No. 97-143.

Castillo DN [1996]. Work-related injuries and illnesses associated with child labor--United States, 1993. MMWR 1996; 45:464-468.

Castillo DN [1995]. NIOSH Alert: Request for Assistance in Preventing Deaths and Injuries of Adolescent Workers. NIOSH Publication No. 95-125.

NIOSH (Castillo DN- Lead) [1994]. Comments of the National Institute for Occupational Safety and Health on the Department of Labor/Wage and Hour Division Advance Notice of Proposed Rulemaking on Child Labor Regulations, Orders and Statements of Interpretation, 29 CFR, Part 570. October 25, 1994.

NIOSH (Castillo DN- Lead) [1994] Comments of the National Institute for Occupational Safety and Health on the Department of Labor/Wage and Hour Division Proposed Rule on Child Labor Regulations, Orders and Statements of Interpretation, 29 CFR, Part 570 (Subpart C). July 12, 1994.

Name: Guang X. Chen

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Division/Office: Division of Safety Research/Analysis and Field Evaluations Branch

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NIOSH Employment: September 1998

Education:

M.D., Hunan Medical University, Changsha, Hunan, China, 1983

M.Sc, major in environmental/occupational medicine, Hunan Medical University, Changsha, Hunan, China, 1993

M.Sc., major in Statistics, West Virginia University, Department of Statistics, Morgantown, West Virginia, United States. 2004

Research Interests: Trucking safety, injury prevention and evaluation

Honors:

NRC Senior Research Associate Award from U.S. National Research Council, 1996-1998

Included in the book of "*Chinese Contemporary Famous Persons in Medicine.*" Beijing, China. 1997

Scholarship from the International Epidemiological Association (IEA) to present a stud of "Tuberculosis and silica exposure" at the XIV International Scientific Meeting of the International Epidemiological Association, August 27-30, 1996 Nagoya, Japan

The Second place in Research Achievement from the Hunan province Medical, Health Science, and Technology Committee, Hunan, China for a study of "Occupational lead exposure and renal damage," 1995

The Fourth Place in Science and Technology Achievement from the Hunan province Science and Technology Committee, Hunan, China for a study of "Occupational lead exposure and renal damage," 1995

Third prize of the Excellent Research Paper, from the Chinese Preventive Medicine Association, Hunan Division, for A study of “Renal function of workers exposed to lead,” 1991

Recent Publications:

Chen GX. Impact of federal compliance reviews of trucking companies in reducing highway truck crashes. Manuscript in peer review

Chen GX, Jenkins EL. Potential work-related bloodborne pathogen exposures by industry and occupation in the United States Part I: An emergency department-based surveillance study. Manuscript submitted to American Journal of Industrial Medicine

Chen GX, Jenkins EL. Potential work-related bloodborne pathogen exposures by industry and occupation in the United States Part II: A telephone interview study. Manuscript submitted to American Journal of Industrial Medicine

Chen GX, Jenkins EL, Husting L. A comparison of crash patterns in heavy trucks with and without collision warning system technology. Safety Performance and Accident Free Driving. SAE Special Publication 2004. SAE, Inc., Warrendale, PA. ISBN 0-7680-1533-2. 31-36. The manuscript was reprinted at SAE 2004 Transactions of Journal of Commercial Vehicles 2004; 113(2): 360-365.

Chen GX, Jenkins EL, Marsh SM, Johnston JJ. Work-related and non-work-related injury deaths in the U.S.: A comparative study. Human and Ecological Risk Assessment 2001; 7: 1859-1868.

Chen GX, Hendricks K. Nonfatal occupational injuries among African-American women by industry. Journal of Safety Research 2001; 32: 75-84.

Stern FB, Ruder A, Chen GX. Proportionate mortality among unionized roofers. American Journal of Industrial Medicine 2000; 37: 478-492.

Chen GX, Johnston JJ, Burnett CA, Alterman T, Steenland K, Stern F, Halperin WE. Expanded analysis of injury mortalities among unionized construction workers. American Journal of Industrial Medicine 2000; 37: 364-373.

Chen GX and Layne LA. Where African American women work and the nonfatal work-related injuries they experienced in the US in 1996, compared to women of other races. American Journal of Industrial Medicine 1999; supplement 1: 34-36.

Chen GX and Fosbroke DE. Work-related fatal injury risk of construction workers by occupation and cause of death. Human and Ecological Risk Assessment 1998; 4(6): 1371-139

Chen GX and Layne LA. Surveillance of occupational injuries treated in hospital emergency department in the United States in 1996. Morbidity and Mortality Weekly Report 1998; 47(15): 302-306.

Chen GX, Burnett CA, Cameron L, Alterman T, Lalich N, Tanaka S, Althouse R. Tuberculosis mortality and silica exposure, a case-control study based on a national mortality data base for the years 1983-1992. International Journal of Occupational and Environmental Health 1997; 3(3): 163-170.

Name: Sharon Chiou

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NIOSH Employment: 04/11/99

Education:

Ph.D., Industrial Hygiene, University of Cincinnati, 1996

Professional Certifications:

Research Interests: Slip and Fall, Construction Ergonomics, Traumatic Injury, Musculoskeletal disorders

Memberships: ASTM, AIHA, HFES

National Committee Assignments:

Honors:

Recent Publications (Journal)

Hsiao, H., Simeonov, P., Dotson, B., Ammons, D., Kau, T. Y., Chiou, S. 'Human responses to augmented virtual models of elevation' *Ergonomics* 48(10) 1223-1242, 2005.

Pan, C.S., Miller, K.M., Chiou, S., Wu, J.Z. 'Evaluation of a computer-simulation model for human ambulation on stilts' *Journal of Mechanics in Medicine and Biology*, 4(3), 2004.

Chiou, S., Bhattacharya, A., Lai, C., Succop, P. A. (2003) 'Effects of environmental and job-task factors on workers' gait characteristics on slippery surfaces' *Occupational Ergonomics* 4(3), 209-223.

Pan, C.S., Chiou, S., Hendricks, S. (2003) 'Effect of drywall lifting method on workers' balance in a laboratory-based simulation' *Occupational Ergonomics* 4(3), 235-249.

Chiou, S., Bhattacharya, A., and Succop, P.A. (2000) 'Evaluation of workers' perceived sense of slip and effect of prior knowledge of slipperiness during task performance on slippery surfaces' *American Industrial Hygiene Association Journal* 61(4), 492-500.

Chiou, S., Pan, C. S., Keane, P. (2000) 'Traumatic injury among drywall installers, 1992 – 1995' *Journal of Occupational and Environmental Medicine* 42(11), 1101-1108.

Name: James W. Collins

Title: Associate Director for Science

Discipline: Injury Epidemiology/Mechanical Engineering

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NIOSH Employment: January 1984 - present

Education:

Johns Hopkins University, PhD in Health Policy and Management, Major: Injury Epidemiology

West Virginia University, MS in Mechanical Engineering, 1989

Georgia Institute of Technology, BS in Mechanical Engineering, 1984

Professional Certifications: None

Research Interests: Occupational traumatic Injury; intervention evaluation; safe patient lifting; slip, trip, and fall prevention; machine safety

Memberships/Professional Societies

American Society of Mechanical Engineers

Society of American Military Engineers

Commissioned Officers Association of the United States Public Health Service

Editorial Board: International Journal of Injury Control and Safety Promotion

National Committee Assignments: Program Coordinator for the National Occupational Research Agenda Team for traumatic injury research

National Occupational Research Agenda Committee Member for the Health Care Industry Sector

Honors: Winner of the 2006 National Occupational Research Agenda Partnership Award for Worker Safety and Health for “Slip, Trip, and Fall Prevention in Health Care Workers”

Who’s Who in Engineering, 2005-2006

Who's Who in America, 2005-2006

Winner of the NIOSH 2005 Alice Hamilton Award for excellence in occupational safety and health research – human studies category, for the publication of "Evaluation of a Best Practices Musculoskeletal Injury Prevention Program in Nursing Homes"

2003 National Occupational Research Agenda 2003 Partnering Award for Worker Safety and Health for "Evaluation of a Best Practices Musculoskeletal Injury Prevention Program in Nursing Homes"

2000 Engineering Literary Award – Research Category, presented by the Chief Engineer of the USPHS, for "A Case-Control Study of Forklift and Other Powered Industrial Vehicle Incidents"

U. S. Public Health Service Awards:

September 6, 2002	Outstanding Unit Citation
July 10, 2002	Commendation Medal
February 15, 2002	Crisis Response Ribbon
June 19, 2001	Unit Commendation Medal
January 1, 1998	Bicentennial Unit Commendation
June 2, 1997	Citation
August 7, 1995	Unit Commendation Medal
May 26, 1996	Citation
December 9, 1992	Surgeon General's Exemplary Service Medal
May 2, 1991	Unit Commendation
April 8, 1991	Special Assignment Award
December 26, 1989	Unit Commendation Medal
July 31, 1989	Regular Corps Ribbon
April 18, 1986	Achievement Medal
March 19, 1985	Unit Commendation Medal

Recent Publications:

Book Chapters:

Collins JW (In press). Overview of Hospital Hazards. To be published in the 3rd Edition of Essentials of Modern Hospital Safety. Eds. William Charney.
Collins JW (In press). Slip, Trip, and Fall Prevention for Health Care Workers. To be published in the 3rd Edition of Essentials of Modern Hospital Safety. Eds. William Charney.

Collins JW and Menzel NN (2006). "Chapter 1 - "Scope of the Problem," in Safe Patient Handling and Movement: A Practical Guide for Health Care Professionals. Springer Publishing Co., pp. 1-26.

Collins JW (2006). "Chapter 10 – Safe Lifting Policies," in Safe Patient Handling and Movement: A Practical Guide for Health Care Professionals. Springer Publishing Co., pp. 151-59 and 241-45.

Courtney TK, Sorock GS, Manning DP, Collins James W, and Holbein-Jenny MA (2003). Occupational slip, trip, and fall-related injuries-can the contribution of slipperiness be isolated? Taylor and Francis, London and New York.

Peer-Reviewed Manuscripts

Collins JW, Bell JL, Gronqvist R, Courtney TK, Sorock GS, Chang WR, et al., (2006). Slip, trip, and fall prevention in health care workers. International Association of Ergonomics (IEA) 2006 Congress Conference Proceedings. Maastricht, Netherlands.

Collins JW, Nelson A, and Sublet V (2006). "Safe Lifting, Handling, and Movement of Nursing Home Residents." DHHS document disseminated to 18,000 U.S. nursing homes to stimulate program implementation.

Nelson AL, Collins, JW, Knibbe H, Cookson K, deCastro AB, Whipple KL, and Hudson A (In press). "Myths and Facts about policies for safe patient handling." *Nursing Management.*

Nelson AL, Collins JW, Siddharthan K, Matz M, and Waters T. (In press) "Link between safe lifting and patient outcomes in long-term care." *Rehabilitation Nursing*.

Waters T, Collins JW, Galinsky T, and Caruso C (In press). NIOSH research efforts to prevent *m*usculoskeletal disorders in the healthcare industry. Orthopaedic Nursing.

Collins JW, Wolf LD, Bell J and Evanoff, B. (2004). "An Evaluation of a Best Practices," Back Injury Prevention Program in Nursing Homes," *Injury Prevention,* 10;206-211.

Evanoff B, Wolf L, Aton E, Canos J, and Collins JW (2003). "Reduction in Injury Rates in Nursing Personnel Through Introduction of Mechanical Lifts in the Workplace." *American Journal of Industrial Medicine*, 44(5):451-457.
Courtney TK, Sorock GS, Manning DP, Collins JW, and Holbein-Jenny MA. "Occupational Slip, Trip, and Fall-related Injuries: Can the Contribution of Slipperiness be Isolated?" *Ergonomics*, Vol. 44, No.13, (2001), 1118 - 1137.

Zhuang Z, Stobbe TJ, Collins JW, and Hsiao H. "Psychophysical Evaluation of Assistive Devices for Transferring Residents." *Applied Ergonomics*, 31 (2000) 35-44.

Zhuang Z, Stobbe TJ, Hsiao H, and Collins JW. "Biomechanical Evaluation of Assistive Devices for Transferring Residents." *Applied Ergonomics*, 30 (1999) 285-294.

Collins JW and Braddee RW. "Preventing Injuries and Death of Workers Who Operate or Work Near Forklifts," NIOSH Alert. DHHS (NIOSH) Publication No. 2000-112, December 1999.

Collins JW, Smith GS, Baker SP, Landsittel DP, and Warner M. "A Case-Control Study of Forklift and Other Powered Industrial Vehicle Incidents," *American Journal of Industrial Medicine*, 36:522-531 (1999).

Collins JW, Smith GS, Baker SP, and Warner M. "Injuries Related to Forklifts and Other Powered Industrial Vehicles in Automobile Manufacturing," *American Journal of Industrial Medicine*, 36:513-521 (1999).

Collins JW, Landen D, Kisner S, Johnston J, Chen S, and Kennedy R. "Fatal Occupational Injuries Associated with Forklifts, United States, 1980-1994," *American Journal of Industrial Medicine*, 36:504-512 (1999).

Name: George A. Conway, MD, MPH

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<u>Education</u>:

August 1987 **Masters of Public Health**, Univ. of South Carolina School of Public Health, Columbia, South Carolina

May 1985 **M.D.**, University of New Mexico School of Medicine, Albuquerque, New Mexico

May, 1974 **Bachelor of Arts**, Antioch College, Yellow Springs, Ohio

July 1, 1988 - June 30, 1990 **Epidemic Intelligence Service**, CDC, Atlanta, GA

July 1, 1986 - June 30, 1988 **Preventive/Occupational Medicine Residency**, University of South Carolina, Columbia, S.C.

July 1, 1985 - June 30, 1986 **Internship - Family Medicine**, University of Wyoming Family Practice Residency Program, Casper, Wyoming

<u>Professional Certifications</u>:

General Preventive Medicine and Public Health, 1/30/90
South Carolina, License Number 12956, Expiration 12/31/07.

Aviation Medical Examiner, Federal Aviation Administration Serial Number 80051-9, Expiration 5/31/07

<u>Research Interests</u>: Generally, the practical application of scientific methods, surveillance, and epidemiology for disease and injury prevention. Specifically, Field epidemiology; effective design, implementation, and management of public health programs; disease and injury surveillance and prevention; international health; occupational injury and infectious disease epidemiology; aviation medicine.

<u>Memberships</u>:

Member, United States Interagency Arctic Policy Group, 2000-present
Professor (adjunct), Rocky Mountain Center for Occupational and Environmental Health, University of Utah School of Medicine, 2003
Member, Alaska Public Health Association, 1992-present
Member, Commissioned Officers Association of the U.S. Public Health Service, 1988-present
Chairperson, 10th International Conference on Safe Communities, 2000-2001
International Union for Circumpolar Health - President (term 1996-2000)
American Society for Circumpolar Health - President (term 1996-2000)
Federal Liaison, Alaska Injury Prevention Center, January 2000-December, 2002
Attending Physician, Alaska Champ Camp (for children with asthma), American Lung Association, Talkeetna and Cooper Landing, Alaska, August 1998 & July, 1999
Consulting Physician, Health Curriculum Committee, Anchorage School District (term 1999-2006)
Consulting Physician, American Board for Medical Advancement in China, 1996-2001
Judge, Antonio T.C. Chong Award for Research in Occupational Health and Safety, American Board for Medical Advancement in China, 1998-2001.
Chair, Steering Committee, Anchorage Safe Communities Program, 1996-1999
Director, Alaska Public Health Association, 1996-1999
Member, International Advisory Board, International Journal of Circumpolar Health, 1996-2001.
Anchorage Healthy Futures Project - Senior Research Consultant, 1995-1998
Member, American Public Health Association, (IC&EM and OS&H Sections)
Alaska Health Summit Steering and Planning Committees - member, 1994-1999

<u>National Committee Assignments:</u>

Member, United States Interagency Arctic Policy Group, 2000-present

Honors:

2004	USPHS Outstanding Service Medal
2003	Alaska Meritorious Health Service Award, Alaska Public Health Assoc.
2003	Alaska Governor’s Special Achievement Award, to NIOSH Alaska Field Station
2002	U.S. Public Health Service Crisis Response Service Award
2001	U.S. Public Health Service Unit Commendation
1998	Alaska Governor’s Special Recognition Award to NIOSH Alaska Field Station
1996	U.S. Public Health Service Commendation Medal.
1994	Federal Leadership Award, Alaska Occupational Injury Surveillance System
1993	U.S. Public Health Service Achievement Medal
1990	U.S. Public Health Service Unit Commendation
1989	U.S. Public Health Service Citation
1988	NIH/Fogarty Institute Young Investigator Award, Stockholm, Sweden
1987-1988	ATPM/CDC/EPO/EIS Fellowship in community-based epidemiology
1981-1985	Peterson Fund Scholar, University of New Mexico School of Medicine

Recent Publications:

Mode, N.A., Hackett, E.J., & G.A. Conway (in press) “Unique Occupational Hazards of Alaska: Animal-related Injuries” *Wilderness and Environmental Medicine*, 16:185-191 (2005).

Husberg, B.J., Fosbroke, D.E., Conway, G.A., & N.A. Mode (2005) “Hospitalized nonfatal injuries in the Alaskan construction industry” *American Journal of Industrial Medicine,* 47:428-433.

Conway, G.A., Mode, N.A., Berman, M., Martin. S., & A. Hill. (2005) “Flight safety in Alaska: Comparing attitudes and practices of high- and low-risk air carriers” *Aviation, Space, and Environmental Medicine,* 76(1): 52-57 (2005).

Conway, G.A., Hill, A., Martin. S., Mode, N. A., Berman, M., Bensyl, D., Manwaring, J., & K. Moran (2004) “Alaska air carrier operator and pilot safety practices and attitudes: A statewide survey” *Aviation, Space, and Environmental Medicine*, 75(11): 984-991 (2004).

Conway, G.C., Moran, K.A., & N.A. Mode (2004) "Scientific worker and licensed professional deaths in Alaska, 1990-2002" *International Journal of Circumpolar Health*, 63 (Suppl2): 353-56.

Conway, G.C., Moran, K.A., & N.A. Mode (2004) "Scientific worker and licensed professional deaths in Alaska, 1990-2002" International Journal of Circumpolar Health, 63 (Suppl2), 353-56.

Conway, G.A., Moran, K.A., and Mode, N.A.: “Scientific Worker and Licensed Professional Deaths in Alaska, 1990-2002” International Journal of Circumpolar Health, at press, 2003.

Hudson, D.S. and Conway, G.A.: "The role of hypothermia and drowning in commercial fishing deaths in Alaska, 1990-2002", International Journal of Circumpolar Health, at press, 2003.

Conway, G.A.: "Casting their lot upon the water: Commercial Fishing Safety", The Lancet, Volume 360, Number 9332, pp 503-4, 17 August 2002.

Lincoln, J.M., Hudson, D.S., Conway, G.A., and Pescatore, R. (Eds.): Proceedings of the International Fishing Industry Safety and Health Conference, DHHS (NIOSH) Publication No. 2003-102, 2002.

Lincoln JM, Husberg BJ, Conway GA [2002]: "Improving Safety in the Alaskan Commercial Fishing Industry". Proceedings of the International Fishing Industry Safety and Health Conference. Woods Hole, MA. DHHS (NIOHS) Publication No. 2002-147: 211-221. October 2002.

Backus AS, Brochu PJ, Lincoln JM, Bensyl, D.M., Ciampa, J.R., Smith, T.J., and Conway, G.A.: "Work Practices, Entanglement of Lobstermen, and Entanglement Prevention Devices in the Maine Lobster Fishery: A Preliminary Survey." Proceedings of the International Fishing Industry Safety and Health Conference. Woods Hole, MA. DHHS (NIOHS) Publication No. 2002-147: 269-282. October 2002

Conway, G.A., Lincoln, J.M., Hudson, D.S., Bensyl, D.B., Husberg, B.J., and Manwaring, J.C.: Surveillance and Prevention of Occupational Injuries in Alaska: A Decade of Progress, 1990-1999, DHHS (NIOSH) Publication No. 2002-15.

Conway, G, Moran, K, and Bensyl, D.: AFactors Associated with Pilot Fatalities in Work-Related Aircraft Crashes - Alaska, 1990-1999" Morbidity and Mortality Weekly Report, 2002; 51: pp347-349.

Conway, G.A., Lincoln, JM, Husberg, B.J., Bensyl, D.M. and Manwaring, J.C.: "Occupational Injury Research and Prevention in Alaska", Arctic Research of the United States, V. 15, pp. 14-26, 2001.

Bensyl, D.M, Moran, K., Conway, G.A.: Factors Associated With Pilot Fatalities in Work-Related Aircraft Crashes, Alaska, 1990-1999", American Journal of Epidemiology, Vol. 154, No. 11, pp. 1037- 1042, 2001.

T.K. Thomas, J.M. Lincoln, B.J. Husberg, G.A.Conway: AIs it Safe on Deck? Fatal and Non-Fatal Workplace Injuries Among Alaskan Commercial Fishermen@, American Journal of Industrial Medicine, 40:693-702, 2001.

Conway, G.A., Lincoln, J.M., Husberg, B.J., Manwaring, J.C., Bensyl, D.M., et al: "Alaska's Model Occupational Injury Program: Applying Surveillance for Prevention,", International Journal of Circumpolar Health, 60:4, pp. 714-723, 2001.

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Conway, G.A.: "Epidemiology and Prevention of Alaska Rotocraft Accidents" in Proceedings of the General Aviation Accident Prevention Symposium, September 21-22, 2000, National Transportation Safety Board, Washington, D.C.

Klatt, M.L. and Conway, G.A., eds.: Proceedings of the Second National Fishing Industry Safety and Health Workshop, DHHS (NIOSH) Publication No. 2000-104, January, 2000.

Garrett, L.C. and Conway, G.A.: Characteristics of Moose-Vehicle Collisions in Anchorage, Alaska, 1991-1995", Journal of Safety Research, Vol. 30, pp. 219-223, 1999.

Conway GA, Lincoln JM, Husberg BJ, et al.: "Alaska's Model Program for Surveillance and Prevention of Occupational Injury Deaths", Public Health Reports, Vol 114, 1999: 6:50-58.

Conway GA, Husberg BJ. "Cold-Related Non-Fatal Injuries in Alaska" American Journal of Industrial Medicine, S1:39-41, September 1999.

Lincoln, JM and Conway, GA. "Preventing commercial fishing deaths in Alaska" Occupational and Environmental Medicine 1999; 56:691-95.

Garrett LC, Conway GA, and Manwaring JC.: "Epidemiology of Work-Related Aviation Fatalities in Alaska, 1990-1994", Aviation, Space, and Environmental Medicine, 1998; 69: 1131-1136.

Husberg BJ, Conway GA, Moore M, Johnson M.: Surveillance for non-fatal work-related injuries in Alaska, 1991-1995. American Journal of Industrial Medicine, 34:493-498. November 1998.

Manwaring JC, Conway GA, Garrett LC. Epidemiology and Prevention of Helicopter External Load Accidents, Journal of Safety Research, Vol. 29:No.2, p107-121, 1998

Conway GA, Husberg BJ, Lincoln JM.: "Cold as a Risk Factor in Working Life in the Circumpolar Regions." Problems with Cold Work, Holmer I, Kuklane K, eds, Proceedings from an International Symposium Held in Stockholm, Sweden, November 1997. National Institute for Working Life, November 1998, Stockholm, Sweden, p1-10.

Conway GA. Hazards Associated with Fish Farming and Aquaculture, International Labor Organization Encyclopedia of Occupational Safety and Health, ILO, Geneva, Switzerland, 1998.

Conway GA, Trent JN, and Brown ME. Hunting and Trapping (chapter) International Labor Organization Encyclopedia of Occupational Safety and Health, ILO, Geneva, Switzerland, 1998.

Fortuine, R., Conway, G.A., Schraer, C.D., Dimino, M.J., and Hild, C.M. (editors): Circumpolar Health 96, Proceedings of the Tenth International Congress on Circumpolar Health, International Journal of Circumpolar Health, Vol 57, Supplement 1, 1998.

Garrett LG, Conway GA.: "Aviation: A Serious Occupational Hazard - Alaska, 1990-1995", International Journal of Circumpolar Health, Vol 57, Supplement 1, 1998, p510-517.

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Conway GA, Lincoln JM, Jorgensen, SA, Klatt ML, and Manwaring, JC.: "Preventing Drownings in Alaska's Commercial Fishing Industry", International Journal of Circumpolar Health, Vol 57, Supplement 1, 1998, p503-509.

Conway GA, Klatt ML, Manwaring J.C.. "Effective Injury Prevention Using Surveillance Data: Helicopter Logging, Alaska, 1992-1995", International Journal of Circumpolar Health, Vol 57, Supplement 1, 1998, p518-526.

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Conway G., Klatt M., Kennedy R, Lincoln JM Manwaring JC, Bledsoe G, Middaugh J. "Occupational Homicide, Alaska, 1993", Morbidity and Mortality Weekly Report, Vol. 43, July 29,1994: pp. 534-36.

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Hjelle B., Khabaz RF, Conway GA, North C, Green D, Kaplan JE.: "Prevalence of HTLV-II in American Indian Populations of the Southwestern United States", American Journal of Tropical Medicine and Hygiene, Vol. 51: 11-15, 1994.

Conway GA. "Surveillance for Work-Related Fatalities in the Alaskan Commercial Fishing Industry", Proceedings of the National Fishing Industry Safety and Health Workshop, Anchorage, Alaska October 9-11, 1992. NIOSH, Centers for Disease Control, 1994.

Shannon S.C., Gensheimer KF, LeHay RH, Ciampa J, Conway GA, Horan JM.: "Fatalities Associated with Harvesting of Sea Urchins - Maine, 1993", Morbidity and Mortality Weekly Report, 43 (13):235-242, 1994.

Kennedy RD, Veazie M, Conway GA, Amandus H. "Fishing Deaths Vary by Fishery," American Journal of Public Health, 84 (3): 496, 1994.

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Kennedy RD, Conway GA., Helmkamp J, et al. "Commercial Fishing Fatalities - Alaska, 1991-1992", Morbidity and Mortality Weekly Report, 1993, 42:350-359.

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Gabel HD, and Conway GA.: "HIV Prevalence in a Medically Indigent Obstetrical Population", South Carolina Medical Journal, Vol. 84, number 9, September, 1988.

Name: Richard S. Current

Title: General Engineer (Research)

Discipline: Mechanical/Safety Engineering

Division/Office: Division of Safety Research/Protective Technology Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road, MS G800, Morgantown, WV 26505

Telephone: 304-285-6084

NIOSH Employment: March 28, 1998

Education:

BS, Aerospace Engineering, 1991
30+ hours graduate engineering education

Professional Certifications:

Registered Professional Engineer (State of WV PE# 015802)

Research Interests:

Worker transportation Occupant Safety (Tractors, Ambulance Safety/Crashworthiness, other worker transportation issues)

Mitigation of Occupational Injury due to Biomechanical impact

Memberships:

Society of Automotive Engineers-Full Member

National Committee Assignments:

ANSI AMT B11 Machine Safeguarding, committee member

Recent Publications, Presentations:

Development of a Pultruded FRP composite material ROPS for Farm Tractors, JR Etherton, MR Ronaghi, RS Current, Journal of Composite Structures, *In-Press Available on-line October 14, 2005*

J. Green, P. Moore, R. Current, J. Yannaccone, G. Whitman, D. Day, S. Proudfoot, T. Bobick, N. Romano ***"REDUCING VEHICLE CRASH-RELATED EMS WORKER INJURIES THROUGH IMPROVEMENTS IN RESTRAINT SYSTEMS"****, XVIIth World Congress on Safety & Health at Work - September 18-22, 2005*

Ambulance Crash Research at NIOSH presentation to National Truck Equipment Association - Ambulance Manufacturers Division meeting in Tampa, FL. Business meeting with 50 some people and about 8 presenters. (45 minute Oral presentation not published)

Pan, C.S., Miller, K., Chiou, S., Kau, T.Y., Current, R. '**Validation of a computer-simulation model for human ambulation on stilts**' 2004 American Industrial Hygiene Conference & Exposition (Atlanta, GA) May 8-13, 2004, Paper 9

Rebecca Giorcelli, PhD, Richard Hughes, PhD, Richard Current(Corresponding Author), and John Myers, Journal of Applied Biomechanics, Technical Note, **"Accuracy of a System for Measuring Three-Dimensional Torso Kinematics during Manual Materials Handling"**, Volume 20, Number 2, May 2004, pp 185-194

J Guan, H Hsiao, R Current, J Powers, D Ammons, [2003]**"Traumatic Injury Potential to Seat Belted Operator during a Rearward Overturn of a ROPS Equipped Farm Tractor",** NORA Symposium 2003 Working Partnerships: Applying Research to Practice [2003] Field-Study, Arlington, Virginia, June 23

Bobick TG, Proudfoot SL, Romano NT, Moore PH, Current RS, Green JD, [2003] **"Ambulance Crash-Related Injuries Among EMS Workers"**, NOIRS 2003 October 28-30, 2003

Career Fire Fighter Dies From Injuries When Stationary Fill Tank Becomes Over-Pressurized and Suffers Catastrophic Failure - California@ , F2001-26 July 26, 2001 ; (engineering expertise for diagrams and reviewed NFPA 1900.1 and related standards for investigation.)

Restaurant Fire Claims the Life of Two Career Fire Fighters - Texas@, NIOSH Fire Fighter Investigation Report F2000-13, February 7, 2001 (engineering assistance for NIOSH investigation)

Ronaghi M, **Current RS**, and Etherton JR [2001], "**Research on the Use of Composite Materials in a New Rollover Protective Structures (ROPS)"** Proceedings of National Institute for Farm Safety Annual Conference (Pittsburgh, Pennsylvania, June 24-27).

McKenzie EA, Powers JR, Harris JR, Ronaghi M, Etherton JR, Current RS, Cantis DM, Newbraugh BH, and Lutz TJ [2001], **"Continuing Developments at NIOSH on ROPS for Agricultural Tractors"** In the Proceedings of The National Institute for Farm Safety Annual Conference, (Pittsburgh, Pennsylvania June 24 -27)

Ackman, T.E., Connie Lyons, and Richard Current, [1998] **"A geophysical evaluation of a small coal mine injected with coal combustion by-products"**, Fifteenth Annual International Pittsburgh Coal Conference, Sept 14-18, 1998 Session 5, ISBN 1-890977-15-2.

Ackman, TE, Lyons CE and R. Current, [1998] **"Post-Injection Evaluation of the Winding Ridge Site"**, Proceedings of the 19th Annual WV Surface Mine Drainage task Force Symposium Morgantown, WV April 7-8 1998. Page 19

Name: Susan J. Derk, MA

Title: Epidemiologist

Discipline: Occupational Injury Epidemiology

Division/Office: Division of Safety Research/Surveillance and Field Investigations Branch

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NIOSH Employment: May 21, 2000

Education:

Master of Arts, Applied Social Research, West Virginia University, 1993
Bachelor of Arts, Political Science, West Virginia University, 1989

Research Interests: Work-related injuries and illnesses

Recent Publications:

Marsh SM, Derk SJ, Jackson LL, 2006. Nonfatal occupational injuries and illnesses among workers treated in hospital emergency departments—United States, 2003; MMWR: 55(16), 449-452.

Henneberger PK, Derk SJ, Sama SR, Boylstein RJ, Hoffman CD, Preusse PA, Rosiello RA, Milton DK, 2006. The frequency of workplace exacerbation among health maintenance organization members with asthma; Occup Environ Med: 63,551-557.

Name: David E. Fosbroke

Title: Statistician (Health)

Discipline: Statistics

Division/Office: Division of Safety Research/Surveillance and Field Investigations Branch

Location: NIOSH/Morgantown, WV

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NIOSH Employment: 1991

Education:

BS, Forestry, University of Maine, Orono, ME, 1982
MSF, Forest Management, West Virginia University, Morgantown, WV, 1991

Research Interests:

Construction injuries, logging injuries, occupational injury surveillance

Memberships:

Standing Member of the National Safety Council Construction Division

National Committee Assignments:

OSHA/NIOSH Roadway Work Zone Safety and Health Coalition

Recent Publications:

Kisner SM, Fosbroke DE [1994]. Injury hazards in the construction industry. J Occup Med 36(2):137- 143.

Robinson CF, Halperin WE, Alterman T, Braddee RW, Burnett CA, Fosbroke DE, Kisner SM, Lalich NR, Roscoe RJ, Seligman PJ, Sestito JP, Stern FB, Stout NA [1995]. Mortality patterns among construction workers in the United States. Philadelphia, PA: Henley & Belfus, Inc., Occupational Medicine: State of the Art Reviews 10(2):269-283.

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Chiou S, Pan CS, Fosbroke DE [1997]. Identification of risk factors associated with traumatic injuries among drywall installers, presented and published in the proceedings of the 12th International Occupational Ergonomics and Safety Conference '97, Washington, DC, June, 1997.

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Chen GX Fosbroke DE [1998]. Work-related fatal-injury risk of construction workers by occupation and cause of death. Human and Ecological Risk Assessment 4(6):1371-1390.

Myers JR, Kisner SM, Fosbroke DE [1998]. Lifetime risk of fatal occupational injuries within industries, by occupation, gender, and race. Human and Ecological Risk Assessment 4(6):1291-1307.

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Pratt SG, Fosbroke DE, Marsh SM [2000]. Building safer highway work zones: measures to prevent worker injuries from vehicles and equipment. DHHS (NIOSH) Publication No. 2001-128.

Fosbroke D [2003]. Moving Beyond Surveillance: Lessons Learned from NIOSH Construction Safety Projects [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

Newbraugh B, Pratt S, Ammons D, Beaupre J, Fosbroke D, Fox J, Griffin C, Hammer R, Markovich S, Hause M, Merinar T, Powers J, Hendricks S [2005]. Evaluating Roadway Construction Work Zone Interventions [Abstract], Lifesavers 2005 National Conference on Highway Safety Priorities, Charlotte, NC, March 13-15, 2005.

Husberg BJ, Fosbroke DE, Conway GA, Mode NA [2005]. Hospitalized Nonfatal Injuries in the Alaskan Construction Industry. Am J Ind Med (47):428-433.

Name: E. Michael Goldcamp

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Discipline: Epidemiology

Division/Office: Division of Safety Research/Surveillance and Field Investigations Branch

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NIOSH Employment: April 21, 2001

Education:

Ph.D., Political Science, West Virginia University, 2000
M.A., Public Policy, West Virginia University, 1996
B.A., Psychology, University of Cincinnati, 1991

Professional Certifications:

Research Interests:

Agriculture-related injuries to youth and adults
All-Terrain vehicle injuries to youth and adults

Memberships:

National Committee Assignments:

Honors:

Recent Publications:

Goldcamp, E, J Myers, K Hendricks, L Layne, and J. Helmkamp. 2006. Nonfatal All-Terrain Vehicle-Related Injuries to Youths Living on Farms in the United States, 2001 The J Rural Health 22 (4) 309-313.

Hendricks K, Myers J, Layne L, Goldcamp M [2005]. Household youth on minority operated farms in the United States 2000: Exposures to and injuries from work, horses, ATVs and tractors, J Safety Res 36:149-157.

NIOSH [2005]. Injury and Asthma Among Youth Less Than 20 Years of Age on Minority Farm Operations in the United States, 2000. Volume 1: racial minority national data. By Myers JR, Hendricks KJ, Goldcamp EM, Layne L, Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication Number 2005-147.

NIOSH (2005). Injury and Asthma among Youth Less than 20 Years of Age on Minority Farm Operations in the United States, 2000: Volume II: Hispanic national data. By Myers JR, Hendricks KJ, Goldcamp EM, Layne L. Morgantown, WV: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005-147.

Goldcamp EM, Myers JR, Hendricks KJ, Layne LA [2004]. Nonfatal all-terrain vehicle injuries to youth on farms in the U.S., 2001 [Abstract] In: the National Institute for Farm Safety 2004 Annual Meeting, Keystone, CO, 2004 June.

Goldcamp M, Hendricks KJ, Myers JR [2004]. Farm fatalities to youth 1995-2000: A comparison by age groups, J Safety Research *35*(2):151-157.

Hendricks K, Goldkamp E, Myers J [2004]. On-farm Falls among Youth Less than 20-years old in the U.S., Journal of Agric Saf Health *10*(1):27-38.

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Goldcamp EM, Myers JR, Hendricks KJ, Layne LA [2003]. Non-fatal Injuries: an Overview of Injuries to Youth on Racial Minority Operated Farms in the United States, 2000 [Abstract] In: Proceedings of The National Institute for Farm Safety 2003 Annual Meeting, June 22-26, 2003, Columbia, MO.

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Layne LA, Myers JR, Hendricks KJ, Goldcamp EM [2003]. Demographics and non-fatal injury patterns of youth less than 20 years of age on Hispanic-operated farms in the United States, 2000. [Abstract] In: Proceedings of The National Institute for Farm Safety 2003 Annual Meeting, June 22-26, 2003, Columbia, MO.

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Professional Certifications: Engineer in Training (EIT)

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Memberships: None

National Committee Assignments: None

Honors: None

Recent Publications:

Green JD, Moore PH, Current RS, Bobick TG, Proudfoot S, Romano NT [2005]. "Reducing Vehicle Crash-Related EMS Worker Injuries Through Improvements In Restraint Systems," *Proceedings of the XVIIth World Congress on Safety and Health at Work* {September 16 – 20} Orlando, Florida.

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Master of Arts in Education, University of Minnesota, 1994.
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Research Interests :

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Biomechanics
Perceptual and motor behavior

Memberships :

National Committee Assignments:

Honors:

Bullard-Sherwood Award for Research-to-Practice, Knowledge Category, Harness Design and Sizing Effectiveness, National Institute for Occupational Safety and Health, 2006.

Recognition Award for Contribution to the Digital Human Modeling for Design and Engineering International Conference and Exposition, Society of Automotive Engineers, June, 2000.
Behavioral and Brain Sciences Associate, 1995 - present.

Graduate School Fellow, University of Minnesota, 1989 – 90.

Recent Publications:

Refereed Articles:

Hsiao H., Whisler R., Kau T., Zwiener J., Guan J., and Spahr J. , Constructing New Harness Fit Charts using 3D Anthropometric Information, Contemporary Ergonomics, 3-7, 2005.

Zhuang, Z., Guan, J., Hsiao, H., and Bradmiller, B. (2004). Evaluating the representativeness of the LANL respirator fit test panels for the current U.S. civilian workers. Journal of the International Society for Respiratory Protection, 21(III-IV):83-92.

Hsiao, H., Guan, J., & Weatherly, M. (2002). Accuracy and precision of two in-shoe pressure measurement systems. Ergonomics, 45(8), 537-555.

Hsiao, H., Guan, J., Mayeux, B., & Cutlip, R. (2000). Identifying less stressful work methods: Computer-aided simulation vs. human subject study. SAE Transactions, 109(6): 2231-2236.

Guan, J. & Wade, M. G. (2000). The effect of aging on adaptive eye-hand coordination. Journal of Gerontology Series B: Psychological Sciences, 55B, P151- P162.
Wade, M. G. & Guan, J. (1996). Anthropomorphizing the CNS: Is it what or who you know? Behavioral and Brain Sciences, 19, 90-91. (Commentary).

Non-Refereed Article:

Guan, J, Higgins, D, Merinar, T, Casini V, Spahr J. (2004). ROPS equipped soil compactor overturn kills operator –Tennessee. Department of Health and Human Services, Public Health Service, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2004-02.

Hsiao, H., Guan, J., Mayeux, B., Cutlip, R. (2000). Identifying less stressful work methods: Computer-aided simulation vs. human subject study. Society of Automotive Engineers Technical Paper, No. 2000-01-2163.

Name: David L. Hard, Ph.D.

Title: Research Health Scientist

Discipline: Agriculture

Division/Office: Division of Safety Research/Analysis and Field Evaluations Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road, Morgantown, WV 26505

Telephone: 304-285-6068

NIOSH Employment: June 1990

Education:

Doctor of Philosophy - December, 1989, The Ohio State University, Columbus, Ohio
Major - Agricultural Education
Areas of Study - Research and Statistics, Agricultural Mechanics, Teacher Education

Master of Education - Practical Arts and Vocational-Technical Education
1981, University of Missouri, Columbia
Major - Agricultural Education
Support Area - Agricultural Mechanics

Bachelor of Science in Agriculture (Cum Laude and Honors Scholar)
1979, University of Missouri, Columbia
Major - Agricultural Education

Professional Certifications: Teaching Certificate - Missouri Life Secondary

Research Interests: Agricultural injury prevention, youth agricultural injury prevention

Memberships:

American Society of Agricultural and Biological Engineers
National Institute for Farm Safety

National Committee Assignments:

American Society of Agricultural and Biological Engineers, Ergonomics, Safety and Health Division, Chair July 2006 – present.

USDA Hazardous Occupational Safety Training in Agriculture National Steering Committee—2001 to present.

North American Guidelines for Children's Agricultural Tasks (NAGCAT) Committee–1998 to present. Developed 62 guidelines for distribution on a national level

NIOSH-wide National Skills Standards Team–member representing NIOSH Agriculture Steering Committee and DSR (2-8-99 to present)

National Committee for Childhood Agricultural Injury Prevention (NCCAIP), March 1995 to April 1996.

National Committee for Childhood Agricultural Injury Prevention (NIOSH representative)–Chair of the Research Committee–1995-1996.

Honors:

National Institute for Farm Safety President's Award (2005 & 2003)

Alice Hamilton Science Award for Occupational Safety and Health, 1996 nominee

Recent Publications:

REFEREED PAPERS

Hard DL & Myers JR. 2006. Fatal Work-Related Injuries in the Agriculture Production Sector Among Youth in the United States, 1992-2002. In press. The Journal of Agromedicine.

Chapman LJ, Taveria AD, Josefsson KG and Hard DL. 2003. Evaluation of an occupational injury intervention among Wisconsin dairy farmers. Journal of Agricultural Safety and Health, 9(3): 197-209.

Hard DL, Myers JR and Gerberich SG. 2002. Traumatic injuries in agriculture. Journal of Agricultural Safety and Health, 8(1):51-65.

Joesefsson KG, Chapman LJ, Taveira AD, Holmes BJ and Hard DL. 2001. A hazard analysis of three silage storage methods for dairy cattle. Human and Ecological Risk Assessment. 7(7):1895-1908.

Landsittel D, Murphy DJ, Kiernan NE, Hard DL, Kassab,C. 2001. An evaluation of the effectiveness of educational interventions in the Pennsylvania Central Region farm safety pilot project. American Journal of Industrial Medicine, 40(2):145-152.

Hard DL, Myers JR, Snyder KA, Casini VJ, Morton LL, Cianfrocco R and Fields J. 1999. Identifying work-related fatalities in the agricultural production sector using two national occupational fatality surveillance systems, 1990-1995. Journal of Agricultural Safety and Health, 5(2):155-169.

Hard DL, Myers JR, Snyder KA, Casini VJ, Morton LL, Cianfrocco R and Fields J. 1999. Young workers at risk when working in agricultural production. American Journal of Industrial Medicine, Volume 36, Supplement 1

Myers JR , Hard DL, Snyder KA, Casini VJ, Moron LL, Cianfrocco R and Fields J. 1999. Risks of fatal injuries to farm workers 55-years of age and older. American Journal of Industrial Medicine, Volume 36, Supplement 1:29-30.

Murphy DJ, Kiernan NE, Hard DL and Landsittel D. 1998. The ennsylvania Central Region farm safety pilot project: Part I--Rationale and baseline results. Journal of Agricultural Safety and Health, 4(1):25-41.

Castillo D, Hard D, Myers J, Pizatella T, Stout N. 1998. A national childhood agricultural injury prevention initiative. Journal of Agricultural Safety and Health, Special Issue 1: 183-191.

Pratt SG and Hard DL. 1998. Risk factors associated with agricultural workplace fatalities. Journal of Agricultural Safety and Health, Special Issue 1: 29-38.

Myers J, Snyder K, Hard D, Casini V, Cianfrocco R, Fields J and Morton L. 1998. Statistics and epidemiology of tractor fatalities--A historical perspective. Journal of Agricultural Safety and Health, 4(2): 95-108.

Landsittel D, Hard DL, Murphy DJ and Kiernan NE. 1998. The Pennsylvania Central Region Farm Safety Pilot project: Part II--Baseline data associations between approach-to-safety and hazard conditions. Journal of Agricultural Safety and Health, Special Issue 1: 21-28.

Hard D. 1997. Fourth edition of the International Labour Offices' Encyclopaedia of Occupational Health and Safety. Volume 3, Part IV: Industries and Occupations, in Chapter *Livestock and Rearing*, Myers M, editor, article *Animal Behaviour*, 70.14.
Mason RW, ed.: Report to Congress on workers' home contamination study conducted under the Workers' Family Protection Act [281 pages]. NIOSH, US Dept Health & Human Services, Cincinnati, OH. September, 1995.

Myers J R.& Hard DL. 1995. Work-Related fatalities in the agricultural production and services sectors, 1980-1989. American Journal of Industrial Medicine, 27(1):51-63. Wiley-Liss, Inc., NY, NY.

REVIEWED PUBLICATIONS

Hard DL and Myers JR. (2005). Fatal Work-Related Injuries in the Agriculture Production Sector Among Youth in the United States, 1992-2002. National Institute for Farm Safety Technical Paper #7, Wintergreen, VA.

Hard DL, Myers JR (2003). Surveillance of on-farm injuries to youth in the United States. Future of Rural Peoples: Rural Economy, Healthy People, Environment, Rural Communities, Fifth International Symposium. Saskatoon, Saskatchewan, Canada: IAREH. Institute of Agricultural Rural and Environmental Health: M23-M24; Oct 19-23, 2003.

Hard, DL(2003). The NIOSH childhood agricultural injury prevention initiative (Abstract & Presentation). NOIRS 2003-Abstracts of the National Occupational Injury Research Symposium 2003. Pittsburgh, PA, Oct., 28-29, 2003.

Lee, B., Gallagher, S., Marlenga, B., & Hard, D. (Eds.). (2002). Childhood Agricultural Injury Prevention: Progress Report and Updated National Action Plan from the 2001 Summit. Marshfield, WI: Marshfield Clinic.

Hard DL, Castillo DN, Myers JR, Pizatella TJ and Olenchock SA. 2000. Overview of the NIOSH childhood agricultural injury prevention initiative (Abstract & Presentation). National Occupational Research Symposium (NOIRS) 2000, p.18. Pittsburgh, PA, October 17-19, 2000.

Hard D, Olenchock S, Lee B and Wilkinson, T. 1998. National Farm Safety and Health Week--September 20-26, 1998. Morbidity and Mortality Weekly Report, Volume 47, Number 35 (Sept. 11, 1998), p.1.

Hard D, Wilkinson T, Knobloch M and Lancaster M. 1998. Rural Health: Farm Watch. National Edition Health Scene: Journal of Wellness and Good Health Care, Jan./Feb., pp. 4.

Murphy DJ, Kiernan NE, Hard DL and Landsittel D. 1997. The Pennsylvania Central Region farm safety pilot project: Evaluating educational interventions. National Institute for Farm Safety Paper No. 97-2.
Pratt SG and Hard DL. 1997. Risk factors associated with agricultural workplace fatalities. National Institute for Farm Safety Paper No. 97-7.

Children and Agriculture: Opportunities for Safety and Health. A National Action Plan. Report of the National Committee for Childhood Agricultural Injury Prevention. National Farm Medicine Center, Marshfield, WI, (#910-035), 1996.

Name: James R. Harris

Title: Research Safety Engineer

Discipline: Mechanical/safety engineering

Division/Office: Division of Safety Research/Protective Technology Branch

Location: NIOSH/Morgantown, West Virginia

Address: 1095 Willowdale Road MS G800, Morgantown, WV 26505

Telephone: 304-285-6120

NIOSH Employment: April 2, 1995

Education

MS, mechanical engineering, West Virginia University, 1995

Professional Certifications

Registered Professional Engineer, #13749, State of West Virginia, 1998

Research Interests

Engineering Controls, Protective Equipment, Incorporating FEA and CAD into Engineering Control Design, Safety Eyewear Performance, Agricultural Safety, Technology Transfer

Memberships

American Society of Mechanical Engineers
American Society of Safety Engineers

National Committee Assignments

ANSI Z87 accredited committee on Occupational and Educational Personal Eye and Face Protection Devices

Honors

2005 Bullard-Sherwood Award for Research***2Practice*** **–** Honorable Mention, ROPS Technology Transfer Team.

The Federal Laboratory Consortium Southeast Region, Honorable Mention for Excellence in Technology Transfer, Automatically Deploying Roll-over Protection System (AutoROPS), January 15, 2003.

2002 Alice Hamilton Award - Honorable Mention, Engineering & Physical Sciences Category for paper: Powers JR, Harris JR, Etherton JR, Snyder KA, Ronaghi M, Newbraugh BH. Performance of an automatically deployable ROPS on ASAE tests. Journal of Agricultural Safety and Health 2001;7(1):51-61.

CDC Invention Award (April 2001) for Snyder KA, Etherton JR, Harris JR, Powers JR, Ronaghi M, Cutlip RG, Means KH, McKenzie EA, Current RS, inventors; U.S. Government, assignee. Automatically Deploying Roll Over Protective System (AutoROPS). US Patent Cooperation Treaty (PCT) PCT/US01/20282, 2001 June 24.

Recent Publications

Harris JR, Struttmann T, Merinar TR. Investigation and implications of a compactor fatality. Proceedings of the 2005 International Mechanical Engineering Congress and Exposition; 2005 November 5-11; Orlando, FL paper # IMECE2005-80005.

McKenzie, Jr. EA, Etherton JR, Harris JR, Cantis DM, Lutz TJ. NIOSH AutoROPS research to practice: Zero turn commercial mowers. Proceedings of the 2005 International Mechanical Engineering Congress and Exposition; 2005 November 5-11; Orlando, FL paper # IMECE2005-81575.

Harris JR, Cantis DM, McKenzie EA, Jr., Etherton JR, Ronaghi M. Commercialization of Cost-Effective rollover protective structures (CROPS). Proceedings of the National Institute for Farm Safety (NIFS) Annual Conference; 2005 June 26-30; Wintergreen, Virginia.

McKenzie, Jr. EA, Etherton JR, Harris JR, Cantis DM, Lutz TJ. NIOSH AutoROPS 3rd generation static testing and human interaction element. Proceedings of the 2003 International Mechanical Engineering Congress and Exposition; 2003 November 15-21; Washington, D.C. paper # IMECE2003-41330.

Harris JR, Whisler R, Ammons DE, Spahr JS, Jackson LL. Assessing PPE protection – Development of a safety eyewear coverage coefficient. Proceedings of the NORA Symposium 2003; 2003 June 23-25; Washington, D.C. p. 105 (abstract).

Harris JR, McKenzie, Jr. EA, Etherton JR, Cantis DM. Designing cost-effective rollover protective structures (CROPS) at NIOSH. Proceedings of the National Institute for Farm Safety (NIFS) Annual Conference; 2002 June 23-27; Ponte Vedra, Florida.

Etherton JR, Cutlip RG, Harris JR, Ronaghi M, Means KH, Howard S. Dynamic performance of the mechanism of an automatically deployable ROPS. Journal of Agricultural Safety and Health 2002;8(1):113-118.

Etherton JR, Cutlip RG, Harris JR, Ronaghi M, Means KH, Gillispie A. Static load test performance of a telescoping structure for an automatically deployable ROPS. Journal of Agricultural Safety and Health 2002;8(1):119-126.

Powers JR, Harris JR, Etherton JR, Ronaghi M, Snyder KA, Lutz TJ, Newbraugh BH. Preventing tractor rollover fatalities: performance of the NIOSH AutoROPS. Injury Prevention 2001; 7(Suppl):i54-58.

Powers JR, Harris JR, Etherton JR, Snyder KA, Ronaghi M, Newbraugh BH. Performance of an automatically deployable ROPS on ASAE tests. Journal of Agricultural Safety and Health 2001;7(1):51-61.

McKenzie E, Powers J, Harris J, Ronaghi M, Etherton J, Current R, Cantis D, Newbraugh B, Lutz T. Continuing developments at NIOSH on ROPS for agricultural tractors. Proceedings of the National Institute for Farm Safety Annual Conference; 2001 June 24-27; Pittsburgh, Pennsylvania.

Snyder KA, Etherton JR, Harris JR, Powers JR, Ronaghi M, Cutlip RG, Means KH, McKenzie EA, Current RS, inventors; U.S. Government, assignee. Automatically Deploying Roll Over Protective System (AutoROPS). US Patent Cooperation Treaty (PCT) PCT/US01/20282, 2001 June 24.

Name: Daniel Hartley

Title: Epidemiologist

Discipline: Epidemiology

Division/Office: Division of Safety Research/Analysis and Field Evaluations Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road, MS1811, Morgantown, WV 26505

Telephone: 304-285-5812

NIOSH Employment: May 1998

Education

EdD	Technology Education	West Virginia University	May 200
MS	Safety Management	West Virginia University	August 1994
MS	Ind. & Labor Relations	West Virginia University	August 1993
BS	Accounting & Bus. Admin.	Fairmont State College	May 1988 .

Research Interests Workplace Violence Prevention

Recent Publications

Hartley, D., Biddle, EA, & Jenkins, E.L. Societal Cost of Workplace Homicides in the United States, 1992-2001. AJIM Vol. 47 pp. 518-527. June 2005

Biddle, EA & Hartley, D. Economic Costs: Another Alternative for Measuring Workplace Fatalities. IAIABC Journal Vol 42(1) pp. 173-192. May 2005.

Biddle, E., Hartley, D., Starkey, S., Fabrega, V., and Richardson, S. Deriving Occupational Fatal Injury Costs: A State Pilot Study. CWC On-line. February 2005

Hartley, D., Biddle, E., Grosch, J. and Marsh, S. The Burden of Occupational Fata Injury for Older Workers in the United States, NSC Injury Insights pp. 1, 2, 11. June/July 2002.

Biddle, E.A. and Hartley, D. Fire- and Flame- Related Events with Multiple Occupational Fatalities in the United States, 1980-1995. Injury Control and Safety Promotion Journal, Netherlands. Vol 9(1) pp. 9-18. March 2002.

Hartley, D. and Biddle, E.A. Will Risks to Older Workers Change in the 21st Century? International Journal of Health and Ecological Risk Assessment. Vol. 7(7) pp. 1885-1894. Dec. 2001.

Biddle, E.A. and Hartley, D. Fire- and flame-related occupational fatalities in the United States, 1980-1994. Journal of Occupational and Environmental Medicine 42(4):430-437. April 2000.

Name: Mathew G. Hause

Title: Research Safety Engineer / LCDR USPHS

Discipline: Industrial Engineering

Division/Office: Division of Safety Research/Protective Technology Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Rd., Morgantown, WV 26505

Telephone: 304-285-5982

NIOSH Employment: May 1995

Education:

B.S. Industrial Engineering, West Virginia University, 1992.

Professional Certifications

Research Interests : Industrial Engineering, Geospacial Information Systems, Fall Prevention

Memberships :

Member, Institute of Industrial Engineers (IIE)
Society of American Military Engineers
Commissioned Officers Association
Military Officers Association of America
Reserve Officers Association

National Committee Assignments:

Technical committee 94, Subcommittee 4, Personal Equipment for Protection Against Falls (ISO TC94/SC4)

ANSI A14.2, Extension Ladders Committee

Honors:

FDA letter of Recognition, BA Schwetz, Associate Commissioner for Science
OSHA Letter of Recognition, Jim Lapping, Assistant Director of Construction
USPHS Commissioned Officer Honor & Service Awards

Recent Publications:

Hause M., Defining Hazard Areas Around Construction Equipment, National Occupational Injury Research Symposium, 2003.

Braddee, R., Pratt, S., and Hause, M., "Worker Deaths by Falls: A Summary of Surveillance Findings and Investigative Case Reports," DHHS (NIOSH) Publication No. 2000-116, November 2000.

Braddee, R., Pratt, S., and Hause, M., "Preventing Falls from Elevations", Welding Journal, 1997.

Numerous Fatality Assessment and Control Evaluation (FACE) Reports

Name: Kitty J. Hendricks

Title: Research Epidemiologist

Discipline: Epidemiology

Division/Office: Division of Safety Research/Surveillance and Field Investigations Branch

Location: NIOSH/Morgantown, West Virginia

Address: 1095 Willowdale Rd, M/S 1808, Morgantown WV 26505

Telephone: 304-285-6252

NIOSH Employment: May 1990 – January 1994; September 1997- present

Education:

M.A., Sociology/Applied Social Research, West Virginia University, 1995
B.A., Psychology, West Virginia University, 1993

Research Interests:

Youth agricultural injuries
Youth occupational injuries

Recent Publications:

Goldcamp M, Myers J, Hendricks KJ, Layne L (2006) Non-fatal All-Terrain Vehicle Injuries to Youth Living on Farms in the U.S., 2001 The J Rural Health 22 (4): 309-313.

Hendricks KJ, Layne LA, Goldcamp EM, Myers JR (2005). Injuries to Youth Living on US Farms in 2001 with Comparison to 1998. *Journal of Agromedicine* 10(4): 19-26.

Hendricks KJ, Myers JR, Layne LA, Goldcamp EM (2005). Household youth on minority operated farms in the United States, 2000: Exposures to and injuries from work, horses, ATVs, and tractors. *J of Safety Research 36: 149-157*.

NIOSH (2005). Injury and Asthma among Youth Less than 20 Years of Age on Minority Farm Operations in the United States, 2000. Volume I: racial minority national data. By Myers JR, Hendricks KJ, Goldcamp EM, Layne L. Morgantown, WV: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2006-109.

NIOSH (2005). Injury and Asthma among Youth Less than 20 Years of Age on Minority Farm Operations in the United States, 2000: Volume II: Hispanic national data. By Myers JR, Hendricks KJ, Goldcamp EM, Layne L. Morgantown, WV: Department of Health and Human

Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005-147.

Goldcamp EM, Hendricks KJ, Layne LA, Myers JR (2005). Nonfatal Injuries to Household Youth on Native American Operated Farms in the U.S., 2000**.** Submitted to the *Journal of Agromedicine***.**

Goldcamp EM, Hendricks KJ, Myers JR (2004). Farm fatalities to youth 1995-2000: A comparison by age group. *Journal of Safety Research* 35(2): 151-157.
CDC (2004). Occupational fatalities during trenching and excavation work - United States, 1992-2001. MMWR 53(15): 311-314.

Hendricks KJ, Goldcamp EM, Myers JR (2004). On-farm Falls among Youth Less than 20 Years Old. *Journal of Agricultural Safety and Health* 10(1): 27-38.

McHugh M, Hendricks KJ, Goldcamp EM, Myers JR (2004). Injuries to Youth on Minority Farm Operations. Morgantown, WV: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-117.

McHugh M, Hendricks KJ, Goldcamp EM, Myers JR (2004). Asthma among Household Youth on Minority Farm Operations. Morgantown, WV: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-118.

NIOSH (2002). *National Institute for Occupational Safety and Health (NIOSH) Recommendations to the U.S. Department of Labor for Changes to Hazardous Orders*. Morgantown, WV: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health

Hendricks KJ, Adekoya N (2001). Non-Fatal Animal-Related Injuries to Youth Occurring on Farms in the United States - 1998. *Injury Prevention* 7(4):307-311.

Myers JR, Hendricks KJ (2001). Injuries Among Youth on Farms in the United States, 1998. Morgantown, WV: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-154.

Chen, G-X, Hendricks, KJ. (2001) Nonfatal Occupational Injuries among African American Women by Industrial Group. *Journal of Safety Research* 32:75-84.

Hendricks, KJ, Layne, LA. (1999) Adolescent Occupational Injuries in Fast Food Restaurants: An Examination of the Problem from a National Perspective. *Journal of Occupational and Environmental Medicine* 41 (12):1146-1153.

Name: Scott A. Hendricks

Title: Statistician

Discipline: Statistics

Division/Office: Division of Safety Research/Analysis and Field Evaluations Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Rd

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NIOSH Employment: April 1991

Education:

1990 M.S. Statistics, West Virginia University, Morgantown, West Virginia.

1988 B.S., Applied Mathematics/Actuarial Science, Clarion University of Pennsylvania, Clarion, Pennsylvania.

Professional Certifications:

Research Interests: Violence, Statistical method in injury epidemiology

Memberships:

National Committee Assignments:

Honors:

Recent Publications:

Pan CS, Chiou SS, and Hendricks SA (2003). The Effect of Drywall Lifting Method on Workers= Balance in a Laboratory-Based Simulation, *Occupational Ergonomics*, in press.

Faulkner KA, Landsittel DP, and Hendricks SA (2001). Robbery Characteristics and Employee Injuries in Convenience Stores, *American Journal of Industrial Medicine*, 40, 703-709.

Hassi J, Gardner L, Hendricks SA, and Bell J (2000). Occupational Injuries in the Mining Industry and Their Association with Statewide Cold Ambient Temperatures in the USA, *American Journal of Industrial Medicine*, 38, 49-58.

Hendricks SA, Landsittel DP, Amandus HA, Malcan J, and Bell J (1999). A Case-Control Study of Convenience Store Robbery, *Journal of Occupational and Environmental Medicine*, 41, 995-1004.

Pan CS, Gardner LI, Landsittel DP, Hendricks SA, Chiou SS, and Punnett L (1999). Ergonomic Exposure Assessment: An Application of the PATH Systematic Observation Method to Retail Worker, *International Journal of Occupational and Environmental Health*, 5, 79-87.

Faulkner KA, Landsittel DP, and Hendricks SA (1998). Robbery-Related Injury in Convenience Stores: Estimating Lifetime Risk and Identifying High-Risk Populations, *Human and Ecological Risk Assessment*, 4, 1391-1403.

Amandus HE, Hendricks SA, et. al. (1997). Convenience Store Robberies in Selected Metropolitan Areas: Risk Factors for Employee Injury, *Journal of Occupational and Environmental Medicine*, 39, 442-447.

Hendricks SA, Wassell JT, Collins JE, and Sedlak SL (1996). Power Determinations for Geographically Clustered Data Using Generalized Estimating Equations, *Statistics in Medicine*, 15, 1951-1960.

Cattledge GH, Schneiderman A, Stanevich R, Hendricks SA, and Greenwood J (1996). Nonfatal Occupational Fall Injuries in the West Virginia Construction Industry, *Accident Analysis & Prevention*, 28, 655-663.

Cattledge GH, Hendricks SA, and Stanevich R (1996). Fatal Occupational Falls in the United States' Construction Industry, 1980-1988, *Accident Analysis & Prevention*, 28, 647-654.

Landen DD and Hendricks SA (1995). Effect of Recall on Reporting of at-Work Injuries, *Public Health Reports*, 110, 350-354.

Amandus HE, Hunter RD, James E, and Hendricks SA (1995). Reevaluation of the Effectiveness of Environmental Designs to Reduce Robbery in Florida Convenience Stores, *Journal of Occupational Medicine*, 37, 1-7.

Johnston JJ, Hendricks SA, and Fike JM (1994). Effectiveness of Behavioral Safety Belt Interventions. *Accident Analysis & Prevention*, 26, 315-323.

Hendricks SA, Johnston JJ, Savage GE, and Shands L (1994). Evaluation of a Needlestick Injury Prevention Device and Risk Factors Associated With Needlestick Injury and Needlestick Injury Reporting, presented to the Indian Health Services as a NIOSH final report.

Noonan GP, Stobbe JA, Keane P, Reed LD, Ronk RM, Hendricks SA, and McCarthy RT (1993). Firesmoke: A Field Evaluation of Self-Contained Breathing Apparatus, *NTIS*.

Landen DD and Hendricks SA (1992). Estimates from the National Health Interview Survey on Occupational Injury among Older Workers in the United Sates, *Scandinavian Journal of Work, Environment, and Health*, 18, 18-20.

Name: Doloris N. Higgins

Title: Safety and Occupational Health Specialist

Discipline: Safety

Division/Office: Division of Safety Research//Surveillance and Field Investigations Branch

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Address: 1095 Willowdale Road, Morgantown WV 26505 m/s 1808

Telephone: 304-285-6276

NIOSH Employment: April 12, 1998

Education:

BS, Nursing, University of Wisconsin, Madison, 1966
MS, Safety Management, West Virginia University, 1999

Professional Certifications: Certified Occupational Health Nurse Specialist

Research Interests: Occupational Injury

Memberships: American Association of Occupational Health Nurses

National Committee Assignments: None

Honors:

Recent Publications:

CDC [1999]. Deaths among children aged _< 5 years from farm machinery runovers--Iowa, Kentucky, and Wisconsin, 1995-1998, and United States, 1990-1995. By Higgins DN, Hendricks K. MMWR 48(28):605-608.

Higgins DN, Helmkamp JC, Williams JM, King ME [2000]. Work related deaths in West Virginia, AAOHN 48(7):331-337.

Higgins DN, Casini VJ, Bost P, Johnson W, Rautiainen R [2001]. The Fatality Assessment and Control Evaluation program's role in the prevention of occupational disease, Injury Prevention 7(Suppl I):i27-i33.

Higgins D, Tierney J, Hanrahan L [2002]. Preventing youth worker fatalities: the Fatality Assessment and Control Evaluation (FACE) Program, AAOHN 50(11):508-514.

Tierney JM, Higgins DN, Hanrahan LP, Washburn MJ [2003]. Preventing Youth Worker Fatalities [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

NIOSH [2003]. NIOSH Fatality Assessment and Control Evaluation Program: FACE Program. By Higgins DN, Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2003-146.

Higgins D, Parker DK, Wahl G [2001]. Hazards associated with using farm tractors to move large bales, Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Hazard ID 13.

Higgins DN, Tierney J, Lins M, Hanrahan L [2004]. School Nurses: A Resource for Young Worker Safety, J Sch Nur 20(6):317-323.

Styles L, Cierpich H, Rogge J, Higgins D, Harrison R [2005]. To live and die in Los Angeles: the California fatality assessment and control evaluation (FACE) program: 1992 - 2002, 2005 National Injury Prevention and Control Conference, Denver, Colorado, May 9-11, 2005 Atlanta, GA: Centers for Disease Control and Prevention.

NIOSH [2004]. NIOSH Alert: Preventing Falls of Workers through Skylights and Roof and Floor Openings. By Higgins DN, Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-156.

NIOSH [1998]. Tree Feller Killed When Struck By Chain Saw-West Virginia. By Higgins DN, Braddee RW, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 1998-09.

NIOSH [1998]. Electrical Mechanic Dies After 45-foot Fall Through Unguarded Floor Opening-North Carolina. By Higgins DN, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 1998-11.

NIOSH [1998]. Machine Operator Dies After Being Crushed By 9,700-Pound Coil Cart-PA. By Higgins DN, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 1998-14.

NIOSH [1998]. 9-Year-Old Child Helping With Blueberry Harvest Dies After Being Run Over by Cargo Truck on Field Road-Michigan. By Higgins DN, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 1998-15.

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NIOSH [2000]. Sixteen-Year-Old Mechanic's Assistant Died After Being Run Over By the Rear Wheels of a Tub Grinder-Connecticut. By Higgins DN, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2000-14.

NIOSH [2000]. 17-Year-Old Lifeguard Dies After Falling Into a Nearly Empty Swimming Pool-Pennsylvania. By Higgins, DN, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for

Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2000-17.

NIOSH [2001. State Department of Transportation Highway Maintenance Worker Dies After Being Struck By a Car while Installing Reflectors on a Guardrail-Pennsylvania. By Higgins DN, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2001-02.

NIOSH [2001]. Fifteen-Year-Old Laborer Dies After Falling Through a Skylight-Florida. By Higgins DN, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2001-04.

NIOSH [2001]. Fourteen-Year-Old Laborer Dies After Falling Through a Skylight-Alabama. By Higgins DN, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2001-07.

NIOSH [2001]. Seventeen-Year-Old Part-Time Road Construction Laborer Dies After Being Run Over by a Water Truck-Indiana. By Higgins DN, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2001-10.

NIOSH [2002]. Seventeen-Year-Old Warehouse Laborer Dies after the Forklift He was Operating Tipped Over and Crushed Him-Arizona. By Higgins DN, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2002-02.

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NIOSH [2002]. Hispanic Dump-Truck Driver Dies After Being Caught Between Frame and Dump Body of an Off-Road Truck While Performing Routine Lubrication-Tennessee. By Higgins DN, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2002-08.

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NIOSH [2003]. Two Hispanic Guardrail Installers Die After Being Struck by a Guardrail-North Carolina. By Higgins DN, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2003-09.

NIOSH [2004]. Hispanic Laborer Dies After Being Crushed Between the Frame of a Skid Steer Loader and the Scraper Attachment on the Loader Lift Arms-Ohio. By Higgins DN, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE), DHHS (NIOSH) Report No.2004-01.

NIOSH [2004]. Seventeen-Year-Old High School Student Working as a Warehouse Laborer in Work-Based Learning Program Dies After Forklift Tips Over and Crushes Him-Tennessee. By Higgins DN, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE), DHHS (NIOSH) Report No. (FACE 2004-03).

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NIOSH [2005]. Hispanic Youth Dies in Densifier at a Plastics Recycling Plant - Tennessee By Chesky JF; Higgins DN, Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2005-05

NIOSH [2005]. Hispanic Worker Dies After Falling From a Pile of Construction Debris in the Bed of a Trash-Style Body Truck to a Paved Driveway Below-North Carolina. By Higgins DN, Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2005-06

NIOSH [2005]. Construction Worker dies After Being Run Over By a Bulldozer at a Commercial Construction Site-North Carolina. By Higgins DN, Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report No. 2005-11

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BSE, Engineering, National Cheng Kung U. (Taiwan), 1977

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Memberships:

Ergonomics Society (UK) – Fellow
Human Factors and Ergonomics Society -- Honorary Fellow
American Society of Safety Engineers (Full Member)
American Society of Biomechanics (1985 – 2003; Full Member)
International Society for Fall Protection (2001 -2004; Full Member)
Society of Automotive Engineers (2002 - 2004; Full Member)

National Committee Assignments:

SAE G-13 Committee for American Standards for Human Modeling (1997- 2006)

U.S. Technical Advisory Group for Fall Protection, Delegation to ISO TC-94 (1999-2006)

Human Factors Society HF-3000 Committee for the American Standards for Anthropometry and Biomechanics (1997)

Ergonomic Invention Competition Committee, the Laborers Health and Safety Fund of North America (1995-1997)

National Civilian American and European Surface Anthropometry Resource (CAESAR) Study Partners Committee (1996-2002)

Research Committee of the American Society of Safety Engineers Foundation (2004-2006)

NORA Program Committee for Musculoskeletal Disorders (1997-2001)

Technical Advisor for the National Research Council Fellowships on Safety Engineering (1996 - 2005).

Editorial board member for Safety Science, Applied Ergonomics, and International Journal of Industrial Ergonomics journals (1999-2006);

Ad hoc Reviewer for Ergonomics (2002-2006), IJIE (1996-2006), HFM (2000-2006), Human Factors (2001, 2003, 2005), Graphical Models (2001), SAE Transactions (2001-2006), and Biomechanics journals (2005-2006).

General Chair for the New Thoughts on 21st Century Labor Policy Program, including occupational safety and health, labor policy, production planning, and employee-employer relations sessions, Chinese-American Academic and Professional Convention, July 1-4, 1999, Washington, D.C.

Coordinator and Session Chair, SAE Digital and Human Modeling for Design and Engineering Conference and Exposition, 2000-present

Honors:

Alice Hamilton Award for Excellence in Occupational Safety and Health (2006)

Bullard-Sherwood r2p Award for Transfer of Knowledge (2006)

Professional Service Award, the Ergonomics Society (2005)

CDC Shepard Award NIOSH Nominee (2004)

National Occupational Research Agenda (NORA) Partnering Award for Worker Safety and Health (2003).

International Ergonomics Association (IEA) Liberty Mutual Prize in Occupational Safety and Ergonomics (2002)

Centers for Disease Control and Prevention (CDC) Invention Award (1999)

Keynote Speaker on falls prevention for the Slip, Trip, and Fall Symposium at the Ergonomics Society annual conference (UK; 2005).

Keynote speaker, International Conference on Advanced Industrial Design, December 9-11, 2001, Tainan, Taiwan.

Recent Publications:

Hsiao H., Whitestone J., and Kau T., Evaluation of Fall-Arrest Harness Sizing Scheme, Human Factors, 48, 2006. [in press]

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Hsiao H**.,** Bradtmiller B., Whitestone J**.,** Sizing and Fit of Fall-Protection Harnesses, Ergonomics, Vol. 46, No. 12, 1233-1258, 2003.

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Hsiao H. and Stanevich R., Injuries and Ergonomic Applications in Construction, Chapter 27 in Bhattacharya and McGlothlin (ed.), Occupational Ergonomics, pp 545-568, 1996.

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Research Interests:

Occupational health and safety
Injury Surveillance
Epidemiology

Recent Publications:

NIOSH [2006]. Proceedings, Second International Fishing Safety and Health Conference, 2006 Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2006-114.

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Lincoln JM, Husberg BJ, Conway GA [2002]. Improving Safety in the Alaskan Commercial Fishing Industry. In: Proceedings of the International Fishing Industry Safety and Health Conference, Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2003-102.

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Conway GA, Husberg BJ [1999]. Cold Related Non-Fatal Injuries in Alaska. American Journal of Industrial Medicine, S1, pages 39-41.

Choromanski D, Husberg BJ [1999]. Occupational Falls Raise Safety Concerns. State of Alaska Epidemiology Bulletin. 3(1).

Husberg BJ, Conway GA, Moore MA, Johnson MS [1998]. Surveillance for nonfatal work-related injuries in Alaska, 1991-95. Am J Ind Med 34(5):493-498.

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Occupational fatal and nonfatal injury epidemiology
Emergency department surveillance for nonfatal injuries
Eye safety
Development of web applications for dissemination of surveillance data

National Committee Assignments:

ANSI Z87 Eye and Face Protection Committee
National Eye Institute Healthy Vision 2010 Workgroup

Recent Publications:

Marsh SM, Derk SJ, Jackson LL, 2006. Nonfatal occupational injuries and illnesses among workers treated in hospital emergency departments—United States, 2003; MMWR: 55(16), 449-452.

National Eye Institute, 2006. Healthy Vision Month 2006: Reduce Occupational Eye Injury; Eye Safety at Work is Everyone's Business; http://www.healthyvision2010.org/hvm/ (Jackson LL, contributor).

Schulte PA, Ahlers HW, Jackson LL, Malit BD, Votaw DM, 2005. Contact Lens Use in a Chemical Environment: Current Intelligence Bulletin 59; DHHS (NIOSH) Publication Number 2005–139; 16 p.

Riggs MA, Jackson LL, 2005. Occupational Health and Safety Survey Tool - Evacuation Centers (Employee Injury or Illness Form); NIOSH Online Interim Assessment Tool http://www.cdc.gov/niosh/topics/flood/pdfs/KatrinaShelterWorkerSurveillance.pdf.

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Zeng S, Powers JR, Jackson LL, Conover DL, Stout NA, Newbraugh BH, 2005. Electrical Injury Protection System: U.S. Patent Application No. 11/126,009; Filed May 9, 2005.

NIOSH, 2004. Worker Health Chartbook: DHHS (NIOSH) Publication No. 2004-146, 354 pages (Jackson LL, contributor).

Jackson LL, 2004. Eye protection for infection control; NIOSH internet page http://www.cdc.gov/niosh/topics/eye/eye-infectious.html.

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Marsh SM, Spiker JR, Leatherman K, Jackson LL, 2004. Standardized Occupation and Industry Coding; NIOSH internet subsite http://www.cdc.gov/niosh/soic/.

OSHA-NIOSH Issues Exchange Group (Jackson LL contributor), 2004. Avian Influenza—Protecting Poultry Workers at Risk; Safety and Health Information Bulletin (SHIB 12-13-2004), 8 pages: OSHA internet page http://www.osha.gov/dts/shib/shib121304.html and http://www.osha.gov/dts/shib/shib121304.pdf.

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Jackson LL, 2001. Nonfatal occupational injuries and illnesses treated in hospital emergency departments--United States, 1998, MMWR 50(16):313.

Jackson LL, 2001. Nonfatal occupational injuries and illnesses treated in hospital emergency departments in the United States, Injury Prevention 7(Suppl I):i21-i26.

Jackson, LL, 2001. Emergency Response and Disaster RecoveryBEye Safety (NIOSH trifold pamphlet for WTC workers and web page: http://www.cdc.gov/niosh/eyesafe.html)

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MBA, University of Pittsburgh, 1983

Professional Certifications:

Research Interests : Economics of Occupational Injury

Memberships:

National Committee Assignments: CDC NIOSH Economics Forum

Honors:

Recent Publications:

Name: Philip Kemp

Title: Guest Researcher

Discipline: Safety

Division/Office: Division of Safety Research/Surveillance and Field Investigations Branch

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NIOSH Employment: August 7, 2006

Education:

BS, Environmental Health Sciences, University of Massachusetts/Amherst, 1992
MS, Environmental Toxicology, University of Massachusetts/Amherst, 1995

Professional Certifications:

Research Interests: Toxicology of metals

Memberships:

National Committee Assignments:

Honors:

60th Aeromedical Squadron, Company Grade Officer of the Year, 1999
Outstanding Military Volunteer, 2000
311th Human Systems Wing, Honor Guard Member of the Year, 2002

Recent Publications:

Name: Robert E. Koedam

Title: Safety and Occupational Health Manager/ Chief, Fatality Investigations Team

Discipline(s): Safety and health

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Master of Science (Occupational Health/Safety), Medical College of Ohio at Toledo, Ohio, Degree Awarded: 2001

Bachelors Chemistry/Natural Science, Lourdes College, Sylvania Ohio, Degree Awarded: 1994

Research Interests:

Preventing occupational injuries and illnesses

Reducing the economic impact of occupational injuries and illnesses

Development of dissemination methods of safety and occupational health prevention information/recommendations to the fire service, general industry / construction sectors and sub-sectors, and the public at large.

National Committee Assignments:

ANSI Z117 Confined Space Committee
International Association of Fire Chiefs (IAFC) Safety and Survival Section

Recent Publications:

NIOSH [2006]. Volunteer Fire Fighter / Rescue Diver Dies in Training Incident at a Quarry - PA. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. F2005–29.

NIOSH [2006]. Four Construction Workers Die after Cantilever Launching Gantry Collapses at Bridge Construction Site- Ohio. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. F2004–05.

NIOSH [2006]. Career Fire Fighter/EMT Dies in Ambulance Crash – Florida. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. F2005–12.

NIOSH [2005]. One Probationary Career Firefighter Dies and Four Career Firefighters are Injured at a Two - Alarm Residential Structure Fire. Texas. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. F2000–38.

NIOSH [2005]. Hispanic Laborer Electrocuted After Boom Truck Contacts Overhead Power Line - North Carolina. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. FACE 2005-02.

NIOSH [2004]. One Volunteer Lieutenant Dies and a Volunteer Fire Fighter is Seriously Injured in a Motor Vehicle Rollover Incident While En-route to a Trailer Fire - North Carolina. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. F2003-30.

NIOSH [2004]. 18-year-old Dies After Being Entangled in a Portable Mortar Mixer - South Carolina. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. FACE 2003-13.

NIOSH [2004]. Hispanic Pipe Layer Dies After Being Struck by Excavator (Track Hoe) Bucket on Construction Site- South Carolina. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. FACE 2003-12.

NIOSH [2002]. Two Career Fire Fighters Die in Four-Alarm Fire at Two-Story Brick Structure – Missouri. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease

Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. F2002–20.

NIOSH [2002] Youth Farm Worker Dies After Falling Into Operating Feed Grinder/Mixer-Ohio. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. FACE 2002–10.

NIOSH [2002] Volunteer Fire Fighter Dies and Two Others Are Injured During Live-Burn Training - New York. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No.F2001-38.

NIOSH [2002] Volunteer Fire Fighter Dies After Being Run Over by Brush Truck During Grass Fire Attack – Texas. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No.F2002-36.

NIOSH [2002] High-Rise Apartment Fire Claims the Life of One Career Fire Fighter (Captain) and Injures Another Career Fire Fighter (Captain) - Texas Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No F2001–33.

NIOSH [2001] Career Fire Fighter Dies From Injuries When Stationary Fill Tank Becomes Over–Pressurized and Suffers Catastrophic Failure – California. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No F2001–26.

Name: Larry A. Layne

Title: Statistician (Health)

Discipline: Injury Surveillance

Division/Office: Division of Safety Research/Surveillance and Field Investigations Branch

Location: NIOSH/Morgantown, West Virginia

Address: 1095 Willowdale Road (M/S H-1808) Morgantown, West Virginia 26505

Telephone: 304-285-6008

NIOSH Employment: August 1991

Education:

MA, Applied Social Research, WVU, 1990

Research Interests: Youth injury, agriculture, mining

Recent Publications:

Layne LA [2006]. Youth Living on Hispanic Operated Farms in the United States: An Examination of Population Growth and Changes in Risk Exposure and Injury Patterns between 2000 and 2003.. In: Proceedings of The National Institute for Farm Safety 2006 Annual Meeting, June 25-30, 2006, Sheboygan, WI.

Layne LA, Myers JR, Hendricks KJ, Goldcamp EM [2003]. Demographics and non-fatal injury patterns of youth less than 20 years of age on Hispanic-operated farms in the United States, 2000. In: Proceedings of The National Institute for Farm Safety 2003 Annual Meeting, June 22-26, 2003, Columbia, MO.

Layne LA [2004]. Occupational Injury Mortality Surveillance in the United States: An Examination of Census Counts From Two Different Surveillance Systems, 1992-1997, Am J Ind Med 45(*1*):1-13.

Layne LA, Pollack KM [2004]. Nonfatal Occupational Injuries From Slips, Trips, and Falls Among Older Workers Treated in Hospital Emergency Departments United States 1998, Am J Ind Med *46*:32-41.

Layne LA, Landen DD [1997]. A descriptive analysis of nonfatal occupational injuries to older workers, using a national probability sample of hospital emergency departments. Journal of Occupational and Environmental Medicine 39(9):855-865.

Layne LA, Castillo DN, Stout N, Cutlip P [1994]. Adolescent occupational injuries requiring hospital emergency department treatment: a nationally representative sample. Am J Public Health 84(4): 657-660.

Hendricks K, Myers J, Layne L, Goldcamp M [2005]. Household youth on minority operated farms in the United States 2000: Exposures to and injuries from work, horses, ATVs and tractors, J Safety Res 36:149-157.

NIOSH [2005]. Injury and Asthma Among Youth Less Than 20 Years of Age on Minority Farm Operations in the United States, 2000. Volume 1: racial minority national data. By Myers JR, Hendricks KJ, Goldcamp EM, Layne L, Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication Number 2005-147.

Goldcamp EM, Myers JR, Hendricks KJ, Layne LA [2004]. Nonfatal all-terrain vehicle injuries to youth on farms in the U.S., 2001 [Abstract] In: the National Institute for Farm Safety 2004 Annual Meeting, Keystone, CO, 2004 June.
Goldcamp EM, Myers JR, Hendricks KJ, Layne LA [2003]. Non-fatal Injuries: an Overview of Injuries to Youth on Racial Minority Operated Farms in the United States, 2000 [Abstract] In: Proceedings of The National Institute for Farm Safety 2003 Annual Meeting, June 22-26, 2003, Columbia, MO.

Hendricks KJ, Myers JR, Goldcamp EM, Layne LA [2003]. Farm hazards to household youth on minority operated farms in the United States, 2000: exposures and injuries from work, horses, ATV's and tractors [Abstract] In: Proceedings of The National Institute for Farm Safety 2003 Annual Meeting, June 22-26, 2003, Columbia, MO.

Hendricks K, Layne L [1999]. Adolescent Occupational Injuries in the Fast Food Industry. Journal of Occupational and Environmental Medicine 41(12):1146-1153.

Marsh SM, Layne LA [2001]. Fatal injuries to civilian workers in the United States, 1980-1995 (National and State Profiles), Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-129S.

Marsh, SM Layne LA [2001]. Fatal injuries to civilian workers in the United States, 1980-1995 (National Profile), Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-129.

Henneberger PK, Metayer C, Layne LA, Althouse R [2000]. Nonfatal work-related inhalations: Surveillance data from hospital emergency departments, 1995-1996, Am J Ind Med 38(2):140-148.

Chen GX, Layne LA [1999]. Where African-American women work and the nonfatal work-related injuries they experienced in the U.S. in 1996, compared to women of other races. Am J Ind Med Supplement 1:34-36.

Sorock GS, Smith GS, Reeve GR, Dement J, Stout N, Layne L, Pastula ST [1997]. Three perspectives on work-related injury surveillance systems. Am J Ind Med 32(2):116-128.

Knight EB, Castillo DN, Layne LA [1995]. A detailed analysis of work-related injury among youth treated in emergency departments. Am J Ind Med 27: 793-805.

Castillo DN, Landen DD, Layne LA [1994]. Occupational injury deaths of 16- and 17-year-olds in the United States. Am J Public Health 84(4): 646-649.

Name: Jennifer M. Lincoln, PhD

Title: Occupational Safety and Health Specialist

Discipline: Injury Epidemiology

Division/Office: Division of Safety Research/Alaska Field Station

Location: NIOSH/Anchorage, Alaska

Address: 4230 University Dr. #310, Anchorage AK, 99508

Telephone: 907-271-2383

NIOSH Employment: January 1992

Education:

INSTITUTION AND LOCATION	DEGREE (If applicable)	YEAR(s)	FIELD OF STUDY
Indiana State University, Terre Haute, Indiana	BS	1991	Environmental Science
University of Alaska Anchorage, Anchorage, Alaska	MS	1997	Environmental Quality Science
Johns Hopkins University, Baltimore Maryland	PhD	2006	Health Policy Management

Professional Certifications: Certified Safety Professional (CSP) 1997

Research Interests: My research interests include the application of injury epidemiology to prevent injuries, in particular work-related injuries. As a strong advocate of providing science to support change, my work is grounded in how to translate research findings into practice. I strive to provide scientific information to develop palatable interventions in the form of engineering solutions, new operating procedures or new policies in concert with industry, other safety advocates and regulators.

Memberships:

Commissioned Officer Association, Aurora Borealis Chapter, **Secretary**, 2001, member since 1999
Alaska Marine Safety Education Association, **Executive Board member**, 1994-present
American Society for Safety Engineers ASSE; Alaska Chapter **President**, (presented with chapter achievement award), 1997-1998;
Planning Committee for the Governor's Safety and Health Conference, 1994-98
Federal-State Interagency Collaborative Working Group on the Prevention of Occupational Traumatic Injuries, 1992-98; **Chairman** of the Commercial Fishing Subcommittee, 1997-present.

Honors:

Special Recognition Award—2003 Governor's Safety and Health Conference
USPHS Unit Citation, 2001. Presented to the Alaska Field Station for outstanding work in occupational injury prevention for workers in Alaska.

Recent Publications:

Husberg BJ, Lincoln JM, Conway GA. On-Deck Dangers in the Alaskan Commercial Fishing Industry. Proceedings - U.S. Coast Guard Journal of Safety at Sea, 58 (2), pages 23-24. April 2001.

Backus AS, Brochu PJ, Lincoln JM, Bensyl DM, Ciampa JR, Smith TJ, Understanding and Preventing Lobsterman Entanglement: A Preliminary Study" Marine Safety Council, Proceedings April-June 2001, Vol. 58, Number 2, pg. 50-53.

Lincoln JM, Husberg BJ, Conway GA. Improving Safety in the Alaskan Commercial Fishing Industry. International Journal of Circumpolar Health. Volume 60, pages 705-713. December 2001.

Thomas TK, Lincoln JM, Husberg BJ, Conway GA. Is it Safe on Deck? Fatal and Non-Fatal Workplace Injuries Among Alaskan Commercial Fishermen. American Journal of Industrial Medicine. Volume 40, pages 693-702. December 2001.

Conway, G., Lincoln, J., Hudson, D., Bensyl, D., Husberg, B., & Manwaring, J. Surveillance and prevention of occupational injuries in Alaska: A decade of progress, 1990-1999. (DHHS (NIOSH) Publication No. 2002-115). Cincinnati, OH: National Institute for Occupational Safety and Health. 2002.

NIOSH. Danger of Entanglement During Lobstering, Workplace Solutions from the National Institute for Occupational Safety and Health. (DHHS (NIOSH) Publication No. 2005-137). Cincinnati, OH: National Institute for Occupational Safety and Health. August 2005.

Name: Kelly A. Loringer

Title: EIS Officer

Discipline: Epidemiology

Division/Office: Division of Safety Research/Surveillance and Field Investigations Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road, MS H1808 Morgantown, WV 26505

Telephone: 304-285-6109

NIOSH Employment: July 31, 2006

Education:

A.B., Biochemistry, Smith College, 1993
Doctor of Naturopathic Medicine, National College of Naturopathic Medicine, 2000
M.P.H, Johns Hopkins Bloomberg School of Public Health, 2005

Professional Certifications:

Oregon ND License (#1071)
Vermont ND License (#099-0000150)

Research interests: Occupational injuries

Memberships:

American Public Health Association
American Association of Naturopathic Physicians

National Committee Assignments: None

Honors:

1998- Navy and Marine Corps Achievement Medal
1997- Reserve Center Sailor of the Year (Wilmington, DE)

Recent Publications: None

Name: Virginia Lutz

Title: Safety and Occupational Health Specialist

Discipline: Safety

Division/Office: Division of Safety Research/Surveillance and Field Investigations Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road, Morgantown, WV 26505

Telephone: 304-285-6342

NIOSH Employment: 06/2002

Education:

RN, Nursing, West Penn Hospital School of Nursing, 1966 – 1967.

Professional Certifications:

Certified Safety Executive – World Safety Organization, 2000
Emergency Medical Technician - Commonwealth of Pennsylvania, 1975, 1981, 1989

Research Interests:

To investigate fire fighter line-of-duty deaths and to formulate recommendations to assist the fire services in preventing future injuries and fatalities.

Memberships: None

Honors: NA

Recent Publications:

NIOSH [2006]. Career Fire Fighter Fatally Injured In Fall From Apparatus - Texas. By Lutz V. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2005-15.

NIOSH [2006]. Career Captain Electrocuted at the Scene of a Residential Structure Fire - California. By Lutz V., Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for

Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2005-07.

NIOSH [2006]. Career Fire Fighter Dies While Exiting Residential Basement Fire - New York. By McFall M., Lutz V., and Berardinelli S. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2005-04.

NIOSH [2005]. One Part-time Fire Fighter Dies and Another Is Seriously Injured When Two Fire Engines Collide at an Intersection While Responding to a Fire - Illinois. By Lutz V., and Frederick L. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2004-43.

NIOSH [2005]. Volunteer Chief Dies and Two Fire fighters Are Injured by a Collapsing Church Façade - Tennessee. By Lutz V. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2004-37.

NIOSH [2005]. Career Fire Dies From Injuries Sustained In Fall From Apparatus - Massachusetts. By Lutz V. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2004-19.

NIOSH [2005]. Forest Ranger/Fire Fighter Drowned After Catastrophic Blow-out of Right Front Tire - Florida. By Frederick L., Lutz V. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2004-15.

NIOSH [2005]. Career Lieutenant Killed and Fire Fighter Injured By Gunfire While Responding To Medical Assistance Call - Kentucky. By Lutz V. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report Number F2004-11.

NIOSH [2005]. Residential Basement Fire Claims the Life of Career Lieutenant - Pennsylvania. By Tarley J., Lutz V. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2004-05.

NIOSH [2004]. Career Captain/Safety Officer Dies in a Single Motor Vehicle Crash While Responding to a Call - Kansas. By Lutz V. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National

Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report Number F2004-03.

NIOSH [2004]. Basement Fire Claims the Life of Volunteer Fire Fighter - Massachusetts. By Tarley J., McFall M., Lutz V. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2004-02.

NIOSH [2004]. Volunteer Training/Safety Officer Dies from Injuries Received in Fall from Pick-Up Truck Following Training Exercise - Tennessee. By Lutz V,.Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report Number F2003-17.

NIOSH [2004]. Volunteer Fire Police Captain Dies From Injury-Related Complications After Being Struck By Motor Vehicle While Directing Traffic - New Jersey. By McFall M., Lutz V. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Report No. F2003-16.

NIOSH [2004]. Career Fire Fighter/Emergency Medical Technician Dies from Injuries Sustained in Fall from Apparatus - California. By Lutz V., Berardinelli S. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report Number F2003-07.

NIOSH [2003]. Volunteer Assistant Chief Dies in Tanker Rollover - New Mexico. By Berardinelli, S., Lutz V. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report Number F2003-23.

NIOSH [2003]. Career Fire Fighter/Emergency Medical Technician Dies In Ambulance Crash - Texas. By Lutz V., Romano N. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2003-05.

NIOSH [2003]. Volunteer Lieutenant Dies Following Structure Collapse at Residential House Fire - Pennsylvania. By Tarley J., Lutz V. Berardinelli S. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-49.

NIOSH [2003]. Emergency Medical Technician Killed in Single-Vehicle Crash While Responding To Structure Fire - North Carolina. By Lutz V.,Romano N. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-42.

NIOSH [2003]. Career Fire Fighter Dies in Tanker Rollover - North Carolina. By Romano N., Lutz V. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-41.

NIOSH [2003]. Volunteer Captain Killed, Two Fire Fighter and Police Officer Injured When Struck By Motor Vehicle at Highway Incident - Minnesota. By Lutz V., McFall M., Guglielmo C. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-38.

NIOSH [2003]. Structural Collapse at Residential Fire Claims Lives of Two Volunteer Fire Chiefs and One Career Fire Fighter - New Jersey. By McFall M., Lutz V., Braddee R. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-32.

NIOSH [2003]. Volunteer Fire Fighter Dies Due to Inadvertent Fireworks Discharge - North Dakota. By Frederick L., Lutz V. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-31.

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NIOSH Employment: 08/1999

Education:

Master of Science, Safety Management, West Virginia University, 1999
Bachelor of Science, Wildlife & Fisheries Resources, West Virginia University, 1998

Professional Certifications: NA

Research Interests: To investigate fire fighter line-of-duty deaths and to formulate recommendations for preventing future deaths and injuries

Memberships: Emergency Responder Safety Institute

National Committee Assignments:

National Fire Protection Association Standard on Fire Department Occupational Safety and Health Program Committee

Honors: NA

Recent Publications:

NIOSH [2006]. Career Fire Fighter Dies While Exiting Residential Basement Fire – New York. By McFall M., Lutz V., Berardinelli S. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2005-04.

NIOSH [2006]. Volunteer Fire Chief Dies from Injuries Sustained During a Tanker Rollover - Utah. By Tarley J., McFall M. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2005-27.

NIOSH [2006]. Career Fire Fighter Dies and Two Career Captains are Injured While Fighting Night Club Arson Fire – Texas. By McFall M., Tarley J. Cincinnati, Ohio: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report Number F2004-14.

NIOSH [2005]. Career Fire Fighter Drowns While Conducting Training Dive - New Hampshire. By Oerter B., McFall M. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2004-36.

NIOSH [2005]. Career Helitack Fire Fighter Dies in Burnover During an Initial Attack at a Wildland Fire Operation - California. By McFall M., Oerter B. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2004-40.

NIOSH [2005]. Career Fire Fighter Dies and Two Career Fire Fighters Injured in a Flashover During a House Fire - Ohio. By Berardinelli S., McFall M. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2003-12.

NIOSH [2005]. Two Fire Fighters Die and Eight Fire Fighters are Injured from a Silo Explosion at a Lumber Company - Ohio. By Berardinelli S., Guglielmo C., McFall M. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2003-32.

NIOSH [2005]. A Career Fire Fighter was Killed and a Career Captain was Severely Injured During a Wildland/Urban Interface Operation - California. By McFall M., Braddee R., Hales T. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report F2003-36.

NIOSH [2004]. Volunteer Fire Police Captain Dies From Injury-Related Complications After Being Struck By Motor Vehicle While Directing Traffic-New Jersey. By McFall M., Lutz V. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Report No. F2003-16.

NIOSH [2004]. Partial Roof Collapse in Commercial Structure Fire Claims the Lives of Two Career Fire Fighters-Tennessee. By Tarley J., Berardinelli S., McFall M. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Report No. F2003-18.

NIOSH [2004]. Career Federal Fire Fighter Dies from Injuries Sustained at Prescribed Burn - Arizona. By McFall M., Braddee R. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2003-25.

NIOSH [2004]. Basement Fire Claims the Life of Volunteer Fire Fighter - Massachusetts. By Tarley J., McFall M., Lutz V. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2004-02.

NIOSH [2004]. Career Fire Fighter Dies Searching For Fire In A Restaurant/Lounge-Missouri. By Oerter B., McFall M., Berardinelli S. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Report No. F2004-10.

NIOSH [2003]. Hardware Store Explosion Claims the Lives of Three Career Fire Fighters – New York. By Braddee R., Mezzanotte T., McFall M., Tarley J. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2001-23.

NIOSH [2003]. Volunteer Fire Fighter Dies after Being Struck by Motor Vehicle on Interstate Highway-Mississippi. By McFall M. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-13.

NIOSH [2003]. Career Fire Fighter Drowns During Final Dive of Training Course – Indiana. By Tarley J., McFall M. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-15.

NIOSH [2003]. Two Career Fire Fighters Die in Four-Alarm Fire at Two-Story Brick Structure – Missouri. By Koedam R., McFall M., Tarley J. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-20.

NIOSH [2003]. Structural Collapse at Residential Fire Claims Lives of Two Volunteer Fire Chiefs and One Career Fire Fighter - New Jersey. By McFall M., Lutz V., Braddee R. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-32.

NIOSH [2003]. Volunteer Captain Killed, Two Fire Fighters and Police Officer Injured When Struck by Motor Vehicle at Highway Incident – Minnesota. By McFall M., Lutz V., Guglielmo C. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-38.

NIOSH [2003]. Parapet Wall Collapse at Auto Body Shop Claims Life of Career Captain and Injures Career Lieutenant and Emergency Medical Technician-Indiana. By McFall M., Braddee R. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-44.

NIOSH [2003]. Structural Collapse at an Auto Parts Store Fire Claims the Lives of One Career Lieutenant and Two Volunteer Fire Fighters – Oregon. By McFall M., Guglielmo C., Merinar T., Braddee R. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-50.

NIOSH [2003]. Volunteer Fire Fighter Dies Following Nitrous Oxide Cylinder Explosion While Fighting a Commercial Structure Fire-Texas. By Frederick L., McFall M., Merinar T. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2003-03.

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NIOSH [2001]. Restaurant Fire Claims the Life of Two Career Fire Fighters – Texas. By Washenitz F., Mezzanotte T., McFall M. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2000-13.

NIOSH [2001]. Arson Fire Claims the Life of One Volunteer Fire Fighter and One Civilian and Severely Injures Another Volunteer Fire Fighter – Michigan. By McFall M., Schmidt E. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2000-16.

NIOSH [2001]. A Volunteer Fire Fighter Died and a Second was Seriously Injured After a Fuel Tank Explosion – Iowa. By McFall M., Cortez K. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2000-25.

NIOSH [2001]. A Lieutenant Dies and Three Fire Fighters of a Career Department were Injured When the Truck They Were Responding in was Struck by Another Vehicle – Illinois. By Cortez K., Romano N., McFall M. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2000-39.

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McFall, M, Schmidt, E [2001]. Hazard ID: Traffic hazards to fire fighters while working along roadways, Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-143.

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NIOSH [2000]. Warehouse Fire Claims the Life of a Battalion Chief – Missouri. By Washenitz F., McFall M., Mezzanotte T., Cortez K. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. 99-F48.

NIOSH [2000]. Volunteer Fire Fighter Drowns During Dry-Suit Training Dive – North Carolina. By Washenitz F., McFall M. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2000-11.

NIOSH [2000]. Career Fire Fighter Dies and Three are Injured in a Residential Garage Fire – Utah. By McFall M., Braddee R., Mezzanotte T. Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2000-23.

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Education:

Ph. D., M.E. West Virginia University, 1998

Professional Certifications: P.E.

Research Interests: Agricultural and Construction

Memberships:

National Committee Assignments: ASABE PM23/2/2, X599

Honors:

Recent Publications:

McKenzie, Jr., E.A.**,** Etherton, J.R., Harris, J.R., Cantis, D.M and Lutz, T.J [2005] "**NIOSH AutoROPS Research to Practice: Zero Turn Commercial Mowers"** (IMECE2005-81575) *Proceedings of 2005 American Society of Mechanical Engineers, Congress and Exposition,* {November 11, 2005}: Orlando, FL

Mick T, Means K, Etherton J, Powers J, McKenzie, Jr.**,** E.A., [2005] **Design "Recommendations for Controlling the Jam-Clearing Hazard on Recycling Industry Baler"** *Proceedings of 2005 American Society of Mechanical Engineers, Congress and Exposition,* {November 11, 2005}: Orlando, FL

Lutz, T.J. and McKenzie, Jr.**,** E.A., [2005] **"Remote Control on a Zero-turn Commercial Lawn Mower To Conduct SAE J2194 Rollover Test"** Proceedings of the 2005 ASAE Annual International Meeting (#055004), {July 17-20 2005}Tampa, FL

Bobick TG, McKenzie, Jr**.,** E.A., [2005]. "**Using Guardrail Systems to Prevent Falls through Roof and Floor Holes"** *Proceedings of the 2005 ASSE Professional Development Conference* {June 12-15} New Orleans, Louisiana. Des Plaines, American Association of Safety Engineers1-18

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Harris JR, Cantis DM, McKenzie, Jr., E.A., Etherton JR, Ronaghi M [2005]. "**Commercialization of cost-effective rollover protective structures (CROPS): research-in-progress"** *Proceedings of the National Institute for Farm Safety (NIFS) Annual Conference*, {June 26-30}: Wintergreen, Virginia. Columbus, OH: National Institute for Farm Safety1-19

Etherton JR, McKenzie, Jr., E.A., Lutz TJ, Cantis DM, Kau TY, [2004]. "**An Initial Farmer Evaluation of a NIOSH AutoROPS Prototype",** *International Journal of Industrial Ergonomics* 34:155-165

Name: Jan C. Manwaring

Title: Occupational Safety & Health Specialist

Discipline:

Division/Office: Division of Safety Research/Alaska Field Station

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NIOSH Employment: 1986

Education:

Masters of public health, health administration and planning, University of Hawaii, 1999
B.S., Environmental Health Science, Brigham Young University, 1976

Professional Certifications:

Registered Environmental Health Specialist (National Environmental Health Association)

Aviation Safety Certificate, University of Southern California

Research Interests:

Occupational safety and health
Environmental health

Memberships:

National Environmental Health Association
American Society of Safety Engineers

National Committee Assignments:

Transportation, Warehousing and Utilities, Traumatic Injury Committee, NORA
NIOSH contact for confined space safety

Honors:

Crisis Response Service Award, U.S. Public Health Service (January 23, 2006)

Unit Commendation, U.S. Public Health Service (February 24, 2006)

Unit Commendation, U.S. Public Health Service (June 24, 2005)

Crisis Response Service Award, U.S. Public Health Service (November 2, 2004)

Field Medical Readiness Badge, U.S. Public Health Service (April 22, 2003)

Founding Member of the U.S. Department of Homeland Security (March 2003)

Outstanding Unit Citation, U.S. Public Health Service (September 6, 2002)

Crisis Response Service Award, U.S. Public Health Service (February 15, 2002)

U.S. Department of Health and Human Services Secretary's Recognition Award for Heroism, Exceptional/Volunteer Service (November 14, 2001)

Unit Commendation, U.S. Public Health Service (October 22, 2001)

Commendation Medal, U.S. Public Health Service (June, 19, 2001)

High Flyer Award (for outstanding support of aviation safety in Alaska), Federal Aviation Administration (September 1999)

Bicentennial Unit Commendation (January 1, 1998)

Commendation Medal, U.S. Public Health Service (June 2, 1995)

Outstanding Unit Citation, U.S. Public Health Service (January 12, 1993)

Achievement Medal, U.S. Public Health Service (December 2, 1991)

Unit Commendation Award, U.S. Public Health Service (February 9, 1989)

Isolated Hardship Service Award, U.S. Public Health Service (August 6, 1984)

Recent Publications:

Conway GA, Hill A, Martin S, Mode NA, Berman MD, Bensyl DM, Manwaring JC, Moran KA [2004]. Alaska Air Carrier Operator and Pilot Safety Practices and Attitudes: A Statewide Survey. *Aviation, Space, and Environmental Medicine,* November 2004.

Conway GA, Lincoln JM, Hudson DS, Bensyl DM, Husberg BJ, Manwaring JC [2002]. Surveillance and Prevention of Occupational Injuries in Alaska: A Decade of Progress, 1990-1999. NIOSH Publication No. 2002-15, May 2002.

Thomas TK, Bensyl DM, Manwaring JC, Conway GA. Controlled flight into terrain accidents among commuter and air taxi operators in Alaska. Aviation Space & Environmental Medicine 2000;71(11):1098-103.

Name: Suzanne M. Marsh, MPA

Title: Statistician (Health)

Discipline: Occupational Injury Epidemiology

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NIOSH Employment: December 1989

Education:

MPA, Public Administration, West Virginia University, 2006
BS, Statistics (Minor, Mathematics), Virginia Polytechnic Institute and State University, 1989

Research Interests: Research interests include work-related fatal and non-fatal injuries. Topical areas of interest include older workers, highway construction workers, and motor vehicle fatalities.

Honors:

NIOSH Alice Hamilton Award, Human Studies Category, Honorable Mention, 1998

Recent Publications:

(Please note that my last name changed from ‘Kisner’ to ‘Marsh’ during this period.)

Extermal Manuscripts

Driscoll T, Marsh S, McNoe B, Langley J, Stout N, Feyer A-M, Williamson A. Comparison of Fatalities from Work Related Motor Vehicle Traffic Incidents in Australia, New Zealand, and the United States. *Injury Prevention* 2005; 11: 294-299.

Biddle EA, Marsh SM. Comparison of Two Fatal Occupational Injury Surveillance Systems in the United States. *Journal of Safety Research* 2002; 33(3):337-354.

Hartley D, Biddle EA, Grosch JW, Marsh SM. The Burden of Occupational Fatal Injury for Older Workers in the United States. National Safety Council *Injury Insights* June/July 2002.

Chen GX, Jenkins EL, Marsh SM, Johnston JJ. Work-related and Non-Work-related Injury Deaths in the U.S.: A Comparative Study. *Human and Ecological Risk Assessment* 2001; 7(7):1859-1868.

Collins JW, Landen DD, Kisner SM, Johnston JJ, Chin SF, Kennedy RD. Fatal Occupational Injuries Associated with Forklifts, United States, 1980-1994. *Amer J Indust Med* 1999; 36(5):504-512.

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Kisner SM, Pratt SG. Occupational Fatalities among Older Workers in the United States: 1980-1991. *J Occup Environ Med* 1997; 39(8):715-721.

Pratt SG, Kisner SM, Moore PH. Machinery-related Fatalities in the Construction Industry. *Amer J Indust Med* 1997; 32: 42-50.

Pratt SG, Kisner SM, Helmkamp JC. Machinery-related Occupational Fatalities in the United States, 1980-1989. *J Occup Environ Med* 1996; 38(1):70-76.

Robinson CF, Halperin WE, Alterman T, Braddee RW, Burnett CA, Fosbroke DE, Kisner SM, et al. Mortality Patterns among Construction Workers in the United States. *Occupational Medicine: State of the Art Reviews* 1995; 10(2):269-283.

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Jenkins EL, Layne LA, Kisner SM. Homicide in the Workplace: The U.S. Experience, 1980-1988. *AAOHN J* 1992; 40:215-218.

Government publications

Marsh SM, Derk SJ, Jackson LL. Nonfatal Occupational Injuries and Illnesses Among Workers Treated in Hospital Emergency Departments – United States, 2003. *Morbidity and Mortality Weekly Report* 2006; 55(16):449-452.

Pratt SG, Marsh SM, DeGuzman G. Fact Sheet: *Older drivers in the Workplace: Crash Prevention for Employers and Workers.* Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication Number 2005-159.

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Casini VJ, Kisner SM, Stout NA. *Worker Deaths by Electrocution*. Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication Number 98-131.

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Mendoza CT, Kisner SM. Fatal Occupational Injuries – United States, 1980-1994. *Mortality and Morbidity Weekly Report* 1998; 47(15):297-302.

Jenkins EL, Kisner SM, Fosbroke DE, Layne LA, Stout NA, Castillo DN et al. *Fatal Injuries to Workers in the United States, 1980-1989: A Decade of Surveillance; National Profile.* Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS(NIOSH) Publication Number 93-108.

Jenkins EL, Kisner SM, Fosbroke DE, Layne LA, Stout NA, Castillo DN et al. *Fatal Injuries to Workers in the United States, 1980-1989: A Decade of Surveillance; National and State Profiles.* Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS(NIOSH) Publication Number 93-108S.

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Education:

Bachelor of Science, Engineering of Mines, West Virginia University, Morgantown, WV, 1979
Master of Science, Occupational Health and Safety Engineering, West Virginia University, Morgantown, WV, 1988

Professional Certifications: None

Research Interests:

Occupational fatality and injury investigations, fire fighter safety, construction safety

Memberships: None

National Committee Assignments: None

Honors:

DHHS Secretary's Award for Distinguished Service: 2002

Recent Publications:

Pettit TA, Merinar TR [1994]. NIOSH Health Hazard Evaluation Report HETA 94-0244-2431. Memphis Fire Department, Memphis, TN. June 1994.

Pettit TA, Merinar TR, Commodore MA, Ronk RM [1994]. NIOSH Alert – preventing injuries and deaths of fire fighters. Cincinnati, OH. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 94-125.

Mattorano DA, Merinar TR [1996]. NIOSH Health Hazard Evaluation Report HETA 96-0138-2691. Torch Operating Company, Santa Maria, CA. August 1996.

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Merinar TR, Braddee RW, Washenitz F, Mezzanotte T, Dunn V, Brannigan F [2005]. NIOSH ALERT: Preventing injuries and deaths of fire fighters due to truss system failures. Cincinatti, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005-132.

Harris JR, Merinar TR, Struttmann T [2005]. Investigation and implications of a compactor fatality. Proceedings of the 2005 ASME International Mechanical Engineering Congress & Exposition (IMECE2005). Orlando, FL, November 5-11, 2005.

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FDA and NIOSH [2006]. FDA and NIOSH Public Health Notification: Oxygen regulator fires resulting from incorrect use of CGA 870 seals. Cincinatti, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

Moore PH, Merinar TR, [2006]. NIOSH ALERT: Preventing worker injuries and deaths from mobile crane tip-over, boom collapse, and uncontrolled hoisted loads. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2006-142.

Merinar TR, Braddee R, Bowyer ME [2006]. Two volunteer fire fighters die when struck by exterior wall collapse at a commercial building fire overhaul – Alabama. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report F2006-07.

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NIOSH Employment: October 6, 2003

Education:

Masters of Science, biostatistics, University of California Los Angeles, 1994

Recent Publications:

Mode, N.A., Wopat, P., & G.A. Conway eds. (2006) *Proceedings of the Second International Fishing Industry Safety and Health Conference*. Cincinnati, OH: Department of Health and Human Services, National Institute for Occupational Safety and Health, No. 2006-114.

Mode, N.A., Hackett, E.J. & G.A. Conway (2005) “Unique occupational hazards of Alaska: Animal-related injuries” *Wilderness and Environmental Medicine,* 16(4):185-191.

Husberg, B.J., Fosbroke, D.E., Conway, G.A. & N.A. Mode (2005) “Hospitalized nonfatal injuries in the Alaskan construction industry” *American Journal of Industrial Medicine,* 47:428-433.

Conway, G.A., Mode, N.A., Berman, M., Martin. S. & A. Hill. (2005) “Flight safety in Alaska: Comparing attitudes and practices of high- and low-risk air carriers” *Aviation, Space, and Environmental Medicine*,76(1): 52-57.

Conway, G.A., Hill, A., Martin. S., Mode, N. A., Berman, M., Bensyl, D., Manwaring, J., & K. Moran (2004) “Alaska air carrier operator and pilot safety practices and attitudes: A statewide survey” *Aviation, Space, and Environmental Medicine*, 75(11): 984-991.

Conway, G.C., Moran, K.A., & N.A. Mode (2004) "Scientific worker and licensed professional deaths in Alaska, 1990-2002" *International Journal of Circumpolar Health*, 63(Suppl2): 353-56.

Name: Paul H. Moore

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Education:

B.S.M.E. Mechanical Engineering, West Virginia University College of Engineering, 1975.

Professional Certifications: None

Research Interests: Occupational Injury (fatality investigation), Emergency Medical Services Safety

Memberships: N/A

National Committee Assignments: N/A

Honors: N/A

Recent Publications:

Moore PH, Merinar TR [2006] NIOSH alert: Preventing Worker Injuries and Deaths from Mobile Crane Tip-Over, Boom Collapse, and Uncontrolled Hoisted Loads. Cincinnati, OH; U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2006-142.

Green J, Moore P, Current R, Yannaccone J, Whitman G, Day D, Proudfoot S, Bobick T, Romano N [2005]. Reducing Vehicle Crash-Related EMS Worker Injuries Through Improvements in Restraint Systems, Proceedings of the XVIIth World Safety Congress, Orlando, FL, 10/20/2005.

Romano NT, Moore P [2005] Career Fire Fighter/Emergency Medical Technician Dies and Paramedic is Injured in a Three-Vehicle Collision, Nebraska. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report F2003–33.

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Casini VJ, Moore P [2003]. Preventing Injuries When Working with Hydraulic Excavators and Backhoe Loaders, Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-107.

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Moore PH [1997]. NIOSH Alert: Request for assistance in preventing worker injuries and deaths from moving refuse collection vehicle. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, NIOSH Publication No. 97-110.

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Research Interests:

Childhood and adult agricultural injuries, logging injuries, survey design, applied statistics.

Memberships:

Xi Sigma Pi Forestry Honorary (1980)
Gamma Sigma Delta Agricultural Honorary (1983)
National Institute for Farm Safety

National Committee Assignments:

DSR representative to the Council of State and Territorial Epidemiologists Occupational Health Working Group developing uniform State occupational injury and illness surveillance guidelines.

DSR representative to the USDA NCERA-197 "Agricultural Safety and Health Research and Extension" committee which is implementing a national agricultural safety and health agenda for Land Grant Universities within the US.

Honors:

Lead author of paper nominated by DSR for the 2002 CDC Shepard Award
Honorable Mention, 1997 Alice Hamilton Award

Recent Publications:

Greife A, Halperin W, Groce D, O'Brien D, Pedersen D, Myers JR, Jenkins EL. [1995]. Hazard surveillance: its role in primary prevention of occupational disease and injury. Appl. Occ. Environ. Hyg., 10(9):737-742.

Myers JR, Fosbroke DE. [1995]. The Occupational Safety and Health Administration logging standard: what it means for forest managers. Jour. Forestry, 93(11):34-37.

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Myers JR, Snyder KA. [1995]. Roll-over protective structure use and the cost of retrofitting tractors in the United States, 1993. Jour. Ag. Safety and Health, 1(3):185-197.

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Castillo DN, Adekoya N, Myers JR. [1999]. Fatal work-related injuries in the agricultural production and services sectors among youth in the United States. Jour. Agromedicine, 6(3):27-42.

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Keane KJ, Martin J, Hornsby-Myers JL, Stephens JW, Harrison JC, Myers JR, Ong T, Wallace WE. [2002]. Particle characterization, free radical generation, and genotoxicity of hard metal and detonation coating dusts. Ann. Occup. Hyg., 46, Supplement 1:402-405.

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Research Interests: Occupational Safety

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National Committee Assignments: None

Honors:

2002 Federal Laboratory Consortium (Southeast Region), Honorable Mention for Excellence in Technology Transfer

2002 Alice Hamilton Award, Honorable Mention, Engineering and Physical Sciences Category

Recent Publications:

Zeng S, Stout, NA, Powers JR, Newbraugh, BH, Jackson LL, Conover DL [2005], CDC Ref. No. I-020-05, U.S. Patent Application No. 11/126,009, Electrical Injury Protection System, Filed at U.S. Patent and Trademark office, May 9, 2005.

JR Powers, JR Harris, M Ronaghi, KA Snyder, BH Newbraugh[2001], **Performance of an Automatically Deployable ROPS on ASEA Test.** Journal of Agriculture Safety and Health Vol 751-61, Alice Hamilton 2002 Award as Honorable Mention in the Engineering and Physical Science Category. Preventing Tractor Rollover Fatalities; Performance of the NIOSH AutoROPS,

McKenzie E., Powers J., Harris J., Ronaghi M., Etherton J., Current R., Cantis D., Newbraugh B., and Lutz T. **Continuing Developments at NIOSH on ROPS for Agricultural Tractors**,@

Proceedings of National Institute for Farm Safety Annual Conference, Pittsburgh, June 24 -27, 2001.

Newbraugh BH, and Lutz TJ [2001] **Continuing Developments at NIOSH on ROPS for Agricultural Tractors** In the Proceedings of The National Institute for Farm Safety Annual Conference, (Pittsburgh, Pennsylvania June 24 -27).

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Powers JR, Harris JR, Etherton JR, Snyder KA, Ronaghi M, and Newbraugh BH [2000] **Performance of a New ROPS on ASAE tests** In the Proceedings of the 93rd Annual International Meeting of ASAE (Milwaukee, Wisconsin July 9-12) [Paper No.007005].

Snyder K., Etherton J., Harris J., Powers J., Ronaghi M., Cutlip R., Newbraugh B., Means K., Howard S., and Mucino V., **Automatically Deploying Roll Over Protective System**, 1998, (CDC Employee Invention Report (EIR) I_005_99/0) (U.S. Provisional Patent Application #60/216,639, July 7, 2000).

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M.S., Industrial Engineering, University of Cincinnati, 1989.
B.S., Industrial Engineering, Tunghai University, Taichung, Taiwan, 1986.

Professional Certifications:

Research Interests: Safety Engineering and Human Factors

Memberships: Human Factors Society

National Committee Assignments: ANSI A10.29

Honors:

Recent Publications (not included conference proceedings):

Pan, C.S., et al., (under review) 'Biomechanical Evaluations of Foot Placement for Construction Workers on Stilts,' an invited column to publish in *Journal of Occupational and Environmental Hygiene*.

Ronaghi, M., Wu, J.Z., Pan, C.S., Harris, J., Welcome, D., Chiou, S., Dong, R. (under review) 'Modeling of the Static Stability of Scissor Lift, '*ASCE Construction Engineering and Management*.

Pan, C.S.**,** et al., (submitted) 'Fatal and Nonfatal Fall Incidents Associated with Aerial Lifts: An Injury Surveillance Approach,' paper was invited for publication in *Journal of Safety Research*.

Chiou S., Pan, C.S.**,** and Bhattacharya, B. (under review) 'Kinematics and Kinetics of Gait on Stilts: Identification of Risks Associated with Construction Stilts Use,' *Human Factors*.

Pan, C.S., Chiou, S., and Keane, P., *Workplace Solutions: Preventing Injuries from Installing Drywall* (CDC/NIOSH publication, under final review).

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Pan, C.S., Chiou, S., & Hendricks, S. 'The effect of drywall lifting method on workers' balance in a laboratory-based simulation,' *Occupational Ergonomics*, 4(3), pp. 235-249, 2003.

Pan, C.S. et al., 'Postural Stability During Simulated Drywall Lifting and Hanging Tasks,' paper was resented at *IEA 2000/HFES 2000 Congress*, and was published in the *Proceedings*.

Pan, C.S. et al., 'Assessment of Perceived Traumatic Injury Hazards During Drywall Taping and Sanding,' *International Journal of Industrial Ergonomics*, 25(6), pp. 621-631, 2000.

Gardner, L. I., Landsittel, D. P., Nelson, N. A., and **Pan, C.S.** 'Misclassification of Physical Work Exposures,' *Scandinavian Journal of Work, Environment and Health*, 26(5), pp. 406-413, 2000.

Pan, C.S. et al., 'Assessment of Perceived Traumatic Injury Hazards During Drywall Hanging,' *International Journal of Industrial Ergonomics*, 25(1), pp. 29-37, 1999.

Pan, C.S. et al., 'Ergonomic Exposure Assessment: An Application of the PATH Systematic Observation Method to Retail Workers,' *IJO&EH*, 5(2), pp. 79-87, 1999.

Pan C.S., & Chiou, S (January, 1999) 'Slip and fall: Fall protection in construction safety,' In A. Mital, M. et al., (Eds.), *Industrial and Occupational Ergonomics: Users Encyclopedia*.

Chiou, S., Pan, C.S., and Keane, P. 'Risk Factors Associated with Traumatic Injuries among Drywall Installers' *Journal of Occupational and Environmental Medicine*, 42(11), November, 2000.

Pan, C.S., and Chiou, S. 'Analysis of Biomechanical Stresses during Drywall Lifting,' *International Journal of Industrial Ergonomics*, Volume 23, pp. 505-511, 1999.

Schleifer, L. M., Ley, R., & Pan, C. S. (1997) 'Breathing, Psychological Stress, and Musculoskeletal Complaints in VDT Work,' In M. J. Smith & G. Salvendy (Eds.), *Human Computer Interaction: Applications and Case Studies*, Elsevier Science Publishers, Netherlands, pp. 545-550.

Swanson, N. G., Galinsky, T. L., Cole, L. L., Pan, C.S., & Sauter, S. L. 'The Impact of Keyboard Design on Comfort and Productivity in a Text-Entry Task' *Applied Ergonomics*, 28(1), pp. 9-16, 1996.

Schleifer, L. M., Galinsky, T., & Pan, C.S. 'Mood Disturbances and Musculoskeletal Discomfort: Effects of Electronic Performance Monitoring,' *IJHCI*, 8(4), pp. 369-384, 1996.

Pan, C.S., & Schleifer, L. M. 'Biomechanical Factors and Right-Arm Musculoskeletal Discomfort and Fatigue in a VDT Data-Entry Task' *Applied Ergonomics*, 27(3), pp. 195-200, 1996.

Galinsky, T., Schleifer, L. M., & Pan, C. S. 'The Influence of Performance Standards and Feedback on Speed and Accuracy,' *IJHCI*, 7(1), pp. 25-36, 1995.

Pan, C.S., et al., 'Performance Variability as an Indicator of Fatigue and Boredom Effects in a VDT Data-Entry Task' *International Journal of Human-Computer Interaction*, 6(1), pp. 37-45, 1994.

Pan, C. S., Schleifer, L., & Shell, R. L. 'Speed and Accuracy Variability as an Indicator of Fatigue and Boredom Effects in a Data-Entry Task,' In A. Luczak, A. Cakir, & G. Cakir, (Eds.), *Work With Display Units '92*: Elsevier Science Publishers, Netherlands, pp. 374-378, 1993.

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Surveillance of occupational injuries
Injuries to workers in the agricultural industry
Injuries to workers in the road construction industry

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Honor Society of Phi Kappa Phi
Honor Society of Agriculture

National Committee Assignments: None

Honors:

Selected for and completed full-time training program through the U.S. Department of Agriculture
National Agricultural Statistics Service Employee of the Month

Recent Publications

Perritt KR, Boal WL, The Helix Group Inc [2005]. Injuries and illnesses treated at the World Trade Center, 14 September – 20 November 2001. Prehosp Disast Med 20(3):177 183.

Jin C, Perritt KR [2004]. Safe work for youth in construction: information for employers. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-113.

Perritt KR, Crouse CJ [2001]. The 2002 U.S. Census of Agriculture data processing system. Proceedings of the Office of Management and Budget's 2001 Federal Committee on Statistical Methodology (FCSM) Research Conference. FCSM Statistical Policy Working Papers, Session XI-B, Arlington, VA, NTIS PB2002-100103.

Perritt KR, Todaro TA [2000]. Overview and evaluation of AGGIES, an automated edit and imputation system. Washington DC: U.S. Department of Agriculture, National Agricultural Statistics Service. Research and Development Division Research Report Number RDD-00-03.

Todaro TA, Perritt KR [1999]. Overview and evaluation of AGGIES, an automated edit and imputation system. Proceedings of the Office of Management and Budget's 1999 Federal Committee on Statistical Methodology (FCSM) Research Conference. FCSM Statistical Policy Working Papers, Session VII-B, Arlington, VA, NTIS PB2000-105886.

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Recent Publications:

Hsiao, H, Simeonov, P, Pizatella, T, Stout, N, McDougall, V and Weeks, J. Extension Ladder Safety: Solutions and Knowledge Gaps, International Journal of Industrial Ergonomics (submitted).

Castillo, DN, Pizatella, TJ, Stout, NA. Injuries, Chapter in: Occupational and Environmental Health: Recognizing and Preventing Disease and Injury, BS Levy, DH Wegman, SL Baron and RK Sokas (Eds.), Lipponcott Williams and Wilkins, Philadelphia, PA, Fifth Edition, pp. 471-487, 2006.

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Moore, PE, Pizatella, TJ. Request for Assistance in Preventing Worker Deaths from Uncontrolled Release of Electrical, Mechanical, and Other Types of Hazardous Energy, DHHS (NIOSH) Publication No. 99-110, August 1999.

Castillo, DN, Pizatella, TJ, Stout, NA. Injuries, Chapter in: Occupational Health: Recognizing and Preventing Work-Related Diseases, BS Levy and DH Wegman (Eds.), Lipponcott Williams and Wilkins, New York, NY, Fourth Edition, pp. 461-476, 1999.

Stout, N, Borwegen, W, Conway, G, Hoskin, A, Jenkins, L, Linn, H, Luchter, S, McWilliams, N, Pizatella, T, Reeve, G, Smith, G, Snyder, K, Steiner, L. Traumatic Occupational Injury Research Needs and Priorities: A Report by the NORA Traumatic Injury Team, DHHS (NIOSH) Publication No. 98-134, June 1998.

Castillo, D, Hard, D, Myers, J, Pizatella, T, Stout, N. A National Childhood Agricultural Injury Prevention Initiative, Journal of Agricultural Safety and Health, Special Issue (1):183-191, 1998.

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Pizatella, TJ, Putz-Anderson, V, Bobick, TG, McGlothlin, JD, Waters, TR. Understanding and Evaluating Manual Handling Injuries: NIOSH Research Studies, Ergonomics, Vol. 35, No. 9, pp. 945-953, 1992.

Hard, DL, Myers, JR, Stout, NA, Pizatella, TJ. A Model Agricultural Health Promotion Systems Program for Building State-Based Agricultural Safety and Health Infrasructures, Scandinavian Journal of Work, Environment and Health, Vol. 18, Supplement 2, pp. 46-48, 1992.

Pizatella, TJ, Etherton, JR. Injuries and Amputations Resulting from Work With Mechanical Power Presses, NIOSH Current Intelligence Bulletin 49, DHHS (NIOSH) Publication No. 87-109, May 1987.

Pizatella, TJ, Moll, MB. Simulation of the After-Reach Hazard on Power Presses Using Dual Palm Button Actuation, Human Factors, Vol. 29, No. 1, pp. 9-18, 1987.

Collins, JW, Pizatella, TJ, Etherton, JR, Trump, TR. The Use of Simulation for Developing Safe Workstation Designs on Mechanical Power Presses, Journal of Safety Research, Vol. 17, No. 2, pp. 73-79, 1986.

Putz-Anderson, V. Anderson, C, Badger, D, Nelson, R, Pizatella, T, Sanderson, L, Tanaka, S. A Proposed National Strategy for the Prevention of Musculoskeletal Injuries, Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries, Part 1, Published by the Association of Schools of Public Health, pp. 17-34, September 1986.

Jensen, RC, Pizatella, TJ. Critical Review of Studies to Support Safe-Distance Formulas for Power Press Actuation Mechanisms, Trends in Ergonomics/Human Factors III, W. Karwowski (Editor), Elsevier Sciences Publishers B.V. (North-Holland), pp. 953-962, 1986.

Horton, JT, Pizatella, TJ, Plummer, RW. The Effect of Palm Button Location on Hand Reach Speed for Power Press Operations, Trends in Ergonomics/Human Factors III, W. Karwowski (Editor), Elsevier Sciences Publishers B.V. (North-Holland), pp. 963-969, 1986.

Parsons, TJ, Pizatella, TJ, Collins, JW. Safety Analysis of High Risk Injury Categories Within the Roofing Industry, Professional Safety, Vol. 31, No. 6, pp. 13-17, 1986.

Drury, CG, Pizatella, T. Hand Placement in Manual Materials Handling, Human Factors, Vol. 25, No. 5, pp. 551-562, 1983.

Pizatella, TJ, Etherton, JR, Jensen, RC, Oppold, JA. Investigation of the After-Reach Hazard in Two-Hand Controlled Power Press Operations, Scandinavian Journal of Work, Environment & Health, Vol. 9, pp. 194-200, 1983.

Lark, JJ, Pizatella, TJ, Bochnak, PM, Jensen, RC. Selected Ignited Leaks During LPG Transfer Operations, Professional Safety, Vol. 27, No. 6, pp. 23-27, 1982.

Name: John R. Powers, Jr.

Title: Supervisory General Engineer

Discipline: Electronics /Electrical Engineering

Division/Office: Division of Safety Research/Protective Technology Branch

Location: NIOSH/Morgantown, West Virginia

Address: 1095 Willowdale Road, M/S-G800, Morgantown, WV 26505

Telephone: 304-285-6219

NIOSH Employment: February 16, 1997

Education: Bachelor of Science, Electrical Engineering, The Pennsylvania State University, 1988

Professional Certifications: None

Research Interests: Primary research interests are in the area of electronic circuit design for safety controls, computer simulations for safety research applications, digital human modeling for safety research applications, and innovative data collection techniques.

Memberships: Institute of Electrical and Electronics Engineers, Society of Automotive Engineers

National Committee Assignments: None

Honors:

2005 Bullard-Sherwood Award for Research 2 Practice, Honorable Mention

2002 Federal Laboratory Consortium (Southeast Region), Honorable Mention for Excellence in Technology Transfer

2002 Alice Hamilton Award, Honorable Mention, Engineering and Physical Sciences Category

Outstanding Performance Ratings: 2005, 2004, 2003, 2002, 2001, 2000, 1999, 1998

Performance Awards: 03/2005, 02/2004, 03/2003, 02/2002, 02/2001, 04/2000, 03/1999, 03/1998, 02/1997, 08/1993, 08/1992, 07/1991

Special Act / Service Awards: 11/1997, 10/1996, 12/1995, 08/1993

On The Spot Awards: 08/2005, 10/2004, 08/2004, 03/2003, 08/1999, 07/1998

Invention Awards: 08/2005 (2), 04/2001, 08/2000, 12/1999

Sick Leave Usage Certificate (0 Hours Used): Leave Year 1994

Recent Publications:

Mick, T., Means, K., Etherton, J., Powers, J., McKenzie, E.A., "Design Recommendations For Controlling The Jam-Clearing Hazard On Recycling Industry Balers", In the Proceedings of the 2005 American Society of Mechanical Engineers Congress and Exposition, Orlando, FL, November 5-11, 2005.

Simeonov P., Hsiao H., Amendola A.A., Powers J.R., Ammons D.A., Kau T., Cantis D.M., "Footwear Effects on Workers' Instability in a Virtual Roof Workplace", The American Industrial Hygiene Conference and Expo 2005, Anaheim, CA, May 21-26, 2005, Abstract.

Guan J., Hsiao H., Zwiener J., Current R.S., Newbraugh B.H., Powers J.R., Spahr J., "Injury Potential to a Seat-Belted Operator During a Rear and Side Overturn of a ROPS Equipped Farm Tractor", In the Proceedings of the National Institute for Farm Safety Conference, Wintergreen, VA, June 28, 2005, Abstract, p.81.

Zeng S., Powers J.R., Jackson L.L., Conover D.L., "Digital Measurement Of Human Proximity To Electrical Power Circuit By A Novel Amplitude-Shift-Keying Radio-Frequency Receiver", In the Proceedings of the IEEE International Symposium on Circuits and Systems, Kobe, Japan, May 23-26, 2005, pp 576-579.

Etherton J.R., McKenzie E.A., Powers J.R., "Commercializing an Automatically Deployable Rollover Protective Structure (AutoROPS) for a Zero-Turn Riding Mower: Initial Product Safety Assessment Criteria", In the Proceedings of the ASME International Mechanical Engineering Congress and Exposition, Anaheim, California, November 13-19, 2004.

Guan J., Hsiao H., Current R.S., Powers J.R., Ammons D.E., "Traumatic Injury Potential to Seat Belted Operator During a Rearward Overturn of a ROPS Equipped Farm Tractor", NORA Meeting [2003], Arlington, Virginia, June 23-24, Abstract, p.51.

Powers J.R., "Fire Fighter Visibility – Which Way is Out?", National Occupational Injury Research Symposium (NOIRS) 2003, Pittsburgh, Pennsylvania, October 28-30, 2003, Abstract, p.62.

Ammons D.A., Powers J.R., Newbraugh B.H., "Caught-In Injury Protection System for Wood Chippers", National Occupational Injury Research Symposium (NOIRS) 2003, Pittsburgh, Pennsylvania, October 28-30, 2003, Abstract, p.82.

Zeng S., Powers J.R., Jackson L.L., Conover L.D., "Development of a New Electrical Injury Protection System - Selection of RF Transmitter Mounting Location on the Human Body,"

National Occupational Injury Research Symposium (NOIRS) 2003, Pittsburgh, Pennsylvania, October 28-30, 2003, Abstract, p.111.

Powers J.R., Harris J.R., Etherton J.R., Snyder K.A., Ronaghi M., Newbraugh B.H., "Performance of an Automatically Deploying ROPS on ASAE Tests", *Journal of Agricultural Safety and Health,* 2001, 7(1):51-61.

Powers J.R., Harris J.R., Etherton J.R., Ronaghi M., Snyder K.A., Lutz T.J., Newbraugh B.H., "Preventing Tractor Rollover Fatalities: Performance of the NIOSH AutoROPS", *Injury Prevention*, 2001, 7(Suppl I):i54-58.

McKenzie E.A., Powers J.R., Harris J.R., Ronaghi M., Etherton J.R., Current R.S., Cantis D.M., Newbraugh B.H., Lutz, T.J., AContinuing Developments at NIOSH on ROPS for Agricultural Tractors@, In the Proceedings of the National Institute for Farm Safety Annual Conference, Pittsburgh, Pennsylvania, June 24-27, 2001.

Zeng S., Powers J.R., Hsiao H., "A New Video-Synchronized Multichannel Biomedical Data Acquisition System", *IEEE Transactions On Biomedical Engineering,*2000, 47(3): 415-419.

Powers J.R., Harris J.R., Snyder K.A., Ronaghi M., Etherton J.R., Newbraugh B.H., APerformance of the NIOSH AutoROPS@, National Occupational Injury Research Symposium (NOIRS) 2000, Pittsburgh, Pennsylvania, October 17-19, 2000, Abstract, p.12.

Ronaghi M., Harris J.R., Powers J.R., Snyder K.A., ADynamic Nonlinear Analysis of Tractor Rollovers@, In the Proceedings of the 9th International ANSYS Conference and Exhibition, Pittsburgh, Pennsylvania, August 28-30, 2000.

Powers J.R., Harris J.R., Etherton J.R., Snyder K.A., Ronaghi M., Newbraugh B.H., APerformance of a New ROPS on ASAE Tests@, In the Proceedings of the 93rd Annual International Meeting of ASAE, Paper No. 007005, Milwaukee, Wisconsin, July 9-12, 2000.

Zeng S., Powers J.R., Hsiao H., AA Video-Synchronized High-Speed-EMG and Metabolic Data Acquisition System@, In the Proceedings of the XIV Triennial Congress of the International Ergonomics Association and the 44th Annual Meeting of the Human Factors and Ergonomics Society, San Diego, California, July 29 - August 4, 2000, pp. 5-124 5-27.

Zeng S., Powers J.R., Jackson L.L., Conover D.L., AFeasibility of Power Line Proximity Warning System Using Radio Frequency Transmission@, In the Proceedings of the 5th World Conference of Injury Prevention and Control, New Delhi, India, March 5-8, 2000.

Zeng S., Powers J.R., Hsiao H., A16-Channel 500-Hz Video-Synchronized EMG Data Acquisition@, In the Proceedings of the 21st AAnnual International Conference of the IEEE Engineering in Medicine and Biology Society, Atlanta, Georgia, October 15, 1999.

Name: Stephanie G. Pratt

Title: Research Health Scientist

Discipline: Epidemiology

Division/Office: Division of Safety Research/Surveillance and Field Investigations Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road, MS H-1808, Morgantown, WV 26505

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NIOSH Employment: 6/1/1993

Education:

M.A., Applied Social Research, West Virginia University, Morgantown, WV, 1987.
M.M., Applied Music, West Virginia University, Morgantown, WV, 1979.
B.M., Applied Music, West Virginia University, Morgantown, WV, 1977.

Professional Certifications: None

Research Interests:

Motor vehicle crashes

Global road safety

Safety and health of transportation workers

Young workers

Work zone safety

Memberships:

Board of Directors (ex officio), Network of Employers for Traffic Safety
Transportation Research Board (individual affiliate)

National Committee Assignments:

ANSI Z-15 Committee (Safe Practices for Motor Vehicle Operations)
Vehicle User Characteristics Committee (AND10), Transportation Research Board
Coordinator, NIOSH Transportation, Warehousing and Utilities Program

Honors:

Special Act Award (2006) recommended by the Deputy Director, EID, for "critical assistance to the Education and Information Division (EID) and the NIOSH Office of the Director in the development of the NIOSH Program Portfolio Template Design."

Recent Publications:

Peer-reviewed and NIOSH publications

Adekoya N, Pratt SG [2001]. Fatal unintentional farm injuries among persons less than 20 years of age in the United States: geographic profiles. DHHS (NIOSH) Publication No. 2001-131.

Castillo DN, Pratt SG, Mardis AL, Hendricks KJ [2002]. National Institute for Occupational Safety and Health (NIOSH) recommendations to the U.S. Department of Labor for changes to Hazardous Orders. Report to the U.S .Department of Labor, Employment Standards Administration, Wage and Hour Division. May 3, 2002.

Kisner SM, Pratt SG [1997]. Occupational fatalities among older workers in the United States: 1980-1991. J Occup Environ Med 39(8): 715-721.

Kisner SM, Pratt SG [1999]. Occupational injury fatalities among older workers in the United States, 1980-1994. Am J Indust Med (Supp 1): 24-25.

Lentz T, Votaw D, Ahlers H, Hendricks K, Pratt S, Coleman P, Gillen M, Ehrenberg R [2004]. Occupational fatalities during trenching and excavation work – United States, 1992-2001. MMWR 53(15):311-314.

Mardis AL, Pratt SG [2003]. NIOSH Alert: Preventing deaths, injuries, and illnesses of young workers. Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Pub. No. 2003-128.

Mardis AL, Pratt SG [2003]. Nonfatal injuries to young workers in the retail trades and services industries in 1998. JOEM 45(3): 316-323.

Moore PH, Pratt SG [1996]. Skid-steer loader-related fatalities in the workplace - United States, 1992-1995. MMWR 45(29): 624-628.

Moore PH, Pratt SG [1998]. NIOSH Alert: Preventing injuries and deaths from skid-steer loaders. Cincinnati, OH: Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 98-117.

.

NIOSH [2004]. Work-related roadway crashes: prevention strategies for employers. By Pratt SG, Le H, Marsh SM. Cincinnati, Ohio: Department of Health and Human Services, Centers for

Disease Control and Prevention, National Institute for Occupational Safety and Health, 2004. DHHS (NIOSH) Pub. No. 2004-136.

NIOSH [2004]. Work-related roadway crashes: who's at risk? By Marsh SM, Pratt SG. Cincinnati, Ohio: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, 2004. DHHS (NIOSH) Pub. No. 2004-137.

NIOSH [2004]. Accidentes viales relacionados con el trabajo: estrategias de prevencion para los empleadores. By Pratt SG, Le H, Marsh SM. Cincinnati, Ohio: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, 2004. DHHS (NIOSH) Pub. No. 2004-136Sp.

NIOSH [2004]. Accidentes viales relacionados con el trabajo: Quien corre peligro? By Marsh SM, Pratt SG. Cincinnati, Ohio: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, 2004. DHHS (NIOSH) Pub. No. 2004-137Sp.

Pratt SG, Kisner SM, Helmkamp JC [1996]. Machinery-related occupational fatalities in the United States, 1980 to 1989. J Occup Environ Med 38(1): 70-76.

Pratt SG, Kisner SM, Moore PH [1997]. Machinery-related fatalities in the construction industry. Amer J Indust Med 32: 42-50.

Pratt SG, Hard DL [1998]. Injury risk factors associated with workplace agricultural fatalities. Journal of Agricultural Safety and Health Special Issue (1): 29-38.

Pratt SG [2000]. Epidemiology of fatal falls from elevation. In: Worker deaths by falls: a summary of surveillance findings and investigative case reports. Cincinnati, OH: Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 2000-116.

Pratt SG, Fosbroke DE, Marsh SM [2001]. Building safer highway work zones: measures to prevent worker injuries from vehicles and equipment. Cincinnati, OH: Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 2001-128.

Pratt SG [2003]. Work-related roadway crashes: challenges and opportunities for prevention (NIOSH Hazard Review). Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Pub. No. 2003-119.

Pratt SG [2004]. Work-related roadway crashes – United States, 1992-2002. MMWR 53(12): 260-264.

Pratt SG, Marsh SM, DeGuzman G [2005]. Older drivers in the workplace: crash prevention for employers and workers. NIOSH fact sheet. DHHS (NIOSH) Pub. No. 2005-159.

Wahl GL, Brown M, Parker DL, Pratt SG [1998]. Fatalities associated with large round hay bales B Minnesota, 1994-1996. MMWR 47(2): 27-30.

Wahl GL, Parker DL, Pratt SG, Moore PH [1999]. Childhood work-related agricultural fatalities B Minnesota, 1994-1997. MMWR 48(16): 332-335.

Comments on Proposed Rulemakings

NIOSH [2000]. Comments of the National Institute for Occupational Safety and Health on the Federal Motor Carrier Safety Administration Proposed Revision of the Hours of Service Rules for Commercial Carriers, 49 CFR Part 395, Docket No. FMCSA 97-2350. December 14, 2000.

NIOSH [2000]. Comments of the National Institute for Occupational Safety and Health on the Department of Labor Notice of Proposed Rulemaking and Request for Comments on Child Labor Regulations, Orders and Statements of Interpretation; Child Labor Violations – Civil Money Penalties, 29 CFR Parts 570 and 579. January 28, 2000.

NIOSH [2002]. Comments of the National Institute for Occupational Safety and Health on the Occupational Safety and Health Administration Regulatory Flexibility Act Review of the Excavation Standard. 29 CFR Part 1926, Docket No. S204A. November 19, 2002.

NIOSH [2002]. Comments of the National Institute for Occupational Safety and Health on the Department of Transportation Notice of Proposed Amendments to the Manual on Uniform Traffic Control Devices (MUTCD); Request for Comments. 23 CFR Part 655, FHWA Docket No. FHWA-2001-11159. August 2002.

NIOSH [2003]. Comments of the National Institute for Occupational Safety and Health on the Federal Highway Administration Proposed Rule on Work Zone Safety and Mobility, 23 CFR Part 630, FHWA Docket No. FHWA-2001-11130. September 2003.

NIOSH [2005]. Comments of the National Institute for Occupational Safety and Health on the Federal Motor Carrier Safety Administration Notice of Proposed Rulemaking on the Hours of Service of Drivers, 49 CFR Parts 385, 390, and 395, Docket No. FMCSA 2004-19608. Cincinnati, OH: National Institute for Occupational Safety and Health. March 2005.

Name: Steven L. Proudfoot

Title: Statistician

Discipline: Statistics/Survey Methodology

Division/Office: Division of Safety Research/Analysis and Field Evaluations Branch

Location: NIOSH/Morgantown, WV

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NIOSH Employment: November 2000

Education:

Bachelor's, Technical Writing/Applied Mathematics, Alderson-Broaddus College, 1987

Professional Certifications:

West Virginia State Certified Firefighter - Levels I and II; National Wildfire Coordinating Group Certified Wildland Firefighter - Level II

Research Interests: Emergency responder safety: emergency medical technicians/firefighters

Memberships: International Association of Bloodstain Pattern Analysts

National Committee Assignments:

Honors: Special Act Award for contributions to NIOSH firefighter program (2004)

Recent Publications:

Proudfoot SL: "Ambulance Safety in the Fire Service: An Update." Invited Speaker at NFPA World Safety Conference. June 5, 2006.

Proudfoot SL: "Ambulance Crashes: Fatality Factors for EMS Workers." Emergency Medical Services: The Journal of Emergency Care, Rescue and Transportation, Vol 34, No 6. June 2005.

Tarley JL, Husting EL, Proudfoot SL: "Divers Beware: Training Dives Present Serious Hazards to Fire Fighters." U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. F2004-152. Jun 2004.

Proudfoot SL, Husting EL: "Fire truck crashes with apparatus driver fatalities: Fatality Analysis Report System (FARS): 1991-2000." Journal of Emergency Management, Vol 2, No 2, Spring 2004. pp 52-56. May 2004.

Proudfoot SL, Fahy RF: "A Profile of Thermal Imaging Camera Ownership in the United States Fire Service." Presented at 3rd National Occupational Injury Research Symposium. 29 Oct 2003

Proudfoot SL, Romano NT, Bobick TG: "Ambulance crash-related injuries among emergency medical services workers – United States, 1991 - 2002." Morbidity and Mortality Weekly Report. 28 Feb 2003, 52(8):154–156, 2003.

Romano NT, Moore PH, Proudfoot SL: "Volunteer Fire Fighter Dies and Junior Fire Fighter Is Injured After Tanker Rollover During Water Shuttle Training Exercise – Kentucky." U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. F2001-01. Mar 2002.

Name: Audrey A. Reichard, MPH, OTR

Title: Epidemiologist

Discipline: Occupational Injury Epidemiology

Division/Office: Division of Safety Research/Surveillance and Field Investigations Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road, MS 1808, Morgantown, WV 26505

Telephone: 304-285-6175

NIOSH Employment: November 2, 2003

Education:

Master of Public Health, Behavioral Science, Emory University, Atlanta, GA, 2000

Bachelor of Science, Allied Medicine, Occupational Therapy, Ohio State University, Columbus, OH, 1995

Professional Certifications:

National Board for Certification in Occupational Therapy (NBCOT) – Registered occupational therapist

Research Interests:

Injury prevention, disability related research, qualitative methods, program evaluation, health behaviors

Memberships:

American Occupational Therapy Association

Recent Publications:

Roberts, C.A., Lobato, M.N., Bazerman, L.B., Kling, R., Reichard, A.A., and Hammett, T.M. Tuberculosis prevention and control in large jails: A challenge to tuberculosis elimination. American Journal of Preventive Medicine, 2006; 30(2): 125-130.

Reichard, A.A., Lobato, M.N., Roberts, C.A., Bazerman, L.B., and Hammett, T.M. Assessment of tuberculosis screening and management practices of large jail systems. Public Health Reports, November–December 2003, 118: 500-507.

Langlois, J.A., Kegler, S. R., Butler, J. A., Gotsch, K. E., Johnson, R. L., Reichard, A.A., Webb, K.W., Coronado, V.G., Selassie, A.W., Thurman, D.J. Traumatic brain injury – Related hospital discharges: Results from a 14-state surveillance system, 1997. In Surveillance Summaries, June 27, 2003. MMWR 2003; 52 (No. SS-4): 1-20.

Name: Nancy T. Romano

Title: Safety and Occupational Health Specialist

Discipline: Occupational Safety and Health

Division/Office: Division of Safety Research/Surveillance and Field Investigations Branch

Location: NIOSH/Morgantown, WV

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Telephone: 304-285-5889

NIOSH Employment: 09/26/99

Education:

Master of Science, Safety Management, West Virginia University, Morgantown, WV, 1992
Bachelor of Science, Criminal Law, Fairmont State University, Fairmont, WV, 1985

Professional Certifications:

Certified Safety and Health Manager (CSHM), Institute of Safety and Health Management

Research Interests:

To identify and study fatal occupational injuries at high risk for injury and then formulate and disseminate prevention strategies to those who can intervene in the workplace.

Memberships: American Society of Safety Engineers (ASSE)

National Committee Assignments:

American Society of Safety Engineers (ASSE), Safety Professionals and the Latino Workforce (SPAWL), Des Plaines, IL. Chairperson for Resource Materials Subcommittee 6/05-Current.

Federal Interagency Committee for Emergency Services (FICEMS), United States Fire Administration (USFA), Emmitsburg, Maryland. Member 1/02-6/06.

FICEMS, Ambulance Safety Committee, United States Fire Administration (USFA), Emmitsburg, Maryland. Chairperson 6/03-6/06.

Recent Publications:

NIOSH [2006]. Hispanic Laborer on Roadway Construction Work Site Run Over and Killed by Backing Flat Bed Dump Truck-NC. By Romano N. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE), DHHS (NIOSH) Publication No. FACE 2004-11.

NIOSH [2005]. Career Fire Fighter/Emergency Medical Technician Dies and Paramedic is Injured in a Three-Vehicle Collision - Nebraska. By Romano N., Moore P. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. 2003-33.

NIOSH [2004]. Hispanic Logger Struck and Killed by a Falling Tree Cut by a Feller Buncher Machine – North Carolina. By: Romano NT. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation FACE Report No: 2004-04.

NIOSH [2004]. Hispanic Painter Electrocuted When the Aluminum Extension Ladder He was Positioning Contacted an Overhead Powerline - South Carolina. By Casini V, Romano N. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation FACE Report No. 2003-11.

NIOSH [2004]. Hispanic Painter Electrocuted while Attempting to Reposition Ladder while it Contacts Powerline-NC, By Romano N. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE), DHHS (NIOSH) Publication No. FACE 2003-10.

NIOSH [2004]. Off-duty Career Fire Fighter Dies and another Off-duty Career Fire Fighter is Injured after being Struck by a Truck while Assisting at a Highway Traffic Incident-FL, By Tarley. J., Romano N., and Berardinelli, S. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. F2002-35.

NIOSH [2004]. Emergency Medical Technician Dies in Ambulance Crash-NY, Cincinnati, OH: By Romano NT., Cortez K., Moore PH. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE), DHHS (NIOSH) Publication No. FACE 2001-12.

Proudfoot SL, Romano NT, Bobick TG, Moore PH [2003]. Ambulance Crash-Related Injuries Among Emergency Medical Services Workers - United States, 1991 - 2002, MMWR *52*(8):154-156.

NIOSH [2003]. Two Hispanic Guardrail Installers Die After Being Struck by a Guardrail- North Carolina, By Higgins D., Romano N.T. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation FACE Report No. 2003-09.

NIOSH [2003]. Career Fire Fighter/Emergency Medical Technician Dies in Ambulance Crash-Texas, Lutz V., Romano NT. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2003-05.

NIOSH [2003]. Volunteer Lieutenant Dies Following Structure Collapse at Residential House Fire-Pennsylvania, By Braddee RW., Romano NT. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2002-49.

NIOSH [2003]. Emergency Medical Technician Killed in Single-Vehicle Crash While Responding to Structure Fire - North Carolina, By Romano NT, Lutz V. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-42.

NIOSH [2003]. Career Fire Fighter Dies in Tanker Rollover - North Carolina, By Romano NT., Lutz V. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-41.

NIOSH [2003]. Career Lieutenant and Fire Fighter Die in a Flashover During a Live-Fire Training Evolution - Florida, By Romano NT., Tarley J., Beradinelli S. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-34.

NIOSH [2003]. One Career Fire Fighter Dies and a Captain Is Hospitalized After Floor Collapses in Residential Fire - North Carolina, By Romano NT., Frederick L. Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-11.

NIOSH [2002]. Career Fire Chief Dies After Being Struck By A Fire Truck At A Motor Vehicle Incident- KS, By Romano N., Frederick L. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. F2002-18.

NIOSH [2002]. Career Fire Fighter Dies After Becoming Trapped by Fire in Apartment Building- NJ, By McFall M., Romano N., Cortez K. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. F2001-18.

Romano Nancy T [2001]. Fire fighter deaths from tanker truck rollovers, Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Hazard ID 14.

Name: Mahmood Ronaghi

Title: Research Safety Engineer

Discipline: Mechanical/Aerospace Engineering

Division/Office: Division of Safety Research/Protective Technology Branch

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NIOSH Employment: 2/1996

Education:

M.S., Aerospace Engineering, University of Colorado at Boulder, 1994

M.S., Mechanical Engineering, North Carolina A&T State University, 1992

B.S., Industrial Technology Mechanical Design, Jackson State University, 1986

M.B.A., Business Administration, Jackson State University, 1979

B.S., Cost Accounting, Institute of Advanced Accounting, Tehran, Iran, 1976

Professional Certifications:

Research Interests:

Aerial lift static/dynamic stability and modeling simulation
Use of Composite Materials in ROPS Structures
Redesign of Auto-ROPS Structures
Finite Element modeling of CROPS

Memberships:

National Committee Assignments:

Honors:

Alice Hamilton Award, 2002, Honorable Mention, "Performance of an Automatically Deployable ROPS on ASAE Tests", Journal of Agricultural Safety and Health 7(1): 51-61
Honorable Mention Award for Excellence in Technology Transfer, 2002, on AutoROPS from the Federal Laboratory Consortium Southeast Region

Inaugural Bullard-Sherwood Award for Research to Practice (r2p) "ROPS Technology Transfer Team", Honorable Mention, for outstanding achievement in transferring technology into the workplace, April 2005

Recent Publications:

M. Ronaghi, J.Z. Wu, C.S. Pan, J.R. Harris, D.E. Welcome, S.S. Chiou, R.G. Dong, Modeling of the Static Stability of a Scissor-Lift, ***Journal of ASCE Construction Engineering and management***, in press

Ronaghi M, Abukhadra SM, McKenzie, Jr., E.A., Etherton JR, Means KH [2005]. Finite Element Modeling of a Fiber Reinforced Plastics Composite Materials in Automatically Deployable Rollover Protective Structure *ASME International Mechanical Engineering Congress* IMECE2005-81365, Poster Presentation, November 4-11, 2005 Orlando, Florida

John R. Etherton, Mahmood Ronaghi, Richard S. Current, Development of a Pultruded FRP Composite Material ROPS for Farm Tractors, ***Journal of Composite Structures***, in press, 2005

Ronaghi, M., J. Etherton, R. Current, Comparison of FE Modeling of Pultruded FRP Composite Materials with Laboratory Results in a feasibility Study of ROPS, Proceeding of 2004 National Symposium on Agricultural Health and Safety, Keystone Resort, CO, June 20-24, 2004.

Ronaghi, M., S. Abukhadra, E. McKenzie, J. Etherton, J. Harris, Mathematical Modeling and laboratory Testing Results in an Application of Pultruded Composite Materials in ROPS, 2004 ASME International Mechanical Engineering Congress, Anaheim, CA, November 13-19, 2004

Ronaghi, M., Current, R., and Etherton, J., Research on the Use of Composite Materials in ROPS, Proceedings of National Institute for Farm Safety Annual Conference, Pittsburgh, June 24 -27, 2001.

Powers, J., Harris, J., Snyder, K., Etherton, J., Ronaghi, M., and Newbraugh, B., Performance of a New ROPS on ASAE Tests, ***Journal of Agricultural Safety and Health***, 7(1): 51-61, 2001.

M Ronaghi, J Harris, J Powers, and K Snyder, "Dynamic Nonlinear Analysis of Tractor Rollovers," *Proceedings of the Ninth International ANSYS Conference and Exhibition*, Pittsburgh, Pennsylvania, August 28-30, 2000.

Name: Peter Simeonov

Title: Research Safety Engineer

Discipline: Traumatic Injury Prevention

Division/Office: Division of Safety Research/Protective Technology Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road, Morgantown, WV 26505

Telephone: 304-285-6268

NIOSH Employment: January 2, 1998

Education:

B.S. & M.S. in Civil and Structural Engineering, University of Architecture, Construction and Geodesy, Sofia, Bulgaria, 1979.
Ph.D. Technical Sciences – Construction Engineering Materials, Bulgarian Academy of Sciences, Sofia, Bulgaria, 1987.

Professional Certifications:

Research Interests: Traumatic injury prevention in construction and related industries, fall prevention and protection. Application of Virtual Reality simulations for safety research (modeling of dangerous environments, i.e., elevated workplaces) for human balance control evaluation and enhancement. Methodology includes a wide range of dynamics, kinematics and psychophysics evaluations of human movement, perceptions and psycho-physiological responses to stimuli in the workplace.

Memberships:

American Society of Safety Engineers
International Society for Fall Protection

National Committee Assignments:

US Technical Advisory Group to ISO TC 94 on Fall Protection,
OSHA alliances - Fall Protection and Design for Safety workgroups

Honors:

Multiple awards for excellence in education at the University of Architecture, Construction and Geodesy, Sofia, Bulgaria, 1974-79.
IREX Foundation Fellowship for research at Northwestern University, Evanston, IL (1991).
NRC Fellowship for research at DSR, NIOSH, CDC (1998-2000).

Recent Publications:

Simeonov P, Hsiao H , Powers J, Ammons D, Amendola A, Kau T, Cantis D. (2006). Footwear effects on walking balance at elevation. (submitted to *Ergonomics*)

Hsiao H, Hause M, Powers J, Kau T, Hendricks, & Simeonov (2006) Effect of scaffold end-frame carrying strategies on worker stepping response, postural stability, and perceived task difficulty (submitted to *Human Factors*)

Hsiao H, Simeonov P, Dotson B, Ammons D, Kau T, Chiou S. (2005). Human responses to augmented virtual scaffolding models. *Ergonomics*, *48(10)*, 1223-42.

Simeonov P, Hsiao H, Dotson B, Ammons D. (2005) Height effects in real and virtual environments. *Human Factors, 47(2)*, 430-438.

Simeonov P, Hsiao H, Dotson B, Ammons D. (2003). Control and perception of balance at elevated and sloped surfaces. *Human Factors*, *45*, 136-147.

Simeonov P, Hsiao H. (2001). Height, surface firmness and visual reference effects on balance control. *Injury Prevention*, *7(Suppl I)*, i50-53.

Hsiao H, Simeonov P. (2001). Preventing falls from roofs: a critical review. *Ergonomics*, *44(5)*, 537-561.

Name: James S. Spahr

Title: Leader, Protective Equipment Team
Captain, USPHS Commissioned Corps

Discipline: Safety & Occupational Health Specialist

Division/Office: Division of Safety Research/Protective Technology Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road., Morgantown, WV 26505

Telephone: 304-285-6242

NIOSH Employment: March, 2001

Education:

USPHS Certificate of Training, IHS Injury Prevention Specialist Fellowship Training Program, Sept. 1998

USPHS Certificate of Training, IHS Institutional Environmental Health Fellowship Training Program, Sept.1986

Masters of Public Health, International Health, The Johns Hopkins University, Baltimore, MD, May 1984

Bachelor of Arts, Anthropology, Miami University, Oxford, Ohio, June 1972

Professional Certifications:

Certified Healthcare Environmental Manager (HEM) - Center for Healthcare Env. Management
Diplomat (DAAS)- American Academy of Sanitarians
Registered Professional Sanitarian (RS) - Texas Department of Health, Registration #2100

Research Interests:

Applied Anthropometry
Personal Protective Clothing and Equipment, other than Respiratory
Institutional Environmental Health

Memberships:

American Society of Safety Engineers
Human Factors and Ergonomics Society
National Fire Protection Association
Society of Automotive Engineers

National Committee Assignments:

Professional Member, NFPA Standard 1971 Technical Committee

Honors:

Eighteen USPHS Uniform Services Awards

Recent Publications/Book Chapters/Articles/Abstracts:

Spahr, JS, et al: *"Selecting, Evaluating, and Using Sharps Disposal Containers"*. NIOSH Publication No. 97-111: DHHS/PHS/CDC/NIOSH, January, 1998, pgs 1- 29.

Spahr, JS. Chapter: *"Personal Protective Clothing and Equipment (Other than Respiratory)"*. In: Heinsohn PA, *et al.* ed. Bio-safety Reference Manual, 2nd edition. American Industrial Hygiene Association. Fairfax VA 1995, pgs 71- 89.

CDC Staff Coauthor: *"Health Concerns Associated with Disaster Victim Identification After a Tsunami – Thailand, December 26, 2006-March 31, 2005"*. DHHS, CDC, MMWR, April 15, 2005/Vol.54/No.14.

Spahr, JS., *Accommodation Comparison between U.S. NFPA 1971 and European EN 659 Glove Size Schemes with a Contemporary (CAESAR) Anthropometric Hand Size Database*., Vienna, Austria. June 6-9, 2004. page 752.

Spahr, and Kau: *Calculation of a Hispanic Obesity Index for Workplace Wellness Programs.* Washington DC, April 18-20, 2006, NORA Symposium, page 250.

Spahr, Kau, Zwiener, Whisler, Hsiao. *Relative Change of Hand Size Over Time: Implications for Glove-Size Schemes and Labeling for End-Users*. Arlington VA June 23-24, 2003, page 57.

Harris, Whisler, Ammons, Spahr, Jackson, PhD. *Assessing PPE Protection – Development of a Safety Eyewear Coverage Coefficient*. Arlington VA June 23-24, 2003, page 105.

Spahr, Kau, Hsiao, Zwiener. *Anthropometric Differences Among Hispanic Occupational Groups*. Pittsburgh PA Oct 28-30, 2003, page 91.

Spahr, J.S. *"Aircraft Disinsection: Overview of Methods, Materials and Hazards"*; USPHS COA Professional Conference, Philadelphia, PA, June 6-10, 2005.

<u>Copyrighted Occupational Health & Safety Training Materials Development:</u>

"HCW Training Program on the OSHA Bloodborne Pathogen Standard",
Interactive Compact Disc (CD-I) format, in association with AMPED, Inc. Atlanta, GA Jan 1994.

Name: Nancy A. Stout, Ed.D.

Title: Director, Division of Safety Research

Discipline: Quantitative Methods / Epidemiology

Division: Division of Safety Research

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road, Morgantown, WV 26505

Telephone: 304-285-5894

NIOSH Employment:

1997 – Present: Director, Division of Safety Research, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention (CDC) Morgantown, WV

1996 - 1997: Acting Deputy Director, Division of Safety Research, National Institute for Occupational Safety and Health, CDC, Morgantown, WV.

1991-1996: Acting Chief, Surveillance and Field Investigations Branch, Division of Safety Research, National Institute for Occupational Safety and Health, CDC, Morgantown, WV.

1993 (Sept.-Dec.): Associate Director for Extramural Coordination, National Institute for Occupational Safety and Health, CDC, Atlanta, GA.

1990-1991: Chief, Injury Surveillance Section, Surveillance and Field Investigations Branch, Division of Safety Research, National Institute for Occupational Safety and Health, CDC, Morgantown, WV.

1988 (July-Dec.): NIOSH liaison to the Australian National Institute of Occupational Health and Safety, CDC, Sydney and Adelaide, Australia.

1985-1990: Statistician (health), Data Analysis Section, Injury Surveillance Branch, Division of Safety Research, National Institute for Occupational Safety and Health, CDC, Morgantown, WV.

Education:

New England Epidemiology Institute, Tufts University, Medford, MA, 1990.

Ed.D.: West Virginia University
Quantitative Methods, Department of Educational Psychology, May (1985)

M.A.: West Virginia University
Sociology (Medical) (1978)

B.A.: West Virginia University
Cum Laude, Sociology and Spanish (1976)

Memberships:

American Public Health Association (APHA)
National Advisory Committee for Injury Prevention and Control
International Collaborative Effort (ICE) on Injury
CDC Credentialing Committee
International Scientific Committee for the World Conference on Injury Prevention and Control
Editorial Board: Journal of Safety Research
Editorial Board: Applied Occupational and Environmental Hygiene
Editorial Board: Injury Prevention
Review Board: American Journal of Health Behavior
Article reviewer for AJPH, JAMA, AJIH, JOM, AJIM,JOEH.

Patents:

Zeng S, Stout N, Powers JR, Newbraugh B, Jackson LL, Conover DL. Electrical Injury Protection System Using Radio Frequency Transmission. The United States of America as represented by the Department of Health and Human Services, Washington DC US 6,897,783 B2 ed.2005.

Recent Publications:

Stout N. Transferring Workplace Injury Prevention Research to Practice:
Strategies and Examples from the National Institute for Occupational Safety and Health. *Professional Safety*. In press.

Castillo D, Pizatella T, Stout N. Injuries. In: Levy B, Wegman D, Baron S and Sokas M, eds. Occupational and Environmental Health: Recognizing and Preventing Work-Related Disease and Injury, 5TH Edition. Lippincott Williams and Wilkins, 2006.

Driscoll T, Marsh S, McNoe B, Langley J, Stout N, Feyer AM, Williamson A. Comparison of fatalities from work-related motor vehicle incidents in Australia, New Zealand and the United States. *Injury Prevention* 2005; 11(5):294-299.

Stout N and Linn H. Occupational Injury Prevention Research: Progress and Priorities. *Injury Prevention* 2002; 8(IV):iv9-14.

Driscoll T, Feyer A-M, Stout N, Williamson A. Assessing the classification of work-relatedness of fatal incidents: a comparison between Australia, New Zealand and the United States. *Injury Control and Safety Promotion* 2002; 9(1):32-39.

Stout N. The Relevance of Occupational Injury Research: Guest Editorial. *Injury Prevention* 2001; 7 (Supplement I):i1-2.

Stout N and Linn H. From Strategy to Reality: 25 Years of Planning and Progress in Occupational Injury Research: Special Feature. *Injury Prevention* 2001; 7 (Supplement I):i11-14.

Feyer A-M, Williamson A, Stout N, Driscoll T, Usher H, Langley J. Comparison of work-related fatal injuries in the United States, Australia, and New Zealand: Methods and Overall Findings. *Injury Prevention* 2001; 7:22-28.

Williamson A, Feyer A-M, Stout N, Driscoll T, Usher H. Use of Narrative Analysis for Comparison of the Causes of Fatal Accidents in Three Countries: New Zealand, Australia, and the United States. *Injury Prevention* 2001; 7 (Supplement 1):15-20.

Rosenstock L and Stout N. Occupational Injury Risk Assessment: Perspective and Introduction to the First Special Issue. *Human and Ecological Risk Assessment* 2001; 7(7):1771-1773.

Feyer A, Williamson A, Stout N, and Driscoll T. International Occupational Injury Mortality Comparisons. In: Proceedings of the International Collaborative Effort on Injury Statistics, Vol. III. Hyattsville, MD: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Health Statistics. 2000.

Castillo D, Stout N. and Pizatella T. Injuries. Chapter in: Levy BS, and Wegman DH (eds.) Occupational Health: Recognizing and Preventing Work Related Diseases, 4th ed. New York, NY: Lippincott Williams & Wilkins: New York, NY, pp. 461-476, 2000.

Rosenstock L and Stout N. Occupational Injury Risk Assessment: Perspective and Introduction. *Human and Ecological Risk Assessment*, 4(6):1255-1258, 1998.

Stout N, Borwegen W, Conway G, et al. Traumatic Occupational Injury Research Needs and Priorities: a Report by the NORA Traumatic Injury Team. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 98-134. 1998.

Bailer AJ, Stayner LT, Stout NA, Reed LD, and Gilbert MS. Trends in Occupational Fatal Injury Rates in the United States (1983-1992). *Occupational and Environmental Medicine* 55: 485-498, 1998.

Castillo D, Hard D, Myers J, Pizatella T, and Stout N. A National Childhood Agricultural Injury Prevention Initiative. *Journal of Agricultural Health and Safety* Special Issue (1):183-191, 1998.

Stout N. Analysis of Narrative Text Fields in Occupational Injury Data, chapter in Occupational Injury: Risk, Prevention, and Intervention, eds. AM Feyer and A Williamson, pp 15-20. London: Taylor and Francis, Ltd. 1998.

Invited Presentations:

The Public Health Approach to Prevention in the US, *invited* presentation to the 3rd International Conference on Working on Safety, September, 2006, Eemhof, The Netherlands.

Research to Practice: Moving Science to Solutions at NIOSH. 2006 American Society of Safety Engineers Professional Development Conference, June, 2006, Seattle, Washington.

Occupational motor vehicle safety of federal employees*.* *Invited* presentation at the OSHA Commemoration of *Drive Safely at Work Week*. Oct. 6, 2004. Washington, DC.

Injury Prevention Research Initiatives at NIOSH. *Invited* presentation to the Educational Resource Center, Johns Hopkins University. April 6, 2004. Baltimore, MD.

The Public Health Approach to Occupational Injury Prevention Research. *Invited* presentation to Occupational Injury Prevention graduate class. Johns Hopkins University. April. 6, 2004. Baltimore, MD.

The Role of Research in Occupational Injury Prevention. *Invited Plenary* at the West Virginia Injury Prevention Conference, Morgantown, West Virginia, August, 2003.

Lighting the Pathway: The Role of Research in Occupational Injury Prevention. *Invited Plenary* at the 2nd Maine Occupational Safety and Health Research Symposium, Portland, Maine, May, 2003.

Occupational International Collaborative Effort on Injury. *Invited* presentation to the International Collaborative Effort on Injury Statistics, Paris, France, April, 2003.

Transforming Occupational Injury Research Findings to Workplace Prevention: Achieving Impact Through Partnership. *Invited Plenary* at the Alaska Governor's Safety and Health Conference, Anchorage, Alaska, March, 2003.

Stout N. "Occupational Injury Prevention Research: Progress and Priorities." *Invited State-of-the Art Lecture* on Occupational Safety. 6th World Conference on Injury Prevention and Control. Montreal, Canada, May 2002 .

Stout N. “Work-related Injury Data Collection in the United States.” *Invited presentation* at the National Seminar on Work-related Injuries in New Zealand. Wellington, NZ, February 3, 1998.

Stout NA. “Use of narrative text fields in death certificate data.” *Invited* presentation at the Annual Meeting of the Association for Vital Records and Health Statistics. San Fransisco, CA, May 11, 1995.

Stout NA. “International Collaborative Efforts on Occupational Injury Surveillance.” Invited presentation to the International Collaborative Effort on Injury. Hyattsville, MD, April, 1993.

Name: Jay Tarley

Title: Safety and Occupational Health Specialist

Discipline: Safety Engineering

Division/Office: Division of Safety Research/Surveillance and Field Investigations Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road Morgantown, WV 26505 m/s 1808

Telephone: 304-285-5858

NIOSH Employment: October 17, 1997

Education:

B.S. Safety Engineering, Fairmont State College, 1995

Professional Certifications: HAZWOPER Trainer, OSHA 500 Construction Safety Trainer, National Fire Protection Association Fire Fighter I & II

Research Interests: Fire Fighter Health and Safety

Memberships: National Fire Protection Association

Recent Publications:

NIOSH [2005]. Volunteer fire fighter/rescue diver dies in training incident at quarry - Pennsylvania, By Koedam R, Tarley J, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2005-29.

NIOSH [2005]. Volunteer fire chief ides from injuries sustained during a tanker rollover - Utah, By Tarley J, McFall M, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2005-27.

NIOSH [2005]. Residential basement fire claims the life of career lieutenant - Pennsylvania. By Tarley J, Lutz V, Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2003-25.

NIOSH [2005]. Preventing Deaths and Injuries to Fire Fighters during Live-Fire Training in Acquired Structures [Workplace Solutions]. By Tarley J, Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005-102.

NIOSH [2005]. A volunteer fire fighter and volunteer assistant lieutenant die after a smoke explosion at a town house complex - Wyoming, By Tarley J, Bowyer M, Merinar T, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2005-13.

NIOSH [2005]. Career captain dies after running out of air at a residential structure fire - Michigan, By Tarley J, Bowyer M, Merinar T, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2005-05.

NIOSH [2005]. Career Fire Fighter Dies After Falling From Tailboard and Being Backed Over by Engine - California. By Tarley J, Morgantown, WV: U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2005-01.

NIOSH [2005]. Career Fire Fighter Dies and Two Career Captains are Injured While Fighting Night Club Arson Fire – Texas. By McFall M, Tarley J, Cincinnati, Ohio: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report Number F2004-14.

NIOSH [2005]. Career Fire Fighter Dies of Carbon Monoxide Poisoning after Becoming Lost While Searching for the Seat of a Fire in Warehouse - New York. By Frederick L, Tarley J, Guglielmo C, Merinar T, Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2004-04.

NIOSH [2004]. Off-duty Career Fire Fighter Dies and another Off-duty Career Fire Fighter is Injured after being Struck by a Truck while Assisting at a Highway Traffic Incident-FL, By Berardinelli S, Romano N, Tarley J, Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. F2002-35.

NIOSH [2004]. Career battalion chief and career master fire fighter die and twenty-nine career fire fighters are injured during a five alarm church fire - Pennsylvania, By Berardinelli S, McFall M, Tarley J, Oerter B, Merinar T, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2004-17.

NIOSH [2004]. NIOSH Workplace Solutions – Divers Beware: Training Dives Present Serious Hazards to Fire Fighters. By Tarley J, Proudfoot S, Husting L, Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-152.

NIOSH [2004]. Career Fire Fighter Dies from Injuries Received during a Chimney and Structural Collapse after a House Fire-Pennsylvania, By Lutz V, Berardinelli S, Tarley J, Morgantown, WV, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Report No. F2003-04.

NIOSH [2004]. Basement Fire Claims the Life of Volunteer Fire Fighter - Massachusetts. By Tarley J; McFall M; Lutz V, Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Report No. F2004-02.

NIOSH [2004]. Partial Roof Collapse in Commercial Structure Fire Claims the Lives of Two Career Fire Fighters-Tennessee, By Tarley J, Merinar T, McFall M, Berardinelli S, Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Report No. F2003-18.

NIOSH [2003]. Live fire training exercise claims the life of one recruit fire fighter and injures four others – Florida, By Hales T, Tarley J, McFall M, Jackson S, Cincinnati, OH: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2003-28.

NIOSH [2003]. Volunteer Captain Killed in Fire Apparatus Crash While Responding to a Training Exercise - Oregon, By Tarley J, Braddee R, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2003-14.

Tarley JL [2003] Review of NIOSH Fire Fighter Structure Fire Fatality Investigations [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirsmain.html

Tarley JL [2003]. Live-Fire Case Studies [Abstract] In: International Association of Fire Fighters Association Redmond Symposium 2003, October 7, 2003, San Francisco, CA

NIOSH [2003]. Volunteer Lieutenant Dies Following Structure Collapse at Residential House Fire-Pennsylvania, By Lutz V, Tarley J, Berardinelli S, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2002-49.

NIOSH [2003]. Career Fire Fighter Dies After Roof Collapse Following Roof Ventilation - Iowa, By Frederick L, Tarley J, Berardinelli S, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-40.

NIOSH [2003]. Career Lieutenant and Fire Fighter Die in a Flashover During a Live-Fire Training Evolution - Florida, By Romano N, Tarley J, Berardinelli S, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-34.

NIOSH [2003]. Two Career Fire Fighters Die in Four-Alarm Fire at Two-Story Brick Structure - Missouri, By Koedam R, Tarley J, McFall M, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-20.

NIOSH [2003]. Career Fire Fighter Drowns During Final Dive of Training Course - Indiana, By Tarley J, McFall M, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-15.

NIOSH [2003]. First-Floor Collapse During Residential Basement Fire Claims the Life of Two Fire Fighters (Career and Volunteer) and Injures a Career Fire Fighter Captain - New York, By Tarley J, McFall M, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2002-06.

NIOSH [2003]. Hardware Store Explosion Claims the Lives of Career Fire Fighters - New York, By Tarley J, Mezzanotte T, McFall M, Braddee R, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No. F2001-23.

NIOSH [2002]. Civilian jumps from fourth-story window of burning apartment building and strikes career fire fighter - Michigan, By Tarley J, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2002-14.

CDC [2002]. The NIOSH Fire Fighter Fatality Investigation and Prevention Program, Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2002-158.

NIOSH [2001]. Volunteer fire fighter dies and two others are injured during live-burn training – New York, By Tarley J, Mezzanotte T, Koedam R, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2001-38.

NIOSH [2001]. Volunteer fire fighter drowns during multi-agency dive rescue exercise - Illinois, By McFall M, Tarley J, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2002-35.

NIOSH [2001]. Career fire fighter dies after falling through the floor fighting a structure afire at a local residence - Ohio, By Tarley J, Mezzanotte, T, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2001-16.

NIOSH [2001]. Residential fire claims the lives of two volunteer fire fighters and seriously injures an assistant chief - Missouri, By Tarley J, Braddee R, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2001-15.

NIOSH [2001]. Volunteer fire fighter dies and another fire fighter is injured during wall collapse at local business - Wisconsin, By Mezzanotte T, Tarley J, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2001-09.

NIOSH [2001]. Two volunteer fire fighters die fighting a basement fire – Illinois, By Tarley J, Braddee R, Cortez K, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2001-08.

NIOSH [2001]. Fire fighter dies after the tanker truck he was driving strikes a utility pole and overturns while responding to a grass fire – Kentucky, By Romano N, Tarley J, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2001-06

NIOSH [1999]. Electrical panel explosion claims the life of a career assistant chief, an electrician, and seriously injuries an assistant building engineer – Illinois, By Pettit T, Tarley J, Morgantown, WV: Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fire Fighter Fatality Investigation and Prevention Program Report No F2001-15.

Name: Nina L. Turner, Ph.D.

Title: Research Physical Scientist

Discipline: Research Physical Scientist

Division/Office: Division of Safety Research/Protective Technology Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Rd., Morgantown, WV 26505

Telephone: 304-285-5976

NIOSH Employment: May 1989

Education:

Ph.D. Physiology, The Pennsylvania State University, University Park, PA, 1991. Minor in Statistics.

M.S. Exercise Physiology, The Pennsylvania State University, University Park, PA, 1986.

B.A. Biology, University of Virginia, Charlottesville, VA, 1980.

Professional Certifications:

Research Interests : Human performance, personal protective equipment, applied physiology

Memberships: American College of Sports Medicine

National Committee Assignments:

Honors:

NIOSH Alice Hamilton Science Award Nomination, 1992.

Rating of “Outstanding” 05/1993, 05/1994, 01/2006

Recent Publications:

Sinkule, E., Turner, N., and Eschenbacher, W. Metabolic and respiratory responses during the performance of a one-hour Man Test 4. Journal of the International Society for Respiratory Protection, Volume 19, Issues I & II, Spring/Summer 2002.

Name: James T. Wassell

Title: Research Mathematical Statistician

Discipline: Mathematical Statistics

Division/Office: Division of Safety Research/Analysis and Field Evaluations Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road, Mailstop 1811, Morgantown, WV 26505

Telephone: 304-285-5946

NIOSH Employment: March 22, 1992

Education:

Ph.D., Preventive Medicine, The Ohio State University, 1989.

M.Ap.St., Experimental Statistics, Louisiana State University, 1982.

M.S., Zoology, Louisiana State University, 1981.

B.S., Biology, University of Pittsburgh, 1976.

Professional Certifications: None

Research Interests: Biostatistics and Epidemiology

Memberships:

American Statistical Association
The International Biometric Society

National Committee Assignments: None

Honors:

NIOSH Alice Hamilton Award
CDC and ATSDR Statistical Science Award

Recent Publications:

Change in Permeation Parameters and the Decontamination Efficacy of Three Chemical Protective Gloves after Repeated Exposures to Solvents and Thermal Decontaminations. Gao P, El-Ayouby N, Wassell JT. *A*merican Journal of Industrial Medicine 47(2), 2005, pp. 131-143.

Relative Mortality for Correlated Lifetime Data. Song JX, Wassell JT, Kapadia A. *C*omputational Statistics and Data Analysis 45, 2004, pp. 849-864.

Occupational Injury Risk Assessment: An Unintended and Unanticipated Consequence of the Red Book. Wassell JT. Human and Ecological Risk Assessment, 9(5), 2003, pp. 1383-1390. (Invited Essay).

Sample Size for K 2x2 Tables in the Equivalence Studies Using Cochran's Statistic. Song JX and Wassell JT. *Controlled Clinical Trials*, 24(4), 2003, pp. 378-389.

Stressful Psychosocial Work Environment Increases Risk for Back Pain Among Retail Material Handlers. Johnston JM, Landsittel DP, Nelson NA, Gardner LI, Wassell JT. *American Journal of Industrial Medicine* 43, 2003, pp. 179-187.

Research Opportunities in Dose Response Modeling to Improve Risk Assessment. Zeise L, Hattis D, Andersen M, Bailer AJ, Bayard S, Chen C, Clewell H, Conolly R, Crump K, Dunson D, Finkel A, Haber L, Jarabek AM, Kodell R, Krewski D, Thomas D, Thorslund T, Wassell JT. *Human and Ecological Risk Assessment* 8(6), 2002, pp. 1421-1444.

Physiological Effects of Back Belt Wearing During Asymmetric Lifting. Bobick TG, Belard J-L, Hsiao H, and JT Wassell. *Applied Ergonomics* 32, 2001, pp.541-547.

The Effect of Wearing a Back Belt on Spine Kinematics during Asymmetric Lifting of Large and Small Boxes. Giorcelli, RJ, Hughes RE, Wassell JT and H Hsiao. *Spine* 26(16), 2001, pp. 1794-1798.

A Prospective Study of Back Belts for Prevention of Back Pain and Injury. Wassell JT, Gardner LI, Landsittel DP, Johnston JJ, Johnston JM. *Journal of the American Medical Association*, 284(21), December 6, 2000, pp. 2727-2732.

Recurrent Injury Event-Time Analysis. Wassell JT, Wojciechowski WC and DD Landen. *Statistics in Medicine*, 18(23), December, 1999, pp. 3355-3363.

Modeling Frailty in Manufacturing Processes. Wassell JT, Kulczycki GW and ES Moyer. *In*: Lifetime Data: Models in Reliability and Survival Analysis, NP Jewell et al., Eds., Kluwer Academic Publishers, 1996, Netherlands, pp. 353-361.

Power Determination for Geographically Clustered Data Using Generalized Estimating Equations. Hendricks SA, Wassell JT, Collins JW and SL Sedlak. *Statistics in Medicine*, 15, 1996, pp. 1951-1960.

Assessment of Perceived Traumatic Injury Hazards During Drywall Hanging. Pan CS, Chiou S, Hsiao H, Wassell JT and PR Keane. *International Journal of Industrial Ergonomics*, 25(1), Nov 1999, pp 29-37.

Name: Richard L. Whisler

Title: Information Technology Specialist

Discipline: Computer Graphics, Anthropometry

Division/Office: Division of Safety Research/Protective Technology Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road, M/S-G800, Morgantown, WV 26505

Telephone: 304-285-6043

NIOSH Employment: October 1998

Education:

Associate Degree, Computer Information Management, International Academy of Design and Technology, 1993

Associate Degree, Computer Animation and Multimedia, Art Institute of Pittsburgh, 1995

Professional Certifications: CompTIA **-** A+ Certified Service Professional, IRIX System Administration, Anthropometric Land Marking and Measuring

Research Interests: Occupational safety, anthropometry, computer modeling for safety research applications, digital human modeling for safety research applications, fall protection harnesses, and laser scanning for safety research applications.

Memberships: None

National Committee Assignments: None

Honors: None

Recent Publications:

Spahr J., Kau T., Zwiener J., Whisler R., Hsiao H. (2003) Relative Change in Hand Size Over Time: Implications for Glove-Size Schemes and Labeling for End- Users. NORA{Arlington, Virginia}{June 23-24}:57

Hsiao, H., Whisler, R., Kau, T., Zwiener, J., Guan, J., & Sphar, J. (2005). Constructing new harness fit charts using 3D anthropometric information. Proceedings at 2005 Ergonomic Society Conference. April 5-7, De Havilland Campus, Hatfield, Hertfordshire, UK.

Hsiao, H., Whitestone, J., Bradtmiller, B., Zwiener, J., Whisler, R., Kau, T., Gross, M., & Lafferty, C., (2005) Anthropometric Criteria for the Design of Tractor Cabs and Protection Frames, Ergonomics (in press).

Harris, J., Whisler, R., Ammons, D., Spahr, J., Jackson, L. Assessing PPE protection – Development of a safety eyewear coverage coefficient. Proceedings of the NORA Symposium 2003; June 23-25, 2003; Washington, D.C. p. 105.

Jackson, L., Spahr, J., Whisler, R., Ammons, D. PPE Design: A New Technique for Assessing Safety Eyewear Coverage with International Results. Oral presentation at the 2005 World Congress on Safety and Health at Work, September 18-22, 2005, Orlando, FL.

Name: Shengke Zeng

Title: Biomedical Engineer (Research)

Discipline: Biomedical Engineering; Radio Technology

Division/Office: Division of Safety Research/Protective Technology Branch

Location: NIOSH/Morgantown, WV

Address: 1095 Willowdale Road, M/S-G800, Morgantown, WV 26505

Telephone: 304-285-6103

NIOSH Employment: February 18, 1998

Education:

Ph.D in Biomedical Engineering, Drexel University, 1993
M.S. in Biomedical Engineering, Drexel University, 1990
B.Eng. in Radio Technology, Guangxi University, 1982

Professional Certifications: None

Research Interests: Occupational Safety; Biomedical Electronics; Biomedical Acoustics; Biomedical Optics

Memberships: Institute of Electrical and Electronics Engineers (IEEE), Engineering in Medicine and Biology Society

National Committee Assignments: None

Honors: None

Recent Publications:

Zeng, S; Powers, JR; Jackson, LL; Conover, DL, "Electrical Injury Protection System Using Radio Frequency Transmission", **U.S. Patent** No. 6,897,783, issued by the United States Patent and Trademark Office, May 24, 2005.

Zeng, S; Powers, JR; Jackson, LL; Conover, DL, "DIGITAL MEASUREMENT OF HUMAN PROXIMITY TO ELECTRICAL POWER CIRCUIT BY A NOVEL AMPLITUDE-SHIFT-KEYING RADIO-FREQUENCY RECEIVER", **Conference Paper**, proceedings of the IEEE International Symposium on Circuits and Systems, Kobe, Japan, May 23-26, 2005, pp576-579.

Zeng S., Powers J.R. , Hsiao H., "Image-synchronized multichannel biomedial data acquisition system," **Australian Patent** No. 779045, issued by Australian Patent Office, Accepted journal date: January 6, 2005.

Zeng S, Powers J, Jackson L.L., Conover L.D., "Development of a New Electrical Injury Protection System-Selection of RF Transmitter Mounting Location on the Human Body," **Presentation**, National Occupational Injury Research Symposium 2003, G3.4, p 111, Pittsburgh, PA, October 28-30, 2003.

Beard R.B., Pourrezaei K., Zeng S., Prout F., Kepics F.M., Park J., Rothwarf, A. Deliwala S., Schmukler R., "Detection of defects in protective barriers," **U.S. Patent** No. 6,204,669, issued in March 2001.

Zeng S., Powers J.R., Hsiao H., "A video-synchronized high-speed-EMG and metabolic data acquisition system," **Conference Paper**, Proceedings of IEA 2000/HFES 2000 Congress, p 5.124 - 5.127. Presented at 14th Triennial Congress of the International Ergonomics Association, San Diego, CA, August 2000.

Zeng S., Berardinelli S.P., "Acoustical method and system for measuring barrier membrane thickness and the correspondent area distribution using maximum transmission or maximum reflection coefficients," **U.S. Patent** No. 6,089,094, issued in July 2000.

Zeng S, Powers J, Jackson L.L., Conover L.D., "Feasibility of power line proximity warning system using radio frequency transmission," **Presentation**, The 5th World Conference on Injury Prevention and Control Abstracts, p 2-1-J-02. Presented at the 5th World Conference on Injury Prevention and Control, New Delhi, India, March 2000.

Zeng S., Powers J.R., Hsiao H., "A new video-synchronized multi-channel biomedical data acquisition system," **Paper (Communication)**, *IEEE Transactions on Biomedical Engineering*, Vol. 47 No. 3, March 2000, p 412-419.

Name: Joyce V. Zwiener

Title: Health Scientist

Discipline: Anthropometry

Division/Office: Division of Safety Research/Protective Technology Branch

Location: NIOSH/Morgantown, WV.

Address: 1095 Willowdale Road

Telephone: 304-285-5814

NIOSH Employment: 5/99 - Present

Education:

Attended: 1996-1999 Diploma Date: 5/99 West Virginia University Credits Earned: 44 Morgantown, WV 26506
Graduated with a Masters of Science in Occupational Health and Safety Engineering. (GPA 3.92)

Attended: 1990-1995 Diploma Date: 5/95 University of Kentucky Credits Earned: 148 Lexington, KY 40506
Graduated with a B.S. Degree in Biology (GPA 3.2)

Research Interests: Human factors and Anthropometry

Honors:

2006 Alice Hamilton Award winner for Excellence in Occupational Safety and Health/Engineering and Physical Sciences Category/Anthropometric criteria for the design of tractor cabs and protection frames

2006 Bullard-Sherwood Award winner for Research2Practice knowledge Category/Harness Design and Sizing Effectiveness

Recent Publications:

Turner, N., Weaver, D., Whisler, R., Zwiener, J., and Wassell, J. Suspension tolerance in men and women wearing safety harnesses, American Industrial Hygiene Conference and Exposition, Chicago, IL, 2006.

Chiou S., Pan, C.S., Zwiener, J., Ronaghi, M. American Industrial Hygiene Conference & Expo (AIHCE), 49 {May 21-26} Anaheim, California. Fairfax, Va: American Industrial Hygiene Association, 2005.

Hsiao, H., J. Whitestone, B. Bradtmiller, R. Whisler, J. Zwiener, C. Lafferty, T. Kau, M. Gross 'Anthropometric criteria for the design of tractor cabs and protection frames,' Ergonomics 48 (4): 323-353, 2005.

Spahr, J., T. Kau, J. Zwiener, R. Whisler, H. Hsiao 'Relative Change of Hand Size Over Time; Implications for Glove-Size Schemes and Labeling for End-Users,' paper was presented in the NORA conference, 2003, Washington, DC and was published in the NORA abstract book.

Zwiener, J., C.S. Pan, S. Chiou, T. Kau, K. Mozingo 'Ergonomic Walkthrough Evaluation of a Pre-Manufactured Home-Fabrication Plant,' NIORS 2003.

Pan, C.S., S. Chiou, D. Long, J. Zwiener and D. Cantis 'Assessment of Postural Instability during Drywall Handling,' Annual International Occupational Ergonomics and Safety Conference, Fairfax, Virginia, June 4-7, 2001 and was published in the proceedings of Advances in Occupational Ergonomics and Safety.

Pan, C.S., S. Chiou, D. Long, J. Zwiener and D. Cantis 'Kinematic analysis of drywall lifting,' paper was presented at the 15th Annual International Occupational Ergonomics and Safety Conference, Fairfax, Virginia, June 4-7, 2001 and was published in the proceedings of Advances in Occupational Ergonomics and Safety.

Long, D.J., C.S. Pan, S. Chiou, P. Skidmore, J. Zwiener 'Perceived Postural Sway and Discomfort During Simulated Drywall Lifting and Hanging Tasks' paper was presented in the NOIRS conference, 2000, Pittsburgh, PA and was published in the NOIRS abstract book.

Pan, C.S., S. Chiou, D. Long, J. Zwiener and P. Skidmore 'Postural Stability During Simulated Drywall Lifting and Hanging Tasks' paper was presented at IEA 2000/HFES 2000 Congress, July 30 - August 4, 2000, San Diego, California and was published in the Proceedings of the IEA 2000/HFES 2000 Congress.

Appendix 4: Traumatic Injury Databases and Information Systems

Name of Surveillance System or Dataset: Alaska Occupational Injury Surveillance System (AOISS)

Owner/Manager/Contact: Jan C. Manwaring

Description/Scope:

Surveillance of occupational fatalities in Alaska is maintained and monitored by the Alaska Field Station in the Alaska Occupational Injury Surveillance System (AOISS) database. AFS staff collect information from over a dozen local, state and federal sources, including the US Coast Guard, the National Transportation Safety Board, Federal Aviation Administration, and the State of Alaska's Section of Community Health & EMS Occupational Injury Prevention Program. The database houses detailed information and serves as the backbone of our research.

Major Analyses Undertaken:

Analysis of AOISS focuses research and intervention efforts on hazardous employment sectors such as commercial fishing and air transportation. AFS researchers have produced over 20 peer-reviewed papers using AOISS data which identify risk factors, and possible solutions to Alaska's high rate of occupational fatalities. The partnerships that AFS staff have developed with other federal agencies, Alaska state agencies, non-governmental organizations and industry are a critical part of our ability to maintain the AOISS database.

Outputs (descriptive report, article, methodology, etc.):

Fiscal Year 1996 to 2005 Publications AOISS Related

1. Conway GA, Hill A, Martin S, Mode NA, Berman MD, Bensyl DM, Manwaring JC, Moran KA [2004]. Alaska air carrier operator and pilot safety practices and attitudes: a statewide survey. Aviat Space Environ Med 75(11):984-991.
2. Conway GA, Mode NA, Berman MD, Martin S, Hill A [2005]. Flight safety in Alaska: Comparing attitudes and practices of high and low-risk air carriers, Aviat Space Environ Med 76(1):52-57.
3. Conway G, Martin S, Berman M, Hill A, Bensyl D, Manwaring J, Moran K [2004]. Risk factors for air transportation safety among air carrier operators and pilots in Alaska: A major survey and case-control analysis [Abstract] In: The 7th World Conference on Injury Prevention and Safety Promotion, Vienna, Austria, June 6th-9th 2004. Vienna, Austria, Vienna Austria: Kuratorium fur Schutz und Sicherheit/Institut Sicher Leben, NN: 20025703.
4. Conway G, Moran K [2004]. Scientific worker and licensed professional deaths in Alaska, 1990-2002 [Abstract] In: The 7th World Conference on Injury Prevention and Safety Promotion, Vienna, Austria, June 6th-9th 2004. Vienna, Austria, Vienna, Austria: Kuratorium fur Schutz und Sicherheit/Institut Sicher Leben, NN: 20025707.

5. Hudson D, Hunt A, Conway G, Ekman R [2004]. Cold-related injuries in Alaska, 1991-1999 [Abstract] In: The 7th World Conference on Injury Prevention and Safety Promotion, Vienna, Austria, June 6th-9th 2004. Vienna, Austria, Vienna Austria: Kuratorium fur Schutz und Sicherheit/Institut Sicher Leben, NN: 20025706.
6. Conway GA, Manwaring J [2003]. Surveys of Alaska's Aviation Industry [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.
7. Husberg BJ, Lincoln JM [2003]. Making Alaska's Fishing Industry Safer: applied Epidemiology and Engineering [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.
8. Manwaring J, Conway GA, Moran K [2003]. Progress in Partnerships for Surveillance and Prevention of Occupational Aircraft Crashes in Alaska 1990-1999 [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.
9. Moran KA, Conway GA, Bensyl D [2003]. Human Errors as a Leading Cause of Occupant Mortality in Air Taxi and Commuter Crashes in Alaska 1990-1999 [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.
10. CDC [2002]. Factors Associated with Pilot Fatalities in Work-Related Aircraft Crashes - Alaska 1990-1999, MMWR 50(11):347-349.
11. Conway GA, Lincoln JM, Hudson DS, Bensyl DM, Husberg BJ, Manwaring JC [2002]. Surveillance and Prevention of Occupational Injuries in Alaska: A Decade of Progress 1990-1999, Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2002-115.
12. Thomas TK, Bensyl DM, Manwaring JC, Conway GA [2000]. Controlled flight into terrain accidents in commuter and air taxi operators in Alaska. Aviation, Space and Environmental Medicine 71(11):1098-1103.
13. Conway GA, Lincoln JM, Husberg BJ, Manwaring JC, Klatt ML, Thomas TK [1999]. Alaska's model program for surveillance and prevention of occupational injury deaths, Public Health Reports 114(6):550-558.
14. Lincoln JM, Conway GA [1999]. Preventing commercial fishing deaths in Alaska. Occup Environ Med 56(10):691-695.
15. Conway GA, Klatt ML, Manwaring JC [1998]. Effective injury prevention using surveillance data: Helicopter logging, Alaska, 1992-1995. Proceedings of the Tenth International Congress on Circumpolar Health, Anchorage, AK, September, 1998.
16. Conway GA, Lincoln JM, Jorgensen , Klatt ML, Manwaring JC [1998]. Preventing drownings in Alaska's commercial fishing industry. Proceedings of the Tenth International Congress on Circumpolar Health, Anchorage, AK, September, 1998.
17. Garrett LC, Conway GA, Manwaring JC [1998]. Epidemiology of work-related aviation fatalities in Alaska, 1990-94. Aviation, Space and Environmental Medicine 69(12):1131-1136.
18. Garrett LG, Conway GA [1998]. Aviation: a serious occupational hazard--Alaska, 1990-1995. Proceedings of the Tenth International Congress on Circumpolar Health, Anchorage, AK, September, 1998.

19. CDC [1997]. Work-related aviation fatalities, Alaska, 1990-1994. MMWR 46(22):496-498.
20. Bledsoe GL, Klatt MK, Lincoln JM [1996]. Occupational fatalities in Alaska—1995. State of Alaska Epidemiology Bulletin No. 10.
21. Conway GA [1996]. Epidemiology of Alaska Helicopter Logging Deaths, presented at Klatt ML, Hudson D, Conway GA, eds. Proceedings of the Helicopter Logging Safety Workshop, Ketchikan, AK, March 1-2, 1995.
22. Conway GA, Lincoln JM [1996]. Preventing deaths in Alaska's fishing industry (Editorial). Public Health Reports 110(6):700.
23. Manwaring J [1996]. Synthesis of NTSB aircraft accident data involving helicopter external load operations in the United States and Alaska, 1980-1994. Presented at Klatt ML, Hudson D, Conway GA, eds Proceedings of the Helicopter Logging Safety Workshop, Ketchikan, AK, March 1-2, 1995.
24. NIOSH [1996]. Proceedings of the Helicopter Logging Safety Workshop, Ketchikan, AK, March 1-2, 1995, 128 pages

Intermediate Outcomes:

The Alaska Department of Health and Social Services (AK DHSS) and the Alaska Department of Labor and Workforce Development (AK DOLWD) use AOISS data to augment their own databases, and to develop and implement the Alaska Injury Prevention Plan. Research findings from AOISS were also instrumental in providing the basis for developing the following intervention strategies: The Medallion Foundation’s Five Star Medallion Program (a voluntary higher safety standard for air carrier companies), FAA’s Capstone Program (state-of-the-art navigational avionics equipment for small aircraft), and FAA’s Circle of Safety Program (educational program for aircraft passengers to encourage safe flying in Alaska).

Outcomes:

AOISS research has resulted in partnerships that AFS staff have developed with other federal agencies, Alaska state agencies, non-governmental organizations and industry. These partnerships are a critical part in the combined effort to reduce occupational fatalities in Alaska.

Analysis of AOISS data shows that over a sixteen year period (1990-2005), AFS, in partnership with many agencies and individuals, showed significant progress in reducing workplace deaths:

- A 67% decline in all occupational deaths
- A 73% decline in commercial fishing deaths
- A 73% decline in commercial pilot deaths

Availability

Raw data is only available through agreement with NIOSH AFS and the Alaska Department of Health and Social Services.

Restrictions on Access:

Access to raw data is restricted to NIOSH AFS and the Alaska Department of Health and Social Services staff who need to know. Requests for aggregate data are reviewed on a case-by-case base.

Name of Surveillance System or Dataset: Alaska Trauma Registry (ATR)

Owner/Manager/Contact: This data source is produced and maintained by the Alaska Department of Health and Social Services (AK DHSS), Division of Public Health, Section of Injury Surveillance and Prevention. Contact - Martha Moore, 465-8631. PO Box 110616 Juneau, AK 99811-0616. NIOSH provides financial and technical assistance, to the State of Alaska, for the development and use of the ATR for the use in work-related injury surveillance.

Description/Scope:

The Alaska Trauma Registry is an information system of the most seriously injured patients in Alaska, and the treatment that they have received. Since 1991, the trauma registry has collected data from all 24 of Alaska's acute care hospitals.

The primary purposes of the registry are to evaluate the quality of trauma patient care and to plan and evaluate injury prevention programs. The criteria for inclusion in the trauma registry are patients with injuries who are admitted to an Alaska hospital, held for observation, transferred to another acute care hospital, or declared dead in the emergency department, and for who contact occurred within 30 days of the injury. Injuries include trauma, poisoning, suffocation, and the effects of reduced temperature.

Trauma Registry data is confidential and protected under Alaska Statute 18.23.010-070. All trauma registry personnel and those requesting trauma registry data are required to sign a confidentiality statement. The trauma registry does not include patient, physician, hospital, clinic, or ambulance service identifiers.

Information from the Trauma Registry is not available online. Requests for information are made to the AK DHSS office and in most instances, provided in summary (aggregate) form. Non-aggregate data may be requested for special research projects through application and in accordance with the Trauma Registry Release of Information Policy.

Trauma registries are a unique source of work-related nonfatal injury data requiring hospitalization: demographics, geographic information, disability, medical cost, payment source, cause of injury, discharge diagnosis, and severity scoring, are only a few of the examples of these data that are collected. Since 1991, all 24 hospitals in Alaska report to the ATR, making it a population-based data source. Analysis of the trend data and identification of hazardous processes have lead to sharing information to foster injury prevention strategies specifically targeted to high-risk areas. NIOSH uses data from ATR to identify hazardous events that lead to the assessment and implementation of injury prevention measures. Current collaboration with NIOSH external partners focus on injury prevention, trend analysis, and increasing worker awareness of safety and injury prevention measures.

Long-term objectives of this project include using information from the ATR to:

- Reduce the morbidity resulting from work-related injuries in Alaska by providing data that would allow the development of appropriate prevention strategies.
- Facilitate state, federal, and international work-related injury comparisons that permit trend analysis.
- Improve the awareness of non-fatal work-related injury as a significant health problem.
- Assist in the evaluation of work-related injury-prevention strategies.
- Facilitate research for the prevention of non-fatal work-related injuries.

Major Analyses Undertaken:

Findings from ATR work-related cases have been analyzed by NIOSH AFS for trends, root causes, and characteristics of injuries for different jobs, industries, and conditions. This information is shared with federal and state agencies, employers, and injury prevention groups in Alaska where it is used to prioritize and focus injury prevention and training for workers. Following are examples of results and impact for this project.

- U.S. Army Injury Prevention Program Development
    - In initial discussions with the U.S. Army in Alaska on work-related injuries, ATR data was presented (identifying cold weather injuries as one of the leading causes of hospitalized injuries to soldiers in Alaska) and a serious discussion on cold weather injuries followed. The army was interested in developing an internal surveillance system for cold weather related injuries.
- Priorities in Construction Safety in Alaska
    - Data from the ATR has identified the construction industry as having a high number of injuries in Alaska. We have shared information on causes and risk factors identified in our surveillance and have shared this information with other groups.
- Priorities and Injury Prevention in Commercial Fishing
    - Surveillance data from the ATR has identified specific machinery and work processes that have led to nonfatal injuries in the commercial fishing industry. These results were shared with the NIOSH, Injury Prevention in the Commercial Fishing Industry Project, USCG, and other organizations.

Outputs *(descriptive report, article, methodology, etc.)*:

NIOSH [2006]. Proceedings, Second International Fishing Safety and Health Conference, 2006 Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2006-114.

Husberg BJ, Fosbroke DE, Conway GA, Mode NA [2005]. Hospitalized Nonfatal Injuries in the Alaskan Construction Industry. Am J Ind Med (47):428-433.

Mode NA, Hackett EJ, Conway GA [2005]. Unique Occupational Hazards of Alaska: Animal Related Injuries. Wilderness and Environmental Medicine (16) 185-191.

NIOSH [2003]. Proceedings of the International Fishing Industry Safety and Health Conference, 2002 Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2003-102.

Conway GA, Lincoln JM, Hudson DS, Bensyl DM, Husberg BJ, Manwaring JC [2002]. Surveillance and Prevention of Occupational Injuries in Alaska: A Decade of Progress 1990-1999, Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2002-115.

Husberg BJ [2002]. Surveillance for Nonfatal Work-Related Injuries in the Alaska Fishing Industry. In: Proceedings of the International Fishing Industry Safety and Health Conference, Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 2003-102.

Lincoln JM, Husberg BJ, Conway GA [2002]. Improving Safety in the Alaskan Commercial Fishing Industry. In: Proceedings of the International Fishing Industry Safety and Health Conference, Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2003-102.

Husberg BJ, Lincoln JM, Conway GA [2001]. On-Deck Dangers in the Alaskan Commercial Fishing Industry, Marine Safety Council, U.S. Coast Guard Journal of Safety at Sea Proceedings 58(2): pp. 23-24.

Lincoln JM, Husberg BJ, Conway GA [2001]. Improving Safety in the Alaskan Commercial Fishing Industry. International Journal of Circumpolar Health. Volume 60, pages 705-713.
Conway GA, Lincoln JM, Husberg BJ, Manwaring JM, Bensyl DM, Choromanski DM [2001]. Alaska's Model Program for Occupational Injury Prevention: Applying Surveillance for Effective Public Health Practice. International Journal of Circumpolar Health. Volume 60, pages 714-726.

Thomas TK, Lincoln JM, Husberg BJ, Conway GA [2001]. Is it Safe on Deck? Fatal and Non-Fatal Workplace Injuries Among Alaskan Commercial Fishermen. Am J of Ind Med. 40:693-702.

Conway GA, Lincoln JM, Husberg BJ, Bensyl DM, Manwaring JM [2001]. Occupational Injury Research and Prevention in Alaska. Arctic Research. 15:14-26.

Conway GA, Lincoln JM, Husberg BJ, Manwaring JC, Klatt ML, Thomas TK [1999]. Alaska's Model Program for Surveillance and Prevention of Occupational Injury Deaths. Public Health Reports. 114:67-73.

Conway GA, Husberg BJ [1999]. Cold Related Non-Fatal Injuries in Alaska. American Journal of Industrial Medicine, S1, pages 39-41.

Choromanski D, Husberg BJ [1999]. Occupational Falls Raise Safety Concerns. State of Alaska Epidemiology Bulletin. 3(1).

Husberg BJ, Conway GA, Moore MA, Johnson MS [1998]. Surveillance for nonfatal work-related injuries in Alaska, 1991-95. Am J Ind Med 34(5):493-498.

Intermediate Outcomes:

- U.S. Army Injury Prevention Program Development
  - The U.S. Army in Alaska is pilot testing a cold weather injury surveillance system using the ATR as a model. Information from the ATR has also been useful to the US Army Center for Health Promotion and Preventive Medicine in developing cold weather injury prevention program and injury prevention materials. (see http://chppm-www.apgea.army.mil/coldinjury/#_CIPP)
- Priorities in Construction Safety in Alaska
  - The Associated Builders and Contractors, Alaska Chapter, has used ATR information to prioritize topics for safety training among their members.
  - Since 1999, the annual Alaska Governor's Safety and Health Conference has used ATR data to focus speaker selection and topics on priority areas where most injuries occur and can be prevented.
- Priorities and Injury Prevention in Commercial Fishing
  - Safety organizations including the USCG, AMSEA, and NPFVOA now includes information in their safety training and publications that address deck safety and injury prevention.
  - Publication, *Deck Safety for Crab Fishermen,* describing crab deck hazards and conditions and recommendations for specific engineering or administrative controls. (can be found at http://www.jensenmaritime.com/articles/crabdeck.pdf#search=%22deck%20safety%20for%20crab%22) Each recommendation lists the benefit, estimated cost, installation/implication information that in some incases include detailed engineering drawings. Approximately 3,000 of these publications have been distributed in the commercial fishing community over the past three years and many of the recommendations have become commonplace on vessels in Alaska waters.

Outcomes:

An analysis of the long-term outcomes for this dataset is currently in process.

Availability *(e.g., raw data or summary data; Web access, electronic access, hardcopy access; etc.)*:

Raw data through agreement with NIOSH AFS and the Alaska Department of Health and Social Services.

Restrictions on Access:

Access to data is restricted. Requests are made to the CHEMS office and in most instances, provided in summary (aggregate) form. Non-aggregate data may be requested through the state of Alaska for special research projects through application and in accordance with the Trauma Registry Release of Information Policy (http://www.hss.state.ak.us/dph/chems/injury_prevention/Assets/ATR/ems_trroi.pdf)

Applications

Name of Surveillance System or Dataset: Childhood Agricultural Mortality Surveillance (CAMS)

Owner/Manager/Contact:

Owner: NIOSH

Manager: John Myers, NIOSH, DSR

Contact: John Myers, NIOSH, DSR

Description/Scope:

The Childhood Agricultural Mortality Surveillance (CAMS) is a death certificate-based surveillance system designed to collect information on youth less than 20 years of age who were fatally injured on farms in the U.S. NIOSH collects these data by purchasing death certificates from 50 State Vital Statistics Registrars that meet the following criteria: fatality occurred to a youth less than 20 years of age; the location of the injury event was a farm; and the cause of death was external (ICD-10 Codes V01-Y98). CAMS data are currently available for the years 1995 through 2003.

Major Analyses Undertaken:

The 1995-2000 CAMS data have extensively analyzed. Data from these analyses have been released through a conference presentation and a peer-reviewed journal article (see "Outputs" for citation). Analyses of the 2001-2003 CAMS mortality data will be conducted once 2 to 3 years of additional data become available. Additional analyses on suicides among farm youth have been provided to the National Center for Rural and Agricultural Health and Safety (NCCRAHS) to support their rural suicide prevention activities (see "Intermediate Outcomes" for details).

Outputs (descriptive report, article, methodology, etc.):

Peer-reviewed Journal Articles:

Goldcamp EM, Hendricks KJ, Myers JR. [2004]. Farm fatalities to youth 1995-2000: a comparison by age groups. Journal of Safety Research 35(2):151-157.

Conference papers:

Goldcamp EM, Hendricks KJ, Myers JR. [2002]. Farm fatalities to youth 1995-1997: a comparison by age groups. National Institute for Farm Safety 2002 Annual Meeting, June 23-27, 2002, Ponte Vedra Beach, FL. Columbia, MO: National Institute for Farm Safety.

Intermediate Outcomes:

1. One significant finding from the NIOSH death certificate studies has been the importance of non-work fatalities to youth on farms. These findings led to the development of a new recommendation in the updated 2002 Childhood Agricultural Injury Prevention National Action Plan to address non-work injuries on farms. In response to this new recommendation, the National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS) produced several documents on the importance and design of safe play areas for children on farms. NCCRAHS also maintains a website dedicated to the topic of safe play areas on farms (see http://www.marshfieldclinic .org/nfmc/pages/default.aspx?page=nfmc_ nccrahs_safe_play_welcome).

2. Based on the 2004 CAMS journal article, NCCRAHS requested NIOSH to provide additional analyses on suicide cases identified in the CAMS. NCCRAHS is now incorporating the results of these analyses in theirs suicide prevention programs and presentations (see http://www.marshfieldclinic.org/nfmc/pages/default.aspx?page=nccrahs_presentations).

Outcomes: None to report.

Availability (e.g., raw data or summary data; Web access, electronic access, hardcopy access; etc.):

A hardcopy of the 1995-2000 CAMS results are available through a peer-reviewed journal article released in 2004 (see "Outputs" for citation). Special data requests are available through NIOSH. Electronic versions of the data are not available.

Restrictions on Access:

These data are not available to the public because of the confidential nature of the data. CAMS is protected under Section 308(d) of the Public Health Service Act. Special data runs are available to users through NIOSH by submitting a written request for summary data.

Name of Surveillance System or Dataset: The Fatality Assessment and Control Evaluation (FACE) Project—First Report database

Owner/Manager/Contact:

NIOSH, Morgantown, WV/John Sines/304-285-6105; Jsines@cdc.gov

Description/Scope:

The dataset includes standard information for each worker fatality investigated by NIOSH through the Fatality Assessment and Control Evaluation (FACE) program. The database includes information on the investigation (e.g. sources of information), incident (e.g. date, time), victim demographics (e.g. age, gender, industry and occupation), and circumstances (e.g. cause and type of death). The dataset currently consists of 630 records.

Major Analyses Undertaken:

This dataset is principally used to log and tabulate worker injury deaths investigated by the NIOSH in-house FACE program. The database has been used in the past to support summary analyses of FACE investigation reports, such as those done for monographs on confined spaces, falls and electrocutions. The utility of this database for this purpose has diminished over time as NIOSH increasingly uses findings from state-based investigations, which are not included in this database. While states maintain similar data for investigations they conduct, they do not routinely forward this data to NIOSH as a result of changes in how NIOSH cooperative agreements are administered.

Outputs:

NIOSH [1994]. Worker deaths in confined spaces. Cincinnati, OH: U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, NIOSH pub. No. 94-103.

NIOSH [1998]. Worker deaths by electrocution: A summary of surveillance findings and investigative case reports. Cincinnati, OH: U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, NIOSH pub. No. 98-131.

NIOSH [2000]. Worker deaths by falls: A summary of surveillance findings and investigative case reports. Cincinnati, OH: U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, NIOSH pub. No. 2000-116.

Intermediate Outcomes:

Outcomes:

Availability: Electronic Access.

Restrictions on Access: Available upon request.

Name of Surveillance System or Dataset: The NIOSH Fatality Assessment and Control Evaluation (FACE) Webpage

Owner/Manager/Contact:

NIOSH, Morgantown, WV/Virgil Casini/304-285-6020; Vcasini@cdc.gov

Description/Scope:

The Fatality Assessment and Control Evaluation (FACE) webpage contains more than 1,600 FACE investigative reports that may be viewed or downloaded in their entirety. The reports include narratives summarizing the circumstances leading to a worker's death, and provide recommendations for preventing future deaths under similar conditions.

The reports have been categorized on the website by location (highway work zones), industry (agriculture, commercial aviation, commercial fishing, construction, logging and youth agriculture), cause (confined space, electrocution, falls, machine related, and motor vehicles), populations (Hispanic and youth), and state. These categories will allow interested end users to quickly access those reports that might be of interest to them. Interested parties may enter their email address into the listserv on the webpage and will then be electronically notified by email when a new report is posted on the webpage. Additionally, all reports completed by NIOSH staff from the year 2000 to the present contain an evaluation page that will allow end users to give NIOSH timely feedback that will allow NIOSH to monitor the usefulness of the reports and modify report content as necessary. The webpage also includes links to publications utilizing FACE reports and links to state FACE programs. These reports may be accessed at: http://www.cdc.gov/niosh/face/.

Major Analyses Undertaken:

NIOSH has completed comprehensive analyses of FACE investigations involving confined spaces, falls, and electrocutions. These analyses were featured in NIOSH publications that also included analyses of national surveillance data and FACE report summaries. Analyses summarizing FACE investigations involving young workers have been printed in peer-reviewed journals.

Outputs *(descriptive report, article, methodology, etc.)***:**

<u>NIOSH Publications</u>

To date, the FACE reports have been utilized as the basis for twenty NIOSH Alerts on a variety of subjects including forklifts, cranes, manure pits, skylights, scalping and scaffolds. Eleven of these Alerts have been translated into Spanish. Three monographs (confined space, electrocution, and falls) have been published. Three NIOSH Hazard IDs have been developed pertaining to wood chippers, moving large hay bales, and ignitions during the penetration of sealed frames of agricultural machinery. Two Workplace Solutions involving backhoes/excavators and ride-on roller compactors were disseminated internationally, and two Workplace Solutions addressing the human hazards of the animal antibiotic Micotil® and contact between overhead powerlines and aluminum ladders are nearing finalization. These products were all based on the FACE reports and finalized publications can be accessed at: http://www.cdc.gov/niosh/face/othpubs.html

MMWR articles

Parker D, Boyle D, Wahl G et al. [1996]. Skid-Steer Loader-Related Fatalities in the Workplace in the United States, 1992-1996. MMWR 45(29): 624-628.

Parker D, Wahl G [1998]. Fatalities associated with large round hay bales -- Minnesota, 1994-1996. MMWR 47(2):27-30.

Higgins DN, Hendricks K, Struttman T, Tierney J [1999]. Deaths among children aged _< 5 years from farm machinery runovers--Iowa, Kentucky, and Wisconsin, 1995-1998, and United States, 1990-1995. MMWR 48(28):605-608.

Moore P, Burkhart J [2001]. Baler and compactor-related deaths in the workplace--United States, 1992-2000, MMWR 50(16):309-313.

External publications authored by NIOSH staff:

Styles L, Cierpich H, Rogge J, Higgins D, Harrison R [2005]. To live and die in Los Angeles: the California Fatality Assessment and Control Evaluation (FACE) program: 1992 - 2002, 2005 National Injury Prevention and Control Conference, Denver, Colorado, May 9-11, 2005 Atlanta, GA: Centers for Disease Control and Prevention.

Helmkamp JC, Bell JL, Lundstrom WJ, Ramprasad J, Haque A [2004]. Assessing safety awareness and knowledge and behavioral change among West Virginia loggers, Inj Prev 10(4):233-238.

Higgins DN, Tierney J, Lins M, Hanrahan L [2004]. School Nurses: A Resource for Young Worker Safety, J Sch Nur 20(6):317-323. (The Editor's publication notification letter indicates that the article was sent to the 12,000 members of the National Association of School Nurses.)

Tierney JM, Higgins DN, Hanrahan LP, Washburn MJ [2003]. Preventing Youth Worker Fatalities [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: http://www.cdc.gov/niosh/noirs/noirsmain.html.

Higgins D, Tierney J, Hanrahan L [2002]. Preventing youth worker fatalities: the Fatality Assessment and Control Evaluation (FACE) Program, AAOHN 50(11):508-514.

Higgins DN, Casini VJ, Bost P, Johnson W, Rautiainen R [2001]. The Fatality Assessment and Control Evaluation program's role in the prevention of occupational disease, Injury Prevention 7(Suppl I):i27-i33.

Examples of external articles by State-based authors:

Hallman EM, Gelberg KH, and Hallisey JL. A NY FACE Case Study: Dairy Farm Owner Dies during Manure Pump PTO Entanglement, Journal of Agromedicine, 2005; Vol 10(3).

Chester DA, Hanna EA, Pickelman BG, Rosenman KD. Asthma death after spraying polyurethane, American Journal of Industrial Medicine, Volume 48, Issue 1, Date: July 2005, Pages: 78-84.

MN FACE [2004]. Summertime Baling: A Time of Increased Risk on Minnesota Farms. Southwest Minnesota Farmer, Vol 1 (15), 2004.

IA FACE [2003]. Investigating a Fatal Tree Shear Incident. Arbor Age, April 2003.

Intermediate Outcomes:

- A packet containing a sample of four crane-related FACE reports and a page from the NIOSH Alert, "Preventing Electrocutions of Crane Operators and Crew Members Working Near Overhead Powerlines" was mailed to approximately 4,600 crane rental and crane service establishments across the nation. The packet described crane-related injury risks and steps employers can take to prevent worker death and injury. Recipients were encouraged to use these materials for training purposes, toolbox talks, and as support for safety program development. A crane rental company requested over 100 copies to issue with each crane rented. A construction contractor who requested multiple copies praised the packet as the most useful safety tool he ever received from the government. "I had heard about the accidents, but didn't know the causes. I will circulate the publication among my employees who work with cranes. It will give us an opportunity to discuss crane safety using real life examples. I am sure my employees will find it as fascinating as I did."

- During 2000 and 2001, NIOSH received five reports of worker death associated with excavators or backhoe loaders as part of the Fatality Assessment and Control Evaluation (FACE) program. These incidents involved two fatal injury scenarios: being struck by the moving machine or by swinging booms and buckets; or, being struck by quick-disconnect excavator buckets that unexpectedly detached from the excavator**.** In response to these incidents, NIOSH developed a Workplace Solution entitled *Preventing Injuries and Deaths When Working With Hydraulic Excavators and Backhoe Loaders*. The Association of Equipment Manufacturers provided NIOSH with an international mailing list with over 200 entries for dissemination purposes. Several OSHA regional offices that are focusing on hazards associated with excavators and backhoes have requested copies for distribution. Much of the information in this Workplace Solution was derived from the FACE reports.

- Mr. Craig Lekutis, President, Wireless estimator.com developed an article on the use of NIOSH telecommunication tower-related FACE reports as training aids for the wireless industry. Wireless Estimator.com is a free internet service for the wireless industry. The article provided links to the FACE reports and can be found at: http://www.wirelessestimator.com/breaking_news.cfm.

- Sarah Sanders Smith, Assistant Professor of Organizational Leadership & Supervision, Purdue University North Central contacted the In-house FACE project officer and said that she is developing for Purdue University an Occupational Safety and Health training program that will establish Purdue University as the educational center for Occupational Safety and Health in the state of Indiana. She is using the NIOSH page in general and the FACE program in particular in the development of this program. The FACE program and the FACE reports and other FACE materials such as Workplace Solutions and Alerts will be used as a basis for training modules and in the development and establishment of prevention strategies for this program.

- Ms. Ellen Parson, contributing Editor for *American Reconstruction* Magazine, a new periodical aimed at contractors performing reconstruction after demolition efforts and/or after natural disasters, interviewed the FACE project officer. A discussion was held on the use of portable generators (electrical and CO hazards), the use of rough-duty extension cords, and the importance of treating all conductors as energized unless they have been verified as de-energized. Ms. Ayrd also wanted information on the FACE program, and liked the FACE reports written after the electrocutions investigated in Puerto Rico following Hurricane Hugo. Ms. Ayrd said she would reprint these reports in the magazine along with other relevant reports. The first few issues of the magazine will contain information from the NIOSH and FACE web pages. The first article entitled “The Shocking Truth—Beware of Electrical Hazards” was published in the July 2006 issue (http://www.ecmweb.com/).
- In a study funded by CPWR using NIOSH grant funding, Michael Behm from East Carolina University analyzed fatality reports from FACE investigations and linked them back to the design-for-safety concept (Linking construction fatalities to the design for construction safety concept, Behm M, SAFETY SCIENCE , 43 (8): 589-611 OCT 2005). FACE cases were used to assess the potential of designing safety into construction projects.

- NIOSH has received feedback on a number of ways in which stakeholders use FACE findings and recommendations to educate employers, workers and the public about work hazards and prevention measures. For example, the Occupational Safety and Health Administration, the American Bureau of Crane Inspection, Inc., West Virginia University, North Carolina State University, and trade associations report using the materials for training. Publications such as Technical Rescue, based in the United Kingdom, reprint FACE reports.

Outcomes:

Availability:

Complete web access to all reports is available.

Restrictions on Access:

There are no restrictions on access to the FACE reports. Interested parties may enter their email address into the listserv on the webpage and will then be electronically notified by email when a new report is posted on the webpage.

Name of Surveillance System or Dataset:

Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) database

Owner/Manager/Contact:

Contact: Steven Proudfoot, Division of Safety Research (DSR)

Description/Scope:

Three separate databases contain information collected during fire fighter traumatic injury investigations. The primary dataset contains information regarding the incident, the victim, and the fire department. Two supplementary datasets hold detailed information related to structure fires and motor vehicle incidents.

Used in conjunction with individual incident reports, the database helps provide information for developing broad-based recommendations and supplemental documents (Alerts, Workplace Solutions, and Fact Sheets) for fire fighter injury prevention programs. Personal and fire department identifiers are not included in the database.

Major Analyses Undertaken:

Analysis of civilian occupancy in burning structures, in support of a NIOSH Alert and a journal manuscript authored by ASPH fellow. Analysis of motor vehicle-related incidents for NIOSH Alert.

Outputs *(descriptive report, article, methodology, etc.)***:**

Annual reports, 2001-2003, disseminated on the FFFIPP website.

Intermediate Outcomes:

A special tabulation of firefighter fatalities in which self-contained breathing apparatus was worn by the victim was performed at the request of the National Fire Academy.

A special tabulation of motor vehicle incidents regarding the age of the fire department apparatus involved in crashes was run for a National Fire Protection Association committee meeting.

A firefighting.com article, “What Happens If We Confuse Our Survival Instincts?” written by Jerry Smith, a former Los Angeles City Fire Captain and California Governor's Office of Emergency Services Fire & Rescue Division Assistant Chief, used data from the 2002 annual report. (http://www.firefighting.com/articles/namFullView.asp?namID=9126)

Anecdotal information has been received from fire service stakeholders related to documents that use data from the NIOSH FFFIPP databases, including information on reader response cards to NIOSH publications:

"I find the NIOSH Reports and Alerts on fire fighter deaths very informative. We utilize the information to change attitudes."

"Thank you very much. Very informative and easy to be used in our training program."

Outcomes:

Availability *(e.g., raw data or summary data; Web access, electronic access, hardcopy access; etc.)***:**

SAS datasets

Restrictions on Access:

NIOSH/DSR employees only.

Name of Surveillance System or Dataset: National Agricultural Workers Survey (NAWS)

Owner/Manager/Contact:

Owner: U.S. Department of Labor, Education and Training Administration (USDOL, ETA)

Manager: John Myers, NIOSH, DSR

Contact: John Myers, NIOSH, DSR

Description/Scope:

The NAWS is an annual survey conducted by USDOL, ETA to collect demographic, economic, and work history information on crop farmworkers in the U.S. NAWS collects these data using a large probability sample of all farmworkers across the U.S. Over 75 percent of these workers are seasonal, migrant, or both. NIOSH, through an interagency agreement with USDOL, has incorporated a farm injury module into the NAWS. The module collects basic information on: the nature of injury; the body part injured; the type of work being performed that lead to the injury; the source of the injury; and what; if any medical treatment was received. NAWS injury data are available for the years 1999 and 2001 through 2004.

Major Analyses Undertaken:

The 1999 NAWS injury data have been analyzed. Estimates for demographics and injuries have been produced at the national levels. Data from this analysis have been released within one NIOSH publication and at several conferences (See "Outputs" for citations). Analyses of the 2001-2004 NAWS injury data are ongoing.

Outputs (descriptive report, article, methodology, etc.):

NIOSH Numbered Document:

NIOSH. [2004]. Worker Health Chartbook, 2004. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication 2004-146. (Pages 195-211 of this publication contain agricultural data developed in part from the NAWS).

Presentations:

Myers JR. [1999]. Work-related injuries among hired, non-family farm workers. The Dynamics of Hired Farm Labor: Constraints and Community Response, October 25-26, 1999, Concordville, PA.

Myers JR. [2000]. Work-related injuries among hired, non-family farm workers. Agricultural Safety and Health in a New Century, April 28-30, 2000, Cooperstown, New York.

Myers JR. [2000]. Comparison of farmworker injury and fatality experiences to all U.S. workers. Presented at the 13th Annual East Coast Migrant Stream Forum, Double Tree Hotel, Philadelphia, PA, November 3-5, 2000.

Intermediate Outcomes: None to report.

Outcomes: None to report.

Availability (e.g., raw data or summary data; Web access, electronic access, hardcopy access; etc.):

A hardcopy of the basic 1999 NAWS results are available as part of the NIOSH 2004 chartbook (see "Outputs" for citation). A hard copy of the 2001-2004 NAWS should be available in 2008. Special data requests are available through USDOL, ETA and NIOSH. Electronic versions of the data are not currently available, but are being developed.

Restrictions on Access:

Under the terms of the interagency agreement between NIOSH and USDOL, ETA, ownership of the NAWS is retained by USDOL, ETA. The injury module is not currently available in electronic form. Rules for electronic access to the NAWS injury module are in process. Special data runs are available to users through USDOL, ETA and NIOSH by submitting a written request for summary data.

Name of Surveillance System: National Electronic Injury Surveillance System for Occupational Injuries and Illnesses (NEISS-Work)

Owner/Manager/Contact:

Owner: U.S. Consumer Product Safety Commission and NIOSH

Manager/Contact: Larry Jackson, NIOSH, Morgantown, WV; (304) 285-5980, LLJackson@cdc.gov

Description/Scope:

NEISS is a national stratified probability sample of hospitals in the U.S. and its territories that have a minimum of six beds and that operate a 24-hour emergency department. Hospitals in the sample were selected from the approximately 5,300 rural and urban U.S. hospitals after stratification by total annual emergency department visits. Nominally, 67 geographically distributed sample hospitals capture work-related injuries and illnesses every day of the year (note: the occupational injury hospital sample is a subset (2/3) of the hospital sample used by CPSC for capture of product-related injuries). All treated cases that are identifiable as work-related are captured and information is abstracted from the medical record. Each case is assigned a statistical weight based on the inverse probability of selection. National estimates are obtained by summing weights for all cases or particular cases of interest. Statistical weights are adjusted within a sample year to account for hospital mergers, hospital closings or withdrawal from NEISS (i.e., less than 67 hospitals reporting information), and incomplete reporting. Statistical weights are adjusted annually based on the number of U.S. hospitals and their total number of ED visits as determined by the most recent census of U.S. hospitals.

NEISS case definition:

Medical: Nonfatal injuries and illnesses treated in an emergency department.
Population: Civilian non-institutionalized workers.
Work: Doing work for pay or other compensation, including arriving or leaving work but on the employer's premises, during transportation between locations as a part of the job (excluding commuting to or from home); doing agricultural production activities; and working as a volunteer for an organized group (e.g., volunteer fire department).
Demographics: All workers without restriction by age, type of employer or industry (e.g., self-employed, private industry, or government), or employer size.
Case exclusions: Injuries or illnesses to active duty Military, National Guard, and State Militia; injuries or illnesses to institutionalized persons including prisoners or mental health patients; common illnesses (e.g., colds and flu); routine drug and alcohol screening; and revisits to the same ED for a previously treated injury or illness.

Uniform NEISS-Work data for all work-related injuries and illnesses are available for analysis from 1998 through the present. Other NEISS-Work data are available prior to the 1997 sample design change based on varying collection criteria: 1981-1987 and 1992-1997.

Major Analyses Undertaken:

Overall summaries of work-related ED-treated injuries and illnesses
- Young and older worker injuries
- Injuries among African-American women
- Injuries among emergency responders
- Injuries among youth on farms
- Violence-related injuries
- Bloodborne pathogen exposures
- Fall-related injuries
- Inhalation injuries
- Eye injuries
- Hospitalized injuries

Outputs:

Marsh S, Derk S, Jackson L, 2006. Nonfatal occupational injuries and illnesses among workers treated in hospital emergency departments--United States, 2003: *MMWR Morb Mortal Wkly Rep*, April 28, 2006/ 55(16)/449-52. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5516a2.htm

Layne LA, Pollack KM 2004. Nonfatal occupational injuries from slips, trips, and falls among older workers treated in hospital emergency departments, United States 1998: *Am J Ind Med*; 46:32-41.

Mardis AL, Pratt SG, 2003. Nonfatal injuries to young workers in the retail trades and services industries in 1998: *J Occup Environ Med*; 45(3):316-323.

Jackson LL, 2001. Non-fatal occupational injuries and illnesses treated in hospital emergency departments in the United States: *Inj Prev*; 7(Suppl I):i21-26.

Jackson LL, 2001. Nonfatal occupational injuries and illnesses treated in hospital emergency departments--United States, 1998. *MMWR Morb Mortal Wkly Rep*, April 27, 2001/ 50(16)/313-7. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5016a3.htm

Chen GX, Hendricks KJ, 2001. Nonfatal occupational injuries among African-American women by industrial group: *J Safety Res*; 32:75-84.

Henneberger PK, Metayer C, Layne LA, Althouse R, 2000. Nonfatal work-related inhalations: surveillance data from hospital emergency departments, 1995-1996: *Am J Ind Med*; 38:140-148.
Hendricks KJ, Layne LA, 1999. Adolescent occupational injuries in fast food restaurants: an examination of the problem from a national perspective: *J Occ Environ Med*; 41(12):1146-1153.

Chen GX, Layne LA, 1999. Where African-American women work and the nonfatal work-related injuries they experienced in the U.S. in 1996, compared to women of other races: *Am J Ind Med*; Suppl. 1:34-36.

CDC, 1998. Youth agricultural work-related injuries treated in emergency departments--United States, October 1995-September 1997: *MMWR Morb Mortal Wkly Rep*; September 11,1998, 47(35):733-7. http://www.cdc.gov/mmwr/preview/mmwrhtml/00054662.htm

CDC, 1998. Surveillance for nonfatal occupational injuries treated in hospital emergency departments--United States, 1996: *MMWR Morb Mortal Wkly Rep*, April 24, 1998, 47(15):302-6. http://www.cdc.gov/mmwr/preview/mmwrhtml/00052225.htm

Layne LA, Landen DD, 1997. A descriptive analysis of nonfatal occupational injuries to older workers, using a national probability sample of hospital emergency departments: *J Occup Environ Med*; 39(9):855-865.

Castillo D, Rodriguez R, 1997. Follow-back study of oldest workers with emergency department-treated injuries: *Am J Ind Med*; 31:609-618.

Knight EB, Castillo DN, Layne LA, 1995. A detailed analysis of work-related injury among youth treated in emergency departments: *Am J Ind Med*; 27:793-805.

Layne LA, Castillo DN, Stout N, Cutlip P, 1994. Adolescent occupational injuries requiring hospital emergency department treatment: a nationally representative sample: *Am J Public Health*; 84(4):657-660.

CDC, 1983. Occupational finger injuries–United States, 1982: *MMWR Morb Mortal Wkly Rep*; 32(45):589-591. http://www.cdc.gov/mmwr/preview/mmwrhtml/00000174.htm

Coleman PJ, Sanderson LM, 1983. Surveillance of occupational injuries treated in hospital emergency rooms–United States, 1982: *MMWR Surveil Summ*; 32(2SS):31SS-37SS. http://www.cdc.gov/mmwr/preview/ind83_ss.html

Intermediate Outcomes:

NEISS-Work data have been used to support recommended changes to US Department of Labor Hazardous Orders for Young Workers.

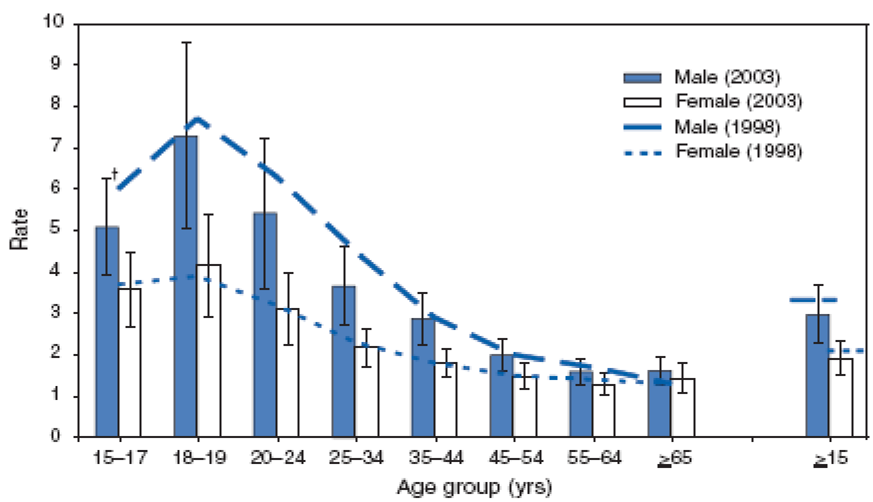
The NIOSH Work-RISQS public query site has been used by external researchers as the sole data source to produce a peer-reviewed journal article (Xiang H, Stallones L, Chen G, Smith GA, 2005. Work-related eye injuries treated in hospital emergency departments in the US: Am J Ind Med; 48:57-62).

Through the use of NEISS data on occupational eye injuries, there has been a significant increase in awareness of work-related safety issues and the magnitude of these injuries in the workplace. Based on NEISS results there has been recognition that about 2,000 work-related eye injuries are treated daily in the U.S. (a doubling of previous estimates). Our work has supported eye safety efforts by Prevent Blindness America, the ANSI Z87 Eye and Face Protection Committee, and, in particular, the National Eye Institute's Healthy Vision Month, May 2006 occupational eye safety campaign (www.healthyvision2010.org/hvm and http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5520a9.htm).

Outcomes:

The NEISS data can be used to track progress in reducing nonfatal occupational injuries over time. Although the NEISS data include occupational illnesses, injuries predominate. The overall number and rate of occupational injuries and illnesses has not changed substantially since 1998, the earliest year with consistent NEISS work data. In 2003, age-, sex-, and diagnosis-related patterns of injury and illnesses among workers treated in EDs (ED-treated injuries/illnesses) were similar to those in 1998 (see Figure 1 from Nonfatal Occupational Injuries and Illnesses Among Workers Treated in Hospital Emergency Departments --- United States, 2003; MMWR April 28, 2006/ 55(16);449-452; available at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5516a2.htm).

FIGURE 1. Estimated rates* of nonfatal occupational injuries and illnesses among workers treated in hospital emergency departments, by age group and sex of worker — United States, 1998 and 2003



* Per 100 full-time equivalent (FTE) workers; one FTE = 2,000 hours worked per year and includes hours for all jobs worked by a person.
† 95% confidence interval (CI). CIs not shown for 1998 but similar in magnitude to CIs for 2003.

Two objectives for Healthy People 2010, reducing young worker and occupational eye injuries, rely on NEISS-Work data for tracking of progress over the decade. Healthy People 2010 includes an objective to reduce youth emergency department injury rates to 3.4 injuries/100 fulltime equivalents by 2010. The rate in 2003 was 4.4. injuries/100 full-time equivalents. The Healthy Vision 2010 objective on reducing occupational eye injuries treated in emergency departments has a goal of a 30% reduction in the eye injury rate from a 1999 baseline rate of 21.0 to the target of 14.7 injuries per 10,000 full-time workers.

Availability:

NEISS microdata files are available electronically for authorized internal data users. Public access is available for tabular results through NIOSH's Work-Related Injury Statistics Query System (Work-RISQS at http://www2a.cdc.gov/risqs). Two data years are currently available at Work-RISQS. More data years will be available in the near future. Tabular results for studies of limited scope are also available to the public including external researchers upon request to the Division of Safety Research Surveillance and Field Investigations Branch.

Restrictions on Access:

NEISS-Work data are protected primarily by the U.S. Consumer Product Safety Act and the Privacy Act. Microdata access is restricted to authorized NIOSH staff (permanent and temporary), qualifying guest researchers (on-site only), and contractors who comply with the DSR Confidentiality Program requirements. Censored tabular results are provided through Work-RISQS and upon request to the Division of Safety Research Surveillance and Field Investigations Branch.

Name of Surveillance System or Dataset: National Traumatic Occupational Fatalities (NTOF) Surveillance System

Owner/Manager/Contact:

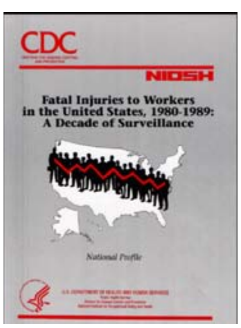
- Data Owner: NIOSH, Division of Safety Research
- Manager: Suzanne Marsh, NIOSH, Division of Safety Research
- Primary Contact: Suzanne Marsh, NIOSH, Division of Safety Research

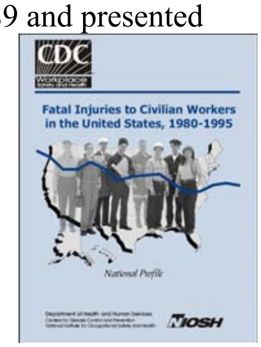
Description/Scope:

Accurate reporting of workplace fatalities is a critical component for determining prevention priorities. Prior to the 1980s, however, no systematic national data collection of traumatic occupational fatalities existed. Recognizing this gap and the disparity in existing estimates, NIOSH began collecting fatality surveillance data through the NTOF surveillance system in the mid 1980s to gain a better understanding of the most severe work-related injuries. NIOSH developed NTOF by collecting death certificates from state vital registrars in all 50 states, New York City, and the District of Columbia. Death certificates were included if the decedent was 16 years of age or older; if the death was an external cause based on the International Classification of Diseases, Ninth Revision (1980-1998) or the international Classification of Diseases, Tenth Revision (1999-2001); and there was a positive response to the “Injury at work?” item. Demographic, industry, occupation, and circumstances of death were abstracted for fatalities occurring from 1980 through 2001. Through the NTOF, NIOSH provided for the first time a uniform surveillance system of work-related injuries for all industries. This collection of death certificates filled a critical data need in identifying and understanding workplace fatalities.

Major Analyses Undertaken:

Although many analyses conducted over the last 20 years have included NTOF data, major analyses have included three comprehensive analyses of NTOF, tractor-related fatalities, homicides, fatalities involving young workers, and falls from elevation.
Three comprehensive analyses were conducted on the NTOF data and published as NIOSH publications. The first publication, released in 1989, included 6 years of data (1980-1985) and presented text and graphs to describe fatalities by type, sex, age, state of death, industry, and occupation. To compare state experiences, the document also presented state fatality rates by industry. A second publication, released in 1993, extended the initial analysis to include data from 1986 through 1989 and presented summary data by cause of death. This document provided a more comprehensive summary of fatal occupational injuries for the U.S. and examined the patterns of work-related injury fatalities in each state. Yet a third publication, released in 2001, presented data from 1980-1995. Unlike the first two publications that included graphs and text that interpreted the graphs, this third document presented detailed data in tabular format in an effort to provide the occupational safety and health community with direct access to





the NTOF data. Data from all three were cited in various news releases and were widely publicized by NIOSH. These publications also directed NIOSH and others to areas where more detailed research was needed.

Analyses of agriculture-related fatalities from NTOF have directed many of the projects that NIOSH has conducted, especially in the area of tractor safety. A 1989 analysis of NTOF agriculture-related deaths was one of the first NIOSH efforts to report that farm tractors caused, by far, the largest number of deaths (Table 1).

Table 1. Machinery-related Agricultural Deaths by Machine Type, 1980-1985
(Source: NIOSH NTOF)

Machine Type	Deaths
Farm Tractor	924
Other Agriculture Machines	483
Lifting Machines	39
Earthmoving Machines	29
Other Specified Machine	36
Unspecified Machines	14

This initial study and numerous subsequent reports clarified the magnitude of tractor-related fatalities and set the course for much of the NIOSH research that followed. NIOSH and others have devoted much research to developing rollover protective structures (ROPS) to prevent a high proportion of the farm fatalities.

In the late 1980s, descriptive analyses on NIOSH's NTOF surveillance system identified homicides as a leading cause of work-related injury death in the U.S. This national recognition formed the basis of NIOSH's efforts that began in the early 1990s to address this serious public health problem. NIOSH convened a panel of experts in 1990 to discuss the findings from NTOF and gather input on priorities for strategies to reduce the number of workplace homicides. The results of these discussions were published in a 1992 NIOSH document entitled Homicide in US Workplaces: A Strategy for Prevention and Research (DHHS (NIOSH) Publication No. 92-103).


HOMICIDE IN U.S. WORKPLACES:

A STRATEGY FOR PREVENTION AND RESEARCH

Project Officers: Catherine A. Bell and E. Lynn Jenkins

This report summarizes the deliberations of participants of a workshop on occupational homicide prevention that was held in Washington, DC on July 23-24, 1990. The workshop and this report were sponsored by the National Institute for Occupational Safety and Health.

This report was transcribed and edited by Mary Ann Fenley, Fenley Communications, under Purchase Order [illegible]

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Safety Research
Morgantown, WV 26505

September 1992

After these initial discussions, the homicide data from NTOF were analyzed in greater detail and published in a 1993 NIOSH Alert entitled Request for Assistance in Preventing Homicide in the Workplace (DHHS (NIOSH) Publication No. 93-109). Publicized as the most extensive study on workplace homicides at that time and one of the first to offer definitive prevention measures, the Alert provided background information and detailed data from NTOF, a discussion of risk factors, and recommended prevention measures. Although there were other subsequent reports on homicides, the most significant of these included an analysis of homicides by detailed industry and occupation.

An additional landmark analysis conducted by NIOSH in the early 1990s was an analysis of young worker deaths. Based on the finding that the full-time equivalent rate for workers 16-17 years old was similar to the rate for adults, the authors concluded that improved enforcement of and compliance with federal and child labor laws and more education were needed to address the high fatality rate among youth. These findings prompted a 1995 NIOSH Alert entitled Request for Assistance in Preventing Deaths and Injuries of Adolescent Workers which included the results of an analysis of NTOF data. These early analyses fueled new partnerships as NIOSH began working closely with safety and health officials, researchers and advocacy groups to improve the safety of young workers.

Finally, in 2000, NIOSH conducted a comprehensive analysis of fatal falls from elevation, which was a component of a NIOSH monograph on preventing fatal falls from elevation. Comprehensive analyses of NTOF data complemented analyses of data from fatality investigations and individual case fatality reports.

Outputs *(descriptive report, article, methodology, etc.)***:**

The primary output from this project is the NTOF database that is accessible by researchers within NIOSH. Results from these data have been disseminated per specific requests for NTOF analyses and through NIOSH publications and scientific journals.

<u>NIOSH Publication Sub-category:</u>

CDC (1987). Traumatic occupational fatalities—United States, 1980-1984. MMWR 36(28):461-474, 469-470.

CDC (1994). Occupational injury deaths--United States, 1980-1989. MMWR43(14)262-264.

CDC (1994). Occupational injury deaths of postal workers--United States, 1980-1989. MMWR 43(32):587-595.

CDC (1998). Fatal occupational injuries—United States, 1980-1994. MMWR 47(15)/297-302.

CDC (1999). Achievements in Public Health, Improvements in Workplace Safety--United States, 1900-1999. MMWR 48(22)/461-469.

CDC (2001). Fatal occupational injuries—United States, 1980-1997. MMWR 50(16)/317-320.

NIOSH (1989). National traumatic occupational fatalities: 1980-1985. DHHS (NIOSH) Pub. No. 89-116.

NIOSH (1993). Fatal injuries to workers in the United States, 1980-1989: A decade of surveillance, national profiles. DHHS (NIOSH) Pub. No. 93-108.

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NIOSH (1993). NIOSH Alert: Preventing homicide in the workplace. DHHS (NIOSH) Pub. No. 93-109.

NIOSH (1994). Worker deaths in confined spaces: A summary of surveillance findings and investigative case reports. DHHS (NIOSH) Pub. No. 94-103.

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NIOSH (2004). Worker health chartbook, 2004. DHHS (NIOSH) Pub. No. 2004-146.

External Publication Sub-category:

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Intermediate Outcomes:

Since initiating the collection of data through the NTOF surveillance system in the mid 1980s, NIOSH has been a leader in improving knowledge on characteristics of occupational fatalities. Within NIOSH, the FACE program has relied heavily on NTOF data to select investigation priorities and support program recommendations. NTOF has also been frequently cited by NIOSH and others as evidence to support or influence more detailed analyses or direct specific safety research projects.

Although the NTOF surveillance data have led to a greater understanding of the industries and occupations at high risk and a greater public awareness of the causes and circumstances surrounding workplace fatalities, limitations inherent in conducting surveillance solely based on death certificates were well recognized. These limitations influenced the National Academy of Science Panel on Occupational Safety and Health Statistics' recommendation for development of a more comprehensive national fatality census (Pollack & Keimig, 1987). This led directly to the development of the Bureau of Labor Statistics' Census of Fatal Occupational Injuries (CFOI) system that became fully operational in 1992. After a decade of overlap, NIOSH discontinued the NTOF data collection at the end of 2001 and now uses the CFOI data for occupational fatality surveillance.

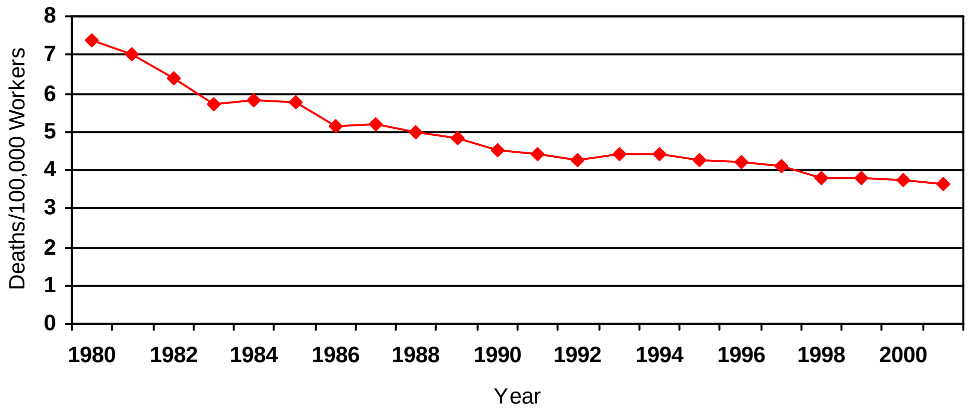
Outcomes:

OVERALL FATALITIES

In the mid 1980s, NIOSH initiated a systematic national collection of workplace fatalities through the National Traumatic Occupational Fatalities (NTOF) surveillance system. For the first time, NTOF provided a uniform surveillance system of work-related fatal injuries for all industries. NTOF successfully filled a critical data need by providing a measurement system for tracking outcomes and important data that many in NIOSH and elsewhere used to direct more detailed projects to address specific causes of death or high-risk worker groups.

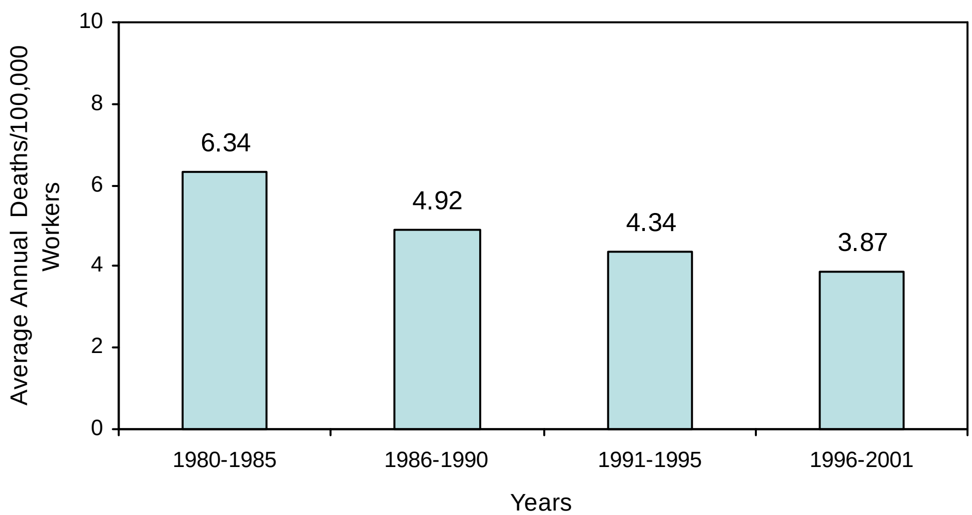
Work-related fatality rates in the U.S. have decreased 51% from 1980 through 2001 based on data from the NTOF surveillance system (Figure 1). The 6-year average fatality rate for the period 1996-2001 decreased 39% compared to the 6-year time period 1980-1985 (Figure 2).

Figure 1. Occupational Fatality Rates by Year
(Source: NIOSH NTOF 1980-2001)*



**Data for 2001 exclude deaths associated with September 11.*

Figure 2. Annual Average Fatality Rates for Four Time Periods Between 1980 and 2001 (Source: NIOSH NTOF)*



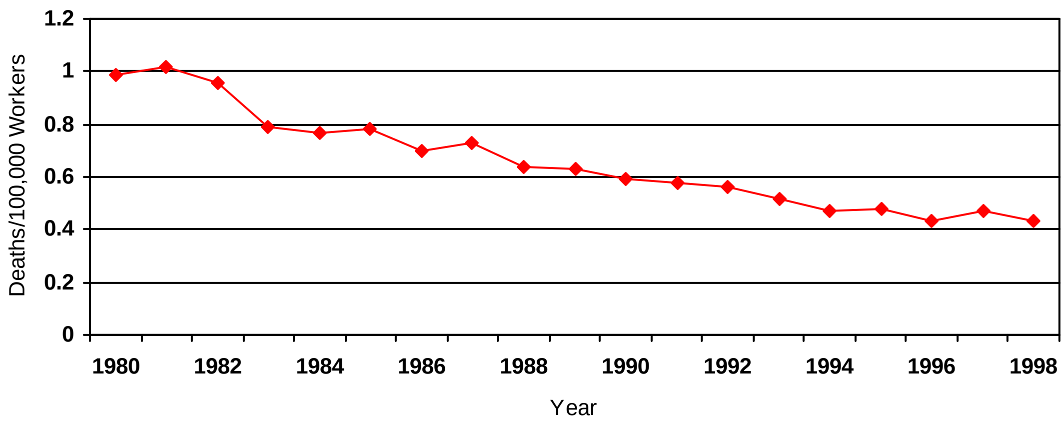
**Data for 2001 exclude deaths associated with September 11.*

MACHINES

NIOSH has been conducting research on machine safety since the early 1970s. With the introduction of the NTOF surveillance system, NIOSH was able to quantify the number of machine-related fatalities and the characteristics of the machines that caused many of the reported fatalities. These results helped stimulate and direct NIOSH's research on machine safety, especially in the agriculture industry.

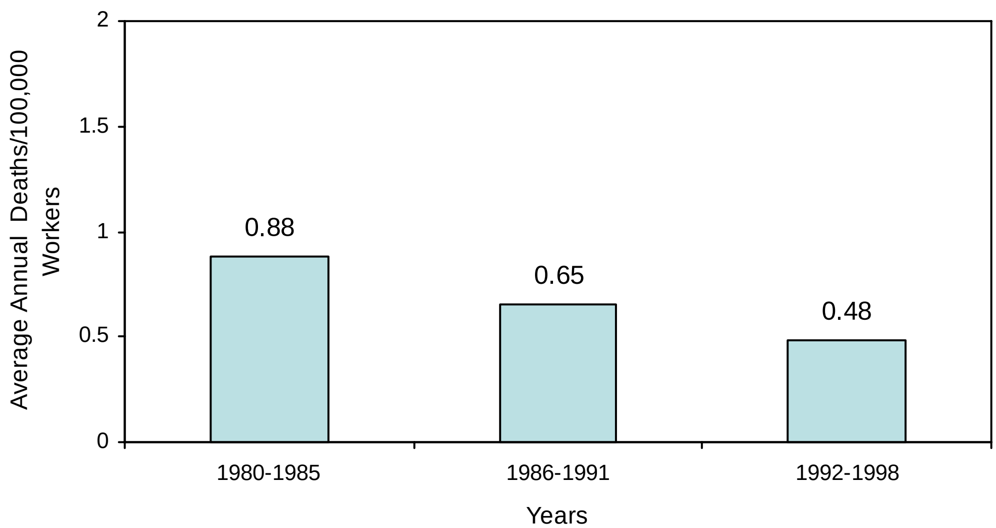
Work-related fatality rates for all machines have decreased 57% from 1980 through 1998 based on data from the NTOF surveillance system (Figure 3). The average fatality rate for machine-related deaths for the 7-year period 1992-1998 decreased 45% compared to the fatality rate for the time period 1980-1985 (Figure 4).

Figure 3. Occupational Fatality Rates for Machine-related Deaths (Source: NIOSH NTOF 1980-1998)*



**Because of significant inconsistencies in machinery codes assigned to the 1980-1998 and 1999-2001 data, data for the later years of NTOF are not presented.*

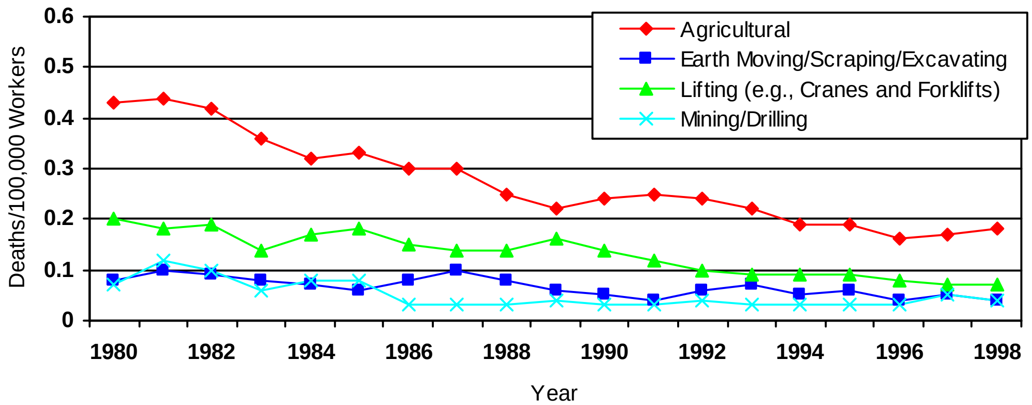
Figure 4. Annual Average Machine-related Fatality Rates for Three Time Periods Between 1980 and 1998 (Source: NIOSH NTOF)*



**Because of significant inconsistencies in machinery codes assigned to the 1980-1998 and 1999-2001 data, data for the later years of NTOF are not presented.*

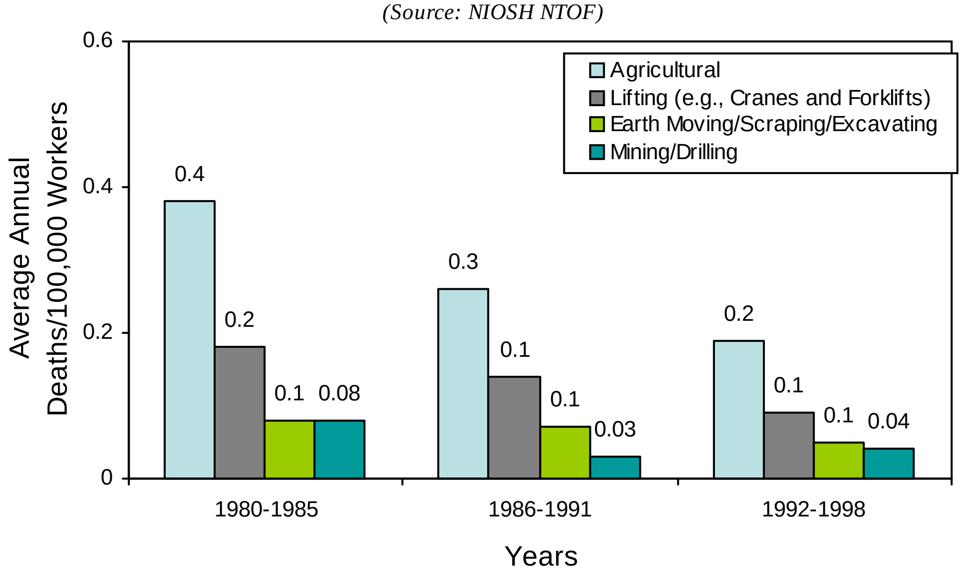
NTOF surveillance data enabled NIOSH researchers and others to establish research priorities for projects targeting specific machine types (e.g., tractors). From 1980 through 1998, rates for agricultural machinery-related fatalities decreased 58% (Figure 5). The fatality rates for selected machine types for the 7-year time period 1992-1998 decreased 38-50% compared to the rates for the 6-year time period 1980-1985 (Figure 6).

Figure 5. Occupational Fatality Rates for Machine-related Deaths by Selected Machine Types (Source: NIOSH NTOF 1980-1998)*



**Because of significant inconsistencies in machinery codes assigned to the 1980-1998 and 1999-2001 data, data for the later years of NTOF are not presented.*

Figure 6. Changes in Annual Average Machine-related Fatality Rates by Selected Machine Types for Three Time Periods Between 1980 and 1998 (Source: NIOSH NTOF)*



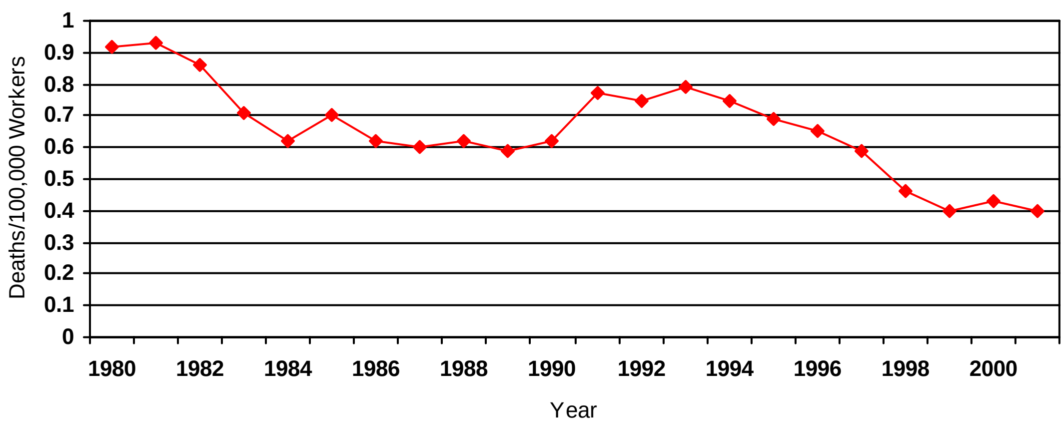
**Because of significant inconsistencies in machinery codes assigned to the 1980-1998 and 1999-2001 data, data for the later years of NTOF are not presented.*

HOMICIDES

In the late 1980s, NIOSH's NTOF surveillance system identified homicides as a leading cause of work-related injury death in the U.S. This national recognition formed the basis of NIOSH's efforts that began in the early 1990s to address this serious public health problem. The NTOF data have supported and directed further research into the characteristics of homicides and provided an index for tracking improvements.

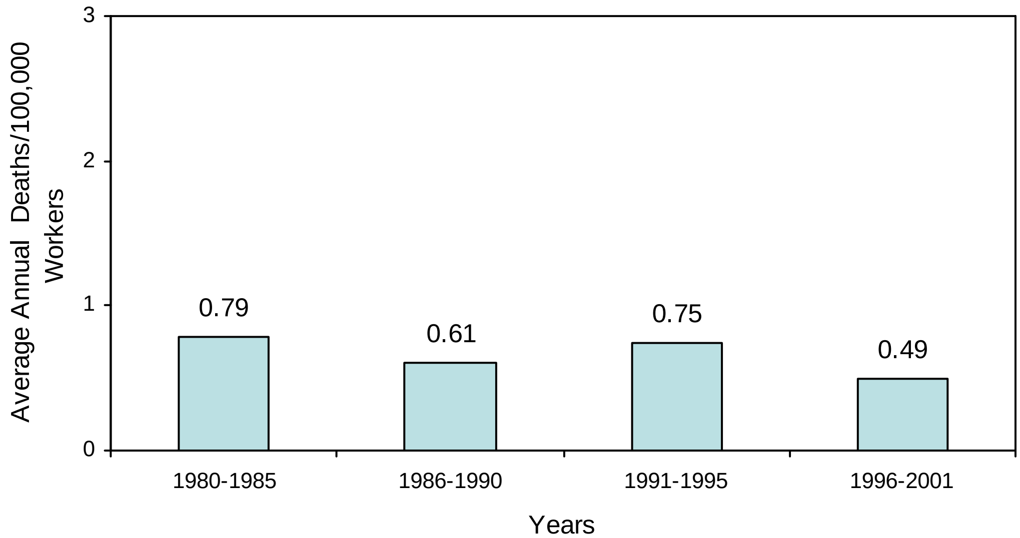
Work-related fatality rates for homicides have decreased 130% from 1980 through 2001 based on data from the NTOF surveillance system (Figure 7). The 6-year average fatality rate for the period after NIOSH began its focus on workplace homicides decreased 37% compared to the rate for the 6-year time period 1980-1985 (Figure 8).

*Figure 7. Occupational Fatality Rates for Homicide-related Deaths**
(Source: NIOSH NTOF 1980-2001)



**Data for 2001 exclude deaths associated with September 11.*

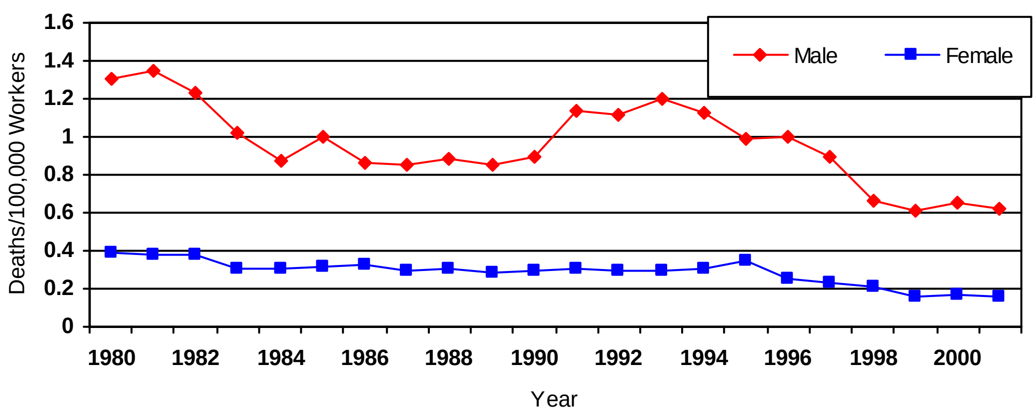
Figure 8. Annual Average Homicide Fatality Rates for Four Time Periods Between 1980 and 2001 (Source: NIOSH NTOF)*



**Data for 2001 exclude deaths associated with September 11.*

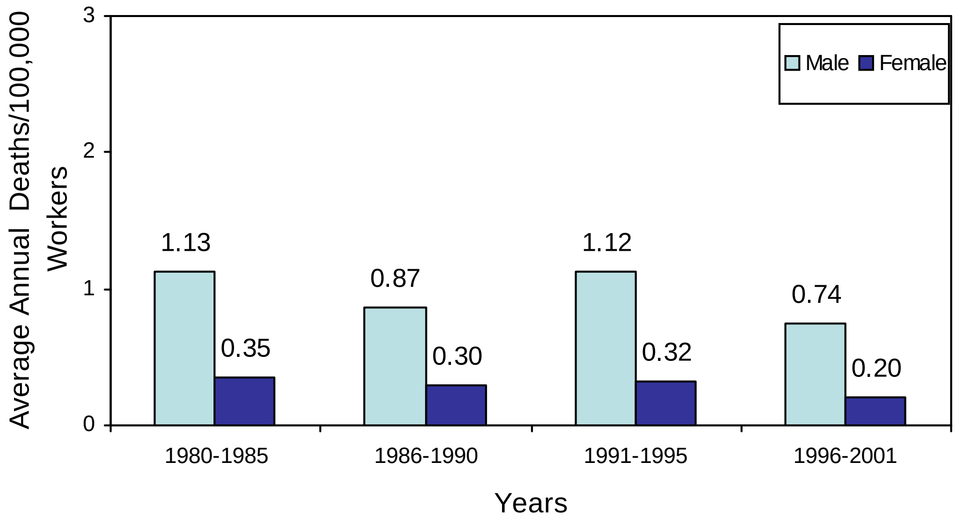
Although the majority of workplace homicides occurred to men, homicides were the leading cause of death among women. Fatality rates for homicides among women decreased 59% from 1980 through 2001 compared to a 53% decrease for men for the same period (Figure 9). The 6-year average fatality rate for the period after NIOSH began its focus on workplace homicides decreased 43% for women and 35% for men compared to the rates for the 6-year time period 1980-1985 (Figure 10).

Figure 9. Occupational Fatality Rates for Homicide-related Deaths by Sex (Source: NIOSH NTOF 1980-2001)*



**Data for 2001 exclude deaths associated with September 11.*

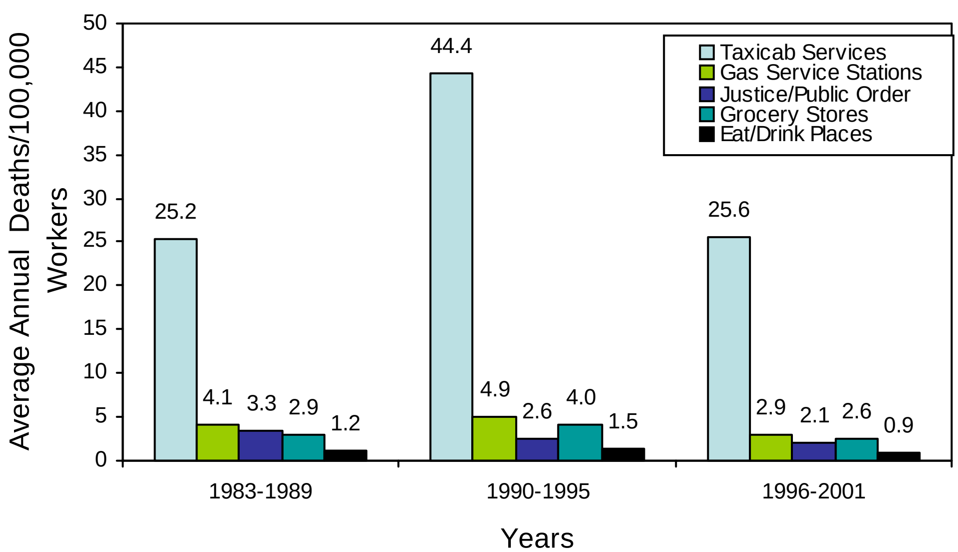
Figure 10. Annual Average Homicide Fatality Rates by Gender for Four Time Periods Between 1980 and 2001 (Source: NIOSH NTOF)



**Data for 2001 exclude deaths associated with September 11.*

NIOSH researchers identified five primary industries as having either a high number of workplace homicides or a high rate of homicides. The number and rate of fatality in all five industries (Taxicab Services, Gas Service Stations, Justice/Public Order Establishments, Grocery Stores, and Eating/Drinking Places) decreased for the period after NIOSH began its focus on work place homicides (Figure 11).

Figure 11. Annual Average Homicide Fatality Rates by Selected Industries for Three Time Periods Between 1983 and 2001 (Source: NIOSH NTOF)*

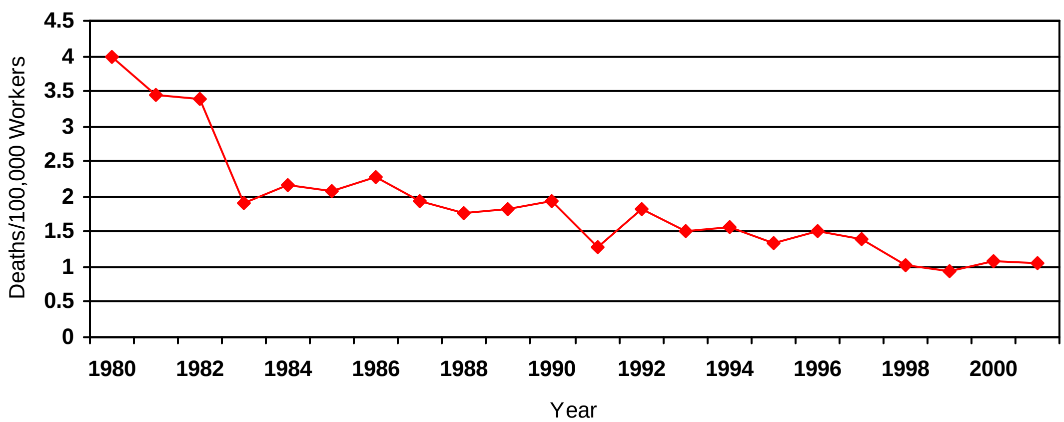


**Data for 2001 exclude deaths associated with September 11.*

YOUTH

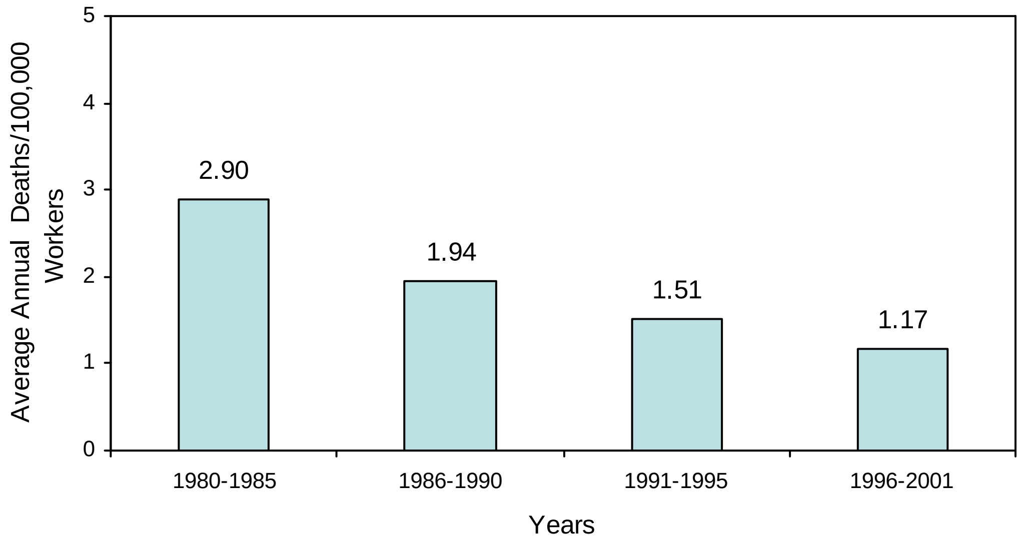
In the early 1990s, NIOSH researchers found that the risk of injury death for workers 16 and 17 was similar to that of adult workers aged 18 and older when comparing rates based on full-time equivalency. Because young workers are less likely to be employed in especially hazardous jobs, this finding raised concern within NIOSH and throughout the occupational safety and health community. NIOSH has worked closely with safety and health officials, researchers and advocacy groups to improve the safety of these young workers. Since 1980, work-related fatality rates for youth aged 16-17 years old have decreased 73% (Figure 12). The average fatality rate for workers aged 16-17 years old for the 6-year period 1996-2001 decreased 60% compared to the rate for the time period 1980-1985 (Figure 13).

*Figure 12. Occupational Fatality Rates for Workers Aged 16-17 Years Old**
(Source: NIOSH NTOF 1980-2001)



**Data for 2001 exclude deaths associated with September 11.*

Figure 13. Annual Average Fatality Rates for Workers Aged 16-17 Years Old for Four Time Periods Between 1980 and 2001 (Source: NIOSH NTOF)*

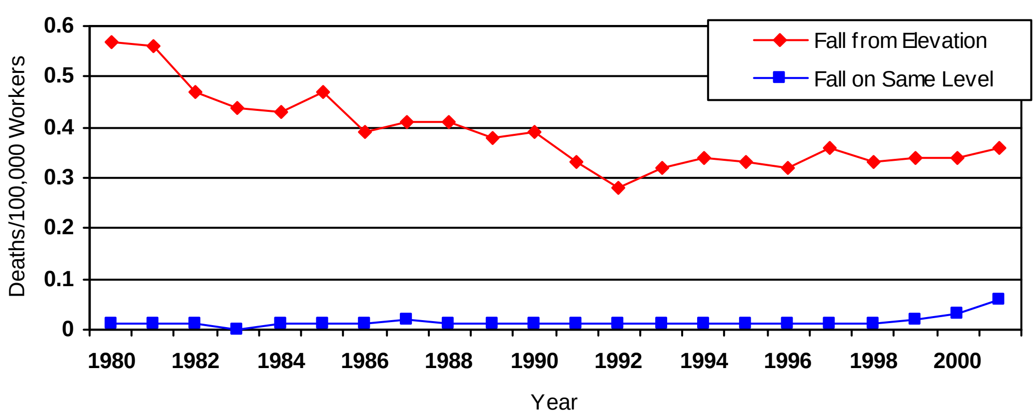


**Data for 2001 exclude deaths associated with September 11.*

FALLS FROM ELEVATION

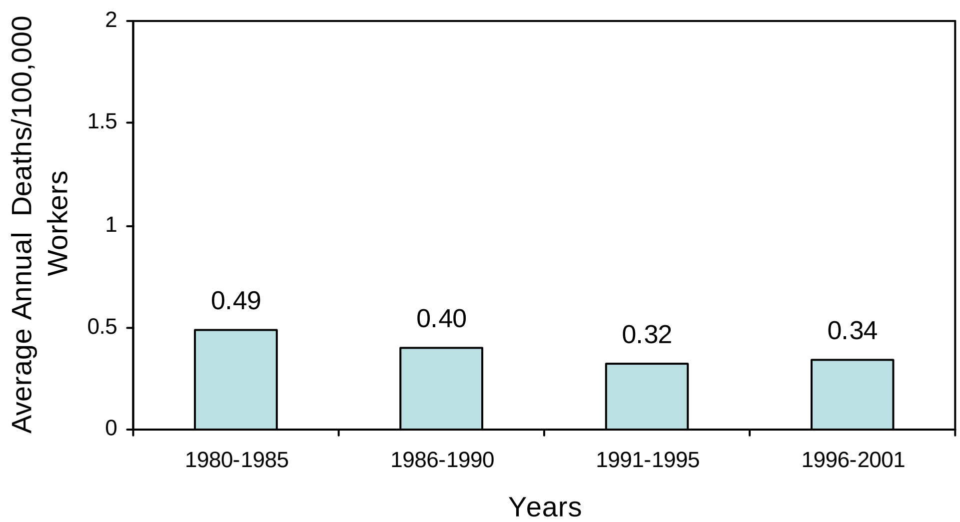
In the late 1980s, through the NTOF surveillance system, NIOSH identified falls as the fourth leading cause of work-related injury death in the U.S. The majority of work-related falls were from an elevation (e.g., ladders, scaffolding, or stairs or steps) (Figure 14). Fatality rates for falls from elevation have decreased 37% from 1980 through 2001 based on data from the NTOF surveillance system (Figure 14). The average fatality rate for falls from elevation for the period 1996-2001 decreased 31% compared to the rate for the time period 1980-1985 (Figure 15).

Figure 14. Occupational Fatality Rates for Fall-related Deaths by Fall Type (Source: NIOSH NTOF 1980-2001)*



**Data for 2001 exclude deaths associated with September 11.*

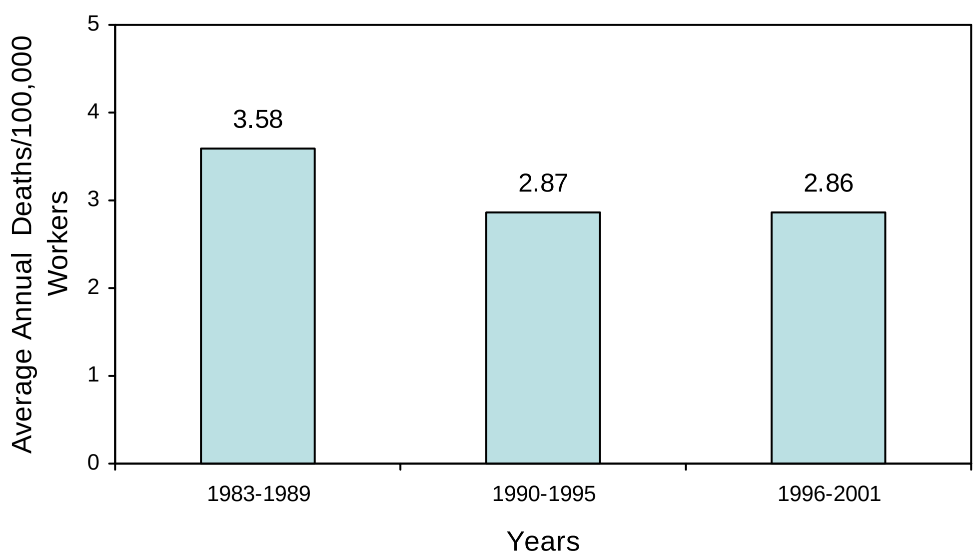
Figure 15. Annual Average Fatality Rates for Falls from Elevation for Four Time Periods Between 1980 and 2001 (Source: NIOSH NTOF)*



**Data for 2001 exclude deaths associated with September 11.*

NIOSH researchers identified workers in construction as having the highest risk of fatal falls from elevation. The rate of fatal falls from elevation in construction has decreased 20% since NIOSH began collecting NTOF data (Figure 16).

Figure 16. Annual Average Fatality Rates for Falls from Elevation by in Construction for Three Time Periods Between 1983 and 2001 (Source: NIOSH NTOF)*



**Data for 2001 exclude deaths associated with September 11.*

Availability *(e.g., raw data or summary data; Web access, electronic access, hardcopy access; etc.)***:**

Case-specific data from NTOF are only available to researchers within NIOSH. For NIOSH researchers who do not have direct access or for the general public, aggregated summary data are available upon request and through NIOSH publications, scientific journal articles, and conference presentations. NIOSH is currently finalizing a queriable public-use dataset.

Restrictions on Access:

NTOF data are protected by Section 308(d) of the Public Health Service Act. This Act prohibits release of case specific data and requires censoring of small cells. Case-specific data may only be accessed by NIOSH personnel who have an identified need and who have participated in annual confidentiality training and signed a data use agreement.

Name of Surveillance System or Dataset: Occupational Injury Surveillance of Production Agriculture (OISPA) and the Minority Occupational Injury Surveillance of Production Agriculture (M-OISPA)

Owner/Manager/Contact:

Owner: U.S. Department of Agriculture, National Agricultural Statistics Service (USDA, NASS).

Manager: John Myers, NIOSH, DSR

Contact: John Myers, NIOSH, DSR

Description/Scope:

OISPA and M-OISPA are periodic surveys conducted for NIOSH by the U.S. Department of Agriculture, National Agricultural Statistics Service (USDA, NASS) through an interagency agreement. OISPA and M-OISPA provide demographic and occupational injury information for farm operators and injury information for adults 20 years old or older who were directly hired to work on farms. Data is also collected on specific farm hazards such as farm tractors and All Terrain Vehicles. OISPA collects these data using a large probability sample of all farming operators in the U.S., while M-OISPA is based on a probability sample of all minority farm operators in the U.S. OISPA data are available for the years 2001 and 2004. M-OISPA data are available for the year 2003.

Major Analyses Undertaken:

The 2001 OISPA survey data have been comprehensively analyzed. Estimates for demographics and injuries have been produced at the national and regional levels. Data from this analysis have been released through a USDA publication (See "Outputs" for citation). Basic analyses of the 2003 M-OISPA and the 2004 OISPA surveys have been conducted. Detailed analyses of these two surveys are ongoing.

Focused analyses of OISPA data have been conducted to look at the changes over time in farm tractor demographics and Roll-Over Protective Structure (ROPS) use on farms; All Terrain Vehicle demographics on U.S. farms; and trends in occupational adult farm injuries over time. These results have or will be released through peer-reviewed journals, and a meeting proceedings (see "Outputs" for citations).

OISPA data has also been used by the external community to look at such topics as tractor use on farms, and the cost benefit of retrofitting ROPS on older tractors (see "Intermediate Outcomes" for details).

Outputs *(descriptive report, article, methodology, etc.)***:**

Results from OISPA analyses have been disseminated at a professional meeting, and through journal articles and a USDA, NASS fact sheet. A list of outputs follows:

Peer reviewed Journal Articles:

Myers JR. [2004]. It's time for change, one way or another. Journal of Agricultural Safety and Health 10(1):3-5.

Goldcamp E, Myers J, Hendricks K, Layne L, Helmkamp J. [2006]. Nonfatal All-Terrain Vehicle-Related Injuries to Youths Living on Farms in the United States, 2001. Journal of Rural Health 22(4):309-313. *(In press).*

USDA/NIOSH Fact Sheet:

USDA. [2004]. 2001 Adult agricultural–related injuries. Washington, DC: U.S. Department of Agriculture, National Agricultural Statistics Service, Sp Cr 9 (12-04).

Presentation:

Myers JR. [2003]. Tractor occupational safety and health update. In: Record of Tractor- Related Injury and Death Meeting. Pittsburgh, PA, February 13-14, 2003, pp. 5-23. Morgantown, WV: NIOSH.

Intermediate Outcomes:

The NIOSH OISPA has led to two intermediate outcomes to date:

1. Tractor data from the 2001 OISPA have been shared with Dr. Barbara Marlenga of the National Farm Medicine Center, Marshfield, Wisconsin. Dr. Marlenga used tractor prevalence data for an ergonomic evaluation of common tractors with and without ROPS for use by youth on farms. Dr. Marlenga's research is being done in collaboration with the NIOSH Agricultural Safety and Health Center located at the University of California-Davis.

2. Dr. Henry Cole at the University of Kentucky also is using OISPA tractor prevalence data from 2001 and 2004 for an economic analysis project of ROPS use on farms. The project includes analysis of tractor and ROPS use by hours worked, farming operation, and the need/feasibility of retrofitting ROPS to existing tractors. This project is part of a larger national NIOSH Agricultural Research Centers' tractor initiative in which NIOSH is also collaborating.

Outcomes:

OISPA and M-OISPA are components of the NIOSH agricultural initiative begun in 1990. These data have been used by NIOSH and stakeholders to guide research and prevention efforts, and track progress over time, using comparable data for the years 1993-1995 collected in an earlier NIOSH survey, the Traumatic Injury Surveillance of Farmers (TISF).

1. NIOSH nonfatal injury data collected in the Traumatic Injury Surveillance of Farmers (TISF) and the Occupational Injury Surveillance of Production Agriculture (OISPA) programs indicate that lost-time occupational injuries on farms decreased between the time period 1993-1995 and 2004. This decrease is collaborated by independent injury surveillance data maintained by the Bureau of Labor Statistics covering the same time period *(Figure 1)*.

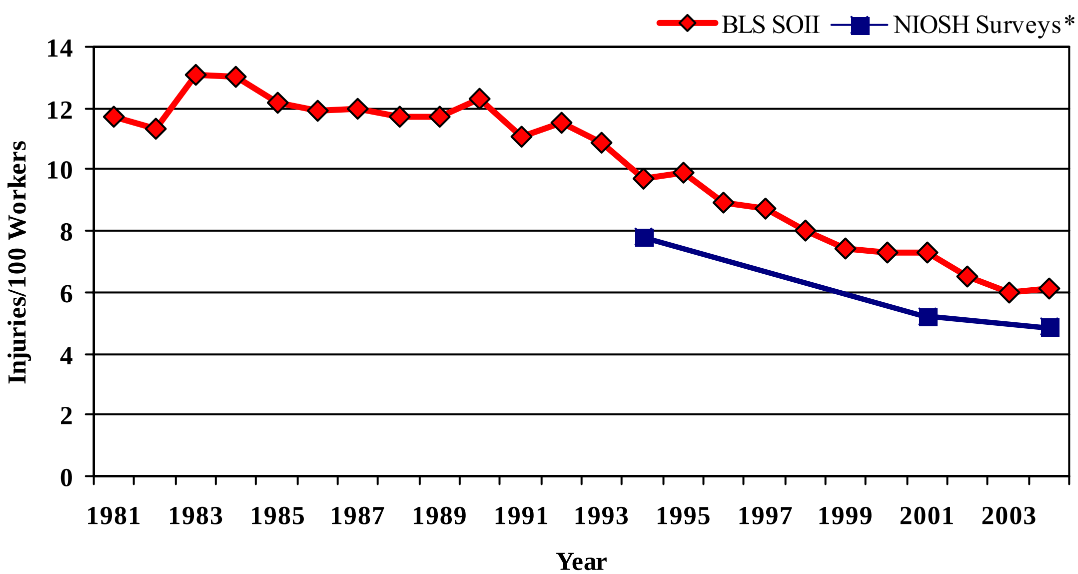


*Figure 1. Injury Rates per 100 Workers, 1980-2004 for the Production Agriculture Industry (**Source**: BLS Survey of Occupational Injuries and Illnesses, NIOSH Traumatic Injury Surveillance of Farmers, and Occupational Injury Surveillance of Production Agriculture).*

2. Roll-Over Protective Structures (ROPS) are special structures attached to farm tractors to prevent the tractor from crushing the operator during an overturn. ROPS represent the best method of preventing tractor overturn-related deaths on farms. The percentage of farm tractors used on U.S. farms fitted with a ROPS increased from 38% in 1993 up to 50% in 2001 *(**Source**: NIOSH Traumatic Injury Surveillance of Farmers, and Occupational Injury Surveillance of Production Agriculture).*

Availability *(e.g., raw data or summary data; Web access, electronic access, hardcopy access; etc.)***:**

A hardcopy of the 2001 OISPA will be available in 2007. A hard copy of the 2003 M-OISPA and 2004 OISPA will be available in 2008. Special data requests are available through USDA, NASS and NIOSH.

Electronic versions of the data are available from USDA, NASS (see "Restrictions on Access"). NIOSH is working with a contractor to make these data available via the web.

Restrictions on Access:

Under the terms of the interagency agreement between NIOSH and USDA, NASS, ownership of the OISPA and M-OISPA are retained by USDA, NASS. Access to electronic versions of these data requires users to apply to USDA, NASS for access. Approved users must agree to follow USDA, NASS data release requirements and to return data to USDA, NASS at the end of the project for which the use was granted. Special data runs are also available to users through USDA, NASS, following a similar application process.

Appendix 5: Laboratory Research Facilities

Name of Laboratory: Anthropometry Scanning Laboratory

Site/Location: H 1502

Description (narrative):

This laboratory is a 28 by 20 by 9 foot facility for the development of anthropometric databases of the working population. Research is focused on improving the ergonomic performance of safety equipment and industrial tools. Three laser scanning systems and a halogen-based system, as described below, are available for use in a wide variety of research applications.

The whole body scanner captures the shape and color of the entire human body. This scanner uses four scanning instruments mounted on two vertical towers to capture the intricacies of the human body. A platform structure supports the subject, while a separate frame provides alignment for the towers. A primary goal of the whole body scanner is to acquire an accurate computer model of the test subject in one pass. The whole-body scanner has a level of resolution of 3 mm and requires only 17 seconds to complete a whole body scan. The head and face scanner completes a scan of the head and face of live subjects quickly, comfortably, and safely. This scanner's high level of resolution—0.7 mm— provides increased accuracy for representation of facial features. This scan operates with a safe, low-intensity laser to create a lighted profile; a high-quality video sensor then captures the profile from two viewpoints. Because the system moves the digitizer while the subject remains stationary, this system works well in many applications involving subjects that are inconvenient to move during digitizing.

The hand and product scanner is used to produce surface images of hands, hand tools, and any other smaller objects that can fit in the scanner system's field of view. The hand- and product-imaging platform will provide accurate images of safety equipment, tools and tool components for the rapid development of prototypes. The platform adjusts quickly to accommodate subjects such as 1/5-scale automobile models and other objects whose digitized models will be input into CAD/CAM systems. The platform features both linear and cylindrical scan paths plus linear/cylindrical combinations. One motion system moves objects along the length of the motion platform while another motion system rotates the object. By combining scan data from these movements, one can get detailed scans of objects. The software gives the user interactive control of the entire digitizing process. Only moments after the digitizer has scanned the subject, the software allows the user to view the results. The user, therefore, gets immediate feedback on the quality of the digitized model.

The Inspeck scanner is a rapid-scanning, state-of-the-art 3D scanner, which uses a halogen light that is safe for human subjects. At this time, the halogen scanner is being used for hand scanning, to determine the geometry and volume of the hand so that accurate sizing information can be established for protective gloves. Other anticipated uses include tool sizing and scans of other body parts for PPE fit testing.

The hand is generally considered the most complex object for 3D body scans, because of the complex morphometrics and the tendency of the hand to move during scanning. This scanner uses multiple heads to reduce calibration, registration and interpolation problems, and can complete a scan in less than a second, which obviates the need to eliminate minor hand movement during the process. Specialized software is used to eliminate any spurious data points, as well as to generate a polygonal mesh which can be output as a standardized data file. These data files can be imported into CAD/CAM/CAE applications for further analysis, and can then be used as input files for use with computer-numerically controlled machine tools, garment and sewing machinery, and similar applications. Files can also be imported into 3D modeling and compositing software for surfacing, scientific visualization applications, and image rendering. This data can be used in a wide variety of advanced imaging applications to generate animated 3D visualizations of scientific interest.

Research conducted:

Improved Equipment Design Through Applied Anthropometry
Harness Design and Sizing Effectiveness

Research equipment:

Name: Whole body 3-D laser scanner
Description: Cyberware Model WB4
Use: This scanner is used to capture whole-body scans of human subjects

Name: Table laser scanner
Description: Cyberware Model Shop 3-D Table Scanner
Use: This scanner is used to capture 3D scans of objects

Name: Head and face laser scanner
Description: Cyberware Head and Face 3-D Laser Scanner
Use: This scanner is used to capture head and face scans

Name: Traditional anthropometry tools
Description: Various calipers and measuring devices
Use: These tools are used to capture human anthropometric dimensions

Name of Laboratory: NIOSH Mobile Emergency Medical Service (EMS) Work Environment Laboratory

Site/Location:

NIOSH Morgantown
1095 Willowdale Road
Morgantown, West Virginia 26505

Description (narrative):

The NIOSH Mobile Emergency Medical Service (EMS) Work Environment Laboratory is a 2005 Wheeled Coach Type III ambulance mounted on a Ford E-450 cut-away van chassis. The vehicle was specially outfitted to allow its use as a mobile laboratory for the evaluation of mobile occupant restraints, patient compartment ergonomics, and potential design changes intended to improve EMS worker safety during ambulance crashes. The laboratory conforms to the General Services KKK-1822E Specifications for the Star-of-Life Ambulance. The vehicle has been outfitted with a video monitoring system to record human subjects in the patient compartment as they perform various EMS tasks. A Road Safety RS 3000 vehicle monitoring system is installed to record vehicle operating parameters during subject testing while the vehicle is operated over closed driving courses. The patient compartment is also outfitted with additional mounting locations for various occupant restraint systems that allow EMS workers to access patients and equipment while still providing crash protection. A PDA Stat EMS training manikin is part of the vehicle equipment.

Research conducted:

The laboratory is being used in support of research conducted under the NIOSH Division of Safety Research Ambulance Crash Survivability Improvement project. Currently, ambulance patient compartments are equipped with lap belt occupant restraints that inhibit EMS worker mobility within the compartment making it difficult if not impossible for them to access the patient and EMS equipment. Consequently, EMS workers do not use occupant restraints placing them at high risk for vehicle crash-related injury. The vehicle is being used to conduct human subject testing of mobile occupant restraints during simulated patient care scenarios using the training manikin. While conducting the scenarios, the subject data is collected via cameras and time-coded VHS recorded tapes. The tapes are analyzed to yield task completion times using various restraint systems. Subject heart rate is also collected. Comparison of this data from system to system is expected to identify potential areas of system refinement.

Using computer modeling techniques and anthropometry data, the vehicle is also being used to study ergonomic issues of ambulance patient compartments. Results of the study should identify areas where equipment can be relocated to reduce the need for mobility within the patient compartment. Since the laboratory's compartment is constructed to GSA KKK-1822 E specifications, the study is expected to provide data that can be used to develop recommended revisions to be included in future GSA specifications.

The laboratory also has potential for use as a concept demonstrator at EMS conferences and meetings.

Research equipment:

2005 Wheeled Coach Type III ambulance, video monitoring system, Road Safety RS 3000 vehicle monitoring system, PDA Stat EMS training manikin.

Name of Laboratory: High Bay Laboratory

Site/Location: H B419

Description (narrative):

This laboratory is a specially constructed facility with elevated (37 feet) ceilings and an overhead catwalk, and which is dedicated to research efforts in reducing fall-related injuries, as well as in improving the safety of large equipment used in industrial, construction, and agricultural applications. Overall dimensions of the laboratory are 30 by 36 by 37 feet, which are necessary for accommodating such research efforts as studies of scaffolding systems, ladder stability, tension/compression testing of fabricated protective structures using hydraulic ram pressure, and access/egress safety for construction equipment.

Test equipment in the High Bay Laboratory includes a 5- ton bridge crane, a test bed, hydraulic power supply and actuator system, and a research manikin. The test bed, which is used for securing equipment in place for testing, measures 10 by 15 feet and is 7 inches thick, and is composed of four sections that can be positioned by the overhead crane. T–slots in the bed surface provide anchors for the equipment under test. The hydraulic power system features a 10 g.p.m. pump and two 22,000 lb. actuators. The actuators can be fully controlled through a personal computer to produce loadings, deflections, or vibrations of desired amplitude and frequency.

This lab is also equipped with an advanced research manikin. The manikin was developed in response to the knowledge gained from the U.S. Air Force's tests of biomechanical effects of acceleration forces on aircrews under high-stress conditions such as aircraft ejection. This manikin is known as ADAM, for advanced dynamic anthropomorphic manikin, and is representative of a 95th percentile Air Force male. This research manikin was designed with a high degree of biodynamic fidelity to the human body under conditions of rapid acceleration and deceleration, such as would be experienced in an aircraft crash or fall incident. The manikin has body segments which approximate that of the human body, articulated limbs with a range of motion that also approximates that of the body, and a spinal system that was designed to replicate the human spine's elasticity along the z axis.

The manikin contains a sophisticated and ruggedized onboard data acquisition system and all joints contain sensors. Internal instrumentation includes three triaxial accelerometers, located in the head, the neck, and the chest, and two internal load cells located in the spine. Finally, there are position sensors mounted in the knees, elbows, and shoulders. This equipment has been used in a series of tests on the biodynamic forces that protective equipment and the human body would experience during free-fall and rapid deceleration while wearing fall-restraint equipment.

Research conducted:

Lab Testing of Adjustable Roof Bracket-Safety Rail Assembly
New Technology to Increase ROPS Use on Tractors

Research equipment:

Name: 5- ton overhead bridge crane
Description: Ground controlled overhead crane with cable and winch assembly. Able to tram in horizontal plane the length of the laboratory.
Use: The overhead crane is used for moving large assemblies the length of the laboratory, as well as raising and lowering assemblies within the vertical dimension. It is also used to restrain objects from uncontrolled movement while under pressure with test conditions.

Name: test bed
Description: Floor-mounted experimental platform with multiple points for securing test objects. The bed measures 10 by 15 feet and is 7 inches thick, and is composed of four sections that can be positioned by the overhead crane. T–slots in the bed surface provide anchors for the equipment under test
Use: Platform used to secure and test machinery, fabricated objects or materials for pressure resistance, durability, deformability and failure under various test and load conditions, in various positions and alignments..

Name: hydraulic power supply and actuator system,
Description: Cyclic-pump mechanism for application of hydraulic pressure to test objects.
Use: Hydraulic pressure through ram or other mechanisms is used to subject test objects to measurable load and determine characteristics of failure modes and range of resistance to failure.

Name: research manikin
Description: The research manikin is a jointed model of the human body, with embedded accelerometers and other sensors. It was designed with a high degree of biodynamic fidelity to the human body under conditions of rapid acceleration and deceleration, such as would be experienced in an aircraft crash or fall incident. The manikin has body segments which approximate that of the human body, articulated limbs with a range of motion that also approximates that of the body, and a spinal system that was designed to replicate the human spine's elasticity along the z axis.

The manikin contains an onboard data acquisition system and all joints contain sensors. Internal instrumentation includes three triaxial accelerometers, located in the head, the neck, and the chest, and two internal load cells located in the spine. Finally, there are position sensors mounted in the knees, elbows, and shoulders.
Use: This equipment has been used in a series of tests on the biodynamic forces that protective equipment and the human body would experience during free-fall and rapid deceleration while wearing fall-restraint equipment.

Name of Laboratory: Human Digital Modeling & Hand Scanning Lab

Site/Location: H 1504

Description (narrative):

This laboratory incorporates specialized scanning equipment, computer workstations and software applications for the acquisition and analysis of digitized models of the human form, in a 40 by 28 by 9 foot facility. This facility is designed to work closely with the Anthropometry Research Laboratory in the acquisition, manipulation, and analysis of digitized information on human forms produced by scanning human subjects and recording this morphological data as digital information. To date research has focused on digitization of the human hand and the interface between the hand and protective gloves.

Research has been conducted in a number of areas, including quantification of proper fit of test subject hand dimensions to glove dimensions, and development of a sizing schema for the National Fire Protection Agency efforts to improve protective gloves for fire fighters.

Research conducted:

Improved Equipment Design through Applied Anthropometry

Research equipment:

Name: A. 3-D Hand Scanner System, manufactured by InSpeck, Inc.
Description: Three dimensional scanner
Use: Obtain 3D scans of hand data

Name: HandScan Flatbed Scanner System, manufactured by VisImage, Inc.
Description: Flatbed scanner for 3D image capture
Use: Acquire 3D image data

Name: Three HP XW500 Windows-based Workstations:
With the following Engineering Software Platforms: INTEGRATE, CYSCAN/ARN, 3D Studio Max, JACK
Description: Workstations with dedicated software
Use: Applications for capturing and manipulating anthropometric data

Name: Jamar Dynamometer
Description: Dynamometer
Use: Test equipment used for grip strength analysis

Name of Laboratory: Human Factors Laboratory

Site/Location: H B413

Description (narrative):

This laboratory is a unique facility for research in the areas of biomechanics, applied physiology, and industrial psychology. The 30- by 40-foot laboratory has a 17-foot-high ceiling to permit the study of a variety of work practices. The lab supports studies of postural stability, human motor and mental responses, machine safety, acute musculoskeletal injuries, and heat stress evaluations.

This laboratory is equipped with three core systems, an environmental control unit (ECU), two types of motion measurement systems, and two force platforms. An electromyography (EMG) measurement system and various physical signal measurement devices are also available, and can be synchronized with the core systems. The ECU can control temperature and lighting with a high degree of precision; temperature can be controlled in a range of 35-degree F to 95-degree F, 30% to 90% humidity, and 0.1 to 100 foot candles lighting. The motion measurement systems use six cameras, which are located in each corner of the room. One system uses an infrared camera which automatically calculates body-position velocities, accelerations, and interfaces directly to software programs which then calculate joint forces. These features make the system optimal for the rapid analysis of motions when all the body markers are visible throughout the range of movement being studied. For movements in which some markers may be hidden at certain times, the second type of measurement system offers a manual digitizing capacity to recover the hidden data points. This video-based system, which is controlled by the Peak Motus software application, can objectively collect, quantify, and document motion in two- and three-dimensional space. These systems are interchangeable within the high bay lab. The last major items of research equipment are two force platforms, which are used to capture data such as the amount of force distribution and direction in workers' feet during walking, as well as the amount of sway in a worker's standing posture, as a predictor of stability and fall potential. These platforms rest on a sunken concrete pad so that the plate surface is level with the floor surface. The supporting pad is isolated from the rest of the floor to reduce the effects of building vibration.

Research within this laboratory will focus, or has focused, on the human factors associated with the use of fire fighters boots, tribologic data collection on the interface between shoes and shoe surfaces in healthcare settings, kinematic data collection for workers performing tasks on the platform of an aerial lift, data collection for studies of gait and joint loadings for workers who use stilts, and the forces imposed on the human body during the lifting and movement of drywall sheeting in construction tasks.

Research conducted:

Fall Prevention for Aerial Lifts in the Construction Industry
Biological and Physiological Study of Firefighter Boots
A Study of Ergonomic Interventions in the Dry Wall Industry

Research equipment:

Name: Variable Incidence Tribometer (VIT), also known as English XL slipmeter
Description: The VIT is a portable device used to measure the slipperiness of floors.
Use: This device is driven by pneumatic pressure using the methodology described in ASTM standards F1679-00 2001. It is a useful tool for determining the tribologic characteristics of flooring material, which may contribute to slip-and-fall incidents.

Name: Portable Inclinable Articulated Strut Tribometer (PIAST), also known as the Brungraber Mark II,
Description: This device is an inclined-strut slipmeter driven by gravity.
Use: This device is cited by ASTM standards F1677-05 2005 as a valid device for measuring floor and shoe slipperiness. This device has a relatively large sensor (58 cm2), compared to English XL (7.9 cm2) which is a better device for measuring shoe slipperiness, which can contribute to loss of balance and slip-and-fall incidents.

Name of Laboratory: NIOSH Lake Lynn Laboratory

Site/Location: Fairchance, PA

Description (narrative): The Lake Lynn Laboratory, an experimental hard-rock mine operated by the NIOSH Pittsburgh Research Laboratory, served as a resource in conducting the "Evaluating Roadway Construction Work Zone Interventions" project, which is evaluating interventions that are intended to prevent ground workers from being struck by construction equipment. In defining the data collection methods for this project, it was necessary to develop blind area diagrams of road construction equipment. These diagrams were used to describe areas around equipment that are hazardous to ground workers. The Lake Lynn facility was utilized in developing diagrams for six pieces of equipment.

Research conducted:

A fenced-in area with a concrete surface at the Lake Lynn facility was utilized in diagramming blind areas for the following equipment, which were provided by a contractor except as noted: Ford F-800 Dump Truck (typical type of two-axle dump truck used to haul asphalt to a paving site); Caterpillar 672 CH Motorgrader (used to develop road grade); Ford F-250 Super Duty Crew Cab Pickup Truck (NIOSH provided; typical of vehicles used by company foreman and quality control personnel); Chevy Astrovan (NIOSH provided; typical of vehicles used to transport construction workers); Clark 75C Wheeled Loader (used to move earth, rocks, and other materials); and Caterpillar 426C Backhoe Loader (used to move material and dig).

The blind area diagramming activity requires that a polar grid be transferred, usually with paint, on to a flat ground surface. The grid consists of 12 meter-long lines radiating from the center of the grid at 10 degree intervals and a series of concentric circles that are centered on the grid at 2 meter intervals. The outer circle has a radius of 12 meters. The equipment being mapped is moved to and held stationary at the center of the polar grid. A mapping crew consists of an equipment operator, an observer, a recorder, and two measurers. The operator and observer communicate to define the border of the blind area; that is, the area in which the operator cannot see the observer who is traversing step-wise around the equipment. The observer marks the grid with defining points of the blind area that are then measured. These measurements are recorded and developed into the blind area diagram. The resulting diagrams were critical in developing the project data collection methodology.

Research equipment: The process used at the Lake Lynn Laboratory facility to develop blind area diagrams of equipment is manual with no specialized research equipment requirements.

Name of Laboratory: NIOSH Pittsburgh Research Laboratory

Site/Location: Bruceton, PA

Description (narrative):

The Pittsburgh Research Laboratory (PRL), a extensive facility located on approximately 180 acres, served as a resource in conducting the "Evaluating Roadway Construction Work Zone Interventions" project, which is evaluating interventions that are intended to prevent ground workers from being struck by construction equipment. In defining the data collection methods for this project, it was necessary to develop blind area diagrams of road construction equipment. These diagrams were used to describe areas around equipment that are hazardous to ground workers. The PRL facility was utilized in developing diagrams for four pieces of equipment. In addition, the PRL facility was utilized in a pilot study to evaluate the project data collection techniques on an active asphalt paving operation.

Research conducted:

The surface of an empty parking area at the PRL facility was utilized in diagramming blind areas for the following equipment, which were all provided by a contractor: CMI Rotomill PR-525-7 (used to mill existing asphalt and prepare the road to be resurfaced); I-R Bobcat 763 with Broom (used to clear debris off of roads prior to paving); Peterbilt 357 Dual Axle Dump Truck (typical type of dual-axle dump truck used to haul asphalt to a paving site); and Mack RD688S Triaxle Dump Truck (typical type of tri-axle dump truck used to haul asphalt to a paving site).

The blind area diagramming activity requires that a polar grid be transferred, usually with paint, on to a flat ground surface. The grid consists of 12 meter-long lines radiating from the center of the grid at 10 degree intervals and a series of concentric circles that are centered on the grid at 2 meter intervals. The outer circle has a radius of 12 meters. The equipment being mapped is moved to and held stationary at the center of the polar grid. A mapping crew consists of an equipment operator, an observer, a recorder, and two measurers. The operator and observer communicate to define the border of the blind area; that is, the area in which the operator cannot see the observer who is traversing step-wise around the equipment. The observer marks the grid with defining points of the blind area that are then measured. These measurements are recorded and developed into the blind area diagram. The resulting diagrams were critical in developing the project data collection methodology.

When a company was contracted to pave an access road at the PRL facility, project researchers took advantage of the opportunity to pilot test the data collection techniques. During the milling and paving operations, ground worker exposure to moving dump trucks and equipment were simultaneously recorded using three methods: direct observation, video recording, and positional logging using global positioning system (GPS) receivers. Positional data were recorded for the following: seven ground workers; dump trucks backing towards the milling machine; a tractor placing geotextile material; a roller; and the paver. Results from this pilot study at PRL enabled researchers to refine data collection methods to better capture ground worker exposures to hazardous areas around road construction equipment.

Research equipment:

Work Zone Data Collection Trailer – Described in a follow-on "Laboratory Research Facilities" form.

Portable Hand Held Video Cameras – Used in the pilot study to record video footage of the paving operation. This footage was used to validate direct observation recordings of ground worker exposures to equipment.

Global Positioning System (GPS) Receivers – These receivers monitored the movement of dump trucks, equipment, and workers for the pilot study. This information was post-processed to calculate exposures of ground workers to equipment.

Name of Laboratory: Protective Systems Laboratory

Site/Location: H 1520

Description (narrative):

This laboratory is a 40 by 28 by 9 foot facility that is equipped with tools for the development of various items of control technology related to the transmission of electrical energy to the human body, as well as items of control technology to serve as warning or protective systems for the control of the transmission of mechanical energy to the human body. In addition, this laboratory includes various sensor-system development tools for developing biomedical instrumentation for workplace hazard exposures and work stressors. Test equipment includes digitizing oscilloscopes, RF phase generators, function generators, digital multimeters, computer workstations and various other items of test equipment for the generation, analysis and modification of items of electronic control technology. The laboratory is also used to develop electronic circuits and sensors to support in-house human subject studies. Current products developed from this laboratory include an EMG-video timecode synchronization unit, ROPS activation sensors, and electronic circuitry for detecting capacitance differential between wood products and humans in the signal path.

Research conducted:

Electrical Injury Protection System

Research equipment:

Name: Electronic signal generator
Description: Agilent 8648B Signal generator
Use: Common item of electronic test equipment used to create stimulus signals and capture responses.

Name: Oscilloscope
Description: Agilent 54832B Digital Oscilloscope
Use: Allows signal voltages and characteristics to be viewed and analyzed. Used in development and testing of electronic circuits.

Name: Electronic Phase Analyzer
Description: Hewlett Packard 4396B Network/Spectrum Analyzer
Use: Test equipment used to analyze phase noise, frequency, phase and transients for electronic devices used in electronic warning and signaling applications.

Name of Laboratory: Safety Engineering Laboratory

Site/Location: H 1610

Description (narrative):

This laboratory houses an array of electronics equipment and sensor-system development instrumentation in a 28 by 14 foot facility. This lab's efforts focus on developing improved designs for agricultural, construction, and industrial equipment. Current research is focused on assessing the safe and efficient operating envelope that equipment operators occupy. This research area focuses on the human factors and design factors of the interface between a truck driver or equipment operator and the operating environment or cab space in which he operates. The Safety Engineering Laboratory is equipped with motion capture Systems, digital measuring devices, foot pressure sensors, dynamic strength simulators, fabricated test bucks for determining the effective volume and space envelope around commercial drivers and equipment operators, and Unix-based workstations for simulations.

Research conducted:

U.S. Truck Driver Anthropometry and Cab Work Space
Evaluation of Fire Fighter Apparel on the Operation of Fire Response Vehicle

Research equipment:

Name: Digital point measurement system
Description: FaroArm, Bronze series
Use: This precision measuring device is used to assign data points to items in 3D space for use in determining effective volume and dimensional envelope around drivers and equipment operators.

Name: Test Bucks
Description: Motor Vehicle Anthropometry and Motion Capture Test Bucks
Use: Test bucks are fabricated mockups of drivers' and operators' seat and equipment space, and are used to model operators' safe and effective operational space, for use in truck and heavy-equipment design.

Name: Motion Capture System
Description: ProReflex Motion Capture System by Qualsys
Use: This technology is used for non-contact, accurate human motion measurement.

Name: Lido Lift
Description: LidoWorkset with dedicated data-capture workstation
Use: This equipment allows measurement of range of motion. The machine, using isokinetic and isotonic principles, responds to the level of strength the test subject to measure limb mobility, stretching capacity and muscle resistance.

Name of Laboratory: NIOSH Spokane Research Laboratory

Site/Location: Spokane Research Laboratory, Spokane, WA

Description (narrative): Preliminary evaluations of tag-based proximity warning systems for construction equipment.

Research conducted:

Evaluations were conducted to determine the detection characteristics and other operating parameters for two systems that are designed to protect workers on foot from being struck by construction equipment. The first system consisted of electronic tags worn by workers that transmit a pulsed radio frequency signal that is detected by tag readers mounted on mobile equipment. Time of flight signal measurements are used to determine distance to the tag. This system, developed by Tag Safety Systems, progressed to proof of concept, but was not far enough in development to progress to field trials. The second system tested was the TramGuard proximity warning system marketed by GeoSteering, Inc. for underground mining. This system uses tags on workers that detect a magnetic marker field generated by a loop antenna mounted on mobile equipment. Tests revealed modifications that were needed in order to use this system on construction equipment. Suggested modifications have been implemented on a new system called Hazardavert that will be tested at roadway and building construction sites.

Research equipment:

Several pieces of electronic test equipment were used during the development and evaluation of these systems: radio spectrum analyzer, oscilloscope, electronic test meter, and a laptop computer.

Name of Laboratory: Virtual Reality Laboratory

Site/Location: H B 209

Description (narrative):

This laboratory contains a virtual-reality-simulation space, which is a computer-generated projection that gives a user the illusion of being fully immersed in a three-dimensional world. The user wears special eyewear that synchronizes and filters the projected images to create a realistic impression of 3D space. At present, this 28- by 35- by 14-foot laboratory is being utilized to understand human behavior, physical response, and decision-making skills under simulated conditions of elevated work; findings are validated and compared with measurements taken under non-simulated work conditions. In addition, investigations of fall risk factors, injury processes, and fall prevention technologies are ongoing.

The Virtual Reality Laboratory is equipped with four projection systems, an image generator, head tracking system, stereo eyewear and a 3-wall-1-floor screen. The projection systems and image generator function as an integrated system, controlling the projected images as well as the software application. The motion tracking system continuously adjusts the stereo projection to the current position of the user, tracking the subject's position and updating the stereo projection in real time to that position. The stereo eyewear is integral to the 3D experience, creating the illusion of depth so that the user can walk through the surrounding virtual environment, experiencing the sights and sensation of elevation.

Various research projects are underway or have been conducted in this innovative and advanced laboratory, including basic research to determine and validate the overall usefulness of SSVR technology in assessing occupational safety issues, research on scaffolding safety, research on maintaining stability while on sloped roof surfaces, and similar research related to falls from elevation and safety while working at heights.

Research conducted:

Evaluation of Sensory-Enhancing Technology for Improving Balance Control at Elevated Workplaces

Research equipment:

Name: CAVE Surround Screen Virtual Reality (SSVR) system
Description: The SSVR is the system used to generate the VR environment
Use: This facility is used to generate virtual imagery for use in testing human subjects under circumstances that would be too dangerous for field studies or laboratory-based tests.

Name of Laboratory: Work Zone Data Collection Trailer

Site/Location: Mobile, currently located at a remote data collection site

Description (narrative):

The Work Zone Data Collection Trailer was designed and constructed to enhance data collection and analysis capabilities for the "Evaluating Roadway Construction Work Zone Interventions" project, which is evaluating interventions that are intended to prevent ground workers from being struck by construction equipment.

Research conducted:

The Work Zone Data Collection Trailer primarily serves as the operational platform for video footage that is recorded as part of the "Evaluating Roadway Construction Work Zone Interventions" project data collection activities. The trailer, powered by a five kilowatt gas generator, is setup alongside active paving operations that are participating in this project. The trailer is equipped with two pan/tilt/zoom cameras positioned on a mast capable of being raised 58 feet. A joystick located inside the trailer controls both of the mast-mounted cameras, allowing for simultaneous views from multiple angles. The trailer is also equipped with three desktop computers that are networked together by a local area network (LAN). All three computers are capable of accessing the internet via the broadband satellite internet connection. Two of the computers control two wireless video cameras that are mounted on separate portable trailers. Through a video splitter, a four-way split image of all video inputs is displayed on one monitor. This video image, in addition to the four independent video inputs, is recorded by VHS video cassette recorders. Time code generators embed a global positioning system (GPS) time code onto all video images.

To date, the trailer has been used in seven pilot sites and eight research sites. The trailer is currently located on the ninth of sixteen scheduled research sites. The study sites have been located in North Carolina, South Carolina, Pennsylvania, West Virginia, Indiana, and Idaho.

Research equipment:

Spectra Mast Camera System – Two pan/tilt/zoom cameras located on top of a telescoping mast that is mounted on the trailer. The cameras are remotely controlled from within the trailer to record video footage of the work site. This video footage can then be analyzed at a later time.

Portable Trailer Mounted Camera System – Two pan/tilt/zoom cameras located on masts that are mounted on two separate portable trailers. These two cameras are controlled wirelessly from the Work Zone Data Collection Trailer to record video footage of the work site. This video footage can then be analyzed at a later time.

Desktop Personal Computer (PC) – Three desktop PCs are located in the trailer. Two wirelessly control the two portable trailer mounted camera systems. One controls the internet connection via the satellite. All three are on a local area network (LAN) for information sharing capability.

Broadband Satellite Internet – Provides the PCs within the trailer with broadband internet access.

Appendix 6: Traumatic Injury Research Partners/Stakeholders

Project: Evaluation of Emergency Services Vehicle Occupant Safety

For Partners and Stakeholders:

Name of Organization: Allied Services Systems

Category of Organization: Manufacturer

Contact:

Ned Dunnington
President
(301) 943-5294

For Partners only:

Type of Formal Agreement (if any)**:**

Letter of Intent to CRADA
Confidential Disclosure Agreement

Description of collaborative activities (narrative):

Allied Services Systems provided materials and engineering support to conduct dynamic tests of their Kicker Vest restraint system through the NIOSH project, "Evaluation of Emergency Vehicle Occupant Safety" project. Allied Services Systems responded to a FedBizOps announcement for this research, and their restraint system was one of four deemed to hold potential for worker occupant crash protection based on computer simulations.

Current U.S. ambulances use lap belts for occupant protection in the patient compartment. Proper use of lap belts require emergency service (EMS) workers to remain seated against the back of the seat. This prohibits mobility needed to access the patient and EMS equipment. NIOSH and its partners explored the potential of four types of mobile occupant restraints to provide crash protection for EMS workers in ambulance patient compartments while allowing needed mobility. The Kicker Vest provides crash protection as well as mobility needed to access patients and equipment. Using crash test dummies, the partners conducted dynamic sled tests and full scale vehicle crash tests. These tests yielded data that can be used for further system development and to support proper selection of restraints for ambulance patient compartments.

Collaborative Outputs:

Data collected from the tests was shared with Allied Services Systems. The company is using the data to support system refinement.

Intermediate Outcomes:

The EMS community has been introduced to a source of improved occupant restraint systems. As a result of this work, Allied Services Systems has been working with EVS Ltd., a seat manufacturer that supplies ambulance manufacturers. EVS and Allied have incorporated the system into a prototype attendant's seat.

End Outcomes:

Though not yet realized, it is expected that EMS services and ambulance manufacturers will ultimately use restraint systems that are improvements over the currently used lap belts. This will lead to a reduction of crash-related injuries to EMS workers.

Project: Evaluation of Emergency Services Vehicle Occupant Safety

For Partners and Stakeholders:

Name of Organization: American Medical Response (AMR)

Category of Organization: Company (Health Care and Social Services Sector; ambulance service provider)

Contact:

Ronald W. Thackery
Vice President, Safety and Risk Management
American Medical Response
ron_thackery@amr-corp.com
(303) 495-1236

For Partners only:

Type of Formal Agreement (if any): Letter of Agreement

Description of collaborative activities (narrative):

NIOSH is currently conducting research to identify ambulance crash-related injury risks and risk intervention for emergency medical service (EMS) workers. The research begun in 2001 is conducted under the "Evaluation of Emergency Vehicle Occupant Safety" project and the "Ambulance Crash Survivability Improvement" project. These projects include analysis of surveillance data that can be used to describe the scope of the ambulance crash-related injury problem for EMS workers. EMS worker fatality data is available on a national level. However, until now, data describing non-fatal ambulance crash-related injuries for EMS workers has not been available. Currently, there is no national-level non-fatal injury database for EMS providers.

AMR is the largest medical transport provider in the United States with more than 200 operations in 32 states, ranging in size from 20 to over 250 employees. AMR maintains an extensive database that includes employee injury, worker's compensation claims, vehicle crashes, and liability claims. Analysts at AMR and NIOSH are working together to examine non-fatal ambulance-related injuries to EMS personnel utilizing AMR data sources. This project provides a national sample of private ambulance service EMS worker non-fatal injury data for analysis.

Collaborative Outputs:

Findings from the analyses will be jointly published in peer-reviewed and trade journals, and presented in other formats, as appropriate. Analyses are currently ongoing.

Intermediate Outcomes:

End Outcomes:

Though not yet realized, it is expected that EMS providers and ambulance manufacturers will ultimately use the findings to make changes to ambulance patient compartment designs and standard operating procedures. This will lead to a reduction in non-fatal injuries to EMS workers.

For Partners and Stakeholders:

Name of Organization: American National Standards Institute Z15.1 Committee

Category of Organization: Consensus standards committee

Contact:

Mr. Tim Fisher
Director, Practices and Standards, American Society of Safety Engineers
1800 East Oakton Street, Des Plaines, IL 60018-2187
Phone: (847) 768-3411
Fax: (847) 296-9221
E-mail: tfisher@asse.org
WWW URL: http://www.asse.org

For Partners only:

Type of Formal Agreement (if any): Letter accepting committee membership

Description of collaborative activities (narrative):

In cooperation with numerous other stakeholders, staff in the NIOSH Division of Safety Research made substantial contributions to the development of the American National Standards Institute (ANSI) standard Z15.1-2006, Safe Practices for Motor Vehicle Operations, which received final approval from ANSI on February 15, 2006. The Z15.1 standard is intended to further prevention of motor vehicle crashes, which are the leading cause of workplace fatalities and a major contributor to workers' compensation and liability costs, lost productivity, and property loss. The standard delineates minimum requirements for workplace traffic safety programs, and was designed for use by any organization whose employees drive on the job. Approval of the Z15.1 standard is a landmark achievement in worker protection; this is the first occupational safety standard that offers comprehensive guidance to protect all workers who operate a motor vehicle as part of their job.

The American Society of Safety Engineers (ASSE) serves as secretariat of the Z15 Accredited Standards Committee. The Z15 Committee draws its membership from more than 30 government agencies, insurance companies, employers, consulting groups, and trade associations.

NIOSH representatives Stephanie Pratt (primary) and Lee Husting (alternate) served on the ANSI Z-15 Committee from its inception in 2001. NIOSH made substantive contributions to all parts of the standard, and took the lead in drafting the portion of the standard that addresses crash data collection and incident analysis. In addition, Ms. Pratt chaired the subcommittee that resolved technical and editorial discrepancies across the sections of the standard and addressed the 100 pages of public comments received.

Collaborative Outputs:

ANSI/ASSE [2006]. Safe practices for motor vehicle operations [American National Standard]. New York, NY: American National Standards Institute, ANSI/ASSE Z15.1-2006.

Intermediate Outcomes:

As early as the public comment periods, the Z15 standard generated substantial interest within the fleet safety community. In response to the flood of interest that followed publication of the standard, ASSE held a special session devoted to Z15 at its 2006 annual meeting. In addition, ASSE's Transportation Practice Specialty published a special issue of its newsletter that detailed the standards development process and offered an attorney's perspective on the value of the standard to businesses.

ASSE [2006]. ANSI/ASSE Z15.1-2006 motor vehicle operations standard approved. Transportation Practice Specialty newsletter (special issue). Available: http://www.asse.org/SpecialZ15Issue.pdf.

End Outcomes: None

For Partners and Stakeholders:

Name of Organization: Bureau of Labor Statistics (BLS)

Category of Organization: Government (Federal)

Contact:

Kate Newman
Office of Compensation & Working Conditions
Newman.Kate@bls.gov
(202) 691-6162

For Partners only:

Type of Formal Agreement (if any): Memorandum of Understanding

Description of collaborative activities (narrative):

NIOSH collaborates with the Bureau of Labor Statistics formally through a Memorandum of Understanding (MOU), and informally through periodic meetings. The MOU between BLS and NIOSH permits BLS to share data files from the BLS Census of Fatal Occupational Injuries (CFOI) with NIOSH. BLS provides NIOSH coded demographic characteristics, information on how the fatal incident occurred, and narrative descriptions of the injury circumstances. Through the MOU, BLS also provides additional data elements not otherwise available on the general public-use data set. Although NIOSH collected 22-years of occupational fatality data, NIOSH now relies almost solely on CFOI for studying current occupational fatality trends and issues and for directing its safety research.

Staff from the NIOSH Surveillance and Field Investigations Branch and BLS staff from the CFOI and Survey of Occupational Injuries and Illnesses (SOII) programs meet approximately annually, to share information about ongoing work and identify potential opportunities for collaboration.

Collaborative Outputs:

Marsh SM, Pegula S. Fatal Occupational Injuries by Incident Event or Exposure –United States, 2005. (in draft format – targeted for publication in the CDC MMWR)

Intermediate Outcomes:

The utility of the NIOSH National Traumatic Occupational Fatalities (NTOF) surveillance system influenced the National Academy of Science Panel on Occupational Safety and Health Statistics' recommendation for development of a more comprehensive national fatality census. This led directly to the development of the BLS CFOI system. After a decade of overlap, NIOSH discontinued the NTOF data collection at the end of 2001 and now uses the CFOI data for occupational fatality surveillance. While BLS only produces aggregated statistics from their data, NIOSH often analyzes the CFOI data in more detail and issues prevention recommendations based on the results. Thus, NIOSH and BLS have developed a mutually beneficial relationship that expands the utility of the CFOI data.

End Outcomes: None

Project: Evaluation of Emergency Services Vehicle Occupant Safety

For Partners and Stakeholders:

Name of Organization: Canadian Forces Health Group

Category of Organization: Government

Contact:

Lt Col. Ray Goulet
Goulet.JJMR@forces.gc.ca
(613) 945-6738

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

Current U.S. ambulances use lap belts for occupant protection in the patient compartment. Proper use of lap belts require emergency service (EMS) workers to remain seated against the back of the seat. This prohibits mobility needed to access the patient and EMS equipment. NIOSH and its partners explored the potential of four types of mobile occupant restraints to provide crash protection for EMS workers in ambulance patient compartments while allowing needed mobility. Using crash test dummies, the partners conducted dynamic sled tests and full scale vehicle crash tests. These tests yielded data that can be used for further system development and to support proper selection of restraints for ambulance patient compartments.

As a part of the project team, the Canadian Forces Health Group provided full funding for the sled test facility, at an estimated cost of $300,000 U.S., two instrumented test manikins, and engineering support both for test plan development and the conduct of all sled testing. In addition, they provided two instrumented manikins and engineering support in support of the crash testing conducted at a private facility near Montreal, Ontario, CA. Finally, the Canadian Forces Health Group facilitated the involvement of an additional Canadian partner: the Ontario Ministry of Health. As a result of the this work, the Canadian Forces Health Group was also able to test a militarized litter lift system concurrent to the testing of the mobile restraint systems. This prototype system was developed to allow the military ambulance to carry up to four patients simultaneously.

Collaborative Outputs:

Data collected from the tests was shared with Canadian Forces Health Group.

Intermediate Outcomes:

To date, we are unaware of any additional activities resulting from the work on this project within the Canadian Forces Health Group.

End Outcomes:

It is expected that military and private EMS services and ambulance manufacturers will ultimately use restraint systems that are improvements over the currently used lap belts. This will lead to a reduction of crash-related injuries to EMS workers.

For Partners and Stakeholders:

Name of Organization: DBI-SALA Fall Protection Inc.

Category of Organization: Manufacturer

Contact:

Tom Wolner
Vice President
twolner@capitalsafety.com
(651) 385-6229

For Partners only:

Type of Formal Agreement (if any): Letter of Agreement

Description of collaborative activities (narrative):

DBI-SALA Fall Protection Inc. has actively participated in the TI Harness Sizing research and is finalizing the adjustment range of each harness component with the NIOSH research team. They have provided original static-test criteria, harness blue prints, and technical input for each study and have continued to provide feedback on proposed new sizing systems. They also are working on prototypes of harnesses based on the proposed new sizing systems and other TI program study results.

Collaborative Outputs:

A provisional sizing scheme with an algorithm that describes the human torso-shape-and-size distribution and a set of recommendations for producing vest-type harnesses has been accepted for publication by the Human Factors journal. DBI-SALA Fall Protection Inc. reviewed the report before our submission to the journal in 2005. The provisional sizing scheme is currently being used by DBI-SALA Fall Protection Inc. for the first-stage prototype development. A simplified version of the provisional sizing schedule was also presented at the Ergonomics Society Conference and was published in the Contemporary Ergonomics in 2005.

The draft report of the second provisional size scheme has been shared with DBI-SALA Fall Protection Inc. NIOSH, two research contractors, and DBI-SALA Fall Protection Inc. are finalizing the adjustment range of each harness component. The final report is expected to be completed in December 2006. DBI-SALA Fall Protection Inc. and NIOSH research team will complete the prototypes of the new generation over-the-head harnesses in year 2007 for NIOSH to conduct validation studies to determine the validity and reliability of the newly established sizing system.

Intermediate Outcomes:

Development of prototype harnesses that incorporates the TI schemata is currently underway at the DBI-SALA Fall Protection Inc. DBI-SALA Fall Protection Inc. and the other harness manufacturer responded to the NIOSH announcement on the Federal Business Opportunities in 2003 for partnership in harness-sizing studies and in transferring the knowledge into design process and commercialization. Since DBI-SALA Fall Protection Inc. and the other NIOSH partner harness manufacturer account for about 60% of the national market share of fall-arrest harnesses, the future adoption potential of the new harnesses and sizing systems in the construction trades is very high.

End Outcomes: Not available yet

Project: HCCB7 9277178 - New Technology to Increase ROPS Use on Tractors

For Partners and Stakeholders:

Name of Organization: FEMCO Inc

Category of Organization: OEM ROPS Manufacturer

Contact:

Rick Young, Managing Director
youngr@femcomfg.com
(620) 241-3513

For Partners only:

Type of Formal Agreement (if any): LOA

Description of collaborative activities (narrative):

FEMCO and NIOSH have collaborated in value assessment and design evaluation of the AutoROPS. FEMCO located and help to form the working agreement between Scag Power Equipment, Inc and NIOSH. FEMCO has manufactured AutoROPS components used in product development and testing evaluation phases of the project.

Collaborative Outputs:

McKenzie, Jr., E.A., Etherton, J.R., Harris, J.R., Cantis, D.M and Lutz, T.J [2005] "NIOSH AutoROPS Research to Practice: Zero Turn Commercial Mowers" (IMECE2005-81575) *Proceedings of 2005 American Society of Mechanical Engineers, Congress and Exposition,* {November 11, 2005}: Orlando, FL

Lutz, T.J. and McKenzie, Jr., E.A.,[2005] "Remote Control on a Zero-turn Commercial Lawn Mower To Conduct SAE J2194 Rollover Test" Proceedings of the 2005 ASAE Annual International Meeting (#055004), {July 17-20 2005}Tampa, FL

Etherton JR, McKenzie, Jr., E.A., Lutz TJ, Cantis DM, Kau TY, [2004]. "An Initial Farmer Evaluation of a NIOSH AutoROPS Prototype," *International Journal of Industrial Ergonomics* 34:155-165

Intermediate Outcomes: With the help of industry, NIOSH successfully introduced a new American Society of Agricultural and Biological Engineers (ASABE) standard for the NIOSH AutoROPS. The new standard, ASABE-X599, Standardized Deployment Performance of an Automatic Telescoping ROPS for Agricultural Equipment, is in draft form and has undergone its first review. This standard, once issued, will give the manufacturers criteria to build, test, and sell AutoROPS to consumers

End Outcomes: This research is still ongoing

For Partners and Stakeholders:

Name of Organization: Garlock Equipment Company

Category of Organization: Manufacturer

Contact:

Richard B. Stoffels
Engineering Manager
rstoffels@garlock.org
(612) 747-8076

For Partners only:

Type of Formal Agreement (if any)**:**

A Material Transfer Agreement has been signed by the Manufacturer on March 16, 2006. It was approved by the CDC Tech Transfer Office on April 14, 2006 and by the NIOSH TTO on April 17, 2006.

Description of collaborative activities (narrative):

The adjustable roof bracket-safety rail assembly was shipped to the company for the company to conduct engineering analyses on the assembly, and to provide NIOSH with an estimate of the cost to produce the assembly and an estimate of what the final customer cost would be. After the company's initial price estimate, there was concern that the price suggested by the manufacturer might have been too expensive for the market to show any interest. The manufacturer has asked for additional time to conduct further marketing analyses, and to consider redesign options to produce this product easier and less expensively.

Collaborative Outputs: None to report.

Intermediate Outcomes: None to report.

End Outcomes: None to report.

For Partners and Stakeholders:

Name of Organization: HJA International

Category of Organization: Manufacturer

Contact:

Peter Hurd, CEO
phurd9@hotmail.com
(716) 332-7061

For Partners only:

Type of Formal Agreement (if any)**:** Cooperative Research and Development Agreement

Description of collaborative activities (narrative):

Through the use of this CRADA, NIOSH and HJA International have agreed to collaborate on the further developments of the "JamAlert" device for balers. Under the agreement, HJA will provide expertise in making the "JamAlert" device marketable. HJA will make modifications and fabricate prototypes for testing. NIOSH will assist with design modifications and testing. Together we will publish the results. The goal is to produce a commercial product that will be available to baler manufacturers and owners.

Collaborative Outputs: None to report.

Intermediate Outcomes: None to report.

End Outcomes: None to report.

For Partners and Stakeholders:

Name of Organization: Helicopter Association International

Category of Organization: Industry association representing helicopter pilots and helicopter transportation companies

Contact:

Harold L. Summers
Director, Flight Operations and Technical Services
Helicopter Association International
1635 Prince Street
Alexandria, VA 22314
Phone: (703) 683-4646
Fax: (703) 683-4745

For Partners only:

Type of Formal Agreement (if any)**:**

Developed Helicopter Logging Safety Committee based on NIOSH sponsored seminars/workshops on helicopter logging safety

Description of collaborative activities (narrative):

Collaborative Outputs:

Intermediate Outcomes:

NIOSH Publication No. 98-147, "Helicopter Logging Safety"

End Outcomes:

Since 1996 there have been no logging helicopter crashes in Alaska in spite of increased helicopter logging operations from 1996 through 1999.

For Partners and Stakeholders:

Name of Organization: Hugs One, LLC

Category of Organization: Manufacturer

Contact:

Joseph Martinez
Vice President of Operations
jmartinez@hugsone.org
(813) 966-7238

For Partners only:

Type of Formal Agreement (if any)**:**

After a lengthy phone conversation, Mr. Martinez expressed his interest in further collaboration with NIOSH regarding the adjustable roof bracket-safety rail assembly. A Confidential Disclosure Agreement has been signed by Mr. Martinez as a prelude to receiving additional information from the research team regarding the prototype assembly. This additional information was sent to Mr. Martinez in mid-September 2006.

Description of collaborative activities (narrative): None to report.

Collaborative Outputs: None to report.

Intermediate Outcomes: None to report.

End Outcomes: None to report.

For Partners and Stakeholders:

Name of Organization: Ideal Shield, LLC

Category of Organization: Manufacturer

Contact:

Chris Parenti
Vice President
cparenti@idealshield.org
(313) 842-7290

For Partners only:

Type of Formal Agreement (if any)**:**

A Material Transfer Agreement has been signed by the Manufacturer on March 24, 2006. It was approved by the CDC Tech Transfer Office (date not known) and by the NIOSH TTO on March 27, 2006.

Description of collaborative activities (narrative):

An adjustable roof bracket-safety rail assembly was shipped to the company for they could conduct engineering analyses on the assembly, and to provide NIOSH with an estimate of the cost to produce the assembly and an estimate of what the final customer cost would be. After receiving the prototype assembly, the company, disappointingly, has not returned any e-mail messages and has not returned any phone calls. They have not provided any feedback to NIOSH as to what their estimate of their manufacturing cost would be, and has not provided an estimate of the final selling cost to customers. The research team is dissatisfied with this lack of communication. They have not responded to an e-mail message to return the prototype materials. The NIOSH Tech Transfer Office has been made aware of this situation.

Collaborative Outputs: None to report.

Intermediate Outcomes: None to report.

End Outcomes: None to report.

For Partners and Stakeholders:

Project: Evaluation of Emergency Services Vehicle Occupant Safety

Name of Organization: H. Koch & Sons

Category of Organization: Manufacturer

Contact:

Charlie Van Druff
Engineering Manager
cvandruff@hkoch.com
(714) 779-7000

For Partners only:

Type of Formal Agreement (if any)**:**

Letter of Intent to CRADA
Confidential Disclosure Agreement

Description of collaborative activities (narrative):

H. Koch & Sons provided materials and engineering support to conduct dynamic tests of their gunner's restraint system through the NIOSH project, "Evaluation of Emergency Vehicle Occupant Safety" project. H. Kock & Sons responded to a FedBizOps announcement for this research, and their restraint system was one of four deemed to hold potential for worker occupant crash protection based on computer simulations.

Current U.S. ambulances use lap belts for occupant protection in the patient compartment. Proper use of lap belts require emergency service (EMS) workers to remain seated against the back of the seat. This prohibits mobility needed to access the patient and EMS equipment. NIOSH and its partners explored the potential of four types of mobile occupant restraints to provide crash protection for EMS workers in ambulance patient compartments while allowing needed mobility. The H. Koch & Sons gunner's restraint is intended for use in military helicopters and allows the door gunner to move around the aircraft while still providing crash protection. The project team believed that this technology could be transferred to a ground ambulance patient compartment. Using crash test dummies, the partners conducted dynamic sled tests and full scale vehicle crash tests. These tests yielded data that can be used for further system development and to support proper selection of restraints for ambulance patient compartments.

Collaborative Outputs:

Data collected from the tests was shared with H. Koch & Sons.

Intermediate Outcomes:

The EMS community has been introduced to a potential source of improved occupant restraint systems.

End Outcomes:

Though not yet realized, it is expected that EMS services and ambulance manufacturers will ultimately use restraint systems that are improvements over the currently used lap belts. This will lead to a reduction of crash-related injuries to EMS workers.

For Partners and Stakeholders:

Name of Organization: The Lehigh Group

Category of Organization: Manufacturer

Contact:

Mr. Ken Laga
Director of Marketing
klaga@thelehighgroup.org
(610) 966-9702, x-141

For Partners only:

Type of Formal Agreement (if any)**:**

After a lengthy phone conversation, Mr. Laga expressed his interest in further collaboration with NIOSH regarding the adjustable roof bracket-safety rail assembly. A Confidential Disclosure Agreement has been signed by Mr. Laga as a prelude to receiving additional information from the research team regarding the prototype assembly. This additional information was sent to Mr. Laga in mid-September 2006.

Description of collaborative activities (narrative): None to report.

Collaborative Outputs: None to report.

Intermediate Outcomes: None to report.

End Outcomes: None to report.

For Partners and Stakeholders:

Name of Organization: National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS)

Category of Organization: Academic/Advocacy

Contact:

Barbara Lee, PhD
Director, NCCRAHS
Marshfield Clinic
1000 North Oak Avenue
Marshfield, WI 54449-5790
E-Mail: Lee.Barbara@mcrf.mfldclin.edu
Telephone: (800) 662-6900 or (715) 387-9182

For Partners only:

Type of Formal Agreement (if any)**:** Cooperative Agreement

Description of collaborative activities (narrative):

NCCRAHS was established through the NIOSH cooperative agreement grants process as part of the broader NIOSH Childhood Agricultural Injury Prevention Initiative. This partnership has existed since fiscal year 1997. The main focus of the partnership is to provide NCCRAHS assistance in conducting a national outreach campaign to promote childhood agricultural injury prevention. NIOSH does this by providing surveillance and research results to NCCRAHS, which helps them define the types of activities the Center should be conducting. In addition, NIOSH staff participate in several NCCRAHS activities, providing scientific and technical assistance on these center projects.

Collaborative Outputs:

Conferences supported:

The Childhood Agricultural Injury Prevention Strategy Workshop: A Private Sector Perspective, November 90-11, 1997, Indianapolis, IN.
Special Session: Childhood Agricultural Injuries, Fourth International Symposium: Rural Health and Safety in a Changing World, October 18-22, 1998, Saskatoon, Saskatchewan, Canada.

Special Session: Childhood Agricultural Injuries, Agricultural Safety and Health in a New Century, April 28-30, 2000, Cooperstown, NY.

Special Session: Childhood Agricultural Injury Prevention, National Occupational Injury Research Symposium, October 17, 2000, Pittsburgh, PA.

Special Session: Childhood Agricultural Injuries, National Institute for Farm Safety 2001 Annual Meeting, June 24-27, 2001, Pittsburgh, PA.
2001 Summit on Childhood Agricultural Injury Prevention, April 30-May 1, 2001, Brooklyn Park, MN.

Special Session: The NIOSH childhood agricultural injury prevention initiative. National Occupational Injury Research Symposium, October 28-29, 2003, Pittsburgh, PA.

Conference Proceedings and Reports:

Lee B, Gallagher S, Marlenga B, Hard D Eds. [2002]. Childhood Agricultural Injury Prevention: Progress Report and Updated National Action Plan from the 2001 Summit. Marshfield, WI: Marshfield Clinic.

Vela-Acosta M, Lee B Eds. [2001]. Migrant and Seasonal Hired Adolescent Farmworkers: A Plan to Improve Working Conditions. Marshfield, WI: Marshfield Clinic.

Presentations:

Hard DL [2003]. The NIOSH childhood agricultural injury prevention initiative. National Occupational Injury Research Symposium, October 28-29, 2003, Pittsburgh, PA.

Hard D, Castillo D, Myers J, Pizatella T, Olenchock S. [2000]. Overview of the NIOSH childhood agriculture injury prevention initiative. National Occupational Injury Research Symposium, October 17-19, 2000, Pittsburgh, PA.

Myers JR, Hendricks K. [2000]. NIOSH approach to childhood agricultural injury surveillance. Agricultural Safety and Health in a New Century, April 28-30, 2000, Cooperstown, New York.

Myers JR, Hendricks K. [2000]. NIOSH approach to childhood agricultural injury surveillance. Presented at the National Occupational Injury Research Symposium (NOIRS), Pittsburgh, PA, October 17-19, 2000.

Intermediate Outcomes:

NCCRAHS Using NIOSH Surveillance:

1. One significant finding from the CAIS, M-CAIS, and NIOSH death certificate studies has been the importance of non-work injuries and fatalities to youth on farms. These findings led to the development of a new recommendation in the updated 2002 Childhood Agricultural Injury Prevention National Action Plan to address non-work injuries on farms. In response to this new recommendation, NCCRAHS produced several documents on the importance and design of safe play areas for children on farms. NCCRAHS also maintains a website dedicated to the topic of safe play areas on farms (see http://www.marshfieldclinic .org/nfmc/pages/default.aspx?page=nfmc_nccrahs_safe_play_ welcome).

2. NCCRAHS reports the results from the NIOSH youth farm injury surveillance studies. Following the lead of NCCRAHS, other childhood injury prevention organizations, such as Farm Safety for Just Kids and the National Safe Kids Campaign now use the NIOSH injury and injury rate estimates for children on farms as their official numbers.

3. In 1999, Dr. Barbara Marlenga of NCCRAHS, approached NIOSH to provide assistance on a research project. Dr. Marlenga's research required a national sample of farms with household youth 7 to 16 years of age. NIOSH worked with NASS to identify farms with household youth in this age range and asked if they would be willing to participate in this study as part of the CAIS data collection effort. Dr. Marlenga was given access to those farm families who agreed to participate. Results of Dr. Marlenga's study are reported in: Marlenga BL**,** Pickett W, Berg RL. [2002]. Evaluation of an enhanced approach to the dissemination of the North American Guidelines for Children's Agricultural Tasks: a randomized controlled trial. Preventive Medicine 35:150-159. PubMed ID: 12200100

4. NIOSH has also worked with NASS to provide CAIS data to Dr. Marlenga for two additional research studies. Results from the 1998 CAIS were used by Dr. Marlenga to assess whether guidelines for assigning youth work tasks based on their age would have prevented certain types of farm injuries. Results of this research are reported in: Marlenga BL**,** Brison RJ, Berg RL, Zentner JL, Linneman JG, Pickett W. [2004]. Evaluation of the North American Guidelines for Children's Agricultural Tasks using a case series of injuries. Injury Prevention 10:350-357. PubMed ID: 15583256

Data from the 1998 CAIS and 2000 M-CAIS have also been provided to Dr. Marlenga to assess the potential impact of applying Child Labor hazardous orders for youth working on farms to youth working on their family's farm. This research is still in progress.

5. Dr. Barbara Lee, Director of the NCCRAHS, recently published an editorial in the Journal of Agromedicine (2005: Vol. 10(4)) entitled 'NIOSH Fills Void with Surveillance of Injuries to Youth Living on U.S. Farms." This editorial commends the work that NIOSH done in the leadership role of the Childhood Agricultural Injury Prevention Initiative and in collecting youth farm injury data that was previously unavailable. Additionally, Dr. Lee encourages others to give their support to NIOSH and the continuation of the NIOSH childhood agricultural injury surveillance plan.

Technical and Scientific Interactions with NCCRAHS:

1. Dr. Hard represented NIOSH as an active participant in the expert panel that developed the 62 North American Guidelines for Children's Agricultural Tasks (NAGCATs) by the NCCRAHS.

2. NIOSH sponsored research has shown that the NAGCATs can be an effective means of reducing injuries to youth on farms. A controlled study conducted in the State of New York found that farm parents who used the NAGCATs reported a 50% reduction in youth farm injuries compared to youth in control farm families.

3. A 2001 Summit on Childhood Agricultural Injury Prevention was convened by the National Children's Center for Rural and Agricultural Health and Safety with substantial involvement by the project officer, Dr. David Hard. The goal of the Summit was to propose specific injury prevention strategies based on knowledge gained from research and interventions undertaken since the endorsement of the 1996 National Action Plan, *Children and Agriculture: Opportunities for Safety and Health.* This resulted in publication:

Lee, B., Gallagher, S., Marlenga, B., & Hard, D. (Eds.). (2002). Childhood Agricultural Injury Prevention: Progress Report and Updated National Plan from the 2001 Summit. Marshfield, WI: Marshfield Clinic.

Available via internet at: http://marshfieldclinic.org/nfmc/Pages/Proxy.aspx?Content=MCRF-Centers-NFMC-nccrahs-reports-summitreport.1.pdf

The 2001 Summit Report was utilized by NIOSH in providing further guidance in administering the NIOSH Childhood Agricultural Injury Initiative.

4. The NCCRAHS published *Creating Safe Play Areas on Farms* in 2003 to provide safety professionals and community leaders guidance on addressing this emerging issue. This document has increased the attention to the development of safe, structured, supervised play areas for children on farms, and has prompted many Safety Day Camps for farm youth to offer parent-oriented programs to promote fenced, supervised play areas for children on farms.

End Outcomes:

1. The NIOSH Childhood Agricultural Injury Prevention Initiative began in 1997. Since the beginning of this initiative, NIOSH has worked closely with the NCCRAHS to identify and promote injury prevention activities nationwide. In addition, NIOSH had funded numerous research projects to improve our understanding of both the effectiveness of existing and new interventions. During the initiative, the total number of youth injured on farms has decreased from 37,800 in 1998 to 27,600 in 2004. For the same time period, the number farm work-related youth injuries decreased by 51% from 16,695 down to 8,130 *(Table 1)* (**Source**: NIOSH CAIS).

*Table 1. Injuries to youth less than 20 years of age that occurred on U.S farms during 1998, 2001, and 2004, by sex and work status (**Source:** NIOSH CAIS).*

	1998	2001	2004
Injuries‡	37,774	29,207	27,590
Male	29,564	16,526	14,390
Female	8,210	12,641	13,201
Work	16,695	9,481	8,130
Non-work	18,169	19,611	19,439

‡ Total injuries may not add up due to rounding or missing data.

2. A major focus of the NIOSH Childhood Agricultural Injury Prevention Initiative has been working with the NCCRAHS on the development and promotion of the North American Guidelines for Childhood Agricultural Tasks (NAGCAT) released in 1999. The primary focus of the NAGCAT is to provide guidance to farm families on how to assign work to farm youth to reduce their risk of injury. The NAGCAT have been widely reported in the popular farm press, and have been shown to be effective in reducing injuries to household youth in one controlled study. Since the establishment and promotion of the NAGCATS, work-related farm injuries to youth living on the farms have decreased from 11,600 injuries in 1998 down to 6,400 in 2004. The work-related injury rate for household youth decreased from 14.1 to 9.1 injuries per 1000 working household youth for the same period *(Figure 1)* (**Source:** NIOSH CAIS).

3. Males account for 58% of the household youth who work on farms, and have traditionally accounted for most of the work-related youth injuries occurring on farms. Since the introduction of the NAGCATs, farm injuries to young males on farms decreased 50%. A major part of this decrease was seen for work-related farm injuries to males that decreased from 11,800 in 1998 to 5000 in 2004 (**Source**: NIOSH CAIS). The male household youth work-related injury rate decreased from 20.3 to 9.0 injuries per 1000 working household youth during this same time period *(Figure 2)* (**Source**: NIOSH CAIS).

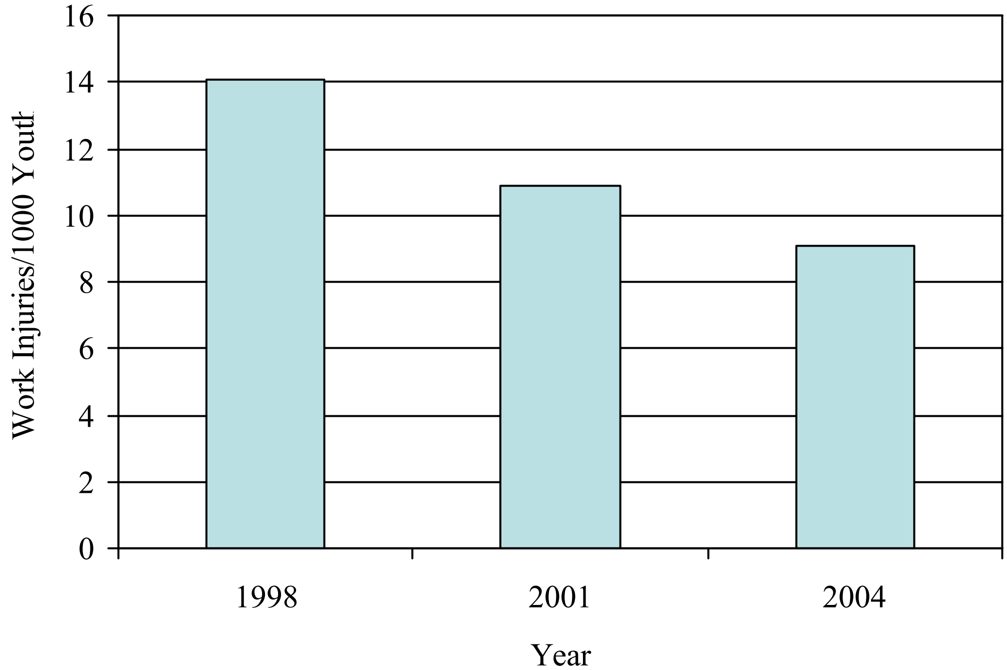


*Figure 1. Work Injuries per 1000 Working Farm Household Youth, 1998-2004 (**Source**: NIOSH CAIS).*

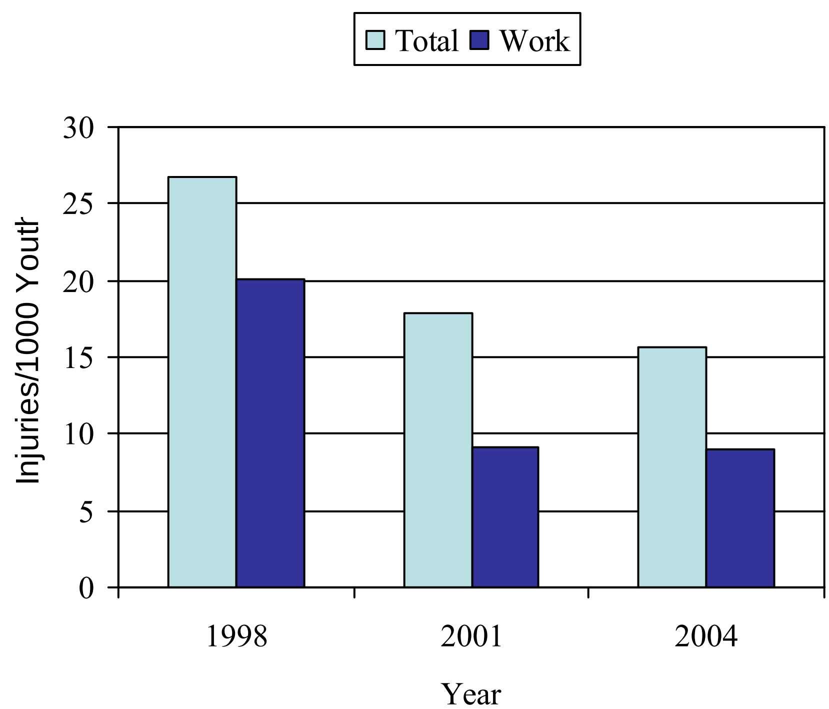


*Figure 2. Injuries per 1000 Household Male Youth and Work Injuries per 1000 Working Household Male Youth, 1998-2004 (**Source**: NIOSH CAIS).*

For Partners and Stakeholders:

Name of Organization: Mine Safety Appliances Co.

Category of Organization: Manufacturer

Contact:

Joseph Feldstein
Manager of Technical Services
Joseph.Feldstein@MSAnet.com
(303) 922-6246 Ext 304

For Partners only:

Type of Formal Agreement (if any)**:** Letter of Agreement

Description of collaborative activities (narrative):

Mine Safety Appliances Co. has actively participated in the TI Harness Sizing research and is finalizing the adjustment range of each harness component with the NIOSH research team. They have provided original static-test criteria, harness blue prints, and technical input for each study and have continued to provide feedback on proposed new sizing systems. They also are working on prototypes of harnesses based on the proposed new sizing systems and other TI program study results.

Collaborative Outputs:

A provisional sizing scheme with an algorithm that describes the human torso-shape-and-size distribution and a set of recommendations for producing vest-type harnesses has been accepted for publication by the Human Factors journal. Mine Safety Appliances (MSA) Co. reviewed the report before our submission to the journal in 2005. The provisional sizing scheme is currently being used by MSA for the first-stage prototype development. A simplified version of the provisional sizing schedule was also presented at the Ergonomics Society Conference and was published in the Contemporary Ergonomics in 2005.

The draft report of the second provisional size scheme has been shared with MSA. NIOSH, two research contractors, and MSA are finalizing the adjustment range of each harness component. The final report is expected to be completed in December 2006. MSA and NIOSH research team will complete the prototypes of the new generation over-the-head harnesses in year 2007 for NIOSH to conduct validation studies to determine the validity and reliability of the newly established sizing system.

Intermediate Outcomes:

Development of prototype harnesses that incorporates the TI schemata is currently underway at the Mine Safety Appliances (MSA) Co. MSA has indicated interest in more extensive efforts to develop the next-generation harness designs and prototypes using the criteria and schemata identified by the TI program. MSA was strategically selected to participate in the TI pilot studies in year 2000 in that MSA expressed interest to TI team in the past that they plan to revise fall protection designs using updated measurements of human form. MSA also responded to the NIOSH announcement on the Federal Business Opportunities in 2003 for partnership in harness-sizing studies and in transferring the knowledge into design process and commercialization. Since MSA and the other NIOSH partner harness manufacturer account for about 60% of the national market share of fall-arrest harnesses, the future adoption potential of the new harnesses and sizing systems in the construction trades is very high

End Outcomes: Not available yet

For Partners and Stakeholders:

Name of Organization: OSHA/NIOSH Roadway Work Zone Safety and Health Coalition Alliance

Category of Organization: Government- led (OSHA). Includes industry associations (Road Construction) and labor unions. Functions as an advocacy group.

Contact:

Todd Briggs, Program Analyst
OSHA Directorate of Cooperative and State Programs
Briggs.Todd@dol.gov
(202) 693-2200

For Partners only:

Type of Formal Agreement (if any)**:** OSHA Alliance Agreement

Description of collaborative activities (narrative):

On November 18, 2003, OSHA, the National Institute for Occupational Safety and Health (NIOSH) and the Roadway Work Zone Safety and Health Coalition (National Asphalt Pavement Association, American Road and Transportation Builders Association, Laborers' International Union of North America, and the International Union of Operating Engineers) formed an Alliance focusing on providing information, guidance, and access to training resources to protect employees' health and safety, particularly in reducing and preventing exposure to roadway work zone safety and health hazards. The NIOSH representative actively participated in Alliance meetings and activities, including providing technical assistance and review of draft materials.

OSHA, NIOSH, and the Roadway Work Zone Safety and Health Coalition are working together to sign a new Alliance agreement with additional signatories, including the Federal Highway Administration and the Associated General Contractors of America. As a result, OSHA and the Roadway Work Zone Safety and Health Coalition agreed to conclude the Alliance signed November 18, 2003 as of February 10, 2006.

Collaborative Outputs:

The Alliance had a number of collaborative outputs. Only those in which NIOSH played a key role are identified below.

Roadway Safety, a CD-ROM-based training program which addresses highway work zone safety hazards including runovers, struck by, noise, electrical and falls. The training program incorporates information regarding working around operating construction equipment, construction equipment blind areas and implementing internal traffic control plans developed by the NIOSH research project, Evaluating Roadway Construction Work Zone Interventions.

An "Internal Traffic Control Plans" brochure which details how to safely manage the flow of construction vehicles and equipment operating near ground workers in a roadway construction work zone. NIOSH played a key role in supporting the development of the brochure by providing content, technical assistance, and review. The brochure is considered a joint publication of the Alliance members and includes the NIOSH logo, as well as logos from other Alliance participants. [Roadway Work Zone Safety and Health Coalition Alliance [2005]. Internal traffic control plans. Washington, DC: Laborers' Health and Safety Fund of North America, CDC Contract 212-2003-M-02677].

Intermediate Outcomes: None to report

End Outcomes: None to report

Project: Evaluation of Emergency Services Vehicle Occupant Safety

For Partners and Stakeholders:

Name of Organization: Ontario (Canada) Ministry of Health

Category of Organization: Government

Contact:

Mr. Tim Cooke
COOKETI@sdsx.moh.gov.on.ca
(416) 326-7325

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

Current U.S. ambulances use lap belts for occupant protection in the patient compartment. Proper use of lap belts require emergency service (EMS) workers to remain seated against the back of the seat. This prohibits mobility needed to access the patient and EMS equipment. NIOSH and its partners explored the potential of four types of mobile occupant restraints to provide crash protection for EMS workers in ambulance patient compartments while allowing needed mobility. Using crash test dummies, the partners conducted dynamic sled tests and full scale vehicle crash tests. These tests yielded data that can be used for further system development and to support proper selection of restraints for ambulance patient compartments.

As a part of the project team, the Ontario (Canada) Ministry of Health provided a fully functional operating ambulance for destructive testing as a part of the instrumented crash test program conducted at PMG Technologies near Montreal, Ontario (Canada). The estimated value of this ambulance to the project team was $25,000 US.

Collaborative Outputs:

Data collected from the tests was shared with Ontario (Canada) Ministry of Health in a joint brief with the Canadian Forces Health Group. Data was also provided in electronic format for their use.

Intermediate Outcomes:

To date, we are unaware of any additional activities resulting from the work on this project within the Ontario (Canada) Ministry of Health.

End Outcomes:

It is expected that EMS services and ambulance manufacturers will ultimately use restraint systems that are improvements over the currently used lap belts. This will lead to a reduction of crash-related injuries to EMS workers.

Project: Evaluation of Emergency Services Vehicle Occupant Safety

For Partners and Stakeholders:

Name of Organization: Pacific Scientific

Category of Organization: Manufacturer

Contact:

Steve Fanelli, Director of Sales
sfanelli@htl.pacsci.com
(626) 434-1178

For Partners only:

Type of Formal Agreement (if any):

Letter of Intent to CRADA
Confidential Disclosure Agreement

Description of collaborative activities (narrative):

Pacific Scientific provided materials and engineering support to conduct dynamic tests of their gunner's restraint system through the NIOSH "Evaluation of Emergency Vehicle Occupant Safety" project. Pacific Scientific responded to a FedBizOps announcement for this research, and their restraint system was one of four deemed to hold potential for worker occupant crash protection based on computer simulations.

Current U.S. ambulances use lap belts for occupant protection in the patient compartment. Proper use of lap belts require emergency service (EMS) workers to remain seated against the back of the seat. This prohibits mobility needed to access the patient and EMS equipment. NIOSH and its partners explored the potential of four types of mobile occupant restraints to provide crash protection for EMS workers in ambulance patient compartments while allowing needed mobility. The Pacific Scientific gunner's restraint is intended for use in military helicopters and allows the door gunner to move around the aircraft while still providing crash protection. The project team believed that this technology could be transferred to a ground ambulance patient compartment. Using crash test dummies, the partners conducted dynamic sled tests and full scale vehicle crash tests. These tests yielded data that can be used for further system development and to support proper selection of restraints for ambulance patient compartments.

Collaborative Outputs:

Data collected from the tests was shared with Pacific Scientific.

Intermediate Outcomes:

The EMS community has been introduced to a potential source of improved occupant restraint systems.

End Outcomes:

Though not yet realized, it is expected that EMS services and ambulance manufacturers will ultimately use restraint systems that are improvements over the currently used lap belts. This will lead to a reduction of crash-related injuries to EMS workers.

Project: HCCB7 9277178 - New Technology to Increase ROPS Use on Tractors:

For Partners and Stakeholders:

Name of Organization: Scag Power Equipment

Category of Organization: Commercial manufacture of lawn care equipment primarily Zero-turn commercial mowers

Contact:

Dave Sugden, Vice President Product Development
dsugden@Mtlcraft.com
(920) 387-0100

For Partners only:

Type of Formal Agreement (if any): Letter of Agreement

Description of collaborative activities (narrative):

NIOSH, through a partnership with SCAG Power Equipment, a zero turn mower manufacturer, obtained support for the Office of Technology Transfer and Commercialization (OTTC) to develop an AutoROPS design for a zero turn mower. OTTC is a private, nongovernmental office with the mission of promoting the transition of new technologies to the marketplace. As part of this process, OTTC conducted a marketing study for NIOSH for this technology.

Collaborative Outputs:

McKenzie, Jr., E.A., Etherton, J.R., Harris, J.R., Cantis, D.M and Lutz, T.J [2005] "NIOSH AutoROPS Research to Practice: Zero Turn Commercial Mowers" (IMECE2005-81575) *Proceedings of 2005 American Society of Mechanical Engineers, Congress and Exposition,* {November 11, 2005}: Orlando, FL

Lutz, T.J. and McKenzie, Jr., E.A.,[2005] "Remote Control on a Zero-turn Commercial Lawn Mower To Conduct SAE J2194 Rollover Test" Proceedings of the 2005 ASAE Annual International Meeting (#055004), {July 17-20 2005}Tampa, FL

Etherton JR, McKenzie, Jr., E.A., Lutz TJ, Cantis DM, Kau TY, [2004]. "An Initial Farmer Evaluation of a NIOSH AutoROPS Prototype,**"** *International Journal of Industrial Ergonomics* 34:155-165

Intermediate Outcomes:

With the help of industry, NIOSH successfully introduced a new American Society of Agricultural and Biological Engineers (ASABE) standard for the NIOSH AutoROPS. The new standard, ASABE-X599, Standardized Deployment Performance of an Automatic Telescoping ROPS for Agricultural Equipment, is in draft form and has undergone its first review. This standard, once issued, will give the manufacturers criteria to build, test, and sell AutoROPS to consumers

End Outcomes: This research is still ongoing

For Partners and Stakeholders:

Project: Evaluation of Emergency Services Vehicle Occupant Safety

Name of Organization: Schroth Safety Products

Category of Organization: Manufacturer

Contact:

Ron Grilliot, President
ron.grilliot@schroth,com
(954) 784-3178

For Partners only:

Type of Formal Agreement (if any)**:**

Letter of Intent to CRADA
Confidential Disclosure Agreement

Description of collaborative activities (narrative):

Schroth Safety Products provided materials and engineering support to conduct dynamic tests of their High Mobility Restraint (HMR) System through the NIOSH project, "Evaluation of Emergency Vehicle Occupant Safety" project. Schroth Safety Products responded to a FedBizOps announcement for this research, and their restraint system was one of four deemed to hold potential for worker occupant crash protection based on computer simulations.

Current U.S. ambulances use lap belts for occupant protection in the patient compartment. Proper use of lap belts require emergency service (EMS) workers to remain seated against the back of the seat. This prohibits mobility needed to access the patient and EMS equipment. NIOSH and its partners explored the potential of four types of mobile occupant restraints to provide crash protection for EMS workers in ambulance patient compartments while allowing needed mobility. Using crash test dummies, the partners conducted dynamic sled tests and full scale vehicle crash tests. These tests yielded data that can be used for further system development and to support proper selection of restraints for ambulance patient compartments.

Collaborative Outputs:

Data collected from the tests was shared with Schroth Safety Products. The company is using the data to support system refinement.

Intermediate Outcomes:

The EMS community has been introduced to a source of improved occupant restraint systems. As a result of this work, Schroth Safety Products has developed a marketing plan for the emergency medical services industry. The company has been working with several U.S. ambulance manufacturers to adapt the systems to specific ambulance designs. Schroth restraint systems are being used to equip concept ambulances. Additionally, Schroth has been working with EVS Ltd., a seat manufacturer that supplies ambulance manufacturers. EVS and Schroth have incorporated the system into a prototype attendant's seat

End Outcomes:

Though not yet realized, it is expected that EMS services and ambulance manufacturers will ultimately use restraint systems that are improvements over the currently used lap belts. This will lead to a reduction of crash-related injuries to EMS workers.

Project: Evaluation of Emergency Services Vehicle Occupant Safety

For Partners and Stakeholders:

Name of Organization: United States Army Tank and Automotive Research Engineering and Development Center

Category of Organization: Government

Contact:

Richard McClelland, PhD
mcclellr@tacom.army.mil
(586) 574-6144

For Partners only:

Type of Formal Agreement (if any)**:** None

Description of collaborative activities (narrative):

Current U.S. ambulances use lap belts for occupant protection in the patient compartment. Proper use of lap belts require emergency service (EMS) workers to remain seated against the back of the seat. This prohibits mobility needed to access the patient and EMS equipment. NIOSH and its partners explored the potential of four types of mobile occupant restraints to provide crash protection for EMS workers in ambulance patient compartments while allowing needed mobility. Using crash test dummies, the partners conducted dynamic sled tests and full scale vehicle crash tests. These tests yielded data that can be used for further system development and to support proper selection of restraints for ambulance patient compartments. As a part of the project team, the U.S. Army provided partial funding for the crash test facility and an instrumented test manikin for use in support of dynamic sled and crash testing for each of the four mobile restraint systems tested.

Collaborative Outputs:

Data collected from the tests was shared with U.S. Army's Tank and Automotive Research Engineering and Development Center.

Intermediate Outcomes:

While we are not aware of any ongoing work with the ambulance environment within the U.S. Army, as a follow-on effort, the U.S. Army is now working with one of the four restraint manufacturers from this project, Schroth Safety Products, to develop and field a restraint system to protect turret gunners riding in a military version of the Humvee. Though it is understood the system to be fielded by the Army has an additional tether or lanyard to mitigate vertical loading in the event of a vehicle roll, the testing and collaborative work undertaken in this project was a catalyst to the Humvee effort.

End Outcomes:

It is expected that EMS services and ambulance manufacturers will ultimately use restraint systems that are improvements over the currently used lap belts. This will lead to a reduction of crash-related injuries to EMS workers.

Project: HCCB7 9270025 – Fall Prevention for Aerial Lifts in the Construction Industry:

For Partners and Stakeholders:

Name of Organization: SkyJack Inc.

Category of Organization: Industry Association

Contact:

Brad Boehler, P.Eng, *Director, Product Safety*
55 Campbell Road, Guelph, Ontario, Canada N1H 1B9
Tel: (519) 837-0888 Toll Free: (800) 265-2738
Fax: (519) 837-3102
brad.boehler@skyjackinc.com
www.skyjackinc.com www.linamar.com

For Partners only:

Type of Formal Agreement (if any): Letter of Agreement (LOA)

Description of collaborative activities (narrative):

Following a presentation to the ANSI committee on scaffolding and aerial lift safety, as well as subsequent, intensive communication and negotiation with officers and representatives of the committee and industry representatives, as well as public announcements, a select group of invitees came to Morgantown, WV, for a public meeting on research directions for aerial lift safety. As a result of these events and negotiations, a letter of agreement (LOA) was signed on October 7, 2004 with a leading scissor lift manufacturer – SkyJack Inc. Based on the LOA, SkyJack agreed to provide the project with the use of two new scissor lifts for the duration of the project, an extra platform, and other critical technical and design data. This represents an unprecedented degree of cooperation between an industrial manufacturer and NIOSH; this manufacturer has provided a significant item of capital equipment for NIOSH research use, and has additionally assumed the responsibility for shipping the lift and platform to NIOSH. Additionally, SkyJack provided training at a NIOSH facility in April, 2005. This LOA not only provides the project with a strong collaborative partnership with a leading scissor lift manufacturer, but it saves the project the funds that would be required to purchase the lifts and experimental hardware; two new scissor lifts and a new platform are valued at approximately $45,000, at this stage. Further, NIOSH-purchased equipment would need to be replaced or repaired in the event of accidental damage during testing; SkyJack has indicated a willingness to continue support of the project in this unlikely event.

Collaborative Outputs:

As the leading manufacturer of scissor lifts, SkyJack is intimately familiar with the myriad of issues related to aerial lifts safety--in terms of design, manufacturing, materials, training, use and misuse, and the record of injuries and deaths associated with the use of this equipment. Mr. Boehler has provided NIOSH with continuous information about acceptable and unacceptable practices and parameters associated with the design and use of this equipment, and has provided expertise, items of capital equipment, design criteria, and assistance in the form of public support for this project, and has indicated willingness to continue to do so in the future, and to assume a leadership role in the dissemination and diffusion of knowledge related to these issues to the manufacturing, user and standards community. Mr. Boehler will also help transfer the study products/outcomes to practical production elements/designs for SkyJack. SkyJack's cooperation is widely recognized within the aerial lift and scaffolding industries, and represents an unprecedented initiative within an industry which had previously been concerned about cooperation with governmental agencies, given the possibility of regulatory and legislative oversight over industry standards.

Intermediate Outcomes:

SkyJack engineers and safety officers have been continuously involved in developing aspects of the study protocol, in transferring information to NIOSH on critical design and engineering parameters, and in providing public testimony. Additionally, Mr. Boehler has presented information to peers within the ANSI A92 committee on the purpose and design of the study, and has indicated willingness to provide material support to ensure that the project continues. Data collection for this project will continue, under field conditions, and Mr. Boehler has indicated willingness to continue to assess effectiveness of the modeling effort in validating performance. Mr. Boehler's involvement in evaluation is twofold: First, validation of the model will establish to the industry that the model will not expose manufacturers to frivolous product-liability lawsuits, and that the design parameters are defensible and safe for widespread dissemination and use within the manufacturing community; and Second, that lifts, if within the parameters or redesigns set forth by the manufacturers are safe, and that he and other colleagues can concentrate on training operators to know and stay within these guidelines for their own safety. Evaluation of the requirements and effectiveness of this operator training could also be additional NIOSH research targets; ANSI members have consistently indicated that proper training and behavioral aspects of operations are of great importance in assuring operational safety. SkyJack and ANSI have indicated a willingness to conduct safety efforts in this area with NIOSH partnership.

End Outcomes:

A validated computer simulation model and related design recommendations/ interventions are the end outcomes of this project. The outcomes of this project will immediately be used for aerial lift companies involved with design and production of equipment — representing a step forward in the r2p process, and involving purposeful collaboration between a leading manufacturing partner and NIOSH. NIOSH partners have indicated that they are willing to be instrumental in the distribution of this information to end users, design engineers, industrial partners, and other stakeholders. External partners have also expressed willingness to support future NIOSH endeavors in this area and to express public support for NIOSH research endeavors in public and private forums. This project has implications for many types of lift equipment used in construction, building maintenance, warehousing, and other applications. The involvement of NIOSH in addressing advanced engineering aspects of cross-sector safety research is directly extensible to boom trucks, cranes, scaffolds, and other elevating equipment. Additionally, this project has implications for the entire area of fall safety, in that the safe engineering of mechanized lift equipment is significantly related to many aspect of fall safety for workers operating at height.

For Partners and Stakeholders:

Name of Organization: Vermeer Manufacturing Company

Category of Organization: Manufacturer

Contact:

Ivan Brand, Senior Technical Coordinator (Product Safety)
ibrand@vermeermfg.com, (641) 621-7323

For Partners only:

Type of Formal Agreement (if any)**:**

Letter of Intent for a Cooperative Research and Development Agreement

Description of collaborative activities (narrative):

Through the LOI, NIOSH and Vermeer were able to share expertise towards the development of a sensor to detect an operator's hands on the controls levers of a stump grinder. Vermeer provided hardware that NIOSH researchers tested in the laboratory. NIOSH provided prototypes to Vermeer, including drawings and source code, that they tested and modified at their manufacturing plant. Remaining collaborative work will involve the testing of the prototype on the stump grinder and jointly publishing results.

Collaborative Outputs: None to report.

Intermediate Outcomes:

Vermeer is developing a prototype device to be tested on the stump grinder.

End Outcomes: None to report.

For Partners and Stakeholders:

Name of Organization: U.S. Consumer Product Safety Commission (CPSC)

Category of Organization: Federal Government

Contact:

Tom Schroeder, Director
Division of Hazard and Injury Data Systems
U.S. Consumer Product Safety Commission
Email: TSchroeder@cpsc.gov
(800) 638-8095 x7431

For Partners only:

Type of Formal Agreement (if any): Interagency Agreement

Description of collaborative activities:

NIOSH and CPSC collaborate to collect nonfatal work-related injuries and illnesses treated in U.S. hospital emergency departments through the CPSC National Electronic Injury Surveillance System (NEISS)—a surveillance system originally intended for the collection of consumer-product related injuries. CPSC collects data for NIOSH at a national probability-based sample of hospital emergency departments (nominally 67) and provides technical expertise on the collection, management, analysis, and interpretation of NEISS data. In turn, NIOSH helps financially support the NEISS program and provides reciprocal technical expertise on matters of joint interest.

From time to time, as funding has permitted, NIOSH has conducted in depth followback special topic interview studies with injured workers identified through the NEISS. CPSC has assisted in development of telephone survey instruments, case identification, assignment of interviews to a third-party contractor, and collection of interview data.

The interagency collaboration provides breadth and stability to the NEISS increasing its utility to a broader public and government audience.

Collaborative Outputs: Annual NEISS data

Intermediate Outcomes:

The NIOSH Work-RISQS public query site has been used by external researchers as the sole data source to produce a peer-reviewed journal article (Xiang H, Stallones L, Chen G, Smith GA, 2005. Work-related eye injuries treated in hospital emergency departments in the US: Am J Ind Med; 48:57-62).

Two objectives for Healthy People 2010, reducing young worker and occupational eye injuries, rely on NEISS-Work data for tracking of progress over the decade.

End Outcomes:

For Partners and Stakeholders:

Name of Organization: US Food and Drug Administration / Center for Devices and Radiological Health (CDRH)

Category of Organization: Government (Federal)

Contacts:

Daniel Schultz, MD., Director CDRH
dbs@cdrh.fda.gov, (301) 827-7975)

John J. Crowley
Director Regulatory Affairs, Office of Surveillance and Biometrics
jjc@cdrh.fda.gov, (240) 276-2389

For Partners only:

Type of Formal Agreement (if any)**):**

Interagency agreement in 1999 for FDA to develop a video on safe handling of oxygen regulators.

Description of collaborative activities (narrative):

In 1998, the International Association of Fire Fighters (IAFF) requested that the NIOSH, Division of Safety Research investigate a series of incidents involving fire fighters who were injured when portable oxygen resuscitators spontaneously ignited and burned. Some of these incidents resulted in serious burn injuries. NIOSH contacted the Food and Drug Administration since the FDA is responsible for the approval of this type of medical device. A review of FDA data identified at least 16 work-related incidents during the prior six years (1993-1999), in which 15 people were injured, including 11 fire fighters, three emergency medical technicians, and one health care worker. A joint FDA and NIOSH investigation was initiated to identify the cause of these regulator fires, with consultation from the NASA White Sands Test Facility that has expertise in compressed oxygen delivery systems, and the contracted services of a forensics testing laboratory, Wendell Hull and Associates (WHA). It was quickly determined that most of the incidents involved the same model oxygen regulator, and NIOSH and FDA worked with this manufacturer who took steps to address the hazard (see "Intermediate Outcomes" section). WHA identified the source of ignition in these incidents to be particle impact within the internal oxygen flow path inside the regulators. This model regulator was constructed of aluminum which is known to be a poor material for use in compressed oxygen systems. In February 1999, FDA and NIOSH issued a joint Public Health Advisory which was distributed to approximately 37,000 fire departments, emergency medical services (EMS), state fire marshals, and healthcare organizations. FDA and NIOSH also entered into an interagency agreement in which FDA produced a video on safe handling procedures for oxygen regulators (see "Collaborative Outputs" section).

On February 23, 2005, the Virginia Beach Fire Department contacted the NIOSH, Division of Safety Research, Fire Fighter Fatality Investigation and Prevention Program and requested NIOSH's assistance in evaluating an oxygen resuscitator that ignited and burned while fire department crew members were going about their daily equipment checks. NIOSH again contacted the FDA, and a joint investigation was undertaken to identify the cause of the resuscitator ignition and resultant fire, with FDA and NIOSH jointly funding WHA to conduct a forensic evaluation of the oxygen resuscitator. The WHA evaluation indicated that the ignition was most likely the result of flow friction caused by oxygen leaking across the surface of the deformed oxygen resuscitator sealing gasket used to create the seal at the cylinder valve / regulator interface. The type of gasket used in this oxygen resuscitator was a plastic (nylon®) crush gasket suitable for single use applications. Because of evidence that this type of single use gasket is routinely re-used in the emergency medical services (EMS) and healthcare professions, FDA and NIOSH issued a joint Public Health Notification in April 2006, to alert users to the dangers associated with the incorrect use of these seals (see "Collaborative Outputs" section). The notice was distributed to approximately 38,000 fire departments, emergency medical services (EMS), state fire marshals, and healthcare organizations.

Collaborative Outputs:

NIOSH [1998a]. Oxygen Regulator Flash Severely Burns one Fire Fighter – Florida. Cincinnati, OH: U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. NIOSH FACE Report 98F-23.

NIOSH [1998b]. Emergency Medical Technician Receives Serious Burns from an Oxygen Regulator Flash Fire - South Carolina. Cincinnati, OH: U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. NIOSH FACE Report 98F-24.

NIOSH [1999]. Aluminum Regulator Fire Injures One Fire Fighter – Nevada. Cincinnati, OH: U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. NIOSH FACE Report 99F-07.

FDA and NIOSH [1999]. FDA and NIOSH Public Health Advisory: Explosions and Fires in Aluminum Oxygen Regulators. Cincinnati, OH: U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Also posted on the internet at the FDA website: http://www.fda.gov/cdrh/oxyreg.html

FDA and NIOSH [2001]. Video - "Hidden Danger: Oxygen Regulator Fires" Rockville, MD: Food and Drug Administration. Available at
http://www.fda.gov/cdrh/ocer/dcm/html/gallery.html

FDA and NIOSH [2006]. FDA and NIOSH Public Health Notification: Oxygen Regulator Fires Resulting from Incorrect Use of CGA 870 Seals. Cincinnati, OH: U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Also posted on the internet at the FDA website: http://www.fda.gov/cdrh/safety/042406-o2fires.html and the NIOSH website: http://www.cdc.gov/niosh/fire/

Intermediate Outcomes:

The primary manufacturer of oxygen regulators that had spontaneously ignited in the 1990s, recalled over 200,000 regulators from the field, developed a retrofit kit to convert the oxygen flow path within existing regulators to brass (a material much better suited for use in compressed oxygen systems), and modified their new production to include brass components.

The 1998-1999 investigation by FDA, NIOSH and NASA ultimately resulted in the development and adoption of a new standard test method to evaluate oxygen regulators for susceptibility to particle impact ignition and fires. Representatives of the NASA White Sands Test Facility led the development of this standard, known as the American Society for Testing and Materials *G175-03 Standard Test Method for Evaluating the Ignition Sensitivity and Fault Tolerance of Oxygen Regulators Used for Medical and Emergency Applications*. (http://www.astm.org/cgi-bin/SoftCart.exe/DATABASE.CART/REDLINE_PAGES/G175.htm?L+mystore+xoqp4502+1158875864). This standard became active in 2006.

News stories on the 2006 FDA and NIOSH publication were printed by at least two publications:

Patricia Shehan [2006]. Improper use of oxygen seals causing fires. All Headline News, April 27, 2006.

Fire Chief [2006]. FDA, NIOSH issue safety alert. Fire Chief, May 4, 2006. Available at: http://www.firechief.com/news/seal_alert05042006/index.html

End Outcomes:

NIOSH and FDA are not aware of any injuries associated with explosions and fires in aluminum oxygen regulators subsequent to the NIOSH and FDA outreach in the late 1990s.

For Partners and Stakeholders:

Name of Organization: National Aeronautics and Space Administration (NASA), White Sands Test Facility

Category of Organization: Government (Federal)

Contacts:

Joel Stoltzfus, White Sands Test Facility
12600 NASA Road, Las Cruces, NM 88012, (505) 524-5731
jstoltzfus@wstf.nasa.gov

Harold D. Beeson, Ph.D., Special Projects Director
White Sands Test Facility
12600 NASA Road
Las Cruces, NM 88004
(505) 524-5542
hbeeson@wstf.nasa.gov

For Partners only:

Type of Formal Agreement (if any):

Interagency agreement in 1999 for NASA to develop a forced ignition test for emergency medical oxygen regulators.

Description of collaborative activities (narrative):

In July 1998, the International Association of Fire Fighters requested that NIOSH investigate the circumstances surrounding a series of incidents involving fire fighters who were injured when portable oxygen resuscitators spontaneously ignited and burned. NIOSH worked with the Food and Drug Administration (FDA) that regulates these devices and the National Aeronautics and Space Administration (NASA) that has a long history of relevant expertise in oxygen safety. NASA provided technical expertise, identified a forensics testing laboratory that could provide an evaluation of burned regulators, co-authored peer-reviewed journal articles, and developed a new testing protocol to ensure safer regulators.

Collaborative Outputs:

NIOSH [1998a]. Oxygen Regulator Flash Severely Burns one Fire Fighter – Florida. Cincinnati, OH: U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. NIOSH FACE Report 98F-23.

NIOSH [1998b]. Emergency Medical Technician Receives Serious Burns from an Oxygen Regulator Flash Fire - South Carolina. Cincinnati, OH: U.S. Public Health Service, Centers for

Disease Control and Prevention, National Institute for Occupational Safety and Health. NIOSH FACE Report 98F-24.

NIOSH [1999]. Aluminum Regulator Fire Injures One Fire Fighter – Nevada. Cincinnati, OH: U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. NIOSH FACE Report 99F-07.

FDA and NIOSH [1999]. FDA and NIOSH Public Health Advisory: Explosions and Fires in Aluminum Oxygen Regulators. Cincinnati, OH: U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Also posted on the internet at the FDA website: http://www.fda.gov/cdrh/oxyreg.html *(NASA contacts provided an expert review of the draft document)*

Washenitz F, Stoltzfus J. et. al. [2001]. Fire Incidents Involving Regulators Used in Portable Oxygen Systems. Injury Prevention. September 2001. pp 24-37.

Hodous T, Washenitz F, Newton B [2002]. Occupational burns from oxygen resuscitator fires: The hazard of aluminum regulators. Am J Industr Medicine 42(1): 63-69.

Intermediate Outcomes:

The primary manufacturer of oxygen regulators that had spontaneously ignited in the 1990s recalled over 200,000 regulators from the field, developed a retrofit kit to convert the oxygen flow path within existing regulators to brass (a material much better suited for use in compressed oxygen systems), and modified their new production to include brass components.

The 1998-1999 investigation by FDA, NASA and NIOSH ultimately resulted in the development and adoption of a new standard test method to evaluate oxygen regulators for susceptibility to particle impact ignition and fires. Representatives of the NASA White Sands Test Facility led the development of this standard, with funding provided by NIOSH. The standard is known as the. (http://www.astm.org/cgi-bin/SoftCart.exe/DATABASE.CART/REDLINE_PAGES/G175.htm?L+mystore+xoqp4502+1158875864)

End Outcomes:

NIOSH and FDA are not aware of any injuries associated with explosions and fires in aluminum oxygen regulators subsequent to the collaborative effort of NIOSH, NASA and FDA to identify and solve the problem, and subsequent outreach by NIOSH and FDA.

For Partners and Stakeholders:

Name of Organization: Child Labor Coalition

Category of Organization: Advocacy group

Contact:

Darlene Adkins
Senior Program Associate
Dak7ncl@sbcglobal.net
(614) 575-2539

For Partners only:

Type of Formal Agreement (if any): None.

Description of collaborative activities (narrative):

The Child Labor Coalition periodically requests assistance in identifying and interpreting young worker injury statistics. The Child Labor Coalition has provided reviews of NIOSH young worker safety and health materials, and provided assistance in disseminating the NIOSH Alerts on young worker safety. NIOSH researchers have given presentations by request at Child Labor Coalition meetings and conferences.

Collaborative Outputs: None

Intermediate Outcomes:

The Child Labor Coalition routinely cites NIOSH statistics, findings and recommendations in their reports and publications, including their annual list of the five worst teen jobs, and a June 2005 report to the International Labour Organization (ILO), "Protecting Working Children in the United States: Is the Government's Indifference to the Safety and Health of Working Children Violating an International Treaty? The Child Labor Coalitions' annual list of the five worst teen jobs gets considerable press coverage. At the 2006 annual meeting of the ILO in Geneva, Switzerland, the Conference Committee on the Application of Standards discussed the U.S. application of Convention No. 182 (Elimination of the Worst Forms of Child Labour) as it relates to children performing hazardous work in agriculture. The Conference Committee requested that the U.S. Government provide copies of any new Hazardous Orders when adopted. In addition, the Conference Committee requested the U.S. government to "indicate, in its next report to the Committee of Experts, the measures taken or envisaged (including but not limited to legislation) to ensure that work performed in particular in the agricultural sector was prohibited for children under 18 years where it was hazardous work within the meaning of the Convention."

End Outcomes: None specific to this partnership.

For Partners and Stakeholders:

Name of Organization: Federal Network for Young Worker Safety and Health

Category of Organization: Federal Government

Contact:

Elise Handelman
Director of Occupational Health Nursing, OSHA
Handelman.elise@dol.gov
(202) 693-1987

For Partners only:

Type of Formal Agreement (if any):

Description of collaborative activities (narrative):

OSHA has lead the Federal Network for Young Workers (FedNet) since April, 2003. FedNet is comprised of 12 federal agencies who work collaboratively to educate, train and provide outreach to youth, their employers, parents and counselors about how young workers (less than 24 years of age) can avoid injury and illness on the job. FedNet provides opportunities for federal agencies to leverage resources by building on existing activities, and broadly disseminating available tools and resources. TI program staff actively participate in Network meetings and the development of FedNet materials and products. NIOSH hosts the FedNet website.

Collaborative Outputs:

Federal Network for Young Worker Safety and Health website: www.youngworkers.net This website includes links to relevant products of each FedNet agency.

OSHA [2004]. Forklift operations by young workers subject of safety initiative: OSHA, Wage and Hour Division, NIOSH join forces to foster youth safety on the job. Washington, DC: OSHA Trade Release, February 11, 2004.

OSHA [2004]. Federal agencies launch effort to help teen workers stay safe and healthy on the job this summer. OSHA Trade Release, May 18, 2004.

OSHA [2004]. Federal agencies launch effort to help teen workers stay safe and healthy on the job this winter. Washington, DC: OSHA News Release 04-2467-NAT, December 6, 2004.

Intermediate Outcomes:

In 2004, the federal Job Corps program and some OSHA training centers began using safety and health curricula developed through NIOSH supported young worker safety demonstration projects.

End Outcomes: None specific to this partnership.

For Partners and Stakeholders:

Name of Organization: Interstate Labor Standards Association

Category of Organization: State government

Contact:

Mary Ellen Grace
Co-Chair, Child Labor Committee
Maryellen.grace@state.tn.us
(609) 984-7356

For Partners only:

Type of Formal Agreement (if any)**:** None

Description of collaborative activities (narrative):

The Interstate Labor Standards Association is an organization of state labor department officials responsible for administering and enforcing state labor laws, including child labor laws. ILSA representatives have provided technical reviews of some NIOSH products on young worker safety, and helped in the distribution of NIOSH publications, including NIOSH Alerts on young workers safety. TI program staff have given invited presentations at annual ILSA meetings.

Collaborative Outputs: None

Intermediate Outcomes: None to report

End Outcomes: None specific to this partnership.

For Partners and Stakeholders:

Name of Organization: Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor

Category of Organization: Federal government

Contact:

Arthur Kerschner, Jr.
Child Labor Team Leader
KerschnerJr.Arthur@dol.gov
(202) 693-0072

For Partners only:

Type of Formal Agreement (if any):

Interagency agreements in 1999, 2000 and 2001 in which the Employment and Standards Administration, Wage and Hour Division funded NIOSH research focused on the safety and health risks for children and adolescents in the workplace, with particular emphasis on issues relevant to child labor regulations as developed and enforced by the Wage and Hour Division.

Description of collaborative activities (narrative):

The TI program and Wage and Hour Division have a long history of collaborative activities. Beginning in 1994, the Wage and Hour Division participated on the NIOSH Child Labor Working Team charged with assessing research and prevention efforts and making recommendations for future directions. Over the years, the Wage and Hour Division has requested technical assistance in assessing injury statistics and injury hazards, including assessing youth hazards associated with balers. The Employment Standards Administration, Wage and Hour Division co-sponsored the National Research Council study on the Health and Safety Implications of Child Labor. The NIOSH TI program and Employment Standards Administration, Wage and Hour Division established interagency agreements in 1999, 2000 and 2001 in which funds were provided to the TI program for research focused on the safety and health risks for children and adolescents in the workplace, with particular emphasis on issues relevant to child labor regulations as developed and enforced by the Wage and Hour Division. These interagency agreements supported the TI-lead development of NIOSH recommendations to the Department of Labor for changes to Hazardous Orders (those activities deemed to be especially dangerous for youth, and prohibited for youth less than 18 years of age in non-agricultural industries, and youth less than 16 years of age in agriculture) and extramural grants on young worker safety and health in construction. The Wage and Hour Division notifies the TI program of young worker deaths and provides reviews of draft fatality investigation reports and other TI publications, such as Alerts on young worker safety and health. The TI program and Wage and Hour Division have also collaborated numerous times on outreach on young worker safety and health, including the TI program providing NIOSH resources for use in Department of Labor campaigns such as “Work Safe this Summer,” and the TI program and Wage and Hour

Division doing targeted mailings on young workers and forklifts, and young workers in construction jobs.

Collaborative Outputs:

NIOSH [1995]. Review of safeguarding technology used on paper balers. Morgantown, WV: Division of Safety Research. *(Report provided to Wage and Hour Division in response to request for technical assistance.)*

NIOSH [1997]. Child labor research needs: Recommendations from the NIOSH child labor working team. NIOSH Publication No. 97-143. *(The Team included two representatives from the Wage and Hour Division).*

NRC (National Research Council/Institute of Medicine) [1998]. Protecting youth at work: health, safety, and development of working children and adolescents in the United States. Washington, DC: National Academy Press. *(Wage and Hour Division was a co-sponsor of this study).*

NIOSH [2002]. National Institute for Occupational Safety and Health (NIOSH) Recommendations to the U.S. Department of Labor for Changes to Hazardous Orders. May 3, 2002. *(This report was a deliverable for the NIOSH/Employment Standards Administration, Wage and Hour Division Interagency agreements).*

DOL stakeholder meetings in 2003. In response to the release of the 2002 NIOSH report recommending changes to Hazardous Orders, the Wage and Hour Division convened a series of stakeholder meetings to gather input on priorities for future rulemaking. TI researchers involved in developing the NIOSH recommendations participated in these meetings.

Packet on forklift safety distributed by the TI program and the Wage and Hour Division to more than 10,000 retail warehouses and storage facilities in December, 2002. The packet included a NIOSH tear-out sheet on forklift safety, 3 FACE reports involving youth and forklifts, and a Wage and Hour Division sticker on youth and forklifts.

Packet on forklift safety distributed by the TI program, Wage and Hour Division and OSHA in January 2004. In addition to materials included in the 2002 mailing, the packet also included OSHA materials and a cover letter signed by agency heads for NIOSH, the Employment Standards Administration and OSHA.

Packet on young worker safety and construction work was distributed by the TI program, Wage and Hour Division and OSHA in May, 2004. The mailing included a cover letter signed by agency heads from NIOSH, the Wage and Hour Division and OSHA, the NIOSH pamphlet Safe Work for Youth in Construction (Information for Employers), and publications from the Wage and Hour Division and OSHA. OSHA provided the mailing list.

Intermediate Outcomes:

Changes to child labor laws based on NIOSH recommendations. A final rule published by the Department of Labor (DOL) in 2004 incorporated NIOSH recommendations, referring to NIOSH comments and recommendations in the accompanying narrative [69 Fed. Reg. 75382 (2004)]. The new federal child labor regulations went into effect on February 14, 2005. NIOSH research and recommendations were cited among the justifications for the rule changes. NIOSH recommendations were submitted to DOL in response to a public comment period on the proposed rule, and a report that NIOSH developed at the request of DOL recommending changes to Hazardous Orders (those activities deemed to be especially dangerous for youth, and prohibited for youth less than 18 years of age in non-agricultural industries, and youth less than 16 years of age in agriculture). These changes have the potential to reduce young worker deaths and injuries associated with working on roofs, compactors and balers, driving, and the manufacture of explosives.

Calls for the Department of Labor (DOL) to implement NIOSH recommendations for changes to Hazardous Orders. Since the release of the NIOSH Hazardous Orders recommendations in May 2002, numerous researchers, standards-setting bodies, legislators, and advocacy groups nationally and internationally have called for implementation of its recommendations or cited them as justification for the need to update child labor laws. Several examples of the many ways in which the report has been used are detailed below.

<u>Action by the International Labour Organization (ILO) Related to U.S. Compliance with Convention No. 182, 2006</u>: At the 2006 annual meeting of the ILO in Geneva, Switzerland, the Conference Committee on the Application of Standards discussed the U.S. application of Convention No. 182 (Elimination of the Worst Forms of Child Labour) as it relates to children performing hazardous work in agriculture. The Committee of Experts report used as a resource by the ILO Conference Committee mentions the NIOSH recommendations on Hazardous Orders, noting that the U.S. Government has indicated that it is “in the process of determining which recommendations concerning the Hazardous Orders will be presented in a first round of proposed rules” [International Labour Organization 2006, p. 231]. The Conference Committee requested that the U.S. Government provide copies of any new Hazardous Orders when adopted. In addition, the Conference Committee requested the U.S. government to “indicate, in its next report to the Committee of Experts, the measures taken or envisaged (including but not limited to legislation) to ensure that work performed in particular in the agricultural sector was prohibited for children under 18 years where it was hazardous work within the meaning of the Convention” [International Labour Organization 2006, p. 230].

Letter from Child Labor Coalition to Secretary of Labor Elaine Chao requesting action on child labor regulations for agriculture, June 28, 2006: The Child Labor Coalition followed the action by the ILO Conference Committee with a letter to Secretary of Labor Elaine Chao requesting that forthcoming proposed changes to child labor laws focus on agriculture. The letter references the 2002 NIOSH report recommending changes to Hazardous Orders (HOs), and the discussions at the 2006 annual ILO meeting questioning U.S. compliance with ILO Convention No. 182 (Elimination of the Worst Forms of Child Labour) in relation to children working in agriculture.

Proposed legislation that references NIOSH Hazardous Orders recommendations: In 2003 and again in 2005, Representative Tom Lantos (D-California) introduced the Youth Worker Protection Act, which would amend the Fair Labor Standards Act of 1938 (FLSA) to revise requirements relating to child labor and to set forth new requirements for the employment of minors. The Act included a provision directing the Secretary of Labor to promulgate a rule relating to particularly hazardous occupations for children between the ages of 16 and 18, specifying that this rulemaking was justified based on the Hazardous Orders recommendations released by the National Institute for Occupational Safety and Health in 2002.

The December 2003 TI program/Wage and Hour Division mailing on young worker safety and forklifts resulted in requests from employers and a trade association for nearly 7,000 stickers and over 2,000 information packets. Request for the stickers continue. In September 2005, the Wage and Hour Division received a request for 300 stickers from the Crown Equipment Corporation, a forklift manufacturer. This firm noted that customers wanted the stickers affixed to forklifts that they sold.

End Outcomes:

The rates of young worker injury deaths have fluctuated over the last decade. Rates since 2000 are generally lower than rates in the 1990s (Figure 1).

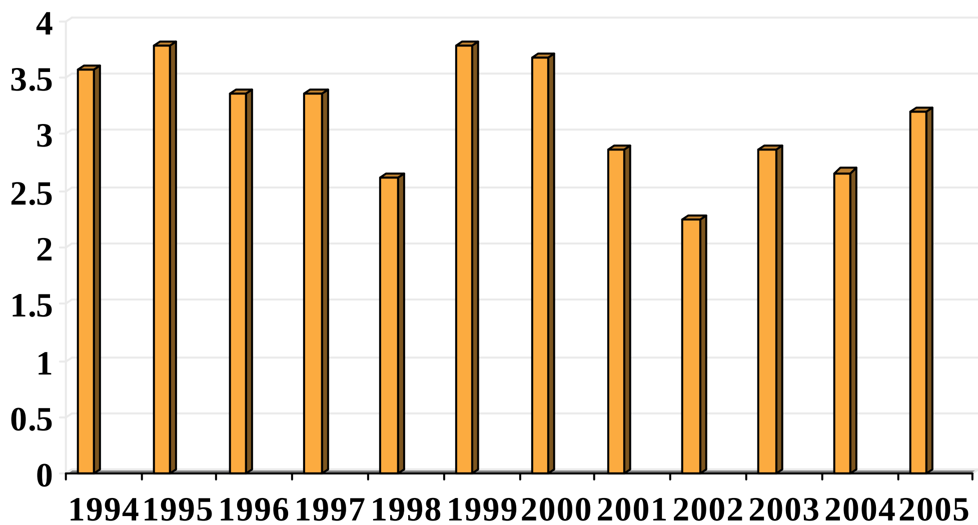


Figure 1. Fatality rates per 100,000 fulltime equivalents, youth 15-17 years of age (Source: Bureau of Labor Statistics, Census of Fatal Occupational Injuries (CFOI))

While there appear to be positive reductions in rates of young worker injury deaths for 16- and 17- year-olds generally since 1996, there has been little change for youth 15 years of age, and apparent increases in fatality rates for 15- and 16-year-olds in agriculture (Table 1). It is important to note that youth less than 14 years of age work, especially in agriculture, but the absence of official statistics for youth employment preclude the ability to calculate comparable fatality rates.

	All Industries			Ag Production		
Age (Years)	**1992-96 Rate**	**1997-02 Rate**	**% Change**	1992-96 Rate	1997-02 Rate	% Change
15	**5.2**	**5.1**	**-1.9**	13.3	24.1	81.2
16	**3.6**	**2.8**	**-22.2**	10.5	15.2	44.8
17	**3.5**	**2.9**	**-17.1**	16.8	12.9	-23.2

Table 1. Fatality rates per 100,000 fulltime equivalents for youth 15-17 years of age for all industries and the agricultural production industry for select time periods. (Source: CFOI. Numbers and rates were calculated by NIOSH and may differ from previously published BLS CFOI numbers and rates. We are currently seeking review by BLS of updated numbers.)

For Partners and Stakeholders:

Name of Organization: Young Worker Safety and Health Network

Category of Organization: Professional Society

Contact: (name, title, email, phone)

Mary Miller, MN, RN
Co-Chair, Young Worker Safety and Health Network
Mmar235@lni.wa.gov
(360) 902-6041

Diane Bush, MPH
Co-Chair, Young Worker Safety and Health Network
dbush@uclink4.berkeley.edu

For Partners only:

Type of Formal Agreement (if any)**:** None

Description of collaborative activities (narrative):

The Young Worker Safety and Health Network is an organization of individuals who have, as a common goal, the safety of youth in the workplace. The Network was founded at the 1997 American Public Health Association Conference, and is comprised of researchers, medical specialists, government and other interested persons. The network operates as an informational tool for anyone with a need or interest in young worker safety. TI researchers participate in the network. In November 2000, TI researchers participated in a meeting sponsored by the Network, "Protecting Youth at Work: A Working Symposium to Discuss Strategies and Develop a National Action Plan."

Collaborative Outputs: None

Intermediate Outcomes:

In March 2003, the Young Worker Health and Safety Network (YWH&S) released its report, *NIOSH Recommendations for Changes to the Federal Child Labor Regulations: A Response from Members of the Young Worker Health and Safety Network* (TI program staff did not participate in the development of this report). The report was provided to the US Department of Labor and findings were described in a peer-reviewed journal article [Miller and Bush 2004]. The Young Worker Safety and Health Network recommendations were recently cited in a June 28, 2006 letter from the Child Labor Coalition to Secretary of Labor Elaine Chao requesting action on child labor regulations for agriculture.

End Outcomes: None specific to this partnership.

For Partners and Stakeholders:

Name of Organization: Young Worker Safety Resource Center

Category of Organization: Resource Center

Contact: (name, title, email, phone)

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For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

The National Young Worker Safety Resource Center (YWSRC) is a collaborative project of U.C. Berkeley's Labor Occupational Health Program (LOHP) and the Education Development Center, Inc. (EDC) in Massachusetts. The Center, supported with funding by OSHA, provides training, technical assistance, and resource materials to state and community groups throughout the country. The work of the Center is an extension of work initiated under NIOSH supported young worker safety and health demonstration projects. The Center partnered with NIOSH to develop a national curriculum which was tested and evaluated in partnership with state educational agencies. The Center also provided a technical review of the 2003 NIOSH Alert on young worker safety.

Collaborative Outputs:

National curriculum on young worker safety and health. This curriculum is currently being customized for each state.

Intermediate Outcomes:

For the years 2000-2005, the Center identified and trained a master trainer in 11 states to deliver occupational safety and health training workshops to teachers and job readiness professionals. Workshops were provided to over 1,700 teachers and job trainers, and 300 employers. Teachers and job trainers documented teaching 9,000 youth. Occupational safety workshops became a part of ongoing training offered by state departments of education, workforce investment boards, and other job readiness programs.

For the years 2000-2005, the Center provided technical assistance to over 340 individuals, agencies or organizations, including advice on developing effective worker safety programs, information on child labor laws and injury data, and background information for media representatives.

For the years 2000-2005, the Center convened and provided technical assistance to key state agencies in 11 states.

End Outcomes: None specific to this partnership.

For Partners and Stakeholders:

Name of Organization: Alaska Air Carriers Association

Category of Organization: Professional society

Contact: (name, title, email, phone)

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For Partners only:

Type of Formal Agreement (if any): Professional Services Contract

Description of collaborative activities (narrative):

The Alaska Air Carriers Association collaborates with the NIOSH Alaska Field Station on translating safety research into practice through an annual aviation conference with pilots and operations managers. The conference takes place during winter, and includes the following elements:

Presentation topics will include an update on pilot/operator training, weather information access, Medallion Program, Capstone Program, Circle of Safety Program, analysis of air carrier and pilot safety, and other relevant aviation safety intervention strategies and information

Compile and summarize symposium evaluations from symposium attendees

Disseminate all the above items to symposium attendees

Collaborative Outputs: Safety presentations, materials to attendees, and a summary of the conference evaluations

Intermediate Outcomes: Translating safety research and trends in aviation safety to the target audience: pilots and aviation operation managers. This is an important part of taking research to practice in Alaska.

End Outcomes: Decreasing the number and rate of occupational fatalities due to aviation crashes in Alaska.

For Partners and Stakeholders:

Name of Organization: Alaska Airmen's Association

Category of Organization: Professional society

Contact:

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Executive Director
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airmens@alaska.net

For Partners only**:**

Type of Formal Agreement (if any): Professional Services Contract

Description of collaborative activities (narrative):

The Alaska Airmen's Association collaborates with the NIOSH Alaska Field Station on translating safety research into practice through an annual aviation conference with pilots and operations managers. The conference takes place during spring, and includes the following elements:

A presentation session that will include topics on pilot training, Capstone Program, consumer safety information, access to weather information, and other aviation safety intervention strategies.

Compile and summarize conference evaluations from session attendees

Disseminate all the above items to session attendees

Collaborative Outputs: Safety presentations, materials to attendees, and a summary of the conference evaluations

Intermediate Outcomes: Translating safety research and trends in aviation safety to the target audience: pilots and aviation operation managers. This is an important part of taking research to practice in Alaska.

End Outcomes: Decreasing the number and rate of occupational fatalities due to aviation crashes in Alaska.

For Partners and Stakeholders:

Name of Organization: Transportation Research Board

Category of Organization: Government/academic

Contact: (name, title, email, phone)

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For Partners only**:**

Type of Formal Agreement (if any)**:** Letters accepting committee membership

Description of collaborative activities (narrative):

The Transportation Research Board (TRB) is a division of the National Research Council which serves as an independent adviser to the federal government and others on scientific and technical questions of national importance. The mission of the Transportation Research Board is to promote innovation and progress in transportation through research. The Board facilitates the sharing of information on transportation practice and policy by researchers and practitioners; stimulates research and offers research management services that promote technical excellence; provides expert advice on transportation policy and programs; and disseminates research results broadly and encourages their implementation. [Information abstracted from TRB website, http://www.trb.org/TRB/About/About.asp]

NIOSH scientists are represented on two Transportation Research Board (TRB) committees: Truck and Bus Safety (ANB70) [Lee Husting]; and Vehicle User Characteristics (AND10) [Stephanie Pratt]. In this capacity, Dr. Husting and Ms. Pratt contribute to committee-authored documents and strategic plans, review manuscripts to be presented at the TRB annual meeting, and participate in committee meetings and related conferences and workshops. Through ANB70, Dr. Husting contributed to a conference proceedings that was published as a TRB document, and Ms. Pratt served as a peer reviewer for the same document. Ms. Pratt also participated in a structured interview about NIOSH involvement in global road safety prior to a TRB-sponsored workshop on the topic. A summary of this workshop was subsequently published by TRB.

Collaborative Outputs:

Husting EL [2006]. Health and wellness: future truck and bus safety research opportunities. In: Future truck and bus safety research opportunities [Conference Proceedings 38]. Washington, DC: Transportation Research Board, p. 48-54.

Transportation Research Board [2006]. Improving road safety in developing countries: opportunities for U.S. cooperation and engagement [Special Report 287]. Washington, DC: The National Academies (National Research Council, Institute of Medicine, and Transportation Research Board).

Intermediate Outcomes: None.

End Outcomes: None.

For Partners and Stakeholders:

Name of Organization: US Department of Agriculture, National Agricultural Statistics Service (USDA, NASS).

Category of Organization: Federal Government

Contact: (name, title, email, phone)

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For Partners only:

Type of Formal Agreement (if any): Interagency Agreement

Description of collaborative activities (narrative):

NIOSH obtains injury and farm hazard surveillance of farm workers, youth, and farmers using USDA, NASS as the data collection agency. NASS maintains the complete list of farm operators in the U.S., and has the necessary data collection resources to conduct this surveillance for NIOSH in a cost efficient and timely manner. This collaborative effort began in 1994 when USDA, NASS conducted the first occupational farm injury survey for NIOSH, the Traumatic Injury Surveillance of Farms (TISF) survey. Since that time, NASS has partnered with NIOSH to establish a series of farm injury surveys covering farm youth, farm operators, and farm workers that cover both the general farming population and minority farm operators. These surveillance systems include: 1) Childhood Agricultural Injury Survey (CAIS); 2) the Minority Childhood Agricultural Injury Survey (M-CAIS); 3) the Occupational Injury Survey of Production Agriculture (OISPA); and 4) the Minority Occupational Injury Survey of Production Agriculture (M-OISPA). NASS is currently working with NIOSH on the collection of a new farm hazard survey. Results of this joint effort should be available in the beginning of 2007.

In addition to serving as a major data collection partner for NIOSH, USDA, NASS also works with NIOSH to increase the dissemination of the findings of these injury surveys. NASS works with NIOSH to develop and release a fact sheet for each survey they conduct for NIOSH. These fact sheets are made available to the public on the USDA publications website. In addition, NASS works with NIOSH to disseminate survey results and recommendations to farms across the U.S. USDA, NASS has distributed more than 100,000 NIOSH pamphlets to farm operators across the U.S., including those specifically targeting minority farm operators. These pamphlets summarize common causes of childhood farm injury and steps that farmers can take to foster safe and healthful farm environments for children. NASS will continue to provide these services to NIOSH as part of our ongoing data collection partnership.

Collaborative Outputs:

Databases:

NIOSH maintains four surveillance systems as part of its current collaboration with USDA, NASS:

Childhood Agricultural Injury Survey (CAIS): data available for 1998, 2001, and 2004.
Minority Childhood Agricultural Injury Survey (M-CAIS): data available for 2000 and 2003.

Occupational Injury Surveillance of Production Agriculture (OISPA): data available for 2001 and 2004.

Minority Occupational Injury Surveillance of Production Agriculture (M-OISPA): data are available for 2003.

NASS is currently collecting farm hazard data for NIOSH. This data collection effort uses the same general methodology as was used to collect the CAIS and OISPA data. The farm hazard data should become available in FY-2007.

NIOSH retains data from an earlier NIOSH-USDA, NASS collaboration, the Traumatic Injury Surveillance of Farmers (TISF) survey. TISF data are available for the years 1993-1995.

NIOSH and USDA Numbered Documents:

Myers JR. 1997. Injuries among farm workers in the United States, 1993. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication 97-115.

Myers JR. [1998]. Injuries among farm workers in the United States--1994. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 98-153.

Myers JR. [2001]. Injuries among farm workers in the United States, 1995. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-153.

Myers JR, Hendricks KJ. [2001]. Injuries among youth on farms in the United States, 1998. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers

for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-154.

Myers JR, Hendricks KJ, Goldcamp EM, Layne LA. [2005]. Injuries and asthma among youth less than 20 years of age on Minority farm operations in the United States, 2000 Volume I: Racial minority national data. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005-147.

Myers JR, Hendricks KJ, Layne LA, Goldcamp EM. [2005]. Injuries and asthma among youth less than 20 years of age on Minority farm operations in the United States, 2000 Volume II: Hispanic national data. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2006-109.

NIOSH. [2004]. Injuries to youth on minority farm operations. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-117.

NIOSH. [2004]. Asthma among household youth on minority farm operations. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-118.

NIOSH. [2004]. Injuries to youth on Hispanic farm operations. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-157.

NIOSH. [2004]. Asthma among household youth on Hispanic farm operations. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-158.

NIOSH. [2004]. Injuries among youth on farms, 2001. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Pub. No. 2004-172.

USDA. [1999]. 1998 Childhood agricultural injuries. Washington, DC: U.S. Department of Agriculture, National Agricultural Statistics Service, Sp Cr 8 (10-99).
USDA. [2002]. 2000 Childhood agricultural injuries on minority-operated farms. Washington, DC: U.S. Department of Agriculture, National Agricultural Statistics Service, Sp Cr 9 (02).

USDA. [2004]. 2001 Childhood agricultural-related injuries. Washington, DC: U.S. Department of Agriculture, National Agricultural Statistics Service, Sp Cr 9 (1-04).

USDA. [2004]. 2001 Adult agricultural–related injuries. Washington, DC: U.S. Department of Agriculture, National Agricultural Statistics Service, Sp Cr 9 (12-04).

Intermediate Outcomes:

NIOSH surveillance collaborations with USDA, NASS have impacted the types of outreach and research being done, especially for childhood agricultural injury prevention and for tractor safety research. Intermediate outcomes related to the joint NIOSH-USDA, NASS surveillance program follow:

1. Data from the 1998 CAIS were used extensively by NIOSH staff in the preparation of recommended changes to the agricultural hazardous orders for the U.S. Department of Labor. The 1998 CAIS provided the most representative and current data on occupational youth farm injuries by covering youth of all ages and farms of all types.

2. One significant finding from the CAIS and M-CAIS has been the importance of non-work injuries to youth on farms. These findings led to the development of a new recommendation in the updated 2002 Childhood Agricultural Injury Prevention National Action Plan to address non-work injuries on farms. In response to this new recommendation, the National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS) produced several documents on the importance and design of safe play areas for children on farms. NCCRAHS also maintains a website dedicated to the topic of safe play areas on farms (see http://www.marshfieldclinic.org/nfmc/pages/default.aspx?page=nfmc_nccrahs_safe_play_welcome).

3. NCCRAHS is just one of the national child safety organizations that use the results from the NIOSH-USDA, NASS youth farm injury surveillance studies. Other organizations, such as Farm Safety for Just Kids and the National Safe Kids Campaign now use these injury and injury rate estimates for children on farms as their official numbers.

4. The estimates of youth farm injuries produced by NIOSH have also been cited in proposed congressional legislation. In July 2005, the Children's Act for Responsible Employment of 2005 ('CARE' Act of 2005, HR 3482) was submitted in the House of Representatives by Representative Roybal-Allard. The CARE Act proposed changes to child labor laws in agriculture, and identified the youth farm injury data collected by the CAIS as one source of data that would be used to develop an annual report on occupational injuries to youth working on farms in the US. At this time, no action has yet been taken on this proposed bill within Congress.

5. As part of a cost-benefit analysis of proposed changes to Child Labor hazardous orders for youth working on farms, a contractor for USDOL requested data from the CAIS in the spring of 2004. The contractor, SiloSmashers, requested information on estimates of youth less than 20 years old working on farms, estimates of working youth who operated farm tractors on farms,

work-related injuries occurring to these youth, and non-work injuries occurring to youth on farms. SiloSmashers concluded that the CAIS surveillance data were the only source of these data, and were critical to conducting the cost-benefit analysis requested by USDOL. This work is still in progress.

6. In 1999, Dr. Barbara Marlenga of the National Farm Medicine Center in Marshfield, Wisconsin, approached NIOSH to provide assistance on a research project. Dr. Marlenga's research required a national sample of farms with household youth 7 to 16 years of age. NIOSH worked with NASS to identify farms with household youth in this age range and asked if they would be willing to participate in this study as part of the CAIS data collection effort. Dr. Marlenga was given access to those farm families who agreed to participate. Results of Dr. Marlenga's study are reported in:

Marlenga BL**,** Pickett W, Berg RL. [2002]. Evaluation of an enhanced approach to the dissemination of the North American Guidelines for Children's Agricultural Tasks: a randomized controlled trial. Preventive Medicine 35:150-159. PubMed ID: 12200100

7. NIOSH has also worked with NASS to provide CAIS data to Dr. Marlenga for two additional research studies. Results from the 1998 CAIS were used by Dr. Marlenga to assess whether guidelines for assigning youth work tasks based on their age would have prevented certain types of farm injuries. Results of this research are reported in:

Marlenga BL**,** Brison RJ, Berg RL, Zentner JL, Linneman JG, Pickett W. [2004]. Evaluation of the North American Guidelines for Children's Agricultural Tasks using a case series of injuries. Injury Prevention 10:350-357. PubMed ID: 15583256

Data from the 1998 CAIS and 2000 M-CAIS have also been provided to Dr. Marlenga to assess the potential impact of applying Child Labor hazardous orders for youth working on farms to youth working on their family's farm. This research is still in progress.

8. A search of the literature has identified a minimum of 22 peer reviewed journal articles that have cited surveillance data from the CAIS.

9. Dr. Barbara Lee, Director of the NCCRAHS, recently published an editorial in the Journal of Agromedicine (2005: Vol. 10(4)) entitled 'NIOSH Fills Void with Surveillance of Injuries to Youth Living on U.S. Farms." This editorial commends the work that NIOSH has undertaken in collecting youth farm injury data in collaboration with USDA, NASS that was previously unavailable. Additionally, Dr. Lee encourages others to give their support to NIOSH and the continuation of the NIOSH childhood agricultural injury surveillance plan.

10. Tractor data collected through the TISF survey were used by engineering researchers within NIOSH as part of their Cost-Effective Roll-Over Protective Structures (CROPS) project. TISF tractor data were used to identify commonly used farm tractors without a ROPS, and to provide low-cost ROPS designs for them to encourage farmers to retrofit to these tractors. Having tractor estimates by manufacturer and model was important in this process because these factors influenced each individual CROPS design. Six CROPS designs have been developed by NIOSH

and have been shared with a ROPS manufacturer (FEMCO). Having an estimate of the potential market for each NIOSH ROPS design was helpful in getting FEMCO to pursue CROPS on a commercial basis.

11. Tractor data collected through the TISF survey were used by the Colorado State University to help target engineering research evaluating the ability of pre-ROPS tractors to withstand the forces of a tractor overturn if a ROPS were designed and mounted on them. This work was conducted by Dr. Paul Ayers, currently with the University of Tennessee, Department of Agricultural Engineering. TISF tractor prevalence data were used to identify common tractors by manufacturer and model for ROPS retrofit evaluations (e.g., Ford 8-N). The TISF data were the only information source for prioritizing these research evaluations.

12. Tractor data from the TISF have been referenced in a minimum of 25 peer reviewed journal articles based on a reference search for the manuscript "Roll-over protective structure use and the cost of retrofitting tractors in the United States, 1993" by Myers and Snyder [1995].

13. Economic analyses of ROPS retrofitting by NIOSH have been referenced in a minimum of 32 peer-reviewed journal articles based on a search of the series of manuscripts published by Myers and Snyder, and Myers and Pana-Cryan.

14. Tractor data from the OISPA have been shared with Dr. Barbara Marlenga of the National Farm Medicine Center, Marshfield, Wisconsin. Dr. Marlenga used the more recent tractor prevalence data for an ergonomic evaluation of common tractors with and without ROPS for use by youth on farms. Dr. Marlenga's research is being done in collaboration with the NIOSH Agricultural Safety and Health Center located at the University of California-Davis.

Dr. Henry Cole at the University of Kentucky is also using OISPA tractor prevalence data from 2001 and 2004 for an economic analysis project of ROPS use on farms. The project includes analysis of tractor and ROPS use by hours worked, farming operation, and the need/feasibility of retrofitting ROPS to existing tractors. This project is part of a larger national NIOSH Agricultural Research Centers' tractor initiative in which NIOSH is also collaborating.

End Outcomes:

NIOSH surveillance collaborations with USDA, NASS provide information for tracking the changes in farm injuries and hazards over time.

1. Nonfatal injury data collected through the Traumatic Injury Surveillance of Farmers (TISF) and the Occupational Injury Surveillance of Production Agriculture (OISPA) programs indicate that lost-time occupational injuries on farms decreased between the years 1993-1995 and 2004. This decrease is collaborated by independent injury surveillance data maintained by the Bureau of Labor Statistics covering the same time period *(Figure 1)*.

2. Roll-Over Protective Structures (ROPS) are special structures attached to farm tractors to prevent the tractor from crushing the operator during an overturn. ROPS represent the best method of preventing tractor overturn-related deaths on farms. The percentage of farm tractors

used on U.S. farms fitted with a ROPS increased from 38% in 1993 up to 50% in 2001 *(**Source**: NIOSH TISF and OISPA)*.

3. The NIOSH Childhood Agricultural Injury Prevention Initiative began in 1997. Since the beginning of this initiative, NIOSH has worked closely with the NCCRAHS to identify and promote injury prevention activities nationwide. In addition, NIOSH had funded numerous research projects to improve our understanding of both the effectiveness of existing and new interventions. During the initiative, the total number of youth injured on farms has decreased from 37,800 in 1998 to 27,600 in 2004. For the same time period, the number of farm work-related youth injuries decreased by 51% from 16,695 down to 8,130 *(Table 1)*. (**Source**: NIOSH CAIS).

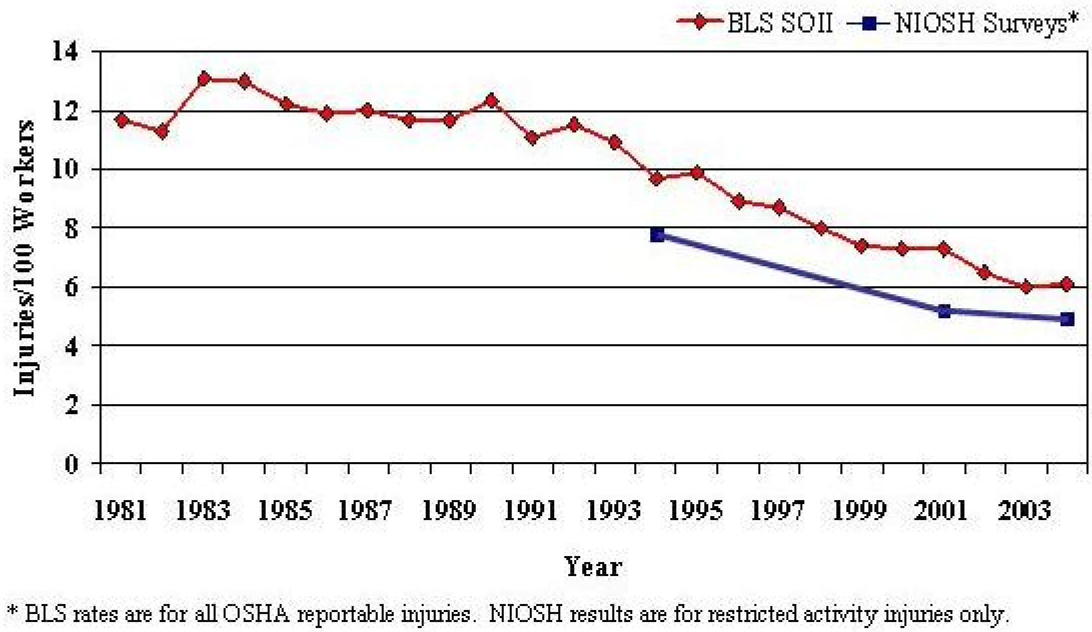

*Figure 1. Injury Rates per 100 Workers, 1980-2004 for the Production Agriculture Industry (**Source:** BLS Survey of Occupational Injuries and Illnesses, NIOSH Traumatic Injury Surveillance of Farmers, and Occupational Injury Surveillance of Production Agriculture).*

*Table 1. Injuries to youth less than 20 years of age that occurred on U.S farms during 1998, 2001, and 2004, by sex and work status (**Source:** NIOSH CAIS).*

	1998	2001	2004
Injuries‡	37,774	29,207	27,590
Male	29,564	16,526	14,390
Female	8,210	12,641	13,201
Work	16,695	9,481	8,130
Non-work	18,169	19,611	19,439

‡ Total injuries may not add up due to rounding or missing data.

4. A major focus of the NIOSH Childhood Agricultural Injury Prevention Initiative has been working with the NCCRAHS on the development and promotion of the North American Guidelines for Childhood Agricultural Tasks (NAGCAT) released in 1999. The primary focus of the NAGCAT is to provide guidance to farm families on how to assign work to farm youth to reduce their risk of injury. The NAGCAT have been widely reported in the popular farm press, and have been shown to be effective in reducing injuries to household youth in one controlled study. Data from the CAIS shows that since establishment and promotion of the NAGCATS, work-related farm injuries to youth living on the farms have decreased from 11,600 injuries in 1998 to 6,400 in 2004. The work-related injury rate for household youth decreased from 14.1 to 9.1 injuries per 1000 working household youth for the same period *(Figure 2)* (**Source:** NIOSH CAIS).

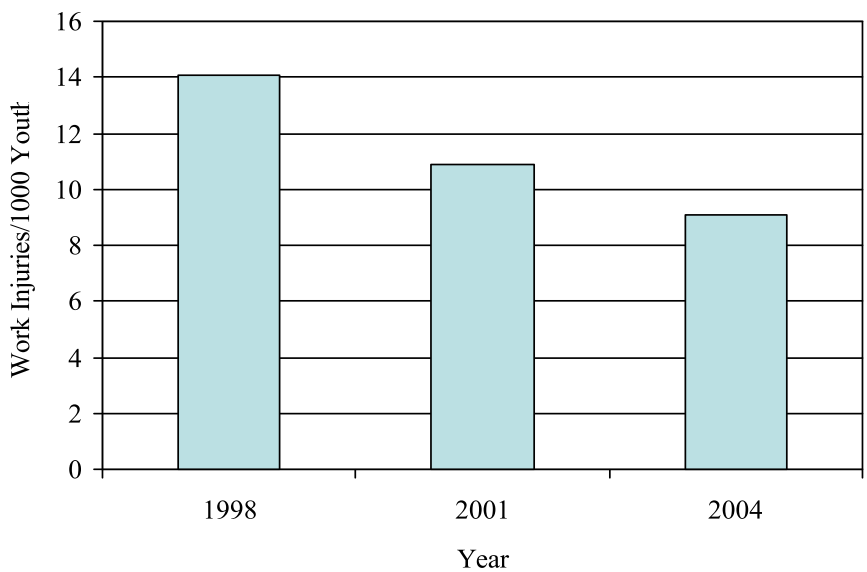

*Figure 2. Work Injuries per 1000 Working Farm Household Youth, 1998-2004 (**Source**: NIOSH CAIS).*

For Partners and Stakeholders:

Name of Organization: U.S. Department of Labor, Education and Training Administration (USDOL, ETA)

Category of Organization: Federal Government

Contact:

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For Partners only:

Type of Formal Agreement (if any): Interagency Agreement

Description of collaborative activities (narrative):

NIOSH obtains injury and farm hazard surveillance of migrant and seasonal farm workers from the USDOL, ETA National Agricultural Worker Survey (NAWS). ETA maintains the NAWS, with is a nationally representative demographic and economic survey of farm workers across the U.S. NIOSH has partnered with ETA to include an injury module to the NAWS to estimate the occurrence of occupational farm injuries to migrant and seasonal farmworkers. This collaborative effort began in Fiscal Year 1999 when NIOSH first included this injury module in the NAWS. Since that time, ETA has partnered with NIOSH to collect this injury module during Fiscal Years 2001-2004. NIOSH is currently working with USDOL, ETA to continue this data collection partnership.

Collaborative Outputs:

Databases:

NAWS with NIOSH Injury Module: data available for FY-1999, and FY-2001 through FY-2004.

NIOSH and USDOL, ETA Numbered Documents:

NIOSH. [2004]. Worker Health Chartbook, 2004. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication 2004-146. ***(Pages 195-211 of this publication contain agricultural data developed in part from the NAWS project).***

Presentations:

Myers JR. [1999]. Work-related injuries among hired, non-family farm workers. The Dynamics of Hired Farm Labor: Constraints and Community Response, October 25-26, 1999, Concordville, PA.

Myers JR. [2000]. Work-related injuries among hired, non-family farm workers. Agricultural Safety and Health in a New Century, April 28-30, 2000, Cooperstown, New York.

Myers JR. [2000]. Comparison of farmworker injury and fatality experiences to all U.S. workers. Presented at the 13th Annual East Coast Migrant Stream Forum, Double Tree Hotel, Philadelphia, PA, November 3-5, 2000.

Intermediate Outcomes: None to report.

End Outcomes: None to report.

Project: Evaluation of Emergency Services Vehicle Occupant Safety

For Partners and Stakeholders:

Name of Organization: National Registry of Emergency Medical Technicians (NREMT)

Category of Organization: Professional Society

Contact:

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Executive Director
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(614) 888-4484

For Partners only:

Type of Formal Agreement (if any): N/A

Description of collaborative activities (narrative):

Through a working relationship with the National Highway Traffic Safety Administration's (NHTSA) EMS Division, NIOSH was invited to contribute questions for the National Registry of Emergency Medical Technicians (NREMT) Longitudinal Emergency Medical Technician Attributes & Demographics Study (LEADS). LEADS is hosted by NREMT with support from NHTSA's EMS Division. NREMT's mission statement is: "To certify and register Emergency Medical Services Professionals throughout their careers by a valid and uniform process that assesses the knowledge and skills for competent practice."

Collaborative Outputs:

A manuscript is currently in review at the Journal of Emergency Medical Services.

Intermediate Outcomes:

End Outcomes:

Though not yet realized, it is expected that EMS providers and ambulance manufacturers will ultimately use the findings to make changes to ambulance patient compartment designs and standard operating procedures. This will lead to a reduction in non-fatal injuries to EMS workers.

For Partners and Stakeholders:

Name of Organization: National Highway Traffic Safety Administration (NHTSA), Office of Emergency Medical Services

Category of Organization: Government

Contact:

Drew Dawson, Chief
ddawson@nhtsa.dot.gov
(202) 366-9966

For Partners only***:***

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

Through a working relationship with the National Highway Traffic Safety Administration's (NHTSA) EMS Division, NIOSH was invited to contribute questions for the National Registry of Emergency Medical Technicians (NREMT) Longitudinal Emergency Medical Technician Attributes & Demographics Study (LEADS). LEADS is hosted by NREMT with support from NHTSA's EMS Division. The survey addressed issues regarding ambulance safety, including restraint usage and types of patient transport.

NIOSH has received letters of support for continued ambulance safety research from NHTSA and is expected to provide a significant content contribution to NHTSA's EMS Safety Consortium meeting planned for the fall of 2006.

Collaborative Outputs:

A manuscript reporting the analysis of the NREMT survey is currently in review at the Journal of Emergency Medical Services.

Intermediate Outcomes:

End Outcomes:

Though not yet realized, it is expected that EMS providers and ambulance manufacturers will ultimately use the NIOSH research findings to make changes to ambulance patient compartment designs and standard operating procedures. This will lead to a reduction in non-fatal injuries to EMS workers**.**

For Partners and Stakeholders:

Name of Organization: General Services Administration, Automotive Division, Office of Vehicle Acquisition and Leasing Services

Category of Organization: Government

Contact:

John McDonald
jmcdonald@gsa.gov
(703) 605-2971

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

The General Services Administration (GSA) Automotive Division is responsible for maintaining the GSA KKK-1822F Specification for the Star-of-Life Ambulance. This specification is the principle influence on ambulance design in the U.S. This specification has been adopted by 34 states as the minimum specification for ambulance acquisition and construction. NIOSH has developed a strong relationship with GSA as a result of sharing preliminary research findings from the "Evaluation of Emergency Service Vehicle Occupant Safety" project. GSA has provided letters of support for continued research and has requested data to support future revisions of the KKK-1822 specification.

Collaborative Outputs:

At GSA's request, NIOSH provided anthropometry data in support of revisions to the KKK-1822 specification scheduled to take affect in the 2007. The data supported a revision to the specification that will increase the required head clearance over occupant seats.

Intermediate Outcomes:

Though not yet finalized, it is expected that the revision will result in safer seating for patient compartment occupants by reducing the risk for head strikes during ambulance crashes.

End Outcomes:

For Partners and Stakeholders:

Name of Organization: National Highway Traffic Safety Administration (NHTSA), National Center for Statistics and Analysis, Crash Investigation Division NRD-32

Category of Organization: Government

Contact:

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John.Brophy@nhtsa.dpt.gov
(202) 366-0328

For Partners only:

Type of Formal Agreement: Interagency Agreement

Description of collaborative activities (narrative):

Through an interagency agreement, NIOSH funded NHTSA's Special Crash Investigations Division to conduct reconstructions of 5 ambulance crashes. This effort was in support of the NIOSH "Evaluation of Emergency Vehicle Occupant Safety" project. The NHTSA reconstructions documented the circumstances and injury risks present during ambulance crashes. In particular, the reconstructions identified injury mechanisms present in an ambulance patient compartment during a crash. This data was not previously available to researchers or the public. The data was used by the NIOSH project team to focus efforts on appropriate engineering interventions for patient compartment occupants.

Collaborative Outputs:

Five ambulance crash reconstruction reports were produced. These reports are available to researchers and the public at the NHTSA Special Crash Investigations Web Page: www-nass.nhtsa.dot.gov/BIN/logon.exe/airmislogon

NHTSA CA02-028, 1999 Ford E-350 Super Duty Van Chassis W/Wheeled Coach Type III Ambulance Body, New Jersey, July 2002

NHTSA CA02-009, 2000 Ford E-350 Type III Ambulance, Kentucky, March 2002

NHTSA CA02-033, 1995 Ford E-350 Type III Ambulance, Minnesota, July 2002

NHTSA CA03-004, 1997 Ford E-350 Type III Ambulance, Kentucky, January 2003

NHTSA DS02-003, Wheeled Coach Moduvan Ambulance on a 1997 Ford E-350 Series Chassis, Washington, February 2002

Intermediate Outcomes:

As a result of this partnership, NHTSA’s Special Crash Investigations Team has become interested in ambulance crashes and has initiated several ambulance crash reconstructions on their own initiative.

End Outcomes:

For Partners and Stakeholders:

Name of Organization: Virginia Department of Criminal Justice; National Association of Convenience Stores

Category of Organization: Convenience store industry

Contact:

VDCJ: Jay Malcan, Ph.D., University of Virginia. No longer with Virginia Dept of Criminal Justice

For Partners only:

Type of Formal Agreement (if any): Protocol for case control study of convenience store study robberies. Joint partners in project

Description of collaborative activities (narrative):

Joint partnership with VDCJ consisted of development of protocol, determination of key risk factors for study, recruiting police teams for field activities, methods of measuring convenience store security features, development of agreements with police departments in and around Norfolk, Fairfax, and Richmond, VA to send copies of all convenience store robbery report to VDCJ. Jay Malcan and staff used GIS software to select control stores matched to robbed stores within 2 miles proximity. NIOSH received all data collections, developed data base, and completed analyses and draft reports/papers.

Partnerships with industry stakeholders included review of protocols and papers, and dissemination of results.

Collaborative Outputs:

Paper for publication. Presentation at the APHA conference.

Intermediate Outcomes:

Results impacted on OSHA and NIOSH recommendations for late night retail workplace violence prevention. Results focused NIOSH future research in late night retail on models for increasing compliance to guidelines.

End Outcomes:

Future research is now being planned to investigate models for increasing compliance to guidelines.

For Partners and Stakeholders:

Name of Organization: WalMart Corporation

Category of Organization: Corporation *(Retail sector)*,

Contact:

John Leynberger
WalMart Corporation
Bentonville, AR

For Partners only:

Type of Formal Agreement (if any):

Description of collaborative activities (narrative):

NIOSH has long had an interest in evidence about the effectiveness of back belts and has made considerable effort in evaluating the existing scientific literature to develop recommendations. The limitations of the existing studies have been addressed in this extensive study. The NIOSH role in this partnership was to conduct a scientifically credible evaluation of back belts that could withstand peer review scrutiny. NIOSH was able to contract for interviews with employees to ensuring confidentiality to obtain honest responses. Wal-Mart has had a long standing policy of recommending back-belts for use by their employees and has even required back belt use. Wal-Mart provided for employees to use time at work to participate in the interviews in a confidential setting. Wal-Mart also provided payroll and injury claims records data for analysis. Employees are interested in preventing back injury and back pain which causes considerable disability and reduced quality of life among its victims.

Collaborative Outputs:

A Prospective Study of Back Belts for Prevention of Back Pain and Injury

This prospective cohort study was designed to address the question of the effectiveness of back belts for the reduction of low back pain and injury claims in material handlers in a retail setting. Back belt use in the workplace has become commonplace, with approximately 4 million back belts purchased in 1995. From April, 1996 until April, 1998, we enrolled material handlers in a prospective cohort study of back belts in 160 Wal-Mart stores, distributed across 30 states, as the stores opened. Baseline interviews were completed for 9,377 employees asking about belt use, job, lifting exposure, demographics, health risks, and other factors. Outcomes included back injury workers' compensation claims filed with Wal-Mart and the six-month incidence of self-reported back pain on a followup interview of 6,311 employees.

We used multivariable logistic regression, controlling for multiple risk factors to compare employees who reported wearing belts "usually every day" with employees who reported "never" or "once or twice a month." We found no statistically significant effects for the rate of back injury claims or self-reported back pain between these groups. We also compared stores having a belt-requirement store policy with stores having a voluntary belt use policy and found no statistically significant differences in either the back injury claim rate or back pain. Our results were confirmed in subgroup analyses of employees with and without a prior history of back injury, employees in the most strenuous job, and employees with consistent belt-wearing habits. Interaction analyses also were confirmatory of our findings. Results based on multiple analyses of data all converge to a common conclusion: back-belt use is not associated with reduced incidence of back injury claims or low back pain in material handlers.

Intermediate Outcomes:

Although not well quantified, some intermediate outcomes have been noted. Anecdotally, there has been a shift in the type of safety products advertised in safety trade journals. The emphasis on back belts before the publication of the research results has shifted to other safety products and there has been a reduction in the number of advertisements for back belts. Annual sales figures for back belts are not available.

End Outcomes:

The expected or potential end outcomes of the evaluation of back belts (that concludes that there is no reduction in back injuries or back pain) is to redirect efforts and attention toward other measures (e.g. engineering controls) that could reduce the burden of back injury and back pain among material handlers. Data from the Department of Labor, Bureau of Labor Statistics indicates that the number of lost time injuries has steadily decreased. Following the publication of the research results in 2000, there was a 10% decline the first year (255,774 overexertion back injuries reported involving lost work days in 2000, to 230,523 in 2001) and 8% decline in 2002 (212,229 injuries reported) followed by a 13% decline in 2003 (184,850 injuries reported). Other external factors may be responsible for the reduction in injuries, but specific causes have not been definitively identified.

For Partners and Stakeholders:

Name of Organization: Bureau of Justice Statistics (BJS)

Category of Organization: Federal Government

Contact:

Michael Rand
RandM@ojp.usdoj.gov
(202) 616-3494

For Partners only:

Type of Formal Agreement (if any): Interagency agreement to conduct the Workplace Risk Supplement questions for the National Crime Victimization Survey (NCVS).

Description of collaborative activities (narrative):

The Workplace Risk Supplement was a supplemental series of questions asked of eligible NCVS household members. These questions were designed to gather critical information about circumstances surrounding incidents involving violence in the workplace, details concerning the relationship of the offender, and other risk factor information that currently do not exist for non-fatal workplace violence.

Collaborative Outputs:

Peer reviewed manuscripts are being written. The first manuscript is scheduled to be submitted for publication in fourth quarter 2006.

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders:

Name of Organization: Bureau of Labor Statistics (BLS)

Category of Organization: Federal Government

Contact:

Kelley Frampton
Frampton.Kelley@bls.gov
(202) 691-6189

For Partners only:

Type of Formal Agreement (if any): Interagency agreement to conduct the Survey of Workplace Violence Prevention.

Description of collaborative activities (narrative):

This survey evaluates the employers' perspective regarding policies, training, and other related issues on workplace violence prevention, including risk factors associated with workplace violence and prevention strategies, in workplaces within the United States.

Collaborative Outputs:

Peer reviewed manuscripts are being written. The first manuscript is scheduled to be submitted for publication in fourth quarter 2006.

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders:

Name of Organization: Consumer Product Safety Commission (CPSC)

Category of Organization: Federal Government

Contact:

Phil Travers
ptravers@cpsc.gov
(303) 504-7447

For Partners only:

Type of Formal Agreement (if any):

Interagency agreement to conduct a follow back survey of victims who presented at a participating National Electronic Injury Surveillance System All Injury Program (NEISS-AIP) hospital with injuries sustained in a workplace violence incident.

Description of collaborative activities (narrative):

Workplace violence victims identified from NEISS-AIP were contacted to voluntarily participate in the NEISS assault follow back survey. The questionnaire was designed by NIOSH TI and administered by CPSC using the computer assisted telephone interview technique. The follow back survey consisted of both open-ended and multiple choice questions that covered items such as: general workplace organization, worker characteristics, perpetrator characteristics, security measures, and prevention strategies.

Collaborative Outputs:

Manuscript – Non-Fatal Workplace Violence Injuries in the United States2003-2004. Will be submitted for publication in November 2006. Other peer reviewed publications will follow.

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders:

Name of Organization: Association of Equipment Manufacturers (AEM)

Category of Organization: Industry Association (Manufacturing)

Contact:

Russell Hutchinson
Association of Equipment Manufacturers
Russell Hutchison [rhutchison@AEM.org]
(414) 298-4118

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

The Association of Equipment Manufacturers (AEM) provides technical reviews of NIOSH products pertaining to equipment and machinery, and provides support in dissemination. For example, AEM provided NIOSH with an international mailing list with approximately 300 entries to support distribution of the NIOSH Workplace Solutions, "Preventing Injuries and Deaths when Working with Hydraulic Excavators and Backhoe Loaders," and helped distribute "Preventing Injuries when Working with Ride-on/Roller Compactors."

Collaborative Outputs:

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders:

Name of Organization: National Association of Tower Erectors (NATE)

Category of Organization: Industry Association (Construction Sector)

Contact:

Don Doty, Vice-Chairman, National Association of Tower Erectors,
[Don.Doty@StainlessLLC.com]
(972) 550-9504

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

Since 1997, NIOSH researchers have worked closely with the National Association of Tower Erectors to improve the safety and health of tower erectors. NIOSH researchers provided technical assistance to NATE in the development of a comprehensive safety and health manual, and have provided safety presentations at annual NATE meetings. NATE assisted with dissemination of the NIOSH Alert, "Preventing Injuries and Deaths from Falls During Construction and Maintenance of Telecommunication Towers," and had provided a technical review of a draft. NATE published two NIOSH-authored articles in their monthly publication *"Tower Times."*

Collaborative Outputs:

The National Association of Tower Erectors best practices safety manual *"NATE Recommended Site Safety Practices-Reference and Developmental Materials."*

NATE published two NIOSH-authored articles entitled "*NIOSH—A Resource for Occupational Health and Safety Support" and "Falls- A Deadly Hazard for Tower Workers"* in the respective October 1998 and March 1999 issues of their monthly publication *"Tower Times."*

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders:

Name of Organization: U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) – Ohio Area Offices

Category of Organization: Federal government

Contacts:

Rob Medlock, Cleveland, Ohio Area Director
U. S. Department of Labor/OSHA
medlock.rob@dol.gov
(216) 615-4242

Deborah Zubaty
Columbus, Ohio Area Director
U. S. Department of Labor/OSHA
(614) 469-5582

Richard Gilgrist
Cincinnati, Ohio Area Director
U. S. Department of Labor/OSHA
(513) 841-4132

Jule Jones
Toledo Ohio Area Director
U. S. Department of Labor/OSHA
(419) 259-7542

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

The four Area Directors for the U. S. Department of Labor/OSHA in the state of Ohio voluntarily notify the NIOSH, Division of Safety Research of selected occupational fatalities (currently machine-related, workers under 18 years of age, highway construction work zones, and Hispanic workers) that occur within their jurisdictions. NIOSH investigators then collaborate with the OSHA investigator(s) during NIOSH FACE investigations. This collaboration includes an exchange of information and/or photographic documentation obtained during witness interviews or site visits, and/or information obtained from other outside entities such as a coroner, medical examiner, or police. This information is utilized in the development of the FACE report and prevention recommendations. Prior to the FACE report being finalized, the draft report is reviewed by and discussed with the OSHA compliance officer. In this way, accurate findings of the investigation can be ensured.

Collaborative Outputs:

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders:

Name of Organization: South Carolina Department of Labor, Occupational Safety and Health Administration

Category of Organization: State government

Contacts:

Dottie Ison
Director of Compliance Programs
South Carolina Department of Labor/OSHA
Dottie.Ison@osha.gov
(803) 896-6910

Thomas Wilkes
Director of Safety Compliance
South Carolina Department of Labor/OSHA
Thomas.Wilkes@osha.gov
(803) 896-6910

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

The Director of Compliance Programs or the Director of Safety Compliance voluntarily notify the NIOSH, Division of Safety Research of selected occupational fatalities (currently machine-related, workers under 18 years of age, highway construction work zones, and Hispanic workers) that occur within their state. NIOSH investigators then collaborate with the OSHA investigator(s) during a NIOSH Fatality Assessment and Control Evaluation (FACE) investigation. This collaboration includes an exchange of information and/or photographic documentation obtained during witness interviews or site visits, and/or information obtained from other outside entities such as a coroner, medical examiner, or police. This information is utilized in the development of the FACE report. Prior to the FACE report being finalized, the draft report is reviewed by and discussed with the OSHA compliance officer. In this way, accurate findings of the investigation can be ensured.

Collaborative Outputs:

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders:

Name of Organization: Tennessee Department of Labor, Occupational Safety and Health Administration

Category of Organization: State government

Contact:

Mike Maenza
Manager, Standards and Procedures
Tennessee Department of Labor/OSHA
(615) 741-6384

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

Mike Maenza, Manager, Standards and Procedures, Tennessee Department of Labor/OSHA notifies the NIOSH, Division of Safety Research of selected occupational fatalities (currently machine-related, workers under 18 years of age, highway construction work zones, and Hispanic workers) that occur within the state of Tennessee. NIOSH investigators then collaborate with the OSHA investigator(s) during the NIOSH Fatality Assessment and Control Evaluation (FACE) investigation. This collaboration includes an exchange of information and/or photographic documentation obtained during witness interviews or site visits, and/or information obtained from other outside entities such as a coroner, medical examiner, or police. This information is utilized in the development of the FACE report. Prior to the FACE report being finalized, the draft report is reviewed by and discussed with the OSHA compliance officer. In this way, accurate findings of the investigation can be ensured.

Collaborative Outputs:

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders:

Name of Organization: Virginia Department of Labor and Industry

Category of Organization: State government

Contact:

Glenn Doyle, Director of Compliance
Virginia Department of Labor and Industry
(804) 786-7776

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

Glenn Doyle, Director of Compliance, Virginia Department of Labor and Industry voluntarily notifies the NIOSH, Division of Safety Research of selected occupational fatalities (currently machine-related, workers under 18 years of age, highway construction work zones, and Hispanic workers) that occur within the state of Virginia. NIOSH investigators then collaborate with the OSHA investigator(s) during the NIOSH Fatality Assessment and Control Evaluation (FACE) investigation. This collaboration includes an exchange of information and/or photographic documentation obtained during witness interviews or site visits, and/or information obtained from other outside entities such as a coroner, medical examiner, or police. This information is utilized in the development of the FACE report. Prior to the FACE report being finalized, the draft report is reviewed by and discussed with the OSHA compliance officer. In this way, accurate findings of the investigation can be ensured.

Collaborative Outputs:

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders:

Name of Organization: Maryland Department of Labor and Industry/Occupational Safety and Health Administration

Category of Organization: State government

Contact:

Craig Lowry, Maryland Department of Labor/Occupational Safety and Health Administration, (410) 767-2363

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

In the 1980s, the Maryland Department of Labor and Industry/Occupational Safety and Health Administration cooperated with NIOSH in in-house Fatality Assessment and Control Evaluation (FACE) investigations. In the early 1990s, Maryland was funded through a cooperative agreement to conduct a state-based FACE program. Recently, the Maryland Department of Labor has agreed to cooperate again in the in-house FACE program. The Maryland Department of Labor notifies the NIOSH, Division of Safety Research of selected occupational fatalities (currently machine-related, workers under 18 years of age, highway construction work zones, and Hispanic workers) that occur within the state of Maryland. NIOSH investigators will collaborate with the OSHA investigator(s) during the NIOSH Fatality Assessment and Control Evaluation (FACE) investigation. This collaboration will include an exchange of information and/or photographic documentation obtained during witness interviews or site visits, and/or information obtained from other outside entities such as a coroner, medical examiner, or police. This information will be utilized in the development of the FACE report. Prior to the FACE report being finalized, the draft report will be reviewed by and discussed with the OSHA compliance officer. In this way, accurate findings of the investigation can be ensured.

In 1989, NIOSH and the Maryland Occupational Safety and Health Administration (MOSH) jointly developed the NIOSH Alert entitled: Preventing Worker Deaths and Injuries from Falls Through Skylights and Roof Openings. MOSH then distributed the Alert to every licensed contractor in the state and required the contractors to attend a safety course on preventing falls through skylights and roof openings.

Collaborative Outputs:

NIOSH [1990]. Alert: Preventing Worker Deaths and Injuries from Falls Through Skylights and Roof Openings. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 90-100.

Intermediate Outcomes:

End Outcomes:

NIOSH and MOSH tracked the fatal falls within Maryland for four and a half years following the publication of the Alert, and did not identify any falls through skylights or roof openings.

For Partners and Stakeholders:

Name: North Carolina Department of Labor/OSHA

Category of Organization: State government

Contact:

Steve Sykes
State Plan Coordinator
North Carolina Department of Labor/OSHA
steve.sykes@nclabor.com
(919) 807-2858

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

Steve Sykes, the State Plan Coordinator, North Carolina Department of Labor/OSHA notifies the NIOSH, Division of Safety Research of selected occupational fatalities (currently machine-related, workers under 18 years of age, highway construction work zones, and Hispanic workers) that occur within the state of North Carolina. NIOSH investigators then collaborate with the OSHA investigator(s) during the NIOSH Fatality Assessment and Control Evaluation (FACE) investigation. This collaboration includes an exchange of information and/or photographic documentation obtained during witness interviews or site visits, and/or information obtained from other outside entities such as a coroner, medical examiner, or police. This information is utilized in the development of the FACE report. Prior to the FACE report being finalized, the draft report is reviewed by and discussed with the OSHA compliance officer. In this way, accurate findings of the investigation can be ensured.

NIOSH data analysis, and information and recommendations from FACE fatality investigations were used by the North Carolina OSHA in the development of the North Carolina Telecommunication Tower standard, the first safety regulation of its kind regarding tower erection in the nation. At the request of North Carolina OSHA, NIOSH staff gave a presentation entitled “Communication Towers: A Rising Injury Risk” to North Carolina stakeholders.

Collaborative Outputs:

Intermediate Outcomes:

Senate Bill 602/S.L. 2006-264 was recently approved by the N.C. General Assembly and provides that, effective August 27, 2006, the N.C. Department of Labor may adopt rules in connection with its requirements regarding tower climbers.

End Outcomes:

For Partners and Stakeholders:

Name of Organization: United States Fire Administration, National Fire Academy

Category of Organization: Federal Government

Contact:

Dr. Kirby Kiefer
National Fire Academy
[Kirby.Kiefer@dhs.gov]
(301) 447-1083

For Partners only:

Type of Formal Agreement (if any): Memorandum of Understanding, signed in 2005

Description of collaborative activities (narrative):

The National Institute for Occupational Safety and Health (NIOSH) and the United States Fire Administration (USFA), including the National Fire Academy (NFA) entered into a Memorandum of Understanding (MOU) to identify specific steps or collaborations the two agencies can undertake with the goal of improving safety and health conditions for fire fighters throughout the United States.

The NIOSH/FFFIPP and the USFA/NFA have agreed to work together to provide the United States' fire service with recommendations for the prevention of future fire fighter fatalities in the following manner:

NIOSH provides USFA/NFA currently published NIOSH/FFFIPP documents and the USFA posts the NIOSH documents and/or provides an Internet URL link to NIOSH documents on the USFA web site.

NIOSH provides the periodic fire fighter health and safety quiz/challenge,
based on NIOSH report recommendations to go along with the USFA monthly provisional fire fighter fatality statistics release via listserve.

NIOSH provides and the USFA disseminates NIOSH reports into the Fire and Emergency Services Higher Education (FESHE) community, other higher education programs, and State and local fire service training programs wherever practicable for the use as case studies in fire service training curriculum(s).

NIOSH provides and USFA incorporates NIOSH/FFFIPP reports into relevant USFA course curriculum and national fire service training curriculums as case studies.

NIOSH and USFA have agreed to research, coordinate, and collaborate on firefighter safety and health initiatives, and in response to emergent issues regarding firefighter health and safety.

Collaborative Outputs:

Intermediate Outcomes:

End Outcomes:

Project: CAN 8861, Fire Fighter Fatality Investigation and Prevention Program

For Partners and Stakeholders:

Name of Organization: National Institute of Standards and Technology

Category of Organization: Government - Federal

Contact:

Mr. Nelson Bryner
National Institute of Standards and Technology
(301) 975-6868
(nelson.bryner@nist.gov)

For Partners only:

Type of Formal Agreement (if any): Past interagency agreements

Description of collaborative activities:

In Fiscal Year 1998, Congress recognized the need for further efforts to address the continuing problem of occupational fire fighter fatalities, and funded NIOSH to undertake this effort. NIOSH has been given a congressional appropriation to investigate fire fighter fatalities within the United States, and has developed and implemented the Fire Fighter Fatality Investigation and Prevention Program. The program's goals/objectives are to prevent fatal work injuries to fire fighters by identifying work situations at high risk for fatal injury.

The National Institute of Standards and Technology (NIST), Building and Fire Research Laboratory, performs fire-related research, including but not limited to: building materials; computer-integrated construction practices; fire science and fire safety engineering; and structural, mechanical, and environmental engineering. Products of the laboratory's research include measurements and test methods, performance criteria, and technical data that support innovations by industry and are incorporated into building and fire standards and codes. NIST has been, and continues to be a valued research partner in the performance of the FFFIPP.

NIOSH and NIST have entered into a few interagency agreements for NIST to conduct research in support of the FFFIPP and fire fighter safety. These interagency agreements have addressed thermal protection properties of fire fighter turnout gear, and the development of fire dynamics simulations models for selected incidents.

To date, NIST developed fire simulation models for three fatal fires investigated by NIOSH: (99F-21) Two fire fighters die and two are injured in townhouse fire - District of Columbia; (F2000-04) Structure Fire Claims the Life of Three Career Fire Fighters and Three Children – Iowa; and, F2000-13 Restaurant Fire Claims the Lives of Two Career Fire Fighters – Texas. Additionally, NIOSH personnel worked with NIST on another fire simulator model regarding Two Fire Fighter Deaths at a Training Fire in Florida (F2002-34). These models have proven to be instrumental to NIOSH investigators in elucidating the circumstances resulting in fire fighter injury and death, and in testing the validity of recommendations for preventing future similar deaths (e.g., impact of ventilation on fire growth). NIOSH has referenced these models in fatality investigation reports, and provided links to the models on the NIST website. NIST has distributed these models at fire service meetings, and makes them available on the NIST website. It is anticipated that these models will enhance communication of findings from these fires, and potentially be of value as training tools.

Collaborative Outputs:

NIST [1999]. NISTIR 6510, Simulation of the Dynamics of the Fire at 3146 Cherry Road NE, Washington D.C., May 30, 1999. National Institute of Standards and Technology, Technology Administrations, U.S. Department of Commerce.

NIST [2000]. NISTIR 6854, Simulation of the Dynamics of a Fire in a Two-Story Duplex - Iowa, December 22, 1999. National Institute of Standards and Technology, Technology Administrations, U.S. Department of Commerce.

NIST [2000]. NISTIR 6923, Simulation of the Dynamics of a Fire in a One-Story Restaurant – Texas, February 14, 2000. National Institute of Standards and Technology, Technology Administrations, U.S. Department of Commerce.

NIST [2001]. NISTIR 6750, Measurement Techniques for Low Heat Flux Exposures to Fire Fighters Protective Clothing – June 2001. National Institute of Standards and Technology, Technology Administrations, U.S. Department of Commerce.

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders:

Name of Organization: U.S. Department of Labor**,** Occupational Safety and Health Administration

Category of Organization: Federal Government

Contacts:

Rob Medlock
Cleveland Area Director
Ohio Department of Labor/OSHA
medlock.rob@dol.gov
(216) 615-4242

Frank Liebrich
Pittsburgh, Pennsylvania Area Director
U. S. Department of Labor/OSHA
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OSHA Directorate of Cooperative and State Programs
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(202) 693-2200

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

In 1996, due to the high incidence of telecommunication tower erector deaths, OSHA placed an emphasis on the inspection of telecommunication tower construction sites. Because this was a relatively new segment of the construction industry, OSHA inspectors were not consistent in the interpretation of OSHA standards during their inspections. For instance, what was considered to be a fall protection violation of a standard at one site by one inspector would not be considered to be a violation by a second inspector at another site. In an effort to gain consistent inspection procedures and regulation interpretations, the National Association of Tower Erectors (NATE) approached the U.S. Assistant Secretary of Labor to develop uniform enforcement policies and procedures. The Assistant Secretary instructed the National OSHA office to develop such policies and procedures, and as a result, the OSHA telecommunication tower task force was formed in April 1997. Members on the task force consisted of representatives from various government agencies and private industry groups. NIOSH, through their representative on the Advisory Committee on Construction Safety and Health (ACCSH,) placed two representatives on the task force. NIOSH targeted tower incidents for investigation by the Fatality Assessment and Control Evaluation Program (FACE) to support task force work. NIOSH representatives actively participated in the task force, providing technical assistance, communicating findings from NIOSH statistical analyses and fatality investigations, and participating in the development of associated products.

OSHA supports the NIOSH FACE program, which includes cooperative agreements with state departments of health and labor to conduct state-based FACE programs. NIOSH personnel worked closely with Tom Galassi and Mary Anderson, U.S. Department of Labor/OSHA, Office of Enforcement Programs in the development of the OSHA Compliance Directive, CPL 02-00-134 - OSHA Support of NIOSH "FACE" Program, effective date January 26, 2004. This directive encourages both federal and state-plan OSHA programs to cooperate with the FACE program, including notification of worker deaths and sharing of investigation findings as appropriate. This directive provides a framework for OSHA, NIOSH, and state-based FACE programs to work cooperatively in distinct, but complementary, worker injury death investigations.

NIOSH consulted with OSHA when first targeting deaths of Hispanic workers for FACE investigations. OSHA representatives provided suggestions for investigation methods, areas of inquiry in investigations, and dissemination of findings. NIOSH has also worked with OSHA to identify OSHA materials that can be highlighted in FACE reports.

The OSHA Outreach Training and Education Centers support OSHA's training and education mission through a variety of safety and health programs. The training provided by the Education Centers serves the public in the recognition, avoidance and prevention of unsafe and unhealthful working conditions. NIOSH FACE staff work with individual Education Centers to gauge their interest and needs, and provide relevant publications (e.g., Alerts, Hazard ID's, and Workplace Solutions) that the Education Centers can use in their training and outreach.

Collaborative Outputs:

OSHA Compliance Directive CPL 02-01-029 - CPL 2-1.29 - Interim Inspection Procedures During Communication Tower Construction Activities, December 1999. This directive contained the procedures to be used during the inspection of tower construction sites, and the procedures to be followed during tower construction. Procedures for the hoisting of materials and employees, hoist selection and use, and fall protection for erectors were outlined.

OSHA Compliance Directive CPL 02-01-036 - CPL 2-1.36 - Interim Inspection Procedures During Communication Tower Construction Activities, effective date March 26, 2002. This was a revision of the 1999 Directive that removed a restriction that an employee's work station had to be over 200 feet in the air before they could ride the hoist line to their workstation. Findings from FACE investigations were considered in making this revision.

Three-day OSHA train- the- trainer program, OSHA 10-hour and OSHA 500 Tower Safety Courses. Findings and prevention recommendations from FACE investigations were used in the development of these training programs.

ACCSH recommended best practices site safety manual.

OSHA Compliance Directive, CPL 02-00-134 - OSHA Support of NIOSH "FACE" Program, effective date January 26, 2004. This directive encourages both federal and state-plan OSHA programs to cooperative with the NIOSH FACE program.

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders:

Name of Organization: International Union of Operating Engineers (IUOP)

Category of Organization: Labor Union

Contact:

Emmett Russell
International Union of Operating Engineers
Emmett Russell [ERussell@IUOE.ORG]
(202) 778-2672

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

The International Union of Operating Engineers (IUOP) provides technical reviews of NIOSH products pertaining to equipment and machinery, and provides support in dissemination. For example, IUOP helped distribute, “Preventing Injuries and Deaths when Working with Hydraulic Excavators and Backhoe Loaders,” and “Preventing Injuries when Working with Ride-on/Roller Compactors.”

Collaborative Outputs:

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders:

Name of Organization: The International Association of Fire Chiefs (IAFC)

Category of Organization: Industry Association (Services Sector)

Contact:

David Daniels
Fire Chief, Fulton County (GA) Fire Department
(404) 505-5722 ipager - daviddaniels@mycingular.blackberry.net

For Partners only:

Type of Formal Agreement (if any):

Description of collaborative activities (narrative):

The International Association of Fire Chiefs (IAFC) is a network of more than 12,000 fire chiefs and emergency officers. A NIOSH employee serves as a non-voting member on the IAFC Executive Board of the Safety, Health and Survival Section. The mission of the Safety, Health and Survival Section is to support and provide leadership for the advancement of occupational safety and health within the fire service and in the greater emergency response community.

Collaborative Outputs:

The NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) partnered with the International Association of Fire Chiefs (IAFC), the International Association of Fire Fighters (IAFF) and the Volunteer and Combination Officers' Section of the IAFC who called for a second fire service stand down that was held starting Wednesday, June 21, 2006 and continued until all personnel and duty nights had been included.

During this stand down and in consonance with all of the 2006 Stand Down sponsors and partners, the NIOSH FFFIPP urged all fire departments to suspend all non-emergency activity and instead focus entirely on fire fighter safety. NIOSH posted a notice regarding the stand down on the NIOSH website. The 2006 stand down focused on emergency vehicle safety, including seatbelt usage and safe driving through intersections. FFFIPP fatality investigation reports and publications were identified as tools for training in stand down materials.

Intermediate Outcomes:

End Outcomes:

Project: CAN 8861, Fire Fighter Fatality Investigation and Prevention Program

For Partners and Stakeholders:

Name of Organization: National Volunteer Fire Council

Category of Organization: Industry association (Services Sector)

Contact:

Ms. Heather Schafer
Executive Director, National Volunteer Fire Council
(202) 887-5700
[hschafer@nvfc.org]

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities:

The United States currently depends on approximately 1.1 million fire fighters, three out of four who are volunteers, to protect its citizens and property from losses caused by fire. Data from recent years indicate that approximately 56 fire fighters die each year from fatal traumatic injuries, and approximately 95,000 are injured at work each year. In Fiscal Year 1998, Congress recognized the need for further efforts to address the continuing problem of occupational fire fighter fatalities, and funded NIOSH to undertake this effort. NIOSH has been given a congressional appropriation to investigate fire fighter fatalities within the United States, and has developed and implemented the Fire Fighter Fatality Investigation and Prevention Program. The program's goals/objectives are to prevent fatal work injuries to fire fighters by identifying work situations at high risk for fatal injury.

The National Volunteer Fire Council (NVFC) is a non-profit membership association representing the interests of the volunteer fire, EMS and rescue services. The NVFC serves as an information source regarding legislation, standards and regulatory issues impacting volunteer fire and emergency services. The NVFC is a valued NIOSH partner helping to disseminate the products produced through the NIOSH FFFIPP. NIOSH has given presentations at annual meetings of the NVFC:

Braddee RW [1998]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the National Volunteer Fire Council, Warwick, RI, October 9, 1998.

Cortez K [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the National Volunteer Fire Council Meeting, Memphis, TN, October 4, 1999.

Cortez K [2001]. NIOSH's Fire Fighter Program and Two Fatality Incidents. Presented at the National Volunteer Fire Council meeting, Wenatchee, Washington, April 20, 2001. Additionally, the NVFC routinely reviews selected fatality reports and other documents such as Alerts and Workplace Solutions documents.

Collaborative Outputs:

The NVFC provides web page links on their web to the NIOSH FFFIPP
http://www.nvfc.org/

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders:

Name of Organization: Emergency Responder Safety Institute (ERSI)

Category of Organization: Advocacy Group

Contact:

Stephen P. Austin
Project Manager/Fire Police Officer
steveaustin@earthlink.net
(302) 995-0336

For Partners only:

Type of Formal Agreement (if any): N/A

Description of collaborative activities (narrative):

A NIOSH employee from the NIOSH Fire Fighter Fatality Investigation and Prevention Program serves as a member of the Emergency Responder Safety Institute (ERSI). Created as a Committee of the Cumberland Valley Volunteer Firemen's Association, the Institute serves as an informal advisory panel of public safety leaders committed to reducing deaths and injuries to America's Emergency Responders.

The Emergency Responder Safety Institute is comprised of members who are personally dedicated to the safety of the men and women who respond to emergencies on or along our nation's streets, roads and highways. Members of ERSI include trainers, writers, managers, government officials, technical experts and fire service leaders. NIOSH works with ERSI members to reduce fire fighter injuries and fatalities resulting from motor vehicle struck-by incidents by providing the ERSI members with recently released NIOSH fatality investigation reports. The Emergency Responder Safety Institute maintains a web site highlighting the NIOSH fire fighter fatality investigation reports and the hazards fire fighters face while working in or near moving traffic.

Collaborative Outputs: None to report.

Intermediate Outcomes: None to report.

End Outcomes: None to Report.

For Partners and Stakeholders:

Name of Organization: The Commonwealth of Pennsylvania, Office of the State Fire Commissioner

Category of Organization: State Government

Contact:

Ed Mann
Pennsylvania State Fire Commissioner
(717) 651-2201
emann@state.pa.us

For Partners only:

Type of Formal Agreement (if any): Letter of Agreement, signed in 2006

Description of collaborative activities (narrative):

The National Institute for Occupational Safety and Health (NIOSH) Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) and the Commonwealth of Pennsylvania, Office of the State Fire Commissioner entered into a Letter of Understanding to identify specific steps or collaborations the two agencies can undertake with the goal of improving safety and health conditions for firefighters throughout the Commonwealth.

The NIOSH/FFFIPP and the Office of State Fire Commissioner have agreed to work together to provide the Commonwealth fire service with recommendations for the prevention of future firefighter fatalities in the following manner:

NIOSH agreed to provide the Office of State Fire Commissioner currently published NIOSH FFFIPP documents and the Commonwealth agreed to post NIOSH documents and/or provide an Internet URL link to NIOSH documents on the Office of State Fire Commissioner web site.

NIOSH provides a monthly/periodic firefighter health and safety quiz/challenge, based on NIOSH report recommendations to go along with the Office of State Fire Commissioner firefighter fatality statistics release via listserve.

NIOSH provides and the Office of State Fire Commissioner disseminates NIOSH reports to the Firemen's Association of the State of Pennsylvania, The Pennsylvania Fire and Emergency Services Institute and other means to include electronic messages through a variety of distribution list wherever practicable.

NIOSH provides, and the Office of State Fire Commissioner incorporates NIOSH FFFIPP reports into relevant Office of State Fire Commissioner and the Pennsylvania State Fire Academy, courses and training curriculum(s) as case studies.

The Office of State Fire Commissioner and NIOSH agreed to research, coordinate, and collaborate on firefighter safety and health initiatives, and in response to emergent issues regarding firefighter health and safety.

Collaborative Outputs:

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders:

Name of Organization: The American Society of Safety Engineers (ASSE)

Category of Organization: Professional Society

Contact:

Terry Wilkinson
Director, Member/Region Affairs
1800 East Oakton Street
Des Plaines, IL 60018
(847) 768-3420
twilkinson@asse.org

Rennie Heath
Manager Practice Specialties
1800 East Oakton Street
Des Plaines, IL 60018
(847) 768-3425
rheath@asse.org

Dave Heidorn
Manager, Government Affairs & Policy
847.768.3406
dheidorn@asse.org

For Partners only:

Type of Formal Agreement (if any): Partnership agreement

Description of collaborative activities (narrative):

The American Society of Safety Engineers (ASSE) is the oldest and largest professional safety organization. Its more than 30,000 members manage, supervise and consult on safety, health, and environmental issues in industry, insurance, government and education. ASSE has 13 practice specialties, 150 chapters, 56 sections and 64 student sections. When a final NIOSH Fatality Assessment and Control Evaluation (FACE) program publication is completed, an electronic version is sent to ASSE. ASSE determines where best the document should be targeted, and prints it in either their Professional Safety Magazine or one of their thirteen practice specialties newsletters.

Collaborative Outputs:

FACE report 2004-11, Hispanic Laborer on Roadway Construction Worksite Run Over and Killed by a Backing Flat Bed Dump Truck-North Carolina, was printed in its entirety in the Summer, 2006 issue of Blueprints, the American Society of Safety Engineers' construction practice specialty newsletter. The Editor's note gave an excellent description of both the in-house and state-based FACE program.

FACE report 2005-06, Hispanic Worker Dies After Falling From a Pile of Construction Debris in the Bed of a Trash-Style Body Truck to a Paved Driveway Below—North Carolina, was printed in its entirety in the Spring, 2006 issue of Blueprints, the American Society of Safety Engineers' construction practice specialty newsletter. The Editor's note gave an excellent description of both the in-house and state-based FACE program.

NIOSH Recommendations Based on fire fighter fatality investigations were printed in an article "Roadway Incident Safety Best Practices for Emergency Responders" in the Spring 2006 issue of Perspectives, the American Society of Safety Engineers' public sector practice specialty newsletter.

Intermediate Outcomes: None to report.

End Outcomes: None to report.

For Partners and Stakeholders:

Name of Organization: Occupational Safety and Health Administration (OSHA) Outreach Training and Education Centers

Category of Organization: Academic

Contact:

Keene State College
OSHA Education Center
175 Ammon Drive
Manchester, NH 03103-3308
Phone: (800) 449-6742
oshaed@keene.edu

West Virginia University
Safety and Health Extension
130 Tower Lane
Morgantown, WV 26506-6615
Phone: (800) 626-4748

Outreach Education and Training
Kitren VanStrander
Rochester Institute of Technology
31 Lomb Memorial Drive, 2209 Eastman Building
Rochester, NY 14623-5603
Phone: (866) 385-7470

Mississippi State University
Center for Safety and Health
2151 Hwy 18, Suite B
Brandon, MS 39042

University of Washington
Rick Gleason
4225 Roosevelt Way NE, Suite 118
Seattle, WA 98105
Phone: (800) 326-7568

Great Lakes Regional OTI Education Center
UAW Health and Safety Dept.
8000 East Jefferson Ave
Detroit, MI 48214-3963
Phone: (800) 605-2046

Great Lakes Regional OTI Education Center
Eastern Michigan University
2000 Huron River Drive, Suite 101
Ypsilanti, MI 48197-1699
Phone: (800) 932-8689

For Partners only:

Type of Formal Agreement (if any):

Description of collaborative activities (narrative):

The OSHA Outreach Training and Education Centers support OSHA's training and education mission through a variety of safety and health programs. The training provided by the Education Centers serves the public in the recognition, avoidance and prevention of unsafe and unhealthy working conditions.

NIOSH disseminated publications (e.g., Alerts, Hazard ID's, and Workplace Solutions) that were developed by the NIOSH Fatality Assessment Control and Evaluation (FACE) program to various OSHA Outreach Training and Education Centers throughout the United States. Contact was made with individual Education Centers to gauge their specific interests and needs, and relevant publications were sent accordingly.

Intermediate Outcomes: None to report.

End Outcomes: None to report.

For Partners and Stakeholders:

Name of Organization: International Association of Fire Fighters (IAFF)

Category of Organization: Labor Union

Contact:

Mr. Richard M. Duffy
Assistant to the General President
International Association of Fire Fighters
(202) 824-1571
rduffy@iaff.org

For Partners only:

Type of Formal Agreement (if any): None

Description of collaborative activities (narrative):

The United States currently depends on approximately 1.1 million fire fighters to protect its citizens and property from losses caused by fire. Data from recent years indicate that approximately 56 fire fighters die each year from fatal traumatic injuries, 46 die from cardiovascular related disease received in the line-of-duty, and approximately 95,000 are injured at work each year. In fiscal year 1998, as a direct result of efforts by the International Association of Fire fighters (IAFF), the U.S. Congress recognized the need for further efforts to address the continuing problem of occupational fire fighter fatalities, and funded NIOSH to undertake this effort. NIOSH was given a congressional appropriation to investigate fire fighter fatalities within the United States, and developed and implemented the Fire Fighter Fatality Investigation and Prevention Program (FFFIPP). The program's goals/objectives are to prevent fatal work injuries to fire fighters by identifying work situations at high risk for fatal injury and formulating prevention strategies for those who can intervene in the workplace.

The IAFF has been, and continues to be, an effective partner in the support and growth of the NIOSH FFFIPP. The IAFF has provided input on the scope and directions of the FFFIPP at stakeholder meetings held in 1998 and 2006. The IAFF notifies NIOSH of fire fighter fatalities and other incidents they believe need to be researched. The IAFF provides expert reviews of some FFFIPP products.

NIOSH provides technical presentations and informational booths, and distributes FFFIPP products at IAFF conferences and meetings. The following are examples of presentations and posters given at IAFF functions -

Presentation – Braddee R [1999]. NIOSH's FFFIPP. Presented at the IAFF Redmond Conference, Honolulu, Hawaii, August 21-28, 1999.

Workshop: Presentations included an Overview of the Fire Fighter Fatality Investigation and Prevention Program Accomplishments, NIOSH Alert “Preventing Injuries and Deaths to Fire Fighters Due to Structural Collapse,” Oxygen Regulator Fires, and Fire Fighter Cardiovascular Fatalities which were presented at the Redmond Conference (International Association of Fire Fighters Safety and Health Conference), Honolulu, Hawaii, August 21-28, 1999. The two workshops were interactive and involved the procedures used in investigating fire fighter fatalities.

Presentation – Braddee R [2001]. Structure Fire Claims the Life of Three Career Fire Fighters and Three Children – Iowa. Presented at IAFF 16th Redmond Symposium, Phoenix, Arizona, September 2001.

Presentation - Castillo D [2001]. NIOSH’s Fire Fighter Fatality Investigation and Prevention Program's Investigation Database. Presented at the IAFF 16th Redmond Symposium, Phoenix, Arizona, September 2001.

Presentation - McFall M [2001]. Restaurant Fire Claims the Life of Two Career Fire Fighters – Texas. Presented at the IAFF 16th Redmond Symposium, Phoenix, Arizona, September 2001.

Presentation - Merinar T [2003]. Fatality cases involving roof and floor truss failures. Presented at the IAFF 17th Redmond Symposium, San Francisco, California, October 2003.

Presentation - Tarley T [2003]. Live-fire training case study. Presented at the IAFF 17th Redmond Symposium, San Francisco, California, October 2003.

Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Fighters Annual Conference, August, 2000, Chicago, Illinois.

Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the IAFF 16th Redmond Symposium, September 2001, Phoenix, Arizona.

Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Fighters Conference, August 2002, Las Vegas, Nevada.

Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Fighters’ Redmond Conference, October 2003, San Francisco, California.

Poster regarding NIOSH’s Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Fighters’ Redmond Conference, October 23-27, 2005, Honolulu, Hawaii.

Collaborative Outputs: None to report.

Intermediate Outcomes: None to report.

End Outcomes: None to report

Project: HCCB7 9278061 - Evaluation of a New Method for Machinery Risk Reduction*:*

For Partners and Stakeholders:

Name of Organization: United Steel Workers (PACE Union)

Category of Organization: Labor Union

Contact: (name, title, email, phone)

Tom McQuiston, Safety and Health Coordinator
tom.mcquiston@earthlink.net
(919) 929-5878

For Partners only:

Type of Formal Agreement (if any): Letter of cooperation

Description of collaborative activities (narrative):

Machine risk assessment site visits were made to 3 paper manufacturing worksites; risk assessment leaders were trained for each site; the research is stopped due to workplace and NIOSH personnel moves.

Collaborative Outputs:

A 2-day machine risk assessment training session was held in Cincinnati in 2004. Also a NIOSH presentation on machine risk reduction was provided for the USW(PACE) national safety committee meeting in Orlando in Sept 2005.

Intermediate Outcomes:

Pending restart of the NIOSH research on machine risk reduction

End Outcomes:

Pending restart of the NIOSH research on machine risk reduction

Project: HCCB7 9278061 - Evaluation of a New Method for Machinery Risk Reduction

For Partners and Stakeholders:

Name of Organization: Design Safety Engineering

Category of Organization: Company (safety consulting)

Contact: (name, title, email, phone)

Bruce Main
bruce@designsafe.com
(734) 483-2033

For Partners only:

Type of Formal Agreement (if any): Task order

Description of collaborative activities (narrative):

Helped design the study, train the test site personnel, and collect data

Collaborative Outputs:

2 journal articles, 2 press releases, NIOSH Workplace Solutions document in process

Intermediate Outcomes:

Study findings were that injury rates fell among the test sites

End Outcomes:

NIOSH is considering new research to follow-up on the positive results of the initial pilot study

For Partners and Stakeholders:

Project: HCCB7 9278061 - Evaluation of a New Method for Machinery Risk Reduction

For Partners and Stakeholders:

Name of Organization: Cloutier Consulting Services

Category of Organization: Company (safety consulting)

Contact: (name, title, email, phone)

Dennis Cloutier
dennis@cloutierconsulting.com
(513) 941-2917

For Partners only:

Type of Formal Agreement (if any): Task order

Description of collaborative activities (narrative):

Helped design the study, train the test site personnel, and collect data

Collaborative Outputs:

2 journal articles, 2 press releases, NIOSH Workplace Solutions document in process

Intermediate Outcomes:

Study findings were that injury rates fell among the test sites

End Outcomes:

NIOSH is considering new research to follow-up on the positive results of the initial pilot study

Project: HCCB7 9278061 - Evaluation of a New Method for Machinery Risk Reduction

For Partners and Stakeholders:

Name of Organization: Christensen Consulting for Safety Excellence

Category of Organization: Company (safety consulting)

Contact: (name, title, email, phone)

Wayne Christensen
wchrissafe@aol.com
(815) 455-7328

For Partners only:

Type of Formal Agreement (if any): Task order

Description of collaborative activities (narrative):

Helped design the study, train the test site personnel, and collect data

Collaborative Outputs:

2 journal articles, 2 press releases, NIOSH Workplace Solutions document in process

Intermediate Outcomes:

Study findings were that injury rates fell among the test sites

End Outcomes:

NIOSH is considering new research to follow-up on the positive results of the initial pilot study

Project: HCCB7 9278061 - Evaluation of a New Method for Machinery Risk Reduction

For Partners and Stakeholders:

Name of Organization: United Auto Workers

Category of Organization: Labor Union

Contact: (name, title, email, phone)

Jim Howe
Safety Consultant
jimhowe@earthlink.net
(248) 797-1741

For Partners only:

Type of Formal Agreement (if any):

Description of collaborative activities (narrative):

Collaborative Outputs:

Intermediate Outcomes:

End Outcomes:

Project: HCCB7 9278061 - Evaluation of a New Method for Machinery Risk Reduction

For Partners and Stakeholders:

Name of Organization: Hazards, Limited

Category of Organization: Company *(safety consulting)*

Contact: (name, title, email, phone)

Fred A. Manuele
Safety consultant
famhl@sbcglobal.net
(847) 392-9449

For Partners only:

Type of Formal Agreement (if any):

Description of collaborative activities (narrative):

Collaborative Outputs:

Intermediate Outcomes:

End Outcomes:

Project: HCCB7 9278061 - Evaluation of a New Method for Machinery Risk Reduction

For Partners and Stakeholders:

Name of Organization: General Motors

Category of Organization: Manufacturer

Contact: (name, title, email, phone)

Mike Taubitz
Global Health and Safety Director
michael.taubitz@gm.com
(248) 753-5771

For Partners only:

Type of Formal Agreement (if any):

Description of collaborative activities (narrative):

Collaborative Outputs:

Intermediate Outcomes:

End Outcomes:

Project: HCCB7 9278061 - Evaluation of a New Method for Machinery Risk Reduction

For Partners and Stakeholders:

Name of Organization: Liberty Mutual

Category of Organization: Company *(worker comp insurance)*

Contact: (name, title, email, phone)

John Russell
Technical Director - Manufacturing Technology & Ergonomics
john.russell@libertymutual.com
(781) 986-5043

For Partners only:

Type of Formal Agreement (if any):

Description of collaborative activities (narrative):

Collaborative Outputs:

Intermediate Outcomes:

End Outcomes:

For Partners and Stakeholders*:*

Name of Organization: National Fire Protection Association (NFPA)

Category of Organization: International Nonprofit

Contact:

Carl E. Peterson
Assistant Director, NFPA Public Fire Protection Division
cpeterson@nfpa.org
(617) 984-7485

For Partners only:

Type of Formal Agreement (if any): N/A

Description of collaborative activities (narrative):

Two NIOSH employees serve as non-voting members on the NFPA 1500 Standard on fire department occupational safety and health program standards setting committee.

The mission of the international nonprofit NFPA is to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating consensus codes and standards, research, training, and education. NFPA membership totals more than 79,000 individuals from around the world and more than 80 national trade and professional organizations.

NIOSH provides the NFPA committee with the causal factors and hazards identified in NIOSH fire fighter line-of-duty fatality investigations. The committee members utilize the NIOSH investigation report findings in discussions and dialogue regarding current and future standards related to fire fighting safety and health.

Collaborative Outputs: None to report.

Intermediate Outcomes: None to report.

End Outcomes: None to report.

For Partners and Stakeholders:

Name of Organization: State Occupational Safety and Health Administration (OSHA) Consultation Programs

Category of Organization: Government (State)

Contact:

Connecticut Occupational Safety Health Administration
John Able, Occupational Safety Training Specialist
38 Wolcott Hill Road
Wethersfield, CT 06109
(860) 263-6902

Nevada Safety Consultation and Training Section (SCATS)
Mary Jo Brown
1301 N. Green Valley Parkway Suite 200
Henderson, Nevada 89074
(702) 486-9140

Michigan Occupational Safety and Health Administration
Department of Labor & Economic Growth
Nella Davis-Ray, Consultation Education and Training Division
7150 Harris Drive-P.O. Box 30643
Lansing, MI 48909-8143
(517) 322-6560

Alaska, Dept. of Labor & Workforce Development
Clifford V. Hustead, Labor Standards & Safety Division
3301 Eagle Street, Suite 305
Anchorage, AK 99503-4149
(800) 656-4972
cliffhustead@labor.state.ak.us

Iowa Division of Labor/OSHA Education
Sue Sirna
1000 East Grand Avenue
Des Moines, IA 50319-0209
(515) 281-0202

Washington State (WISHA) Services
Dan McMurdie
7273 Linderson Way S.W.
Tumwater, WA
(981) 501-5414

Arizona Consultation
Toni DeDomenico
800 West Washington Street
Phoenix, AZ 85007
(520) 628-5478

Virginia Department of Labor & Industry
David L. Atkins, Occupational Safety & Health Training Officer
13 South 13th Street
Richmond, VA. 23219
(804) 786-6359

MOSH Training and Education
Linda Price
312 Marshall Ave Suite 600
Laurel, MD 20707
(410) 767-2190

For Partners only:

Type of Formal Agreement (if any): N/A

Description of collaborative activities (narrative):

States with OSHA-approved programs have their own cooperative and voluntary compliance programs. Outreach services are responsible for coordinating OSHA's compliance assistance and outreach activities. Resources for these activities include print and electronic information and assistance tools, and worker safety education and training. States promote cooperative programs, such as employer safety and health consultation programs, the Voluntary Protection Programs (VPP), the Strategic Partnerships Program, and the Alliance Program. They also promote OSHA's training resources and the tools available on OSHA's web site.

NIOSH disseminated publications (e.g., Alerts, Hazard ID's and Workplace Solutions) that were developed by the Fatality Assessment and Control Evaluation (FACE) program to various OSHA Consultation Programs. Contact was made with OSHA Consultation Programs to gauge their specific interests and needs, and relevant publications were sent accordingly.

Collaborative Outputs:

The Washington State Department of Labor and Industry utilized and disseminated 150 copies of the NIOSH "Building Safer Highway Work Zones: Measures to Prevent Injuries from Vehicles and Equipment" publication (Pub. No. 2001-18) during training for compliance officers and consultation officials. The training addressed a new standard and enforcement procedures for dump trucks on highway work zones.

Intermediate Outcomes: None to report.

End Outcomes: None to report.

Appendix 7: Conferences, Meetings, Workshops

Name of Conference/Meeting/Workshop: National Fishing Industry Safety and Health Workshop

Dates: October 9-11, 1992

Location: Anchorage, Alaska

Attendance: 77 from Alaska and the west coast

Description: The workshop was convened to address commercial fishing safety and health. The objectives were to increase awareness, build coalitions, disseminate information and encourage action to prevent injury and disease in fishing. The focus was on North Pacific fishermen. The workshop scheduled sessions with 33 presenters. The first day was geared to surveillance, and the next two days were geared to control and interventions.

Results: All papers presented were included in a proceedings volume (see below). These were disseminated to participants and key prevention leaders nationally and internationally, particularly to leaders in circumpolar nations.

Participants identified preventative actions that could be implemented immediately, and research actions that are needed to discover the causes of, and solutions to, these problems. A broad range of concerned parties engaged and listened to each other, providing opportunities for collaborative networking.

Outputs: NIOSH [1994]. Proceedings of the National Fishing Industry Safety and Health Workshop. Cincinnati, OH: US Department of Health and Human Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 94-109.

Immediate Outcomes:

Name of Conference/Meeting/Workshop: 1995 Annual Fatality Assessment and Control Evaluation (FACE) Meeting

Date(s): June 13-15, 1995

Location: NIOSH Prete Building, Morgantown, WV

Attendance: Approximately 45 attendees, primarily grantees funded through NIOSH as State-based FACE programs, and NIOSH staff.

Description (narrative): The purpose of this meeting was to allow grantees to discuss field-based research issues, to provide field investigators and data managers with an opportunity to share knowledge and information, and to gain new insights from presentations provided by internal and external speakers. Discussion topics included the development and justification of prevention recommendations in FACE reports. A demonstration of fall protection equipment was provided by an outside vendor and an outside speaker discussed aerial work platform safety. State-based FACE colleagues worked as field teams to conduct mock fatality investigations, and presented findings and safety recommendations based on the field exercise to the group.

Outputs:

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: Helicopter Logging Safety Seminar and Workshop

Date(s): March 1-2, 1995
February 28-29, 1996
March 6, 1997

Location: Ketchikan, AK

Attendance: Approximately 200 each year

Attendees were commercial helicopter pilots and companies involved in helicopter logging operations, insurance companies, Helicopter Association International representatives, and federal and state agencies who share an interest in helicopter logging safety.

Description (narrative): Staff from the NIOSH, Alaska Field Station sponsored the helicopter logging safety seminar and workshop and gave several presentations defining the problem of logging helicopter crashes in Alaska and the Pacific Northwest. Attendees from helicopter logging companies, insurance companies, and government agencies also gave presentations on the subject. Attendees broke into groups to define the problems and to suggest intervention strategies for prevention.

Outputs: Published conference proceedings and NIOSH publication, No. 98-147, "Helicopter Logging Safety."

Intermediate Outcomes: Published proceedings from the seminars and the NIOSH Publication, "Helicopter Logging Safety" provided research findings that were instrumental in providing the basis for developing and refining intervention strategies for preventing logging helicopter crashes. The Helicopter Association International used these findings to establish the Helicopter Logging Safety Committee and developed aggressive voluntary safety standards in helicopter logging. Insurance companies who insure helicopter logging companies offered discounts in insurance premiums for helicopter logging companies who adopted the voluntary safety standards.

Name of Conference/Meeting/Workshop: National Childhood Agricultural Injury Prevention Town Meeting

Date(s): April 22, 1997

Location: A town meeting was held in Marshfield, Wisconsin, to publicly announce a new federal initiative aimed at protecting the health and safety of young people on farms.

Attendance: 100

Description (narrative): Sufficient funding and cooperation from the public and private sectors were objectives of the National Action Plan. The town meeting provided an opportunity to publicize the National Action Plan, garner private sector support, and clarify NIOSH's goals for the initiative. Representative David Obey (WI), and Dr. Barbara Lee, National Committee for Childhood Agricultural Injury Prevention (NCCAIP) chairperson, addressed an audience of more than 100 people about the National Action Plan and the need for such an initiative. The town meeting-style event was intended to solicit suggestions and participation by the farming community for designing and carrying out this national safety and health effort. Eighteen different farmers or farm family members provided testimony about how dangerous working on a farm can be. The event was covered on 40 television stations in the Marshfield area and in other farming communities across the U.S. through a video news release produced for the town meeting.

Outputs: A video news release produced for the town meeting included messages by Secretary of Health and Human Services, Donna Shalala, and NIOSH Director, Dr. Linda Rosenstock, on the importance of working with our partners in the farming community to protect young people on farms from agriculture-related injury and death. The initiative was also reported widely across the U.S. through an Associated Press newspaper article and radio coverage.

Intermediate Outcomes: National recognition of a new NIOSH Childhood Agricultural Injury Prevention Initiative was accomplished.

Name of Conference/Meeting/Workshop: Childhood Agricultural Injury Prevention Strategy Workshop: A Private Sector Perspective.

Date(s): November 9-11, 1997

Location: Indianapolis, IN

Attendance: More than 250 groups representing the following industrial areas: agricultural chemical manufacturers, agricultural cooperatives, insurance companies, private consultants and legal professionals, farm media, safety equipment manufacturers, feed and grain suppliers, utilities, commodity groups, farm structure providers, suppliers of farm services, medical professionals and lending institutions. As a result of these contacts, forty-three individuals representing these types of organizations attended and participated in the workshop.

Description (narrative): Sufficient funding and cooperation from the public and private sectors are objectives of the NCCAIP National Action Plan. Public and private sectors are encouraged to become partners in efforts to plan, implement, and evaluate childhood agricultural injury prevention initiatives. Representatives from agribusiness, private foundations, and community-based organizations were invited to a workshop to strategize how the NIOSH Childhood Agricultural Injury Prevention Initiative can be transitioned from being centered in the public sector to being centered in the private sector. Stakeholder groups which were invited to participate in this workshop included large corporate farm organizations, trade associations, private foundations such as the W.H. Kellogg Foundation and the Robert Wood Johnson Foundation, unions, equipment manufacturers, health care associations, educational associations, child safety advocates, youth group organizations, and religious organizations. The goal of the workshop was to focus on (1) identifying perceived needs of private sector groups to move forward with funding and/or implementing prevention activities, (2) how the public sector can best meet these needs, and (3) what are the continuing roles for the public and private sectors in maintaining the Initiative.

Workshop participants identified corporate image, name recognition, media attention, and increased leverage in future litigation as important justification for involvement in injury prevention programs. Reasons for supporting specific activities included consistency with corporate mission, enhanced public relations, and the potential for successful outcomes. Budget restraints and a perceived lack of benefits to the organization were identified as primary reasons why requests for support were rejected. Internal barriers for organizational support of injury prevention programs were budget limitations, the potential for creating a liability risk, and the lack of support from management.

Workshop participants indicated the private sector should be recognized and acknowledged by planners of agricultural childhood injury prevention efforts. Participants felt the private sector commitment to injury prevention is a reflection of concern for families that use their products and services. Participants believed the problem is a community problem which will require a broad-based collaborative effort involving all stakeholders and that additional regulations are not needed.

Outputs: Childhood Agricultural Injury Prevention Strategy Workshop: A Private Sector Perspective. Final Report: A Summary of Strategies and Successes. NTIS Order # PB99147596. 1999.

Intermediate Outcomes: Representatives from national farm organizations and trade associations were involved and asked their input into developing a National Childhood Agricultural Injury Prevention Initiative.

Name of Conference/Meeting/Workshop: National Fishing Industry Safety and Health Workshop

Dates: November 21-22, 1997

Location: Seattle, Washington

Attendance: Approximately 75

Description: The workshop scheduled sessions with 20 presenters and working groups. The purpose of the workshop was to describe current circumstances and plan the next steps to ensure that fishermen have relatively safe workplaces. The FISH II workshop's goal was to build on the accomplishments of FISH I, and continue to increase awareness, support coalitions, share information and experiences, and encourage action to prevent injury in the commercial fishing industry. The focus was on North Pacific fishermen, and Coast Guard search and rescue personnel. The first day was used to define the current problem and identify the populations at risk. The second day, participants were asked to participate in certain working groups. These included:

1) prevention of vessel-related fatalities
2) prevention of man overboard fatalities in the industry
3) prevention of diving fatalities in the commercial fishing industry and
4) prevention of non-fatal work-related injuries.

Results: Working groups developed recommendations that were included in the workshop proceedings volume (see below). These were disseminated to participants and key prevention leaders across the nation and internationally, particularly to leaders in circumpolar nations.

Outputs: NIOSH [2000]. Proceedings of the Second National Fishing Industry Safety and Health Workshop. Cincinnati, OH: US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2000-104.

Intermediate Outcomes: Many of these recommendations led to successful interventions including: the *Dockside Pre-Season Boardings* of Bering Sea Crab vessels led by the USCG, the *Lobstermen Entanglement Prevention Project* in Maine- led by the Harvard School of Public Health NIOSH ERC, and the *NIOSH Deck Safety Project*. Information from all working groups and the CIB was used in marine safety training offered by the *Alaska Marine Safety Education Association*.

Name of Conference/Meeting/Workshop: NIOSH Fire Fighter Injury Prevention Initiative

Date(s): January 28-29, 1998

Location: Washington Court Hotel, Washington, DC

Attendance: 57 total

- NIOSH personnel – 15
- International Association of Fire Fighters – 14
- Career Fire Departments – 9
- Other Federal Government Agencies - 6
- Volunteer Fire Departments – 3
- Academic Institutions - 3
- National Fire Protection Association – 2
- International Association of Fire Chiefs – 1
- National Volunteer Fire Council – 1
- State Fire Marshals – 1
- Fire Equipment Manufacturers – 1
- Fire Department Safety Officers Association – 1

Description (narrative): In Fiscal Year 1998, Congress recognized the need for further efforts to address the continuing problem of occupational fire fighter fatalities, and funded NIOSH to undertake this effort. NIOSH was given a congressional appropriation to "… to conduct fatality assessment and control evaluation investigations to gather information on factors that may have contributed to traumatic occupational fatalities, identify causal factors common to fire fighters fatalities, provide recommendations for prevention of similar incidents, formulate strategies for effective intervention, and evaluate the effectiveness of those interventions." NIOSH sought input on the draft NIOSH initiative for preventing fire fighter fatalities and injuries through a public meeting held January 28-29, 1998.

More than 50 public and private sector experts representing different perspectives within the fire fighting community were sent letters of invitation to the meeting. A total of 42 non-NIOSH attendees participated in the meeting, and presentations were given by individuals representing the U.S. Fire Administration (USFA), the National Volunteer Fire Council (NVFC), the National Fire Protection Association (NFPA), the International Association of Fire Chiefs (IAFC), and the International Association of Fire Fighters (IAFF), among others. Participants were provided a form to provide written comments. NIOSH considered input received through this public meeting, and revised the draft plan, increasing the emphasis on fire fighter fatality investigations. The revised plan was sent to all meeting participants.

Outputs:

NIOSH [1997]. NIOSH proposed plan : Fire Fighter Fatality Prevention Initiative. Morgantown, WV: U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Division of Safety Research, December 8, 1997.

NIOSH [1998]. Fire Fighter Fatality Investigation and Prevention Program (Revised version: March 1998). Morgantown, WV: U.S. Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Division of Safety Research, March 1998.

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: 1998 Annual Fatality Assessment and Control Evaluation (FACE) Meeting

Date(s): June 2-4, 1998

Location: NIOSH Building, 1095 Willowdale Road, Morgantown, WV

Attendance: Approximately 45 attendees, primarily grantees funded through NIOSH as State-based FACE programs, and NIOSH staff.

Description (narrative): The purpose of this meeting was to allow grantees to discuss field-based research issues, to provide field investigators and data managers with an opportunity to share knowledge and information, and to gain new insights from presentations provided by internal and external speakers. Topics discussed at this meeting included: potential issues with the year 2000 and state databases, development and documentation of prevention recommendations in FACE reports, and dissemination of FACE products and recommendations. Participants met in small groups to discuss potential collaborative work.

Outputs:

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: Workshop entitled "Preventing Vehicle and Equipment-related Occupational Injuries in Highway and Street Construction Work Zones"

Date(s): December 2-4, 1998

Location: Washington, DC

Attendance: There were a total of 54 attendees. The majority of the attendees represented government, labor, industry, academia, and state departments of transportation, and all had some interest in protecting workers in highway construction work zones.

Attendees were: 7 NIOSH, 10 other federal agencies, 8 state government agencies (6 transportation departments, 2 state universities), 8 manufacturers, 5 safety associations (all National Safety Council), 6 trade associations, 4 unions, 4 private sector consultants, 1 insurance company, and 1 construction contractor.

Description (narrative): In 1997, NIOSH organized a series of forums for discussion of research needs with construction industry stakeholders. One key area of concern for groups with interest in highway construction was prevention of injuries related to vehicles and equipment. NIOSH determined that a significant risk existed for workers in highway and street construction based on numbers of reported fatalities and injuries. NIOSH also determined that a broad effort to involve interested parties would be helpful in developing guidelines addressing work zone safety. The following year, in response to a request from the Jefferson Group, NIOSH agreed to convene a workshop focused on prevention of injuries due to motor vehicles and equipment. To prepare for this workshop, NIOSH undertook a comprehensive review of the scientific literature; data from the Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) and Survey of Occupational Injuries and Illnesses; and relevant investigations conducted by the NIOSH Fatality Assessment and Control Evaluation (FACE) program. The December 1998 workshop gathered input on safe work practices in road construction and perceived gaps in work zone safety standards and regulations. The workshop was attended by a broad range of over 50 stakeholders including individuals from government, labor, industry, academia, and state departments of transportation. After a plenary session that included background information on the problem, attendees participated in breakout sessions that addressed four topic areas: safety of workers on foot around traffic vehicles; safe operation of construction vehicles and equipment in highway work zones; planning for safe operations within work zones; and special safety issues associated with night work in highway construction. During the breakout sessions, a series of questions was presented to stimulate discussion about preventing occupational injuries in highway work zones.

The general information, experiences, research results, resources, and suggestions for prevention shared during the four sessions were the starting point for the NIOSH publication, *Building Safer Highway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Equipment*, which contains specific measures that contractors, contracting agencies, policy makers, manufacturers, law enforcement, and the research community can use to reduce occupational injuries in highway work zones. This document also includes an Appendix with descriptions of highway construction fatalities investigated through the NIOSH FACE program. Each fatality description includes case-specific prevention recommendations.

Outputs:

Pratt SG, Fosbroke DE, Marsh SM [2001]. Building safer highway work zones: measures to prevent worker injuries from vehicles and equipment. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-128.

The workshop and resulting document formed the basis of an ongoing project launched by the NIOSH Division of Safety Research in 2002: “Evaluating Roadway Workzone Interventions.”

Intermediate Outcomes: A June 2000 article in the Engineering News Record noted the pending release of Building Safer Highway Work Zones, and included specific recommendations from the to-be-released report on traffic control, internal traffic control, high visibility clothing and the contracting process. The article also noted that “OSHA officials say they are awaiting the NIOSH report with great interest because the agency is launching its own assault.” [Krizan 2000. Construction declares war on highway workzone carnage. Engineering News Record, 244 (23): 36-41.]

NIOSH distributed the document, *Building Safer Highway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Equipment*, through targeted mailings, conference and exhibition handouts, and downloads from the NIOSH website. The publication went through four printings, with approximately 15,000 copies distributed. Information from the document has been used by stakeholders in a variety of ways. External organizations that helped distribute the document include Occupational Safety and Health Administration offices in Washington, D.C. and Puerto Rico, the Laborer’s International Union of North America, the American Road and Transportation Builders’ Association, and the Washington State Department of Labor and Industries.

Building Safer Work Zones has been incorporated into new worker training materials and best work practice guides. For example, the National Safety Council (NSC) and the American Road and Transportation Builders’ Association (ARTBA) worked with NIOSH to develop an OSHA 10-hour course specifically for the road construction industry. Modules addressing safety when working around construction vehicles and equipment, as well as nighttime road construction were incorporated into this training program. The OSHA 10-hour course for roadway construction is provided to member construction companies by both the NSC and the ARTBA. The course is also a core component of the Northeast Regional Safety Academy’s road construction safety training program in Montpelier, Vermont.

The Laborers’ Health and Safety Fund of North America incorporated the document in its entirety as an Appendix to their 2003 “Highway Work Zone Safety Manual,” and information on internal traffic control plans into their new worker orientation training program, “Roadway Safety.”

Other ways that organizations use information from “Building Safer Work Zones” include providing risk management recommendations to clients by both the St. Paul and the CNA insurance companies; supporting development of contract language to require disaster cleanup contractors to use high-visibility clothing during cleanup operations by the Federal Emergency

Management Agency; developing two safety training videos, "Flagger Safety" and "Work Zone Safety for Construction and Utility Employees" by J.J. Keller & Associates; incorporating injury prevention measures into a best practices guide by The Dallas Area Road Construction Work Zone Task Force; developing a 3½-hour PowerPoint presentation by the Texas Engineering Extension Service; and incorporating safety measures and case examples into tool-box safety talks by roadway construction companies.

Name of Conference/Meeting/Workshop: NIOSH Childhood Agricultural Injury Prevention Initiative Midcourse Review

Date(s): September 22, 1999

Location: Washington, DC

Attendance: Thirty-eight individual comments were received or made at the in-person meeting held in Washington, DC. These individuals represented a wide range of stakeholders, ranging from agricultural center directors, insurance companies, medical doctors, national organizations, and individual researchers.

Description (narrative): The purpose of the meeting was to seek public comments on the progress and proposed future activities of the Childhood Agricultural Injury Prevention Initiative implemented by NIOSH in October 1996. The National Institute for Occupational Safety and Health (NIOSH) of the Centers for Disease Control and Prevention (CDC) sought public comments on the progress and proposed future activities for the Childhood Agricultural Injury Prevention Initiative from interested stakeholders. This would allow for any midcourse adjustments to be made, if needed.

Outputs: An announcement in the Federal Register: July 7, 1999 (Volume 64, Number 129)[Notices - Page 36693] gave public announcement of the intent to hold a public meeting seeking comment and input on the National Institute for Occupational Safety and Health regarding the PROGRESS AND PROPOSED FUTURE ACTIVITIES OF THE NIOSH CHILDHOOD AGRICULTURAL INJURY PREVENTION INITIATIVE—A PUBLIC MEETING.

Intermediate Outcomes: In general, no one disagreed with the course NIOSH had taken with the Childhood Agricultural Injury Prevention Initiative, and all believed funding should be continued. Stakeholders were satisfied that the intent of the original National Action Plan was being followed by NIOSH.

Name of Conference/Meeting/Workshop: 1999 Annual Fatality Assessment and Control Evaluation (FACE) Meeting

Date(s): September 28-30, 1999

Location: Holiday Inn, Morgantown WV

Attendance: Approximately 45 attendees, primarily grantees funded through NIOSH as State-based FACE Programs.

Description (narrative): The purpose of this meeting was to allow grantees to discuss field-based research issues, to provide field investigators and data managers with an opportunity to share knowledge and information, and to gain new insights from presentations provided by internal and external speakers. The group received an 8-hour highway and street work zone safety training. The group discussed two new targets for FACE investigations, deaths of workers under 18 years of age, and deaths of workers working in street and highway work zones. Investigative tools for investigating these targeted fatalities were discussed, and the tools were refined by grantees**.**

Outputs:

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: Aviation Passenger Safety Seminar

Date(s): March 20, 2000

Location: Anchorage, AK

Attendance: Approximately 100

Attendees were Federal Aviation Administration staff, pilots, air taxi and commuter operators, and people who fly for work.

Description (narrative): In an attempt to reduce the number of aviation-related occupational fatalities in Alaska, NIOSH offered a free seminar entitled "Aviation Passenger Safety Seminar" prior to the 2000 Alaska Governor's Safety and Health Conference. Seminar speakers shared information about what passengers can do prior to take-off and while in-flight to make their flight safer, and what passengers can do during and after a crash to increase their chances of survival. Additionally, seminar attendees learned about available training that can teach them the basics of flying and landing a small aircraft if the pilot is unable. Finally, information regarding how to incorporate safety measures into a company's contract with an air carrier to transport its employees was discussed.

Outputs:

Intermediate Outcomes: The information and format was used by the Federal Aviation Administration to create the Circle of Safety consumer education program.

Name of Conference/Meeting/Workshop: 2000 Annual Fatality Assessment and Control Evaluation (FACE) Meeting

Date(s): September 26-28, 2000

Location: NIOSH Building 1095 Willowdale Road, Morgantown, WV

Attendance: Approximately 35 attendees, primarily grantees funded through NIOSH as State-based FACE programs, and NIOSH staff.

Description (narrative): The purpose of this meeting was to allow grantees to discuss field-based research issues, to provide field investigators and data managers with an opportunity to share knowledge and information, and to gain new insights from presentations provided by internal and external speakers. The meeting was designed to share information gained from FACE investigations conducted in new target areas which included youth occupational deaths and street/highway construction deaths, and to provide training on a first report fatality data collection using Microsoft Access software.

Outputs:

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: International Fishing Industry Safety and Health Conference (I FISH)

Dates: October 23-25, 2000

Location: Woods Hole, Massachusetts

Attendance: Over 100 fishermen and safety professionals from 13 countries

Description: NIOSH partnered with the Harvard School of Public Health to present the conference. The focus was global issues in commercial fishing safety. The purpose was to share information, establish a foundation on which to build new projects and programs, and encourage action to prevent injury and disease in fishing.

An international group of commercial fishing safety experts presented 48 papers. Topics covered included a summary of worldwide problems and challenges in the industry, innovative approaches to investigating and preventing fishing vessel casualties, risk perception, intervention programs, surveillance, and unique approaches to safety training.

Results: Conference proceedings were published in a volume including 43 of the participants' papers (see below). These were disseminated to participants and key prevention leaders across the nation and internationally, particularly to leaders in circumpolar nations.

Output: NIOSH [2002]. Proceedings, First International Fishing Industry Safety and Health Conference. Cincinnati, OH: US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2002-147.

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: Aviation Passenger Safety Seminar

Date(s): March 26, 2001

Location: Anchorage, AK

Attendance: Approximately 40

Attendees were Federal Aviation Administration staff, pilots, air taxi and commuter operators, and people who fly for work.

Description (narrative): In an attempt to reduce the number of aviation-related occupational fatalities in Alaska, NIOSH offered a free seminar entitled "Aviation Passenger Safety Seminar" during the 2001 Alaska Governor's Safety and Health Conference. Seminar speakers shared information about air taxi and commuter crashes, and passenger awareness to prevent flying into bad weather.

Outputs:

Intermediate Outcomes: The information and format was used by the Federal Aviation Administration to create the Circle of Safety consumer education program.

Name of Conference/Meeting/Workshop: Alaska Governor's Safety and Health Conference

Date(s): March 26, 2001

Location: Performing Arts Center, Anchorage, AK

Attendance: Approximately 250

Attendees were commercial pilots, air carrier operators, companies that fly employees throughout Alaska

Description (narrative): Staff from the NIOSH, Alaska Field Station sponsored the "Alaska Aviation Safety Seminar." The seminar addressed how passengers can influence the outcome of safe flying in Alaska.

Outputs:

Intermediate Outcomes: Presentation contained research findings that were instrumental in providing the basis for developing the intervention strategies: Five Star Medallion Program (a voluntary higher safety standard for air carrier companies), Capstone Program (state-of-the-art navigational avionics equipment for small aircraft), and Circle of Safety Program (educational program for aircraft passengers to encourage safe flying in Alaska).

Name of Conference/Meeting/Workshop: 2001 Summit on Childhood Agricultural Injury Prevention

Date(s): April 30 – May 1, 2001

Location: Brooklyn Park, a suburb of Minneapolis, MN

Attendance: 88 people attended the in-person meeting, including six youth advisors and four farm parent panel members. Farmers, growers, professors, physicians, adolescents, and safety professionals, along with representatives of agricultural organizations and federal agencies were involved.

Description (narrative): The goal of the Summit was to propose specific injury prevention strategies based on knowledge gained from research and interventions undertaken since the endorsement of the 1996 National Action Plan, *Children and Agriculture: Opportunities for Safety and Health.* The 2001 Summit on Childhood Agricultural Injury Prevention was directed by the National Children's Center for Rural and Agricultural Health and Safety with substantial involvement by the project officer, Dr. David Hard.

The primary work of the in-person meeting involved seven different working groups on topics of: (1) Leadership, Funding, and Partnerships; (2) Interventions and Evaluations; (3) Policy; (4) Professional Training; (5) Public Education; (6) Research; and (7) Injury Surveillance. Each group included 5 to 10 individuals with interest and/or expertise in the topic under review. Groups were given specific questions to address, based on the 1996 National Action Plan recommendations, along with successes and shortcomings that were identified during the initial assessment phase. Each group had an assigned facilitator, note taker, and spokesperson. Over the two-day period groups worked to generate realistic and effective strategies that addressed priority areas for childhood agricultural injury prevention. The in-person meeting allowed time for full group reaction to the topic-specific ideas generated with the seven working groups. They produced plans for a coordinated, comprehensive effort to prevent agricultural-related injuries among children and adolescents who live on, visit, and/or work on farms and ranches.

In 1996, a National Committee for Childhood Agricultural Injury Prevention issued a National Action Plan, Children and Agriculture: Opportunities for Safety and Health (National Committee for Childhood Agricultural Injury Prevention, 1996). The plan provided a blueprint for action that involved federal and state agencies, professional health and safety organizations, youth-serving organizations, agribusiness and farm organizations, educators, researchers, and other stakeholders.

The United States Congress adopted the plan and allocated funds to the National Institute for Occupational Safety and Health (NIOSH) to serve as the lead agency accountable for its implementation. Since that time, research studies, injury data collection, and demonstration programs have been initiated, in large part due to implementation of that plan under the leadership of NIOSH.

The emphasis of the 2001 Summit on Childhood Agricultural Injury Prevention was to conduct an extensive five-year review of the 1996 National Action Plan and to use a consensus development process to generate strategies and priorities for the future. Specifically, to document successes and shortcomings, to identify effective interventions that may or may not have been addressed in the National Action Plan, and to propose recommendations for the future.

This 2001 Summit served as an update to the 1996 National Action Plan. While some of the 1996 objectives, such as those related to policy, have not been accomplished, they should not necessarily be abandoned. In a spirit of cooperation, with hopes of strong collaboration among farm owners, parents, and safety professionals, this updated plan proposed strategies upon which all stakeholders can offer their commitment.

Outputs: The following report describes the justification for the meeting, external factors affecting childhood agricultural injury prevention efforts, the data collection and meeting processes used for gathering information and achieving consensus, and finally, the outcome of this endeavor which includes three broad goals, 12 recommendations, and 36 specific strategies for preventing childhood agricultural injuries.

Lee B, Gallagher S, Marlenga B, and Hard D (Eds.). (2002). Childhood Agricultural Injury Prevention: Progress Report and Updated National Plan from the 2001 Summit. Marshfield, WI: Marshfield Clinic.

Available via internet at: http://marshfieldclinic.org/nfmc/Pages/Proxy.aspx?Content=MCRF-Centers-NFMC-nccrahs-reports-summitreport.1.pdf

Intermediate Outcomes: The 2001 Summit Report was utilized by NIOSH in providing further guidance in administering the NIOSH Childhood Agricultural Injury Initiative.

Name of Conference/Meeting/Workshop: 2001 Annual Fatality Assessment and Control Evaluation (FACE) Meeting

Date(s): November 13-14, 2001

Location: NIOSH Building, 1095 Willowdale Road, Morgantown WV

Attendance: Approximately 45 attendees, primarily grantees funded through NIOSH as State-based FACE programs, and NIOSH staff.

Description (narrative):

The purpose of this meeting was to allow grantees to discuss field-based research issues, to provide field investigators and data managers with an opportunity to share knowledge and information, and to gain new insights from presentations provided by internal and external speakers. At the meeting the group elected its first coordinating committee (CC) chairman and addressed the tasks of the CC. The committee voted to continue sending first report data and quarterly reports to NIOSH. The CC developed a form that members could use to identify specific interest areas for collaborative effort. New opportunities for FACE funding and new submission requirements were discussed.

Outputs:

Intermediate Outcomes:

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Name of Conference/Meeting/Workshop: 2002 Annual Fatality Assessment and Control Evaluation (FACE) Meeting

Date(s): September 24-26, 2002

Location: NIOSH Building, 1095 Willowdale Road, Morgantown WV

Attendance: Approximately 45 attendees, primarily grantees funded through NIOSH as State-based FACE programs, and NIOSH staff.

Attendance: Approximately 45 attendees, primarily grantees funded through NIOSH as State-based FACE programs, and NIOSH staff.

Description (narrative): The purpose of this meeting was to allow grantees to discuss field-based research issues, to provide field investigators and data managers with an opportunity to share knowledge and information, and to gain new insights from presentations provided by internal and external speakers. Per the request of the FACE Coordinating Committee, the 2002 Annual FACE meeting included training in industry and occupational coding using BOC, SIC, and NAICS coding. In addition, an overview of e-coding systems using ICD 9 and ICD 10 was provided. Hispanic worker deaths, as a target for investigation was discussed, and an update was provided on highway work zone safety issues and child labor safety issues.

Outputs:

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: 2003 Annual Fatality Assessment and Control Evaluation (FACE) Meeting

Date(s): April 2-3, 2003

Location: Tumwater, Washington

Attendance: Approximately 45 attendees, primarily grantees funded through NIOSH as State-based FACE programs, and NIOSH staff.

Description (narrative): The purpose of this meeting was to allow grantees to discuss field-based research issues, to provide field investigators and data managers with an opportunity to share knowledge and information, and to gain new insights from presentations provided by internal and external speakers. This meeting focused on logging safety and included a field trip to a logging site; Hispanic culture and how culture influences our views and safety practices; and improving written and verbal communication to strengthen safety recommendations.

Outputs:

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: International Fishing Industry Safety and Health Conference (I FISH II)

Dates: September 22-24, 2003

Location: Sitka, Alaska

Attendance: 135 from 18 nations

Description: NIOSH partnered with AMSEA to convene and facilitate the IFISH II conference in Sitka, Alaska. The purpose was to share information, establish a foundation on which to build new projects and programs, and encourage action to prevent injury and disease in fishing.

Forty speakers addressed topics ranging from deck safety needs for crabbers working in northern waters to policy changes affecting Pacific Island States. Seven speakers sponsored by FAO provided overviews of commercial fishing safety programs in developing countries including Tonga, Sri Lanka, Pakistan, India, Senegal, and Chile.

Results: The proceedings volume includes manuscripts submitted for 28 of the 40 presentations (see below). These were disseminated to participants and key prevention leaders across the nation and internationally, particularly to leaders in circumpolar nations.

Output: NIOSH [2006]. Proceedings, Second International Fishing Industry Safety and Health Conference. Cincinnati, OH: US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2006-114.

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: NIOSH Workplace Violence Prevention Stakeholder Meetings

Date(s): Health care industry May 2003, Domestic Violence in the Workplace June 2003, Retail industry August 2003, Security/Law Enforcement November 2003.

Location: Washington, DC

Attendance: Health care (38)
Domestic Violence (38)
Retail (17)
Domestic Violence (25)

The attendees were from government agencies, universities, unions, trade associations, police departments, health departments, insurance agencies, security and safety consultants, military, retail organizations, etc.

Description (narrative): The purpose of these meetings was to bring together subject matter experts from different disciplines to discuss current progress, research gaps, and collaborative efforts in addressing workplace violence.

Outputs: One of the recurring discussion points that emerged from the meetings was the need for a national conference on workplace violence prevention. NIOSH convened the conference "Partnering in Workplace Violence Prevention: Translating Research to Practice," November 17-19, 2004 in Baltimore, Maryland.

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: 2004 Annual Fatality Assessment and Control Evaluation (FACE) Meeting

Date(s): March 29-April 1, 2004

Location: NIOSH Building, 1095 Willowdale Road, Morgantown, WV

Attendance: Approximately 45 attendees, primarily grantees funded through NIOSH as State-based FACE programs, and NIOSH staff.

Description (narrative): The purpose of this meeting was to allow grantees to discuss field-based research issues, to provide field investigators and data managers with an opportunity to share information, and to gain new insights from presentations provided by internal and external speakers. The meeting included a 10-hour training course in Construction Safety and Health; a Coordinating Committee meeting; a field trip to an equipment rental company; and a discussion regarding dissemination of FACE products.

Outputs:

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: Aerospace Medical Association Annual Meeting – Panel on Aviation Safety in Alaska

Date(s): May 5, 2004

Location: Anchorage, AK

Attendance: Approximately 20

Description (narrative): This panel included research results and updates from several areas of the Alaska Aviation Interagency Initiative including the nonprofit Medallion Foundation and the National Weather Service.

Outputs:

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: NIOSH Childhood Agriculture Safety and Health Research (R01) Grantee Meetings

Date(s): September 20, 2001
September 17, 2002
September 25, 2003
September 17, 2004

Location: 2001, 2002 & 2003 – Morgantown, WV
2004 – Pittsburgh, PA

Attendance: 2001: 13 attendees
2002: 15 attendees
2003: 12 attendees
2004: 10 attendees

Attendees were researchers affiliated with research organizations, universities, and state health departments.

Description (narrative): The primary emphasis of the meeting was to facilitate information exchange, specifically of research efforts completed and progress of on-going research in this area. Secondary aims of the meeting were to foster collaborative research efforts and encourage both research and information linkages among participants in the area of childhood agricultural injury prevention.

Outputs: None

Intermediate Outcomes: The 2004 meeting was used to gather input from the researchers on the most important and/or pressing needs in agricultural safety and health research from their perspective.

Name of Conference/Meeting/Workshop: Partnering in Workplace Violence Prevention: Translating Research to Practice

Date(s): November 17-19, 2004

Location: Baltimore, Maryland

Attendance: Total number of attendees was 182.

The attendees were from government agencies, universities, unions, trade associations, police departments, health departments, insurance agencies, security and safety consultants, military, retail organizations, etc.

Description (narrative): The plenary session was designed to set the stage for the break out sessions by presenting the magnitude of the problem and what is currently being done to address it. The breakout sessions were structured to give participants an opportunity to discuss the current state of national research and prevention efforts. The intent was to draw out their best professional judgments on (1) identification and implementation of effective prevention programs and strategies, (2) identification of barriers to prevention and steps for overcoming them, (3) current research and communication needs, and (4) the advancement of research and prevention through effective partnerships.

Outputs: Distribution of the conference report “Workplace Violence Prevention Strategies and Research Needs” started in October 2006.

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: 2005 Annual Fatality Assessment and Control Evaluation (FACE) Meeting

Date(s): February 8-9, 2005

Location: Coast Long Beach Hotel, Long Beach, California

Attendance: Approximately 60 attendees, primarily grantees funded through NIOSH as State-based FACE programs, and NIOSH staff.

Description (narrative): The purpose of this meeting was to allow grantees to discuss field-based research issues, to provide field investigators and data managers with an opportunity to share information, and to gain new insights from presentations provided by internal and external speakers. This meeting focused on discussing prevention of work-related injury among immigrant workers, with a special emphasis on Hispanic workers. Young worker issues were also discussed with speakers from the amusement park industry, and from the University of California Berkeley, Young Worker Project, Labor Occupational Health Program. Speakers provided information and related their experiences with working youth. The meeting also included a field trip to an active roadway construction work site to demonstrate recommended prevention measures.

Outputs:

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: North American Guidelines for Children's Agricultural Tasks (NAGCAT) Advisory Board

Date(s): March 17-18, 2005

Location: Milwaukee, WI

Attendance: 13 advisors and 5 staff from the National Children's Center for Rural and Agricultural Safety and Health were in attendance at the meeting. The advisors were individuals who represented national youth-serving organizations and regional or national farm safety and health organizations.

Description (narrative):
The North American Guidelines for Children's Agricultural Tasks (NAGCAT) are a resource developed to assist parents in assigning farm jobs to their children 7 - 16 years of age, living or working on farms. There are 62 specific task guidelines for youth which are developmentally oriented with recommendations for adult supervision.

A group of about 12 advisors were formed to plan for the future of the NAGCAT and they developed "NAGCAT Priorities for 2010" at which,
at a meeting of advisors in March 2005, five priorities for NAGCAT were identified:

- Address the perceptions and barriers of NAGCAT users
- Revise and reformat a core set of the guidelines
- Develop a NAGCAT dissemination/marketing plan
- Create a training and support materials for NAGCAT users
- Conduct further research to facilitate accomplishing these priorities

Outputs: These recommendations are available at the following website:
http://www.nagcat.org/nagcat/pages/default.aspx?page=nagcat_priorities

Intermediate Outcomes: These recommendations are being used for any current work or revisions to the NAGCAT.

Name of Conference/Meeting/Workshop: United States Department of Agriculture Hazardous Occupations Safety Training for Agriculture (HOSTA) Advisory Group Meeting

Date(s): December 10, 2001 – Chicago, IL
October 23, 2002 – Itasca, IL
October 14, 2003 – Itasca, IL
November 4, 2004 – Itasca, IL
October 5, 2005 – Washington, DC

Location:

Attendance: 15 invited members. The members are experts in youth farm safety, stakeholder organizations and Federal agency representatives with related programs.

Description (narrative): The committee members make recommendations to USDA/CSREES on HOSTA program priorities and provide candid, open discussion of project goals, priorities and progress within an environment that encourages participation of all steering committee members. Committee members provide input into the HOSTA program and on specific projects. Grant recipients brief members on currently funded project objectives and accomplishments.

Outputs: None

Intermediate Outcomes: HOSTA advisory committee input has been utilized by USDA/CSREES to develop and expand the HOSTA program. There has been collaboration among and between the HOSTA program/projects and the NIOSH Childhood Agricultural Injury Prevention Initiative, notably the National Children's Center for Rural and Agricultural Safety and Health (NCCRAHS) and the Tractor Training projects.

Name of Conference/Meeting/Workshop: Federal Interagency Task Force on Workplace Violence Research and Prevention

Date(s): January 2003, September 2003, April 2004, and November 2005

Location: Washington, DC

Attendance: Total number of attendees ranged from 15 to 33.

The attendees were from federal government.

Description (narrative): Provided an opportunity for all of the agencies that are doing work or who have an interest in workplace violence research to share information and identify opportunities for collaborative efforts.

Outputs:

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: International Fishing Industry Safety and Health Conference (I FISH lll)

Dates: February 1-4, 2006

Locations: Chennai, India

Attendance:

Description: These international conferences bring research on fishing vessel safety from many parts of the world. The conference focused on artisanal fishermen and unique safety concerns for this group of fishermen.

Results:

Outputs:

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: Aviation Safety Alliance Seminar

Date – Place (speaker)

February 2000 – Anchorage, Alaska (Diana Bensyl, George Conway)
March 2, 2001 – Anchorage, Alaska (George Conway, George Kobelnyk (FAA detailed to NIOSH))
March 1, 2002 – Anchorage, Alaska (George Conway)
February 27, 2003 – Anchorage, Alaska (George Conway)
March 5, 2004 – Fairbanks, Alaska (George Conway)
March 2, 2005 – Anchorage, Alaska (George Conway)
February 15, 2006 – Anchorage, Alaska (Nicolle Mode)

Attendance: Approximately 30-70 (depending on year)

Attendees were members of the Alaska Air Carrier's Association

Description (narrative): Presentations were given on up-to-date information about air safety in Alaska, focusing on air taxi and commuter operations. Recent safety research information was included as research was finished. This transfer activity allowed NIOSH researchers to give research results directly to the target audience (pilots and operators) in industry-appropriate language.

Outputs: The presentations generated discussion and collaboration among the agencies involved, and elicited information from pilots and operators. Each year symposium evaluations were collected and tabulated from attendees and reviewed by NIOSH staff.

Name of Conference/Meeting/Workshop: 2006 Annual Fatality Assessment and Control Evaluation (FACE) Meeting

Date(s): March 8 and 9, 2006

Location: NIOSH Building, 1095 Willowdale Road, Morgantown WV

Attendance: Approximately 45 attendees, primarily grantees funded through NIOSH as State-based FACE programs, and NIOSH staff.

Description (narrative): The purpose of this meeting was to allow grantees to discuss field-based research issues, to provide field investigators and data managers with an opportunity to share knowledge and information, and to gain new insights from presentations provided by internal and external speakers. The meeting was designed to share information gained from FACE investigations; gain information about product evaluation designs; learn about cultural aspects of grieving; explore stress relief strategies; discuss examples of research to practice; discuss NIOSH sector-based research; and to explore changes in the FACE program as it becomes part of a state-based fundamental occupational surveillance program.

Outputs:

Intermediate Outcomes:

Name of Conference/Meeting/Workshop: The National Institute for Occupational Safety and Health Stakeholder's Meeting to Seek Input on the Fire Fighter Fatality Investigation and Prevention Program

Date(s): March 22, 2006

Location: Washington Court Hotel, Washington DC

Attendance: 66 total attendees:

- NIOSH personnel – 29
- Career Fire Departments – 9
- Other Federal Government Agencies - 5
- International Association of Fire Fighters – 4
- Fire Equipment Manufacturers - 4
- Volunteer Fire Departments – 3
- National Fire Protection Association – 3
- International Association of Fire Chiefs – 2
- National Volunteer Fire Council – 2
- Academic Institutions - 2
- National Wildfire Coordinating Group - 1
- National Fallen Firefighters Foundation – 1
- Emergency Responder Safety Institute - 1

Description: In fiscal year 1998, Congress recognized the need for further efforts to address the continuing problem of occupational fire fighter fatalities, and funded NIOSH to undertake this effort. NIOSH was given a congressional appropriation "… to conduct fatality assessment and control evaluation investigations to gather information on factors that may have contributed to traumatic occupational fatalities, identify causal factors common to fire fighters fatalities, provide recommendations for prevention of similar incidents, formulate strategies for effective intervention, and evaluate the effectiveness of those interventions." NIOSH sought and incorporated input from stakeholders in 1998 in the design of the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP). Approximately eight years after the implementation of the FFFIPP, NIOSH again sought stakeholder input to ensure the FFFIPP was meeting stakeholders' needs, and to identify ways in which NIOSH might improve upon the program to increase its impact on the safety and health of fire fighters across the United States.

A stakeholders' meeting was held in Washington, DC on March 22, 2006. A document summarizing progress, proposing future directions, and seeking specific input from stakeholders was posted on the NIOSH web prior to the meeting. A total of 37 non-NIOSH attendees participated in the meeting, and invited presentations were given by individuals representing the U.S. Fire Administration (USFA), the National Volunteer Fire Council (NVFC), the National Fire Protection Association (NFPA), the National Fallen Firefighters Foundation (NFFF), the National Wildfire Coordinating Group (NWCG), the International Association of Fire Chiefs (IAFC), and the International Association of Fire Fighters (IAFF). Five individuals responded to the opportunity to provide comments following the presentations. Three were associated with career fire departments, one with a safety advocacy group (Emergency Responder Safety Institute), and one represented a manufacturer. Numerous participants provided input and participated in a rich discussion following the presentations. In addition to the stakeholders' meeting, input was also sought through a public docket (Docket Number NIOSH-063). Eleven stakeholders provided input through the docket.

Outputs: NIOSH [2006]. National Institute for Occupational Safety and Health (NIOSH) Fire Fighter Fatality Investigation and Prevention Program, 1998 – 2005. Available at http://www.cdc.gov/niosh/fire/progress.html

A draft "Next Steps" document based on feedback from the March 22, 2006 Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) Stakeholder's meeting has been drafted. Anticipated finalization of this document (for posting to the FFFIPP website) is on or before October 31, 2006. These next steps include modifications in the areas of investigations, outreach, document production, dissemination, research, and evaluation.

Intermediate Outcomes: Stakeholders expressed their support of the NIOSH FFFIPP at the stakeholders' meeting, and identified how they use and rely upon FFFIPP fatality investigations and products. This feedback is summarized in an Occupational Safety and Health Reporter article, "Successful Firefighter Fatality Program Should be Expanded, Stakeholders Say" [Volume 35, Number 13, Thursday March 30, 2006].

Appendix 8: Previous Program Evaluations

Evaluation of the Fatality Assessment and Control Evaluation (FACE) Program

Program Evaluator(s) *(individuals, their organization, and contact information)*:

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What Part of the TI Program was Evaluated?

The FACE project has two components. The first is the NIOSH in-house program which began in 1982. NIOSH staff conduct on-site epidemiologic investigations of selected types of death, and develop a narrative report with recommendations for preventing future similar deaths. Fatality investigation findings are incorporated into NIOSH products, such as Alerts that describe hazards and identify prevention measures. In 1990, NIOSH expanded the FACE program through cooperative agreements to state health or labor departments. Under these cooperative agreements, states conduct fatal occupational injury surveillance, investigations of selected types of worker deaths, and prevention activities at the state level, using the FACE model.

There were two phases to the FACE evaluation. The first involved an evaluation of the dissemination component of the three originally funded state-FACE programs (Colorado, Massachusetts, and New Jersey). The second was an evaluation of the usefulness of five NIOSH documents.

In phase 1, RTI used interviews of selected key people at the state and local level, employers, and focus groups to determine the most effective dissemination techniques.

Examples of questions for key people at the state and local level were:
- How were the reports used?
- Is the level of detail appropriate?
- Is the report format useful?
- What additional information would be useful?

Examples of questions for employers were:
- What was the general reaction to the report?
- Was the report understandable
- Were the recommendations feasible?
- Were any report recommendations implemented?

Examples of questions for focus groups were:
- Was the report format eye-catching?
- Was the report read all the way through?
- Do the recommendations realistic?
- What changes could be made to improve the report?

In phase II, RTI conducted a limited number of phone interviews of workers and intermediaries to: get their assessment of the accuracy, relevance, and appropriateness of FACE publications; learn how the publications were used and disseminated by users; assess whether the content and format were appropriate for users' needs; and, identify impacts resulting from the publications. This phase of the evaluation focused on five NIOSH publications:
- NIOSH Alert: Preventing Scalping and Other Severe Injuries from Farm Machinery (NIOSH Pub. No. 94-105)
- NIOSH Alert: Preventing Injuries and Deaths of Fire Fighters (NIOSH Pub. No. 94-125)
- NIOSH Alert: Preventing Injuries and Deaths of Loggers (NIOSH Pub. No. 95-101)
- NIOSH Alert: Preventing Electrocutions of Crane Operators and Crew Members Working Near Overhead Powerlines (NIOSH Pub. No. 95-108)
- Worker Deaths in Confined Spaces: A Summary of NIOSH Surveillance and Investigative Findings (NIOSH Pub. No. 94-103)

Period of Time Evaluated: Phase I: 1994; Phase II: 1995

Description of Findings:

Phase 1: RTI performed an evaluation of the Colorado, Massachusetts, and New Jersey FACE programs' dissemination component for the year 1994. Program strengths identified were:

a broad audience, with varied uses of its materials and extensive secondary dissemination of materials.

- Fatality reports were recognized as credible, accurate and comprehensive assessments that presented balanced descriptions of the circumstances of the fatality.

- The program extended the reach of regulatory agencies and monitoring efforts through its active surveillance, enhanced access to information, and detailed reporting.

- Through collaborative relationships with university centers, the State programs supported professional training in occupational health and industrial hygiene while gaining access to expert consultative services.

Specific recommendations to increase the programs responsiveness and reach included:

- Providing rapid feedback to employers to maximize the likelihood of worksite changes being made;

- Offering shortened and simplified versions of FACE reports for broader dissemination;

- Increasing access to existing materials by offering indexes and listings to help users identify reports of interest;

- Considering allocating staff or support services to allow increased production of FACE materials;

- Publicizing the program's existence and products through broad dissemination networks in order to identify potential users;

- Disseminating materials through industry-specific channels, such as those suggested by focus group participants; and

- Incorporating techniques for monitoring reach into all efforts to increase dissemination.

Phase II: In 1995, RTI performed an evaluation of the usefulness of four NIOSH Alerts and the NIOSH Confined Space Monograph. The publications' strengths were identified as:

- The publications were considered technically accurate and focused on significant occupational hazards;

- The publications supported a variety of applications by diverse users, including use "as is" or incorporation into, reference materials, training curricula, and safety publications;

- The publications, or information abstracted from them, were widely distributed through existing information networks, extending their impact well beyond their dissemination by NIOSH;

- Impacts of FACE program publications included improvements in worker training programs, heightened awareness of hazards and prevention measures among both workers and employers, and strengthened safety standards and regulations.

Specific recommendations to enhance the impact of FACE publications included:

- Improving the tear-out sheets' effectiveness at capturing and holding workers' attention by increasing use of graphics and case histories and simplifying text;

- Increasing tear-out sheets' persuasiveness through judicious use of emotional and/or fear-based appeals, and by addressing concerns related to feasibility of prevention measures;

- Increasing intermediaries' access to materials through the use of electronic dissemination channels;

- Using formative evaluation to identify themes and approaches that are most effective in conveying messages to worksite audiences

Outputs *(e.g., evaluation report, article; include full citation)*:

1994]. Evaluation of the Fatality Assessment and Control Evaluation (FACE) Program: Dissemination Component (Workplan). Research Triangle Park, NC: RTI, CDC contract no. 200-93-0697, RTI project no. 5761-03, September 23, 1994.
RTI [1995]. Evaluation of the Fatality Assessment and Control Evaluation (FACE) Program: Dissemination Component (Final Report). Research Triangle Park, NC: RTI, CDC contract no. 200-93-0697, RTI project no. 5761-03, July 14, 1995.

RTI [1996]. Evaluation of the Fatality Assessment and Control Evaluation (FACE) Program: Phase II (Final Report). Research Triangle Park, NC: RTI, CDC contract no. 200-93-0697, RTI project no., 5761-06, November 25, 1996.

TI Program Response to Findings *(if any)*:

NIOSH expanded the state-based FACE program based on the positive findings of the RTI evaluation. The program was expanded to 15 states by 2001, though the number of funded states recently dropped to nine. NIOSH and states made several modifications in response to recommendations in the RTI evaluation, including:

- FACE investigators provide employers with a packet of FACE materials, such as reports, NIOSH Alerts, and Workplace Solutions that are relevant to the case being investigated. This provides the employer with preventive recommendations in a very timely fashion.
- State programs have increased the use of products that condense and simplify information in FACE reports, specifically FACE facts. The NIOSH FACE program has also increased the production of more concise user-friendly documents, specifically NIOSH Workplace Solutions which are typically 3-5 pages in length, with clear and concise prevention recommendations and short case studies.
- All NIOSH and State-based FACE reports are now available on the NIOSH internet at www.cdc.gov/niosh/face/face. The FACE webpage has been equipped with a listserv. Any interested party can enter their email address and they will automatically receive an

email notification when a new product is placed on the FACE webpage. Several states distribute new reports electronically.

- All of the fatality investigation reports on the FACE website are indexed by industry or cause of fatality such as construction, electrocution, or youth. This allows the end user to view their area of interest and also allows them access to all the reports.
- Several organizations include links on their websites to the FACE website or individual reports, including the National Safety Council, American Society of Safety Engineers, the Occupational Safety and Health Administration, and the National Association of Tower Erectors.
- NIOSH recently sent approximately 600 letters nationally and internationally to stakeholders describing the FACE program, FACE website, and providing instructions on how to subscribe to the listserv. Recipients included other government agencies, trade associations, safety and health professionals and regional education centers.
- NIOSH and states have undertaken targeted dissemination efforts, including using industry-specific mailing lists.
- NIOSH has increased the use of graphics and pictures in NIOSH publications and tear-out sheets.
- The number of hits the FACE website receives is tallied and monitored. Additionally, a reader response card has been incorporated into the FACE Alerts and FACE website in an effort to receive timely user response. This will help evaluate the effectiveness and usefulness of FACE program products.

Program Evaluator(s) *(individuals, their organization, and contact information)***:**

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What Part of the TI Program was Evaluated?

In 2000, Congress passed legislation aimed at reducing the number of occupational aviation fatalities in Alaska by 50 percent for the years 2000 through 2009. This legislation created an interagency initiative—the Alaska Aviation Safety Initiative—to improve safety in Alaska through the combined efforts of the Federal Aviation Administration (FAA), the National Transportation and Safety Board (NTSB), the National Weather Service (NWS), and the National Institute for Occupational Safety and Health (NIOSH). In the report, ISER describes the evolution of the programs of the Alaska Interagency Aviation Safety Initiative. Next, they document other recent developments in the Alaska aviation industry that were not part of the interagency initiative but might affect safety, including changes in safety-related infrastructure. After providing this context, they analyze trends and variation in accidents, incidents, and documented occurrences over the period 1990-2004. Then, they discuss changes in aviation operations levels over the period 1997-2002, and analyze accident rates based on the operations estimates. ISER concludes with an assessment of the evidence for the effects of the interagency initiative on safety, qualified by the study's limitations.

Period of Time Evaluated: 1997-2002

Description of Findings:

During the past 15 years, the total number of aviation accidents and the number of fatal accidents have both declined by nearly 50 percent. There have been no fatal accidents involving commuter aircraft since late 2001. In this study, ISER reviewed a number of factors that may have contributed to this outcome.

In general, accident rates as a whole have declined, but the decline in rates has not been as great as the decline in the total number of accidents. At least some, if not most, of this improvement in accident rates appears to be associated with the shifts in the type of operations.

It is challenging to sort out whether the Alaska Interagency Aviation Safety Initiative has contributed to the observed reduction in accident rates, much less quantify the role of any one of its constituent programs. The interagency initiative combines a number of different programs that were all implemented during a short window of time since 2001. Only Capstone Phase I (Southwest Alaska) was fully implemented by the end of our study period, providing just two complete years (2003 and 2004) of post-implementation data. The Medallion program held its first seminar in August of 2002, Mic-in-hand operated out of only one weather service office in 2001, and has been slowly growing since. Circle of Safety began in late 2002. If we are not able to link declining accident rates to individual programs, it does not necessarily imply that that program is ineffective. Rather, it may be simply too early to tell. Unless the effect of a program is very large, one typically needs to observe data over many years to determine statistically whether the effect is significant.

Another complication with the evaluation is that the interagency initiative combines a set of programs with overlapping target populations. The Capstone program was intensively implemented in certain regions. Capstone operators are eligible to enter the Medallion program, and some have. Many operators participating in the Capstone program fly in other parts of the state. Circle of Safety targets passenger operations.

It is also difficult to separate effects of the different programs, and program effects from those resulting from infrastructure changes. When multiple factors affect all operations statewide, we cannot determine how much of that change is attributable to each program or infrastructure change. There also may be combined effects of mixes of infrastructure and programs that are greater than the sum of the individual infrastructure and program effects. One successful program may raise awareness about safe operating practices, and thereby make other programs more likely to succeed. Indeed, the sum total of programs in the interagency initiative may have cumulative effects on creating a 'culture of safety' that make the combined initiative more successful than any of its parts.

Outputs *(e.g., evaluation report, article; include full citation)***:**

Berman, M., Martin, S., Hill, A. (2005) *Evaluation of the Alaska Interagency Aviation Safety Initiative*, Institute of Social and Economic Research, University of Alaska Anchorage: Anchorage, Alaska. Dated July 16, 2005.

TI Program Response to Findings *(if any)***:**

None

The NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) was evaluated by means of surveys, interviews and focus groups of the principal target audience: fire fighters and fire chiefs.

Program Evaluator(s) *(individuals, their organization, and contact information)***:**

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What Part of the TI Program was Evaluated?

Fire Fighter Fatality Investigation and Prevention Program (FFFIPP)

Period of Time Evaluated: October 1997 – December 2003

Description of Findings:

The purpose of this evaluation was to

1. assess the effects of FFFIPP recommendations and information products on the safety knowledge, attitudes, and behavior of the nation's firefighters and

2. identify possible strategies for improving the impact of FFFIPP, including improvements in the approaches used by NIOSH to disseminate the findings from FFFIPP investigations.

The evaluation was based on data from two sources: (1) a national survey of fire departments and (2) a series of focus groups with frontline firefighters.

NIOSH issued several hundred recommendations during the first 5 years of the FFFIPP program. Many of these recommendations overlap or duplicate one another. For this evaluation, NIOSH identified 31 "key" recommendations, 22 involving traumatic injury fatalities and 9 involving cardiovascular disease (CVD) fatalities. From this list, 17 recommendations were selected to serve as sentinel recommendations for the evaluation. The selections were based on frequency of mention in FFFIPP reports, specificity of the recommendation, and balance among the categories of safety recommendations. The evaluation focused on the impacts of these sentinel FFFIPP recommendations in firefighter training, standard operating procedures, safety practices, and the safety environment of the fire departments.

FIRE DEPARTMENT SURVEY

The Fire Department Survey was mailed to the fire chiefs of a stratified random sample of 3,000 fire departments across the country during spring 2006. The sample includes

- all 208 fire departments that had experienced a FFFIPP investigation as of December 31, 2003,
- a random sample of 215 fire departments where a firefighter fatality had occurred but no FFFIPP investigation had been conducted,
- the 10 largest fire departments, because of their unique status, and
- a stratified random sample of 2,575 fire departments where there had not been a fatality as of December 31, 2003.

This sample includes representative subpopulations defined by geographic location, department type (career and volunteer), jurisdiction size, and population density.

The overall response rate for the survey was 54.9%.

FIREFIGHTER FOCUS GROUPS

A series of six focus groups was conducted with frontline firefighters to collect additional information. The focus groups took place during March and April 2006 and included participants from both career and volunteer fire departments and from departments in both rural and urban jurisdictions.

RTI is still in the process of analyzing survey results. However, a draft report recommended the following:

Outreach Efforts

1. Enhance outreach efforts to small, rural, and volunteer fire departments.

Technical Assistance

2. Develop documents about recommended equipment, training, or procedures that could be used to justify budget requests.

3. For smaller, volunteer departments, provide additional technical assistance for preparing grant applications.

NIOSH Web Site

4. Improve the FFFIPP Web site with a firefighter-friendly page that connects broad topics with recommendations and action items, with links to specific FFFIPP LODD reports and other FFFIPP materials and resources.

Outreach

5. Contact fire departments that experience a firefighter fatality or "near miss" incident, regardless of whether an investigation is planned. Partnering with other organizations, as needed, provide relevant FFFIPP materials and offer technical assistance to help address safety issues.

LODDs

6. Continue developing and disseminating LODD reports.

7. Continue providing all four sections of the current reports, including a summary, investigation results, discussion, and recommendations.

8. Consider the use of formatting, headings, and headlines to enhance the messages communicated both in individual LODDs and over the LODD series.

Content of the LODDs

9. To improve accessibility and information, incorporate more photos, timelines, diagrams, and other visual aids into the FFFIPP reports.

10. Review the investigation protocol, particularly the sources used for developing technical recommendations. Consider using an outside panel of experts to review findings.

Fire Fighter Fatality Investigation and Prevention Program Evaluation Ancillary Materials

11. Help transfer knowledge gained from FFFIPP investigations by creating training tools based on the FFFIPP reports including PowerPoint slides and lesson plans. Incorporate photos, timelines, diagrams, and other visual aides.

12. Expand the production of existing publications such as Safety First, Workplace Solutions, and Hazard IDs to include additional topics. Make use of graphics, statistics, and other tools to communicate the level of risk and practical steps firefighters and fire departments can take to promote safety.

13. Explore new technology for disseminating the findings of FFFIPP investigations in a public service campaign format. Use videos, public service channels, and Internet streaming video to present safety messages on each key FFFIPP recommendation. These messages should draw from multiple fatality investigations and should employ public safety advocacy techniques.

Distribution of FFFIPP Materials

14. Ensure NIOSH materials reach all fire departments by instituting new measures to maintain a complete and up-to-date mailing list.

15. Ensure that NIOSH e-mail lists are up to date (e.g., with an e-mail cohort maintenance—or refresher—program that generates automatic e-mails to listserv members to confirm addresses).

Marketing

16. Improve the promotion of the FFFIPP Web site. Create a poster suitable for fire department station bulletin boards with the NIOSH Web site featured prominently.

17. Consider coordinated promotional campaigns on single themes.

18. Develop additional mechanisms for raising awareness about FFFIPP across the fire service and the public.

Outputs *(e.g., evaluation report, article; include full citation)***:**

As stated in “Findings”, RTI is in the process of analyzing survey data. A draft report has been issued, and a comprehensive evaluation report is planned.

TI Program Response to Findings *(if any)***:**

Appendix 9: Citation and Dissemination Data for TI Output (Fiscal Year 1996-2005)

Publications

Acute Back Injuries Related

1. Collins JW, Wolf L, Bell J, Evanoff B [2004]. An evaluation of a "best practices" musculoskeletal injury prevention program in nursing homes, Injury Prevention (10):206-211. **[10 Cited]**

2. Giorcelli R, Hughes R, Myers J [2004]. Accuracy of a System for Measuring Three Dimensional Torso Kinematics during Manual Materials Handling, J Appl Biomech *20*(2):185-194. **[0 Cited]**

3. Johnston JM, Landsittel DP, Nelson NA, Gardner LI, Wassell JT [2003]. Stressful psychosocial work environment increases risk for back pain among retail material handlers, Am J Ind Med 43(2):179-187. **[4 Cited]**

4. Bobick TG, Belard J-L, Hsiao H, Wassell JT [2001]. Physiological effects of back belt wearing during asymmetric lifting, Applied Ergonomics 32(2001):541-547. **[3 Cited]**

5. Giorcelli RJ, Hughes RE, Wassell JT, Hsiao H [2001]. The effect of wearing a back belt on spine kinematics during asymmetric lifting of large and small boxes, Spine *26*(16):1794-1798. **[4 Cited]**

6. Wassell JT, Landsittel DP, Gardner LI, Johnston JM [2001]. Do Back Belts Prevent Back Injury? In reply to letters to the editor. JAMA 285(9):1152. **[0 Cited]**

7. Wassell JT, Gardner LI, Landsittel DP, Johnston JJ, Johnston JM [2000]. A prospective study of back belts for prevention of back pain and injury, Journal of the American Medical Association 284(21):2727-2732. **[20 Cited]**

8. Zhuang ZQ, Stobbe TJ, Collins JW et. al. [2000]. Psychophysical assessment of assistive devices for transferring patients/residents. Appl Ergonomics 31(1):35-44 Feb. **[10 Cited]**

9. Zhuang Z, Stobbe TJ, Hsiao H, Collins JW, Hobbs GR [1999]. Biomechanical evaluation of assistive devices for transferring residents. Applied Ergonomics 30(4):285-294. **[17 Cited]**

10. Gardner LI, Landsittel DP, Nelson NA [1999]. Risk factors for back injury in 31,076 retail merchandise store workers, Am J Epidemiol 150(8):825-833. **[10 Cited]**

11. Landsittel DP, Gardner LI, Arena VC [1998]. Identifying populations at high risk for occupational back injury with neural networks, Human and Ecological Risk Assessment 4(6):1337-1352. **[0 Cited]**

12. Gardner LI, Sweeney MH, Waters TR, Fine LJ [1997]. Distinguishing back-belt effects from other factors in reduction of back injuries (letter to editor). International Journal of Occupational and Environmental Health 3(3):236-239. **[3 Cited]**

13. Kraus JF, Gardner L, Collins JW, Sorock G, Volinn E [1997]. Design factors in epidemiologic cohort studies of work-related low back injury or pain. Am J Ind Med 32(2):153-163. **[15 Cited]**

14. Collins JW, Owen BD [1996]. NIOSH research initiatives to prevent back injuries to nursing assistants, aides and orderlies in nursing homes. Am J Ind Med 29(4):421-424. **[17 Cited]**

15. Hersey JC, Collins JW, Gerson R et. al. [1996}. Methodologic issues in intervention research – health care. Am J Ind Med 29(4):412-417, Apr. **[2 Cited]**

Alaska Related

1. Conway GA, Hill A, Martin S, Mode NA, Berman MD, Bensyl DM, Manwaring JC, Moran KA [2004]. Alaska air carrier operator and pilot safety practices and attitudes: a statewide survey. Aviat Space Environ Med 75(11):984-991. **[1 Cited]**

2. Conway GA, Mode NA, Berman MD, Martin S, Hill A [2005]. Flight safety in Alaska: Comparing attitudes and practices of high and low-risk air carriers, Aviat Space Environ Med 76(1):52-57. **[0 Cited]**

3. Husberg BJ, Fosbroke DE, Conway GA, Mode NA [2005]. Hospitalized Nonfatal Injuries in the Alaskan Construction Industry. Am J Ind Med (47):428-433. **[0 Cited]**

4. Conway GA [2002]. Casting their lot upon the water: commercial fishing safety. Lancet North Am Ed 360:503-504. **[2 Cited]**

5. CDC [2002]. Factors Associated with Pilot Fatalities in Work-Related Aircraft Crashes - Alaska 1990-1999, MMWR 50(11):347-349.

6. Backus AS, Brochu PJ, Lincoln JM, Bensyl DM, Ciampa JR, Smith TJ, et al. [2001]. Understanding and preventing lobsterman entanglement: A preliminary study. Marine Safety Council, Proceedings 58(2):50-53.

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Publication Dissemination Data

Publication Number	Title	Copies Requested*	Total Copies Distributed*	Research Goal
96-100	CIB 57: Violence in the Workplace: Risk Factors and Prevention Strategies	36,264	83,242	Violence
97-108	Improper hitching to tractors can be fatal	14,184	32,446	Machines
97-110	NIOSH Alert: Preventing worker injuries and deaths from moving refuse collection vehicles	8,143	20,292	Motor-vehicle
97-113	Hazard Controls: Control of Scrap Paper Baler Crushing Hazards	2,717	26,416	Machines
97-132	Are you a working teen? What you should know about safety and health on the job	106,606	291,703	Youth
97-163	CIB 58: Commercial Fishing Fatalities in Alaska: Risk Factors and Prevention Strategies	83	8,000	Alaska
98-117	NIOSH Alert: Preventing Injuries and Deaths From Skid Steer Loaders	7,595	20,413	Machines
98-120	Safety & health on the job [poster]	---	---	Youth
98-131	Worker Deaths by Electrocution: A Summary of Surveillance Findings and Investigative Case Reports	19,694	34,193	Other
98-134	NORA Traumatic Injury Team Report: Traumatic Occupational Injury Research Needs and Priorities	1,757	16,340	Other
98-142	NIOSH Alert: Preventing Worker Injuries and Deaths From Traffic-Related Motor Vehicle Crashes	20,355	128,500	Motor-vehicle
98-146	Hazard ID 4: Ignition Hazard From Drilling Into Sealed Frames of Agricultural Equipment	11,730	23,079	Machines
99-110	NIOSH Alert: Preventing Worker Deaths From Uncontrolled Release of Electrical, Mechanical, and Other Types of Hazardous Energy	19,350	27,125	Other
99-129	NIOSH hazard id: Fire fighting hazards during propane tank fires	---	51,117	Emergency Responders
99-141	Promoting safe work for young workers: A community-based approach	8,165	16,300	Youth

Publication Number	Title	Copies Requested*	Total Copies Distributed*	Research Goal
99-145	Hazard ID 8: Injury Associated With Working Near or Operating Wood Chippers	5,613	32,757	Machines
99-146	NIOSH Alert: Preventing Injuries and Deaths of Fire Fighters In Structural Collapse	22,917	71,040	Emergency Responders
2001-109	NIOSH Alert: Preventing Injuries and Deaths of Workers Who Operate or Work Near Forklifts	---	32,442	Machines
2000-116	Worker Deaths by Falls: A Summary of Surveillance Findings and Investigative Case Reports	8,435	10,300	Falls
2001-128	Building Safer Highway Work Zones: Measures to Prevent Worker Injuries From Vehicles and Equipment	16,810	21,563	Motor-vehicle
2001-143	NIOSH hazard id: Traffic hazards to fire fighters while working along roadways	30,834	71,193	Emergency Responders
2001-146	Hazard ID 13: Hazards Associated With Using Farm Tractors to Move Large Bales	---	16,110	Machines
2001-154	Injuries among youth on farms in the United States, 1998	4,352	7,716	Youth
2001-156	NIOSH Alert: Preventing Injuries and Deaths From Falls During Construction and Maintenance of Telecommunication Towers	24,765	25,444	Falls
2002-101	Workplace Solution: Preventing Injuries when Working with Ride-On Roller/Compactors	35,563	41,273	Machines
2002-111	Hazard id: Fire fighter deaths from tanker truck rollovers	2,595	42,039	Emergency Responders
2002-112	Hazard id: Fire fighters exposed to electrical hazards during wildland fire operations	1,090	40,148	Emergency Responders
2002-115	Surveillance and Prevention of Occupational Injuries in Alaska: A Decade of Progress, 1990-1999	1,541	3,176	Alaska
2003-119	Work-Related Roadway Crashes - Challenges and Opportunities for Prevention	4,778	7,549	Motor-vehicle
2003-121	Your Safety 1st: Railroad Crossing Safety For Emergency Responders	39,209	44,086	Emergency Responders

Publication Number	Title	Copies Requested*	Total Copies Distributed*	Research Goal
2003-124	NIOSH Alert: Preventing Deaths and Injuries While Compacting or Baling Refuse Material	5,391	6,930	Machines
2003-128	NIOSH Alert: Preventing Deaths, Injuries and Illnesses of Young Workers	29,010	31,916	Youth
2004-01	NIOSH safety checklist program for schools and other safety databases	---	---	Youth
2004-100D	Violence on the Job – Video	20,038	32,101	Violence
2004-101	CD-ROM NIOSH Safety Checklist Program from Schools and Other Safety Databases	57,379	64,505	Youth
2004-107	Workplace Solution: Preventing Injuries when Working with Hydraulic Excavators and Backhoe Loaders	7,865	17,233	Machines
2004-113	Fact Sheet: Safe Work for Youth in Construction	7,446	16,932	Youth
2004-117	Injuries to Youth on Minority Farm Operations	---	0	Youth
2004-118	Asthma Among Household Youth on Minority Farm Operations	---	0	Youth
2004-136	Fact Sheet: Roadway Crashes—Prevention Strategies for Employers	9,848	12,114	Motor-vehicle
2004-137	Fact Sheet: Roadway Crashes—Who's at Risk?	8,330	10,245	Motor-vehicle
2004-144	Protecting Emergency Responders, Volume 3: Safety Management in Disaster and Terrorism Response	11,057	16,923	Emergency Responders
2004-152	Workplace solutions: Divers beware: training dives present serious hazards to fire fighters	5,234	62,059	Emergency Responders
2004-156	NIOSH Alert: Preventing Falls of Workers through Skylights and Roof and Floor Openings	9,021	11,089	Falls
2004-157	Injuries to Youth on Hispanic farm operations	3,309	7,257	Youth
2004-158	Asthma among household youth on Hispanic farm operations	3,029	6,578	Youth
2004-172	Injuries Among Youth on Farms, 2001	5,050	8,272	Youth
2005-101	Workplace solution (rollers/compacters)	---	27,781	Machines

Publication Number	Title	Copies Requested*	Total Copies Distributed*	Research Goal
2005-102	Workplace solutions: Preventing deaths and injuries to fire fighters during live-fire training in acquired structures	2,313	37,498	Emergency Responders
2005-132	NIOSH Alert: Preventing Injuries and Deaths of Fire Fighters due to Truss System Failures	---	42,083	Emergency Responders
2005-134	Working Together for Safety — A State Team Approach to Preventing Occupational Injuries in Young People	1,982	3,815	Youth
2005-147	Injury and Asthma Among Youth Less Than 20 Years of Age on Minority Farm Operations in the United States, 2000. Volume 1: racial minority national data	542	3,041	Youth
2005-159	Roadway Crashes: Older Drivers in the Workplace: Crash Prevention For Employers and Workers	1,007	5,496	Motor-vehicle
2006-109	Injury and Asthma Among Youth Less Than 20 Years of Age on Minority Farm Operations in the United States, 2000. Volume II: Hispanic national data	513	2,388	Youth
2006-117	Safe Lifting and Movement of Nursing Home Residents	8,361	22,950	Back
2006-142	Preventing Worker Injuries and Deaths from Mobile Crane Tip-Over, Boom Collapse, and Uncontrolled Hoisted Loads	624	10,680	Machines
2006-144	Preventing Worker Injuries and Deaths from Mobile Crane Tip-Over, Boom Collapse, and Uncontrolled Hoisted Loads	1,405	2,967	Machines
Total Publications Distributed		**653,899**	**1,708,855**	

* Dashes indicate data not available.