Chapter 3. Goal 1: Reduce Hazards, Illnesses, and Injuries in the AFF Workforce By Conducting Population-Based and Hazard Surveillance

One of the cornerstones of public health is the use of surveillance to track the health of populations over time. Surveillance serves many public health purposes, including defining the current health status of a population, identifying health risks within a population, and tracking changes in a population's health risk over time.

Occupational illness, injury, and hazard surveillance has evolved over the last 35 years and relies primarily on the BLS Survey of Occupational Injuries and Illnesses (SOII). However, for a variety of reasons, the SOII does not provide adequate surveillance for large portions of the agriculture industry. Since 1976, the SOII covers only those farming establishments with 11 or more full-time workers, which represent less than 5% of the farms in the United States. In addition, the SOII does not track injuries occurring on the 74% of farms with no hired workers. For similar reasons, the SOII does not cover small, family-oriented fishing operators in the United States.

This chapter presents three sections on surveillance research conducted by the AFF Program: illnesses and related hazards, injuries and related hazards, and injuries leading to fatalities and related hazards.

3.1 Illness Surveillance

3.1a Challenge or Issue

There are a number of challenges to illness surveillance in general and to surveillance in agriculture, fishing, and forestry. The relationship between illnesses and work exposures is generally less evident than the relationship between injuries and work activity. Diagnosis of health problems adds to the complexity of surveillance because of the potential for misdiagnoses and subsequent reporting bias. In agriculture, occupational health expertise is often not available. Agricultural workers are less likely to seek medical assistance for a variety of reasons, including time-sensitivity of completing agricultural tasks, inadequate medical insurance, lack of trust of health care professionals, and cultural norms. This leads to illness undercounts.

The NCASH report (Appendix 2-01) noted that epidemiologic studies have indicated that the NSC data underestimate farm injury rates by as much as 50%. In addition, a wide range of agriculturally related diseases have been documented in several epidemiological studies, but adequate population-based rates are not available. Accurate rates are needed for specific types of injury and disease (according to type and size of farm, demographic characteristics, and other risk factors) to better target prevention and intervention efforts. To obtain these rates, the NCASH report recommended that CDC/NIOSH conduct health and hazard surveys for agricultural workers.

The information previously available on excess mortality and morbidity experienced by farm workers lacks the detailed descriptors needed for the design of intervention programs. Apart from pesticides, little population-based data are available on the physical, chemical, and biologic hazards that exist on farms.

Over the past 20 years, there has been ample concern about environmental health issues, particularly the impacts of pesticide exposure. AFF workers are often exposed to an extensive mixture of pesticides. The health impacts of these mixtures are poorly understood, and human susceptibility to pesticide toxicity is likely to be highly variable.

More and better surveillance data are needed to determine appropriate prevention activities.

3.1b Activities

To address surveillance gaps within the agriculture industry and the mandate of Congress, the AFF Program pursued a mixture of population and case-based surveillance approaches. They are summarized in Table 3-1.

Table 3-1. Overview of Surveillance Projects

Project	Intramural staff	Extramural projects	Budget
Farm family health and hazard surveillance	5.0 FTE plus consultations	6	$1.5 to 2.0 million annually for 10 years
Occupational health nurses in agricultural communities	~5.0 FTE	1 for 4 years 1 for 5 years 8 for 6 years	$2 million / year for 6 years = $12 million
Community partners for healthy farming surveillance (Community Partners)	~1.5 FTE	1 for 3 years 8 for 4 years	$4 million
SENSOR− Pesticides	n/a	n/a	$1.5 million

n/a = not available. Budgets are estimates and are only available from 1996 to present. Therefore, budgets are likely an underestimation.

Farm Family Health and Hazard Surveillance

The Farm family health and hazard surveillance (FFHHS) surveys were started in 1994. The purpose of the FFHHS surveys was to provide data that would enable estimation and description of the prevalence and incidence of illnesses, injuries, and exposures to workplace hazards on family farms. Surveys were conducted through cooperative agreements with six States—California, Colorado, Iowa, Kentucky, Ohio, and New York. The FFHHS obtained population-based prevalence and incidence data for farmers and farm families on disease, injury, workplace exposures, and access to health care according to commodity, size of farm, demographic characteristics, nonfarm employment, and other risk factors. (Appendices 3.1-01, 3.1-02)

A mixture of intramural and extramural resources conducted the FFHHS effort. Partners for each participating group are listed in Table 3-2.

Table 3-2. FFHHS Collaborators and Resources, 1990 to present	
Sub-project lead agency	Major partners
Intramural NIOSH Occupational Health Branch Department of Health Services State of California	Universities, health departments, cooperative extension services, agricultural centers, and agricultural organizations with other agricultural initiatives. California State University Safe-Net Consultants Public Health Institute Westat, Inc. California Institute for Rural Studies Center for Agricultural Business
College of Veterinary Medicine and Biomedical Sciences Colorado State University	National Animal Health Monitoring System of USDA Colorado Department of Public Health
College of Medicine University of Iowa	Iowa Agricultural Statistics Service
College of Medicine University of Kentucky	Kentucky Agricultural Statistics Service Kentucky Farm Bureau Survey Research Center, University of Kentucky Cooperative Extension Service, University of Kentucky Mobiletek, Inc.
New York State Department of Health Department of Preventive Medicine The Ohio State University	Cornell University Extension Service New York Center for Agricultural Medicine and Health New York State Department of Agriculture and Markets Ohio Agricultural Statistics Service National Center for Environmental Health Ohio Department of Agriculture Ohio Fruit and Vegetable Grower's Society

The sample for each State-based survey was to be a probability sample based on certain geographic regions within the State. The samples represented a broad range of farming practices in terms of farm size, commodities, terrain, and farmer demographics. The survey consisted of health and hazard components. The health component was modeled after parts of the National Health Interview Survey (NHIS) and National Health and Nutrition Examination Survey (NHANES). The hazard component was modeled after the National Occupational Exposure Survey (NOES). The specific health events, hazardous exposures, and target populations varied among the six surveys because of the regional differences in agriculture work.

Investigators analyzed the data to identify farm subpopulations with excess rates of disease, injury, or workplace exposures. Excess rates were determined by comparing farm subpopulations within States and across States, and by comparing them with the reference surveys (NHIS, NHANES, NOES). The FFHHS series of surveys was completed in 2000.

Occupational Health Nurses in Agricultural Communities

Occupational health nurses in agricultural communities (OHNAC) was created in response to the Congressional mandate to fund nurses to conduct surveillance in rural communities. The OHNAC program funded 31 public health nurses in 10 States (California, Georgia, Iowa, Kentucky, Maine, Minnesota, New York, North Carolina, North Dakota, and Ohio) to conduct case-based and sometimes rate-based surveillance. Investigations identified previously unknown or under-recognized causes of illness and injuries. Selected OHNAC activities are outlined in Table 3-3. (Appendix 3.1-03)

Community Partners for Healthy Farming Surveillance (1996–2000) was an outgrowth of OHNAC and was funded in California, Iowa, Kentucky, Maine, Minnesota, New York, North Dakota, Ohio, Oregon, and Wisconsin (Appendix 3.1-04). This extension of OHNAC focused on more targeted hazards, included more hired farm workers, had wider geographic regions, and often collaborated with intervention research projects. The AFF Program nurses conducted surveillance primarily with emergency department logs for case identification. They conducted onsite investigations of selected cases. Emphasis was placed on timely identification, investigation, and dissemination of prevention information, especially in relationship to the seasonality of agriculture. From their surveillance findings, the nurses engaged communities to help. They leveraged support of stakeholders for education about illnesses, hazards, and injuries associated with farming. Farm safety day camps, newspaper columns, and interactive active displays at fairs are examples of these collaborative activities.

In 1993, a call to an Iowa OHNAC nurse by a community newspaper resulted in a finding that small engines can produce hazardous levels of carbon monoxide, even in apparently ventilated areas. The sentinel event/index case was reported to the Iowa OHNAC nurse by the editor of a local newspaper who called her about a death of a 33-year-old farmer while cleaning his 3420- cubic-foot-swine barn. This led to review of surveillance records for prior fatal or non-fatal carbon monoxide poisonings while using pressure washers. NIOSH staff subsequently assisted Iowa nurses in investigating that fatality and other non-fatal incidences of carbon monoxide poisoning reported to hospital emergency rooms across Iowa. OHNAC investigators and the Iowa nurses interviewed the four surviving persons and family members. It became apparent that some of their incidences could have been fatal had not family members or other co-workers found the person, recognized the problem, got them out of the hazardous environment, and obtained medical assistance. A follow-up survey in Missouri during the floods found that people were not aware that small engines could produce hazardous levels of carbon monoxide indoors in areas that were apparently ventilated [Grief et al. 1997].

AFF Program support included annual training meetings, a listserv, annual site visits, technical assistance for onsite investigations, and assistance in disseminating findings and interventions.

Table 3-3. Selected OHNAC Activities

State health department and number of local nurses	Examples of activities (especially those unique to extramural project)	Examples of unique partners and case investigations
California; 2 nurses and 1 outreach worker (2 counties)	Only project that focused on hired farm workers. Created NURSE Reports from selected investigations.	Migrant health clinics: Worker scalped in fruit packing plant Cotton harvester operator's arm mangled in cotton harvester spindles Bee stings
Iowa 4 nurses; State-wide	Nurses provide an active component to an existing rate-based, passive injury surveillance system	Grain suffocations Carbon monoxide (CO) poisoning from farmers using gasoline-powered pressure washers indoors
Kentucky 3 nurses; selected regions	-Ascertained (rate based surveillance) of hospital-treated injuries	Green Tobacco Sickness (GTS) Fatality related to dermal and respiratory exposure to a pesticide, endosulfan CO poisoning outdoors
Maine (2) Selected regions	-Initiated Noise-Induced Hearing Loss training with youths attending tractor safety training. -Contributed to annual surveillance of injuries during potato harvest	University of Maine Department of Audiology Northeast Agricultural Center Maine Agriculture in the Classroom State Board of Education Wrist tendonitis among blueberry rakers
Minnesota 4 nurses; selected regions	-Conducted farm surveys as their primary surveillance - Conducted an innovative intervention where grain elevator employees encouraged farmers to use appropriate respiratory personal protective equipment (PPE)	Grain elevator operators Milk testers Eye injuries from survey data Auger injuries
New York 3 nurses; selected regions	- Another AFF Program-funded project provided engineering expertise for selected case investigations. -Sheriff called nurse to respond to calls involving serious injuries or fatalities	Northeast Agricultural Center Cornell University Scalping incidents affecting women using hay baler/kickers Injuries associated with unloading Forage wagons Explosions related to drilling into sealed frames
North Dakota 5 nurses; entire State	In response to parents' request about safe tasks for children, created a table top educational display on age-appropriate farm tasks	Q fever in a sheep farmer Horse injuries
North Carolina 2 nurses and 1 outreach worker; Selected regions	Targeted education for four audiences at their request: farm women, migrant workers, children, and pork production workers	Farm Bureau Women's organizations State and local organizations related to Pork production
Ohio 3 nurses; regional	-Nurses in rural hospitals with occupational health capability -In response to a request of Ohio occupational nurses, assisted NIOSH in day-long agricultural health and safety program at a statewide conference.	Local college, farmers, and extension service assisted in training nurses from 10 States for onsite case investigations. A preventable tetanus fatality. The investigation found that the women had prior medical visits for chronic health problems and no record of tetanus inoculation. Respiratory conditions
Georgia 2 nurses for 4 years only selected regions	- Overnight camps with swimming lessons - Pond safety programs in response to drowning case - Skin cancer prevention	Red Cross for swimming Drowning in farm ponds

SENSOR - Pesticides

The mission of the SENSOR Program is to build and maintain occupational illness and injury surveillance capacity within State health departments. Under this program, NIOSH provides cooperative agreement funding and technical support to conduct surveillance on one or more occupational illnesses or injuries. Acute pesticide-related occupational illness and injury is one area that receives support. (Appendix 3.1-05)

Ten States currently participate in the SENSOR−Pesticides program. NIOSH funds health departments in five States (California, Michigan, New York, Texas, and Washington) to bolster pesticide-related surveillance. The remaining five are unfunded SENSOR−Pesticides Program partners (Arizona, Florida, Louisiana, New Mexico, and Oregon). In addition to tabulating the number of acute pesticide-related occupational cases, these surveillance programs conduct in-depth investigations for case confirmation and develop preventive interventions aimed at particular industries and hazards. The SENSOR−Pesticides Program is most useful for timely identification of outbreaks and emerging pesticide problems. However, a national aggregated database is also available. It consists of acute occupational cases submitted annually by each of the SENSOR−Pesticides States. This database includes cases identified between 1998 and 2004 and is useful to assess the magnitude and trend of acute pesticide-related occupational illness and injury.

Between 1987 and 1997, only three States participated in SENSOR−Pesticides. Since 1997, the number of participating States and activities has increased dramatically. One thing that made this possible was finalizing a standardized case definition and standardized variables in 1998. These were developed through a modified nominal group process. The group consisted of experts from Federal agencies (EPA, NIOSH, and NCEH), the Council of State and Territorial Epidemiologists (CSTE), and State health departments or other state designees.

Although all participating States require physician reporting of pesticide-related illness cases, SENSOR now obtains case reports from multiple sources. Between 1998 and 2004, the three leading sources were other government agencies (e.g. State department of agriculture, State departments of industrial relations, and county health departments), workers' compensation, and poison control centers. Health care professionals reported a much smaller proportion. Other sources of case reports vary by State. They include emergency medical services, medical laboratories, worker representatives (e.g., Migrant Legal Aid, selected community contacts, co-workers, friends, and relatives), employers, news reports, death certificates, and self reports.

The information collected by the State agencies in a standardized manner includes date of illness, information on the ill person (sex, race, age, signs, and symptoms), industry, occupation, whether the illness occurred as a result of workplace exposures, identification of the pesticide(s) that produced the illness, activity of the individual when exposed, type of exposure (e.g., drift, direct spray, indoor air exposure, or exposure to a spill or leaking container), biological monitoring information (i.e., cholinesterase testing and results, and whether other biological testing was performed), and PPE use.

The SENSOR−Pesticides Program captures illnesses resulting from both occupational and non-occupational exposures. However, collaborating States with limited resources are advised to focus their efforts on detecting occupational cases of pesticide poisoning. A case is classified as occupational if the pesticide exposure occurred at work. All other cases are classified as non-occupational.

The SENSOR−Pesticides Program has identified many emerging pesticide problems (listed under outputs). These reports led to targeted efforts to prevent their recurrence. For example, after illnesses were associated with the pesticides used to eradicate medfly infestations, additional resources were used to successfully prevent subsequent medfly infestations through mid-2005. The SENSOR−Pesticides Program also supported the need for public notification requirements for medfly eradication and mosquito abatement programs. Another emerging pesticide problem that was detected involved illnesses associated with automatic insecticide dispensers. Following publication of this report, the Association of American Pesticide Control Officials recommended that the EPA change the label on these devices to prevent their use in public spaces. Finally, another report documented the problem with off target drift of pesticides, specifically, off-target drift into a low-income Hispanic community where many residents lacked health insurance. After this report was published, a law was passed in California that makes growers liable for the uncompensated medical care provided to those who become sick from pesticides that drift from their farms (State of California Food and Agriculture Code, Sections 12996.5, 12997.5 and 12997.7).

Keokuk County Rural Health Study

Extramural AFF Program researchers in Iowa started the Keokuk County Rural Health Study in 1990. It is a prospective cohort study of agricultural budget and environmental exposures, risk behaviors, and health outcomes of a stable population in a highly agricultural county. Row crop farming and livestock production in this county are typical of Iowa and other parts staff for each of the rural Midwest. The primary foci of the study are respiratory diseases, occupational injuries, and occupational/environmental exposures. Other areas included are noise-induced hearing loss, mental health and stress, allergies, and farm safety. We found high rates of childhood asthma, noise-induced hearing loss, depression, adults who were overweight or obese. We also found young children performing dangerous farm chores, exposure to agricultural chemicals and low usage of personal protective equipment, and the presence of loaded and unlocked firearms in most homes. In addition to feeding the results of the study back to the county residents, program staff has conducted community services such as spirometry and blood pressure screenings.

The Keokuk study has sponsored and coordinated two Occupational and Industrial Coding classes with NIOSH staff. People from a variety of departments within The University of Iowa attended the classes. Further, the Iowa AFF Program staff participated annually in the training of University of Iowa College of Medicine students enrolled in medical research classes. Numerous Fogarty scholars and physicians from Eastern European countries (Czech Republic, Slovakia, Romania) have worked with theses researchers, both to receive training and to work on their own projects using our data. Several post-doctoral fellows, including a dermatologist from Finland, have spent a year working with our study data.

The Iowa researchers of the AFF Program have collaborated with others on related studies. Collaborating organizations include University of Nebraska Medical Center, Omaha; University of Arizona College of Medicine, Tucson; Creighton University; and Creighton University.

The Farmer Health Study

Extramural AFF Program researchers in California are conducting the Farmer Health Study, which began in 1990. The study is an investigation of prevalence and risk factors for acute and chronic diseases among California farmers (e.g., dry climate farming as a risk factor for respiratory disease). The results of a questionnaire indicate conditions limiting work, musculoskeletal problems, neuritis/nerve problems, and occupational injuries were the most commonly self-reported conditions, and those conditions were not associated with age. In comparison to the general population of the same age, chronic health conditions that were more prevalent in farmers included musculoskeletal conditions, lung problems, and injuries. However, the farmers appeared to be healthier than the rest of the population with respect to diabetes and heart disease. Farmers were still vulnerable to new respiratory symptoms even after many years in farming. The prevalence of asthma, chronic bronchitis, chronic cough and persistent wheeze had increased in 2004 from previous years, and incidence of new symptoms ran between 5% and 8%.

The project has a community advisory board, composed of local officials and community leaders that meets regularly and is informed of the study progress. The project also has relationships with local medical and dental health practitioners, and regular contact with them provides opportunities to disseminate practice-related findings. Program staff made presentations to the Merced and Fresno county health departments and will continue to inform them of study results.

3.1c Selected Outputs

Work-Related Lung Disease (WoRLD) Surveillance Report and System

The *WoRLD Surveillance Report* is an important result of the AFF Program surveillance efforts. This report presents a summary of occupational respiratory disease surveillance data at the national and State levels. In 1991, this information was published by NIOSH in the first of a series of six *WoRLD Surveillance Reports*, with subsequent publications in 1992, 1994, 1996, 1999, and 2002. Recently, these reports were placed in a Web based reporting system, the *Work-Related Lung Disease Surveillance System (eWoRLD)* located at http://www2a.cdc.gov/drds/WorldReportData/. (Appendix 3.1-06)

Although the summary focuses on respiratory disease related to several occupations, agriculture constituted approximately 60% of the tables and figures in the report present agricultural data. Included are statistics such as counts, crude and age-adjusted mortality rates, and years of potential life lost to age 65 and to life expectancy. Proportionate Mortality Ratios (PMRs) by industry and occupation are based on the most recent decade of data from a subset of States for which usual industry and occupation have been coded for decedents. The summary also presents U.S., State, and county maps showing the geographic distribution

of age-adjusted mortality rates. For the pneumoconiosis, tables and figures summarize selected occupational exposure data for cotton dust and other hazards.

The *WoRLD Surveillance Report* includes analyses of data from the NCHS NHIS and the Social Security Administration disability award files. Other identified data sources include the following:

- The SOII
- Industrial hygiene sampling data from OSHA compliance inspections and consultation surveys
- NHDS reports
- Occupational and environmental diseases and chronic injuries database developed by the AOEC
- National population estimates from the Bureau of the Census
- SENSOR data on silicosis and work-related asthma

In August 2004, the highlights section of the *WoRLD Surveillance Report 2002* was incorporated into the NIOSH topic Web page on occupational respiratory disease surveillance and the electronic version of the *WoRLD Surveillance Report (eWoRLD)* was developed. Also, direct links to the hard copy versions of the *Report* series were created. The user is offered quick access to all summary tables, figures, and maps of the *Report* in three formats—html, gif, PDF, and data in CSV format.

More than 5,300 copies of *WoRLD Surveillance Report 1996* and 3,090 copies of *WoRLD Surveillance Report 2002* were distributed using NIOSH mailing lists and an American Lung Association mailing list. The lists include international and national researchers, physicians, employers, universities, and government agencies. In addition, the AFF Program responded to 202 e-mails received in the *WoRLD* e-mail box (WoRLD@cdc.gov) during 2000–2006.

As of March 2006, approximately 140 documents have cited the *WoRLD Surveillance Reports*. They include journal articles, trade articles, and newspapers. Several publications advertised the 2002 report, often in the form of a note to the reader. These are examples:

- MMWR: http://iier.isciii.es/mmwr/preview/mmwrhtml/mm4911a4.htm
- JAMA archive (reprinted from MMWR): http://jama.ama-assn.org/cgi/content/extract/283/15/1955
- *UTNE Reader*, Fall, 2000
- *American Family Physician*, August, 2000
- *Business and Legal Reports,* July, 2003

The *WoRLD Surveillance Report* or portions of the *Report* are also directly linked from several university, State, Federal and private Web sites, including Duke University and the American Lung Association.

Respiratory Disease in Agricultural Workers: Mortality and Morbidity Statistics

The AFF Program published this report in 2005. It presents surveillance data for agricultural respiratory disease to direct prevention activities. The report is intended to help prevent adverse respiratory health effects associated with AFF industries. Data were drawn from major existing database sources, including NCHS, BLS, and the *Current Population Survey*. PMRs are calculated for each worker group for selected respiratory conditions. Summary statistics and prevalence ratios are included. (Appendix 3.1-07)

Keokuk County Rural Health Study

This study has yielded publications, databases, newsletters (for participants), community presentations, a Website (http://www.kcrhs.org), and local press coverage.

The Farmer Health Study

One program staff member serves on the Rural Community Assistance Corporation board on health and housing, which is a forum for advancing the hired farm workers' health needs. That person has presented results from studies of hired farm workers in numerous national and international forums, such as Binational Health Week, increasing awareness and providing direction for interventions to address health needs in this population. Other components of the study, such as the pulmonary function testing and pesticide exposure sub-study provide opportunities to directly educate participants and the community at large. The investigators have experience communicating results to Hispanic farm workers from their previous investigations. Our research on the impact of inorganic dust exposure and the lack of protective equipment use among farmers has been disseminated through a variety of scientific and lay publications, with the goal of improving knowledge and reducing exposure to dust that was previously thought by many to be no more than a nuisance.

Other Outputs

Since 1991, the AFF Program disseminated surveillance findings and recommended interventions through the following:

- At least 185 peer-reviewed journal articles
- 24 MMWR articles
- Six NIOSH Updates that were used for targeted mailings to media, agricultural organizations, equipment manufacturers and health departments
- A multiagency Alert on CO poisoning related to small engines
- A how-to guide for pesticide surveillance
- Four other NIOSH publications
- At least 150 presentations at conferences and workshops
- Several unpublished reports
- Web sites

In 2005, AFF program staff in California gave a policy briefing at the California State Capitol on "Policies to Improve the Health and Well-Being of California's Hired Farm

Laborers" to an audience of legislative staff and advocacy groups. The presentation was based on their research findings and provided suggestions for policy changes to improve the health of hired farm workers. They have also made presentations to national and international forums with similar recommendations.

Intramural and extramural AFF program staff wrote all the articles and editorials for a special edition of the AAOHN journal in 1993. In cooperation with AAOHN, the AFF Program reprinted all of the articles without other journal content into a publication that was distributed by OHNAC nurses and NIOSH (3,000 copies).

Peer-reviewed Publications

Among the most important publications from the program are the following two:

Ballard and colleagues published "Green tobacco sickness: Occupational nicotine poisoning in tobacco workers," in 1995 in the *Archives of Environmental Health*. This article drew attention to the problem for the first time in many years. It may have contributed to the development of multiple interventions targeting Hispanic farm workers, family farmer operations, and health care professionals.

Brandt and colleagues published, "Exposure to endosulfan in farmers: Two case studies," in the *American Journal of Industrial Medicine* in 2001.The EPA used the article in its scheduled review of the pesticide.

MMWR Articles

The 24 MMWR's published by the AFF Program were about a variety of agricultural exposures, including pesticides, growth regulators, dermal absorption of nicotine among tobacco harvesters, tetanus, carbon monoxide poisoning out-of-doors and in ventilated areas, eye injuries, tractors, and other machinery. Four examples:

Zwerling and colleagues published a MMWR on "Use of rollover protection structures (ROPS) - Iowa, Kentucky, New York, and Ohio, 1992-1997," in 1997. This article was an extensive summary of multistate data, useful in guiding ROPS work.

AFF Program researchers collaborated with OSHA, EPA, and the Colorado State Health Department in developing one of the MMWR articles and an Alert on the use of small engines indoors. People incorrectly assumed that using such equipment in a building with doors and windows open would be adequate ventilation. The Alert continues to be available on Web sites of multiple agencies, and JAMA reprinted the MMWR (http://www.cdc.gov/mmwr/preview/mmwrhtml/00022020.htm).

The AFF Program staff also contributed to the selection of carbon monoxide poisoning as one of the four occupational issues to be included in a CDC-wide telenovela outreach effort to the Hispanic community.

Program researchers collaborated with the Iowa Department of Health on carbon monoxide poisoning related to the use of pressure washers powered by small engines. A MMWR article and a NIOSH Update resulted.

Extramural AFF Program researchers in Ohio investigated a tetanus death in 1993. This person was regularly seen by her physician for chronic health problems, but her tetanus status was never updated. A MMWR article reported the case in 1993. As a result, the Ohio health department issued press releases and other outreach encouraging physicians to see that tetanus status is updated when seeing patients for other problems. This work led to an increase in tetanus inoculations in Ohio that were sustained for at least five years.

NIOSH Publications

AFF Program findings of increased risks for pesticide poisoning among working youths were published in peer-reviewed journals (*American Journal of Public Health* and *Environmental Health Perspectives*) in 2003. The findings formed the basis for the NIOSH recommendation to DOL to prohibit youths from handling and applying pesticides.

AFF Program staff produced the publication *Simple Solutions: Ergonomics for Farm workers*. The document includes one fact sheet based on an investigation of tendonitis among youths and adults harvesting blueberries in Maine. Seventy-seven thousand copies (in English and Spanish) have been disseminated. The AFF Program will print additional copies in 2007 because of continuing demand. Table 3-4 presents details on the dissemination of selected AFF Program publications

Over 77,000 copies have been requested. Contains fact sheets that can be printed individually and often include cost-effectiveness data.

Web sites

Many materials developed by the OHNAC staff are available on the National Agricultural Safety Database. Local organizations and university professors use these materials to teach agricultural safety and health.

Each participating FFHHS State provided year-end reports detailing methodologies and findings from their surveys. All final reports and data are available on the NIOSH–FFHHS

Table 3-4. Dissemination of selected AFF program publications via OHNAC and community Partners for health farming surveillance projects

Publication title	NIOSH Pub No.	Number of copies printed and date	Copies distributed and total printed	Web hits from 10/01/03 to 09/30/05
NIOSH reprint of *AAOHN J.* Issue dedicated to agricultural health and safety; 1993. 41(9)		1,200 1/7/94 1,200 5/2/94	2,400/2,400 (Last sent: before 2000)	NA
NIOSH Update: NIOSH Issues Warning to Tobacco Harvesters	93-115	20,000 7/9/93 3,500 11/14/96 8,500 9/12/97	31,457/ 32,000 (In stock: 543)	79
NIOSH Update: NIOSH Warns of Deadly Carbon Monoxide Hazard from Using Pressure Washers Indoors	93-117	3,000 4/23/93 5,500 5/7/93 20,000 6/9/93	28,500/ 28,500 None in stock: (Last sent: 9/05)	772
NIOSH Update: Farm Safety Danger of Hair Entanglement in Hay Baler Drive Shafts	93-126	15,000 5/12/94	15,000/15,000 (None in stock. Last sent: 9/05)	402
NIOSH Alert: Preventing Scalping and Other Severe Injuries from Farm Machinery	94-105	10,000 7/25/94 2,000 7/14/97 2,000 7/7/98	14,000/14,000 (None in stock Last sent: 7/06)	1811
NIOSH Update: NIOSH Warns Farmers of Forage Wagon Hazards	95-118	10,000 9/14/95 3,000 12/6/95 10,000 10/30/97	21,489 /23,000 (In stock: 1511)	186
NIOSH Alert: Preventing Carbon Monoxide Poisoning from Small Gasoline-Powered Engines and Tools	96-118	4,200 12/30/96 800 1/6/97 10,000 3/21/97 6,000 11/17/99	20,527 /21,000 (In stock: 473)	3,736
NIOSH Tear-Out-Sheet for Alert: Preventing Carbon Monoxide Poisoning from Small Gasoline-Powered Engines and Tools	96-118a	10,800 12/30/96 20,000 3/14/97 6,000 11/17/99	36,309 /36,800 (In stock: 491)	Not available
NIOSH Update: NIOSH Warns: Improper Hitching to Tractors Can Be Fatal	97-108	10,000 1/16/96 25,000 3/12/97	32,262 / 35,000 (In stock: 2738)	699

Web site, established in 1991 (http://www2a.cdc.gov/ffhhs/). A measure of the success of this site may be the number of hits per year: 6,391 in 2002; 18,035 in 2003; 12,487 in 2004; and 8,181 through September 2005. The number of these hits that were executed by extramural AFF Program staff is not known.

Sponsored Conferences and Workshops

AFF Program staff presented a seven-hour continuing education program on agricultural health and safety for the Ohio Occupational Health Nurses' conference in 1995. Registration (185) exceeded the two prior conferences by this organization by 50% and 100%. Nearly all participants were nurses in general industry that had employees that also farmed.

Theses and Dissertations

FFHHS analyses resulted in 15 masters theses, three Ph.D. dissertations, and two post-doctoral research studies.

Survey Instruments

The survey instruments used in individual State FFHHS surveys consisted of a series of modules: demographics, medical care access, injuries, musculoskeletal conditions, respiratory symptoms, hearing loss, dermatologic conditions, mental health, neurotoxic effects, cancer, and hazards. Examination protocols for spirometry and audiometry were also developed, as was a protocol for onsite walk-through surveys of potential exposure sources.

Training Curriculum

AFF Program staff created CAST, a series of approximately 500 slides illustrating agricultural hazards and proper working conditions. It also includes 28 lectures and instructor and student training manuals. Videotapes of the lectures were made available. CAST was used to train people to do observational surveys of potential exposures at farm sites. Approximately 50 sets of tapes were produced and sent to FFHHS participating states, other agricultural schools, and foreign countries. Several hundred copies of the hard copy manuals were produced.

Brochures, Checklists, Fact Sheets, White Papers

Investigators in several FFHHS projects developed brochures and fact sheets:

- Health checklists at the University of Kentucky (http://www.mc.uky.edu/scahip/).
- Three white papers for the National Institute for Farm Safety (NIFS) by investigators at Cornell University collaborating with the New York State Department of Public Health.
- Six Cornell Cooperative Extension Service fact sheets on AFF hazards
- Two sets of educational materials on occupational injuries and hazards distributed by California's Occupational Health Surveillance and Evaluation Program.

Exhibit Materials

Each OHNAC project nurse produced exhibit materials. The AFF Program nurses often engaged volunteers from 4-H and FFA to help develop these exhibits. Some 4-H and FFA groups produced additional exhibits they themselves used in their schools and communities.

Danger, a table top educational display on appropriate farm tasks for children (created by an OHNAC nurse) won "Best" in all three categories of exhibits at a national agricultural safety conference in 1995. The display continues to be distributed by request about four times a month in North Dakota by the Farm Bureau and nationally by Farm Safety 4-Just Kids, the latter for a moderate fee. The North Dakota Farm Bureau updated the display in 2003.

A complete list of outputs can be found in section 3.4 at the end of this chapter.

3.1d Intermediate Outcomes

A wide range of stakeholders are using the data produced by the AFF Program surveillance activities.

Farm Family Health and Hazard Surveillance

Spirometry and audiometry protocols developed for the FFHHS have been used in, for example, longitudinal studies in California (Farm Worker Family Health Cohort Study) and Iowa (Keokuk County Farm Health Study). In addition, the CAST training materials have been useful for environmental assessments in these studies. (Appendices 3.1-01, 3.1-02)

Occupational Health Nurses in Agricultural Communities

Data from OHNAC (Appendix 3.1-03) guided the Certified Safe Farm program in Iowa and the Kentucky ROPS project and other intervention research projects on tractors (see Research Goal 5). Those surveillance activities also informed a study of pesticide exposure (atrazine) in children in Ohio.

AFF Program staff learned of tetanus cases in OHNAC states. This resulted in inoculation programs in Ohio, Minnesota, and Iowa. In Minnesota, a creamery provided 71 tetanus immunizations to area farmers. The Ohio Health Department tracked an increase in inoculations following press releases related to a fatality of a woman who had received periodic care by a primary provider for chronic health conditions but whose tetanus immunizations had not been updated.

OHNAC nurses stimulated interest in occupational safety and health issues within the regions they served, which led to actions by others. Other media activity stimulated by the AFF Program surveillance activities includes the following:

- A writer for *Farm Journal* often attended OHNAC annual meetings. The writer provided input about dealing effectively with local media. She used surveillance data for stories she published in national trade publications.
- Local media initially cooperated with the nurses requests for promoting the program and subsequently offered free space for periodic columns such as *Ask the Farm Nurse*. OHNAC nurses were consulted for feature stories and reports of local fatalities.
- An article on OHNAC in *Successful Farming* generated 35 letters to NIOSH, primarily by nurses, praising the program and requesting further information about

becoming involved (e.g., in their practices or as a community volunteer). Each was provided with resources. They were encouraged to network and build support for outreach and research with such people as key community leaders, agricultural organizations, and hospital outreach and public health departments.

- When the AFF Program produced an MMWR article on green tobacco sickness, at least 14 newspaper and newsletter articles ensued summarizing the story.
- For example, a local newspaper published a local farmer's letter about his thoughts and feelings while trapped under his tractor and how to prevent such incidents.

EPA used AFF Program case reports in their scheduled review of endosulfan in 2003. One of the OHNAC investigators identified a fatal endosulfan poisoning case due to dermal or respiratory exposure. That led to the identification of a second case with permanent, disabling injuries requiring permanent institutional care [Brandt 2001].

North Carolina and Maine expanded their occupational injury State reporting laws, which resulted from an increased appreciation of the value of such data by exposure to OHNAC nurses.

Safety camps developed in response to identified hazards became one of two types of intervention products. In response to drowning of youths in farm ponds, the AFF Program nurses in Georgia initiated pond safety training and day camps that included teaching swimming to youths. *Progressive Farmer* (farm periodical) subsequently asked the project coordinator to assist them in establishing a national program of day camps modeled after camps in Georgia and other states. Nurses in most OHNAC States helped initiate such camps in their locales. Many of those locales have continued the annual camps. Evaluations of the day camp programs have found them to be effective in raising safety awareness and behavior change in children, disseminating hazard awareness to parents by participating children, and meeting other objectives (Table 3-5).

In 1995, 19 day camps operated in 11 States and reached 2,020 campers. In 2006, 350 Progressive Agriculture Safety Days™ are planned in 34 States, 5 Canadian provinces, the U.S. Virgin Islands, and American Samoa. These safety days could reach 59,000 participants with the help of 19,000 adult and older teen volunteers in 2006. The not-for-profit Progressive Agriculture Foundation uses both public and nongovernmental partners nationally and in local communities. Individuals have communicated specific incidences where specific knowledge learned at the camps saved them from serious injury or death.

Table 3-5. Progressive farmer safety day camps: historical program statistics, 1995–2005

Item	Number
Safety days	
Participants	380,440
Volunteers	125,392
Total participants and volunteers	505,832
States	42
Canadian provinces	6
U.S. territories	2
Persons receiving in-depth training to conduct safety days	2631
Training sessions	99

An Anecdotal End Outcome

Lee Powell, age 15, of Omega, Georgia, credits a 1992 farm safety camp he attended with saving him when his tractor lurched forward into a ditch. A 15-year-old, from Shelton, Nebraska credits what he learned at a 1998 day camp with saving his life in 2004 when he was operating a tractor with a four-row ridger that struck a power pole, causing power lines to fall on the tractor; he called for help on his cell phone and stayed inside the tractor cab until the power company arrived and turned off the power to the lines (http://www.progressiveag.org/, http://progressiveag.org/content/blogcategory/19/25/).

California

For more than 12 years, insurance company risk managers have used the OHNAC-generated NURSE reports to train farm workers, crew leaders, and managers during training mandated by the DOL and others to prevent injuries and illnesses. University professors and safety trainers also use the reports.

OHNAC case investigations in California identified the need for first aid/CPR training, which resulted in Kellogg Foundation grants for several migrant health clinics to hire bilingual outreach workers who could provide such training.

North Carolina

OHNAC nurses initiated a *Farmwives Night Out* in collaboration with Farm Bureau Women, Farm Credit, and the North Carolina Cooperative Extension Service. The purpose was to raise the awareness of hazards and their preventability and to engage these women in supporting the reduction of hazards on their farms and in their communities. This program was continued after the project ended and was later repeated by cooperative extension educators.

Wisconsin

Analysis was performed on traffic accident reports involving tractors and farm trucks and postcard reports of other farm-related incidences. The findings are being used in ongoing educational intervention efforts through the Wisconsin Cooperative Extension Service. For example, data analysis and prevention recommendations were disseminated to the 200 high school agricultural teachers in Wisconsin. These teachers were involved in the ~240 tractor safety training programs that were conducted for ~3600 youth between 2000 and 2006. The reports were also used in numerous education programs related to production agriculture.

SENSOR−Pesticides

In 2005, AFF researchers published in JAMA the results of an investigation of pesticide exposure and related illnesses in schools [Alarcon 2005]. Subsequent media reports described school districts that had decided to adopt integrated pest management programs after learning

of the JAMA report. After the article was published, U.S. Senator Frank Lautenberg (New Jersey) introduced a bill in the Senate that would require schools to adopt integrated pest management strategies. A similar bill was introduced in the House (neither passed). (Appendix 3.1-05)

AFF investigators published an MMWR article in August 2004 that described a large outbreak of pesticide poisoning caused by a chloropicrin drift exposure from a farm in California [Centers for Disease Control and Prevention 2003]. The article reinforced the need for a regulatory reevaluation of chloropicrin that was underway in California. The article also provided justification for legislation that was enacted just a month after the article appeared. It required growers to reimburse any medical expenses incurred by pesticide-drift victims.

A 2003 MMWR article describing the AFF Program findings on illnesses associated with mosquito control efforts provided public health authorities with information to better assess the benefits and risks associated with the use of adulticides to control mosquito populations [Centers for Disease Control and Prevention 2003]. Following publication of this article, EPA proposed revisions to adulticide labels to incorporate some of the recommendations made in this report [Environmental Protection Agency 2005].

Following release of an MMWR article in 2000 that described AFF Program findings on illnesses associated with automatic insecticide dispensers, information and recommendations contained in the article were used by EPA in cooperation with the American Association of Pesticide Control Officials in efforts to change the label on these devices to prevent their use in public spaces (e.g., restaurants). These label changes have not been finalized.

Following the release of an MMWR article in November 1999 describing AFF Program findings on illnesses associated with efforts to control medfly infestations, NIOSH recommendations for accomplishing medfly control without the use of pesticides (based on the MMWR) were adopted by the USDA. and the Florida Departments of Agriculture [Centers for Disease Control and Prevention 1998; US Department of Agriculture 2001]. No infestations of medfly have since been detected in the United States.

After we published a 1999 MMWR article that described 42 cases of pesticide-related illnesses attributed to occupational use of flea-control products (of which 17 were related to phosmet exposure), the manufacturers voluntarily cancelled the use of phosmet on all domestic pets in 2001 [Centers for Disease Control and Prevention 1999; Edwards 2006]. The article also led EPA and eight State health departments to notify grooming shops, veterinary offices, and professional veterinary associations about hazards associated with flea-control products and how to mitigate these hazards. Since 2001, the SENSOR−Pesticides Program has not identified any illnesses related to phosmet use for flea control.

AFF researchers published an MMWR article in February 1999 that described an incident in which a crew of 34 field workers became ill after entering a field sprayed 2 hours earlier with a pesticide solution containing carbofuran (this insecticide has a restricted entry interval of 48 hours) [Centers for Disease Control and Prevention 1999]. This article was praised by

EPA for reinforcing the importance of compliance with the EPA's Worker Protection Standard, and documenting the need for safer pesticide alternatives. The continuation of funding for SENSOR-Pesticides by EPA reflects the agency's high regard for SENSOR-Pesticides and its accomplishments.

Other Intermediate Outcome

AFF Program data were used to develop the National Agenda for Action, a national land grant research and extension agenda for agricultural safety and health prepared by the NCR–197 Committee on Agricultural Safety and Health Research and Extension of the North Central Regional Administrators of the Association of Agricultural Experiment Station Directors (http://www.tmvc.iastate.edu/).

3.1e End Outcomes

Evidence of reductions in occupational hazard exposures, illnesses and/or injuries as a result of the AFF Program research efforts is elusive at best. Many external factors affect the impact of research outputs in the workplace. Surveillance activities are no exception. Nevertheless, we feel that we have presented sufficient evidence above to establish our contribution to two end outcomes.

Between 1998 and 2004, the AFF SENSOR−Pesticides Program effort has observed a decrease in the rate of acute pesticide poisoning in the agricultural industry (Figure 3-1). Many factors contributed to this decline, including EPA's prohibition of some of the most toxic pesticides, worker training, new work practices, and adoption of integrated pest management strategies. We believe that surveillance data from this program are among those drivers. The Program has identified many emerging pesticide problems (described above) and provided recommendations to solve these problems (Appendix 3.1-05).

OHNAC and FFHHS surveillance data guided the development of an intervention project that has been shown to increase the use of ROPS by farmers. Case-based surveillance reports provided important details for development of realistic composite stories, interactive computer-based training, press releases, and other materials for promoting ROPS. In the intervention project, the use of retrofitted ROPS increased from 4 in 2 treatment counties the year before the intervention to 81 in the 3.5 years following the intervention (Appendices 3.1-01, 3.1-03).

3.1f External Factors

In addition to the social and economic conditions as well as regulatory environments relevant for any safety and health work in agriculture, these projects also had unique external influences that impacted their outcomes.

The seasonality of agricultural tasks and the unavailability of farmers during busy seasons sometimes delayed or complicated research efforts. The OHNAC nurses often made themselves available 24/7 to investigate incidents in a timely manner. For example, the investigation of green tobacco sickness in Kentucky was successful because of the

availability of nurses to follow-up within hours of incidents. By contrast, in the same State, data on exposure to carbon monoxide while planting tobacco was not collected because all seedlings had been planted on area farms before a farm could be identified that would permit data collection (Appendix 3.1-03).

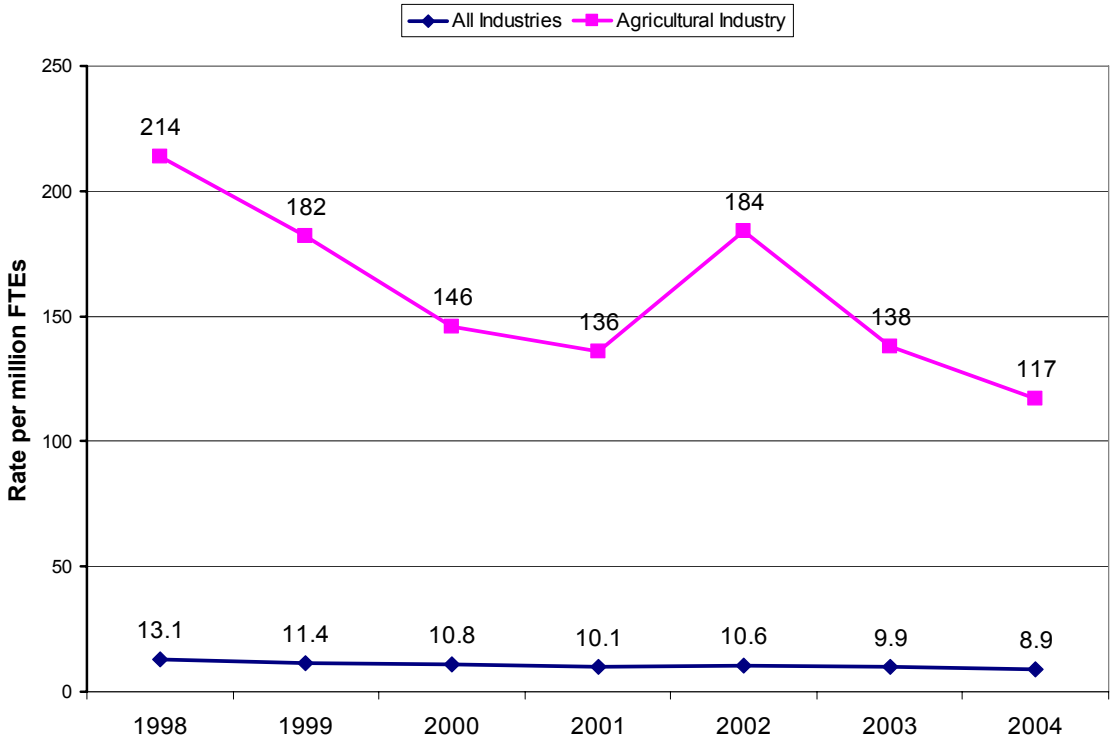


Figure 3-1: Incidence rate of acute occupational pesticide-related illness by year, 1998−2004.

3.1g Future Directions

SENSOR−Pesticides Program

Some regions of the country are not covered by the SENSOR−Pesticides Program (Appendix 3.1-05), including the prairie States and the States on the southeastern seaboard. We would like to add at least one State from each of these regions to the SENSOR−Pesticides program.

WoRLD Surveillance Report and System

A 2007 issue of the report will be released. *e-WoRLD* will be updated as soon as data relevant to respiratory disease outcomes and hazards are released. Also, in response to NIOSH researchers' requests, data will be presented by NORA sector, industry, and occupation. In addition, an Index will be developed. (Appendix 3.1-06)

RHAg Report

The *RHAg Report* is concerned only with health outcomes. In September 2005, we began a program of occupational respiratory disease hazard surveillance in agriculture to augment the

report. The program will identify respiratory hazards and all relevant data available. The NIOSH Surveillance in Agriculture Web topic page is currently under development and will incorporate the *RHAg Report* and the agriculture hazard database. (Appendix 3.1-07)

3.1h List of NIOSH projects included in this section

- DSHEFS-VMO8549-Farm Family Health and Hazard Survey (Appendix 3.1-01)
- DSHEFS-9278549-Agriculture Research, Development and Planning Using State Farm family Health and Hazard Surveys (Appendix 3.1-02)
- DSHEFS-9278585-Occupational Health Nurses in Agricultural Communities (Appendix 3.1-03)
- DSHEFS-9278501-Community Partners for Healthy Farming (Appendix 3.1-04)
- DSHEFS-9278645-SENSOR Pesticides (Appendix 3.1-05)
- DRDS-927Z1NK-WoRLD Surveillance Report and System (Appendix 3.1-06)
- DRDS-9277416- Respiratory Health and Hazards in Agriculture Report (Appendix 3.1-07)

3.2 Injury Surveillance

3.2a Challenge or Issue

Health surveillance of the agriculture population presents unique challenges that have only begun to be significantly addressed in the last two decades. The agricultural worker population is made up of farmers, farm families, migrant and seasonal workers, and others. It is highly mobile as well as racially and ethnically diverse. The population includes large numbers of self-employed workers, most of who are not represented by organized groups or unions or covered by workers' compensation programs. Farmers are often an economically marginal group for whom preventive safety and health methods may seem unaffordable. Access to medical care is frequently distant or unavailable, and medical insurance may be marginal or nonexistent. Hence, medical usage patterns are frequently different from those of urban populations. Self-treatment is a common occurrence.

Farmers and their families represent one of the greatest age-spans of workers in any industry. From an early age to well past common U.S. retirement ages, they are exposed to hazards from machinery, animals, crops, chemicals, and the vagaries of the weather. They have preconceived notions about chores, production activities, and daily living that make traditional definitions of work-relatedness (particularly for children) difficult to apply to agricultural hazard assessments.

The AFF Program has pursued a mixture of population- and case-based surveillance approaches in the agriculture industry (Table 3-6). This approach has answered significant

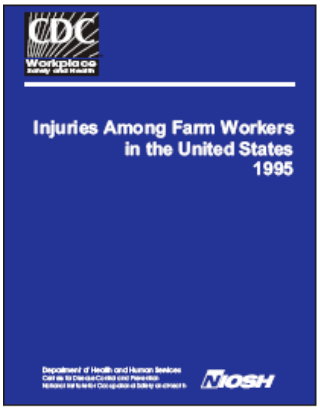
questions about farm hazards. However, continuity over time, filling missing gaps, and capturing information from the diverse farm population still remain as difficult challenges.

Table 3-6. NIOSH injury surveillance activities covering the agriculture industry 1990 to present

Activity	Years	Sector covered	Type of surveillance	Type of activity	Major partners
FFHHS	Varied	Farming	Population	External (Coop. Agreement)	States
OHNAC	1990–1996	Farming	Case-based	External (Coop. Agreement)	States
TISF	1993–1997	Farming	Population	Internal	NSC, USDA
CPHR–Surveillance	1996–2000	Farming	Case-based	External (Coop. Agreement)	States
NAWS	1999, 2002–2004	Crop Farming	Population	Internal	USDOL
NEISS-Work	1997–present	Farming	Population	Internal	CPSC
OISPA	2001-present	Farming	Population	Internal	USDA

3.2b Activities

Traumatic Injury Surveillance of Farmers



In 1986, the NSC−AD identified a need for farm injury data in the United States and established a sub-committee to evaluate different methods of obtaining these data. The AFF Program had identified a similar need and joined the NSC−AD data subcommittee. Between 1988 and 1992, nine States pilot tested a standard survey instrument and a contact approach developed by Murphy and Huizinga [1989]. Based on the results of the pilot test, the AFF Program established the TISF surveillance system in 1993. TISF was a population-based, cross-sectional survey conducted through an interagency agreement between NIOSH and the USDA National Agricultural Statistics Service (NASS). TISF results are available for the calendar years 1993–1995, and provide descriptive injury statistics and injury rates at the national and regional levels. Data are also available for States, with each State being reported at least once in the TISF over this three-year time period (Figure 3-2). (Appendix 3.2-01)

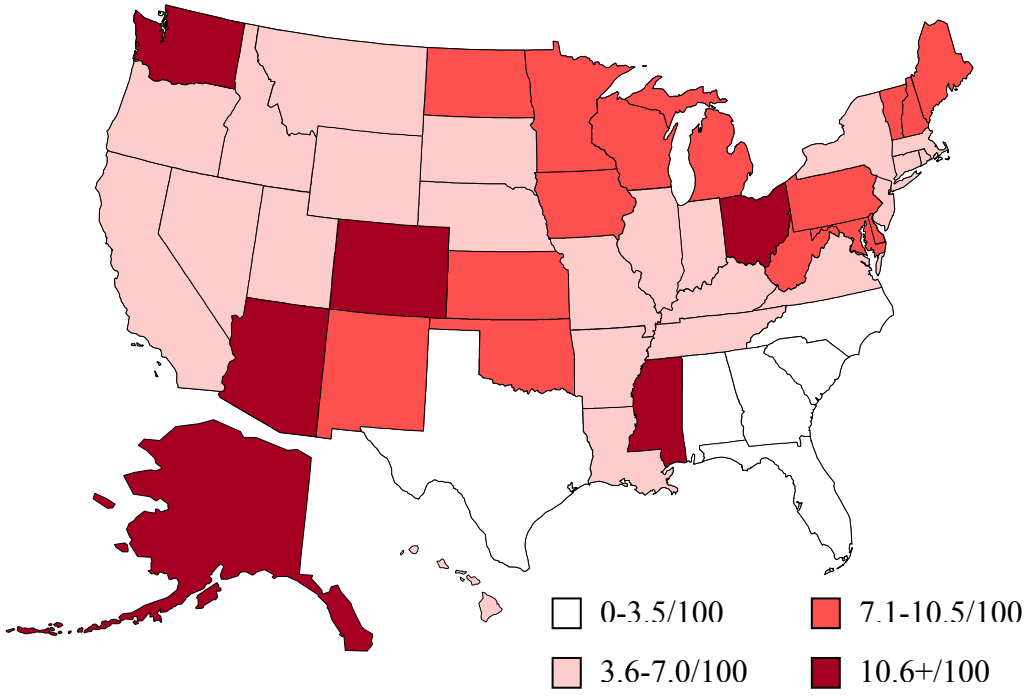


Figure 3-2.: Work-related nonfatal farming injury rates by State, 1993-1995.
Source: NIOSH Traumatic Injury Surveillance of Farmers.

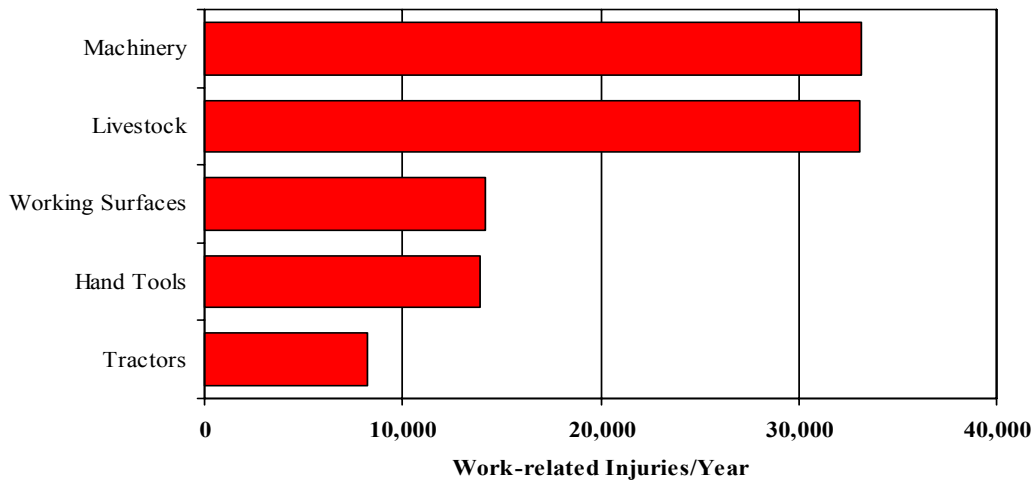


Figure 3-3: Leading Causes of Injury on Farms in the U.S., 1993-1995
Source: Traumatic Injury Surveillance of Farmers

Based on the TISF, an estimated 173,000 lost-time injuries occurred annually among farm operators and farm workers between 1993 and 1995, with 66% occurring to farmers or farm family members. The average annual injury rate for this 3-year period was 7.8 lost-time injuries per 100 workers. The leading causes of injury were machinery and livestock (Figure 3-3). In addition to occupational injury data, the TISF collected information on what tractors were in use on U.S. farms and whether they had a ROPS.

Farms averaged more than two tractors each. Average tractor age was more than 20 years. More than 60% of U.S. farm tractors were without a ROPS (Table 3-7).

Table 3-7. Summary of farm tractors used on farms in the US 1993

Item	Estimate
Tractors in use	4,800,000
Average tractor age	22.8 years
Tractors per farm	2.3
Tractors with ROPS	1,824,000
ROPS Roll bar	528,000
ROPS Cab	1,296,000
Tractors without ROPS	2,980,000
ROPS tractors per farm	0.90
Source: TISF	

In addition to providing baseline tractor information, the TISF tractor data also provided estimates of the most common tractors without ROPS used on farms (Table 3-8). AFF Program researchers used these data to identify common older tractor models to target engineering research designing new ROPS and assessing the structural integrity of older tractors to support ROPS structures during overturns.

Table 3-8. The five most common farm tractors without ROPS in use on U.S. farms, 1993

Manufacturer and model	Non-ROPS units in use
John Deere 4020	100,000
Ford 8N/9N	84,000
International Farmall M	77,000
International Farmall H	66,000
John Deere 3020	56,000

Note: TISF tractor prevalence data were used by Colorado State University to identify common tractors by manufacturer and model for ROPS retrofit evaluations (e.g., Ford 8–N). TISF was discontinued in 1997.

Occupational Injury Surveillance of Production Agriculture

In 2001, the AFF Program re-established a farm-operator-based surveillance system that built on TISF. The new surveillance system, the OISPA , also expanded on an existing partnership between NIOSH and USDA-NASS under which youth farm injury data were being collected (Appendix 3.2-02).

OISPA is a telephone-based survey of a random sample of farm operators across the United States The target population for the survey is adults working on the farm that are aged 20 or older. Occupational farm injuries for youths under age 20 are addressed by the AFF Program's CAIS. The OISPA sample design allows regional (but not State) injury estimates. Like TISF, OISPA collects information on farm demographics, occupational injuries, and hired workers. To date, three OISPA surveys have been conducted by NASS for us. Surveys in 2001 and 2004 provided estimates for all farm operators in the United States and the 2003 survey specifically collected information from racial minority and Hispanic farm operators, an AFF Program priority population.

Table 3-9. Estimated occupational injuries and injury rates per 100 workers in production agriculture, 2001 and 2004

Year	Lost-time injuries for workers aged 20 or older	Lost-time injuries for workers under age20	Lost-time injuries per 100 workers
2001	87,500	9,500	5.2
2004	80,300	8,300	4.9

Source: OISPA and CAIS

By combining injury estimates from 2001 and 2004, OISPA and CAIS farm injury numbers and rates comparable with 1993–1995 TISF reports were obtained (Table 3-9).

Table 3-10. Summary of farm tractors used on farms in the United States in 2001

Item	Estimate
Tractors in use	4,700,000
Average tractor age	25.7 years
Tractors per farm	2.5
Tractors with ROPS	2,326,000
ROPS Roll bar	926,000
ROPS Cab	1,400,000
Tractors without ROPS	2,374,000
ROPS tractors per farm	1.2

Source: OISPA

Occupational farm injuries during the earlier part of this decade averaged approximately 93,000 lost-time injuries annually, with a lost-time injury rate of about 5 per 100 workers. Working surfaces were identified as the most frequent source of injury in 2001, followed by livestock and parts and materials (Figure 3-4).

As with the TISF, OISPA collected similar information on farm tractors. These data indicated that the use of ROPS increased in the United States, with nearly 50% of all tractors in use on farms having either a ROPS roll bar or ROPS cab (Table 3-10). From 1993 to 2001, the use of roll bar ROPS dramatically increased (75%). Historically, tractors have had a long useful lifetime, and the average age increased somewhat over the 8 years between surveys. The distribution of tractors without ROPS changed little between the surveys, with the oldest tractors (the Farmalls) being slowly taken out of service.

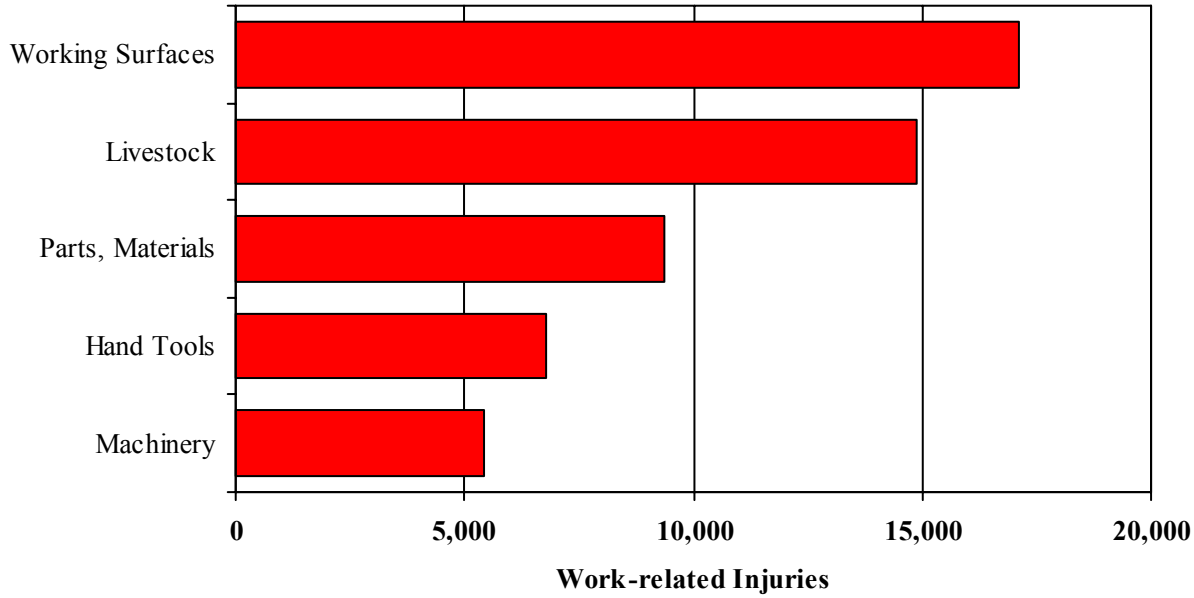


Figure 3-4: Leading Causes of Injury on Farms in the U.S. for Adults 20 Years of Age or Olders, 2001
Source: Occupational Injury Surveillance of Production Agriculture.

Extramural AFF Program researchers at the National Farm Medicine Center, Marshfield, Wisconsin, used the more recent tractor prevalence data from the OISPA for an ergonomic evaluation of common tractors with and without ROPS for use by youths on farms. The Agricultural Safety and Health Center located at the University of California–Davis is collaborating.

Another extramural AFF Program researcher at the University of Kentucky is using OISPA tractor prevalence data 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 and feasibility of retrofitting ROPS to existing tractors.

National Agricultural Workers' Survey

NAWS (Appendices 3.2-02, 3.2-03) is a special data collection activity maintained by DOL since 1988 [DOL 2006]. The primary purpose of NAWS is to collect economic and demographic information on the estimated 1.8 million farm workers in the United States. However, NAWS has not traditionally looked at occupational safety and health issues. In 1998, as part of a broader surveillance activity, the AFF Program identified NAWS as a potentially useful means of collecting occupational health and injury data on this special population. The AFF Program provided funds to DOL in 1999 to collect special modules on a variety of topics, including farm work-related injuries. Results from this initial survey yielded an estimate of 64,000 farm worker injuries occurring in 1999, and an average farm work injury rate of 7.8 per 100 full-time workers (Figure 3-5). These data suggested that migrant and seasonal farm workers aged 45–54 were at highest risk for these farm work injuries.

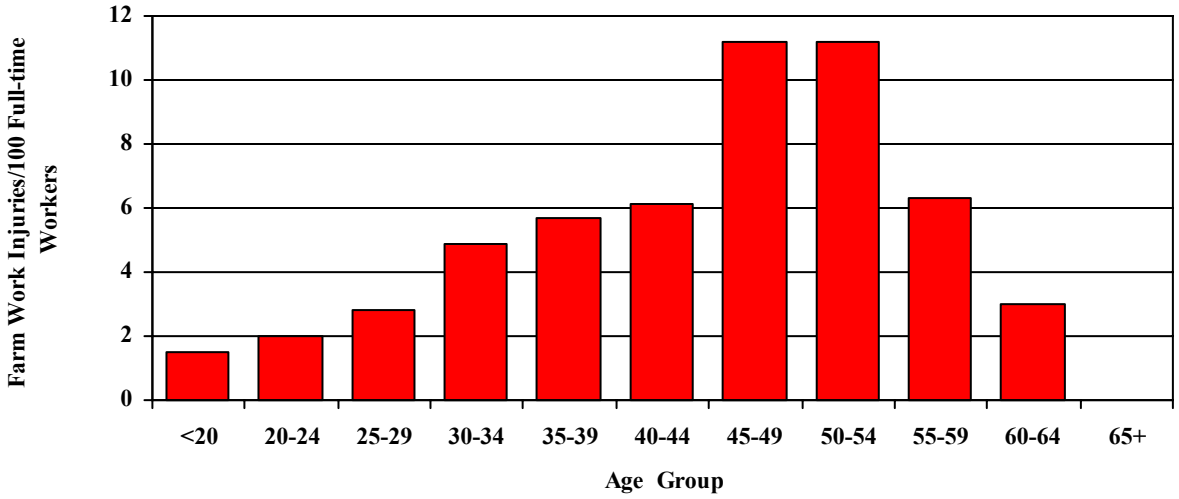


Figure 3-5: Farm work injury rates by age group

In 2002 and 2004, the AFF Program supported additional NAWS agricultural injury data collection to enhance surveillance of migrant and seasonal farm workers. Results of these data collection efforts have not been released.

National Electronic Injury Surveillance System

NEISS (Appendix 3.2-04), which is maintained by the U.S. Consumer Product Safety Commission (CPSC), collects injury and illness data from a national probability sample of U.S. hospital emergency departments to identify hazards related to consumer products under their jurisdiction. NEISS has been an invaluable data source for meeting this need. It has also been used to study farm-related injuries based on an injury locale variable.

These studies have frequently focused on injuries to children, particularly those resulting from horses and all-terrain vehicles. Historically, NEISS excluded work-related cases as a general rule. This makes interpreting these older studies somewhat difficult when work and recreational uses of consumer products, horses, and ATVs are commonly blurred on farms, which is still a problem today. In the 1980s and again in the 1990s, the AFF Program partnered with CPSC for special studies to collect work-related injuries and illnesses regardless of consumer product involvement. Since 1998, uniform data collection has been maintained for all work-related cases captured at a sub sample of the NEISS hospitals.

One of the strengths of using NEISS-Work data for agricultural injury prevention activities is the capture of all work-related cases without limitation by self-employment, number of hired workers, age, family relationship, or working for direct payment. NEISS-Work includes all production-related injuries. The NEISS program also allows the opportunity to do in-depth

follow back interviews with injured workers—a process that was used to study injuries to youths on farms. One of the weaknesses is the lack of coded, standardized industry classifications.

As has been done in the past for agricultural injury studies, an injury locale of farm/ranch can be used as a surrogate for industry classification. In recent years, the NEISS product-related injury estimates for emergency department-treated injuries that occurred at a farm/ranch locale have remained about 20,000 cases per year, whereas work-related injuries at farm locales have ranged from about 50,000 to 70,000 cases (Figure 3-6). Identifying cases by farm locale alone does not capture all agriculture-related injuries, and not all injuries are treated in emergency departments. Plans exist for more complete and robust identification of agriculture cases by reviewing text fields.

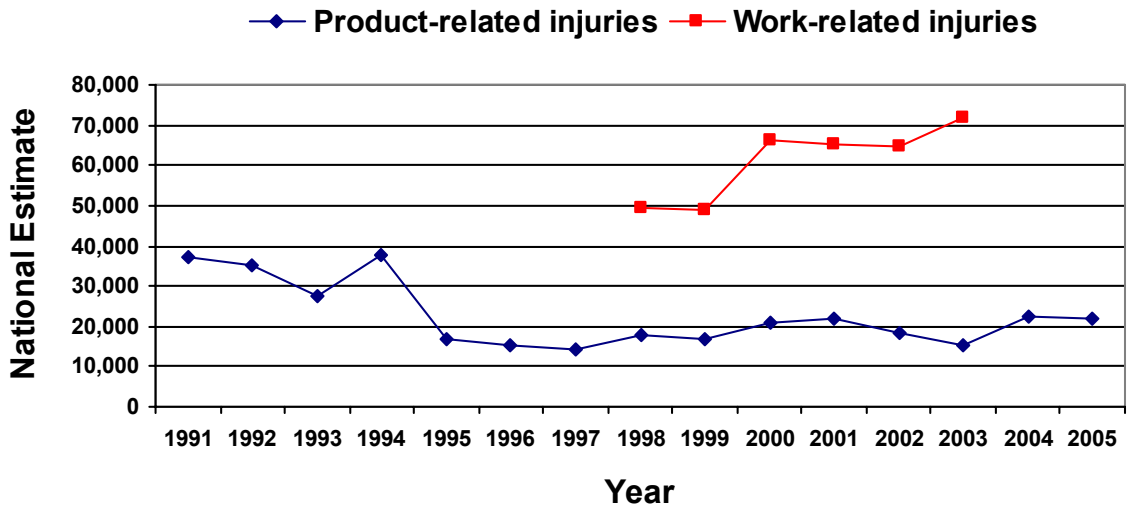


Figure 3-6. National estimates of injuries and illnesses incurred at a farm location and treated in a U.S. hospital emergency department. Sources: NEISS, CPSC, and NIOSH

3.2c Selected Outputs

The major output from the TISF was the manuscript, "Roll-over protective structure use and the cost of retrofitting tractors in the United States, 1993 [Myers 1993]." The paper provides information on the makes and models of tractors that were in use on farms without ROPS in the United States and an estimate of the cost to retrofit these tractors with ROPS. This manuscript has been referenced in at least 29 peer-reviewed journal articles to date.

Other major output from the TISF have been the three volume statistical abstract of results from the 1993-1995 surveys [Myers 1993, 1998, 2001]. These reports have been referenced in a minimum of 39 peer-reviewed journal articles to date.

A complete list of outputs can be found in section 3.4 at the end of this chapter.

3.2d Intermediate Outcomes

Tractor data collected through the TISF survey were used by engineering researchers within the AFF Program as part of their 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 the AFF Program and have been shared with a ROPS manufacturer (FEMCO). Having an estimate of the potential market for each AFF Program ROPS design was helpful in getting FEMCO to pursue CROPS on a commercial basis.

In 2002, data from the TISF were used by NIOSH to support recommendations to DOL on changes to their existing child labor regulations. The recommendations were requested by DOL.

3.2e End Outcomes

Since end outcomes usually result from intervention activities that surveillance activities stimulate, they are reported under other AFF Program goals.

3.2f Future Directions

The AFF Program is moving toward more online dissemination of surveillance data. However, because agricultural families and migrant workers may have less online access than other groups of workers, we will continue to partner with farm safety advocates and organizations to distribute important farm safety information by other means.

3.2g List of NIOSH Projects included in this section

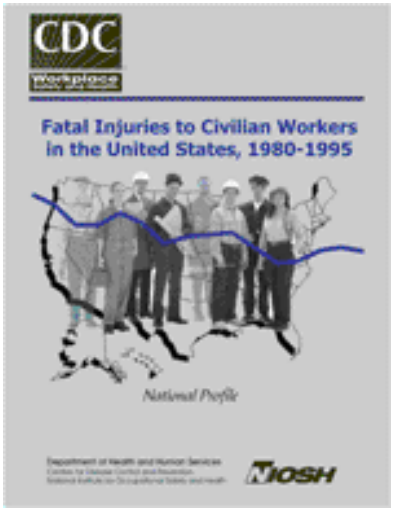
- DSR-VLB827-Occupational Traumatic Injury Surveillance of Farmers (Appendix 3.2-01)
- DSR-9277135-Occupational Injury Surveillance of Production Agriculture (Appendix 3.2-02)
- DSHEFS-9278639-National Agricultural Workers Survey (Appendix 3.2-03)
- DSR-9278875-National Surveillance of Nonfatal Occupational Injury Using the NEISS (Appendix 3.2-04)

3.3 Traumatic Fatality Surveillance

3.3a Challenge or Issue

Until the mid-1980s, little research was focused on farm safety, and no clear picture of the number and characteristics of farm fatalities existed. BLS and the NSC independently produced widely disparate survey estimates of agricultural worker fatalities, ranging from a low of 100 to a high of 1,600 deaths for 1985 [NSC 1986; BLS 1997]. These estimates were consequently suspect, and the studies did not provide the detailed information needed to develop safety interventions [Stout-Wiegand 1988]. However, these surveys noticeably demonstrated that agriculture apparently had one of the highest fatality rates of all U.S. industries.

In the early 1980s, no systematic national data collection of fatal agricultural injury information existed. What data did exist resided in death certificate files of State vital statistics registrar offices with minimal information identifying the injury event or the deceased's occupation. In the absence of a mandate for collecting this information, an agency specifically tasked with compiling the state data, or a broad community or scientific partnership to push for focusing on agricultural fatalities, surveillance for fatal injuries and intervention research began slowly.



The 1989 report *Agriculture at Risk: A Report to the Nation* highlighted many agricultural safety issues by taking advantage of new fatality surveillance data. The report also forms a coalition of partners to address these issues. But implicit in the policy recommendations was the need for better data—more information about injury characteristics and a more complete injury census.

3.3b Activities

To provide a better understanding of occupational fatalities, NIOSH began two separate fatality research programs in the early 1980's: a fatality investigation program (FACE); and a fatality surveillance system (NTOF). Although general in nature and not specifically targeted to agriculture, these programs proved valuable in identifying and addressing agricultural safety needs.

FACE Investigations

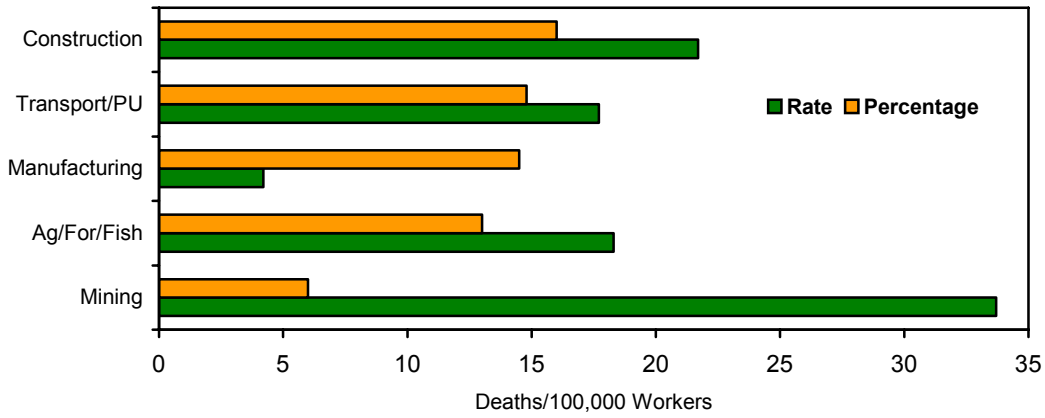
Beginning in 1982, the FACE program used onsite investigations to obtain detailed information about selected events such as related to machinery, electrocution, and confined spaces fatalities; such targets are particularly apropos to agriculture. The FACE model of obtaining a thorough understanding of the chain of events leading to a fatal incident and the contributing factors has identified new hazards and supported evidence-based safety recommendations. Because this model was so successful in getting safety and health information out in a timely fashion, NIOSH began funding selected States to conduct their

own FACE investigations in 1987. Thus far, 19 States have participated and investigated more than 360 agriculture-related fatalities (http://www.cdc.gov/niosh/injury/traumaagface.html). (Appendices 3.3-01, 3.3-02)

From 1986 until the present, the AFF Program conducted 16 agriculture-related FACE investigations. These investigations explored the worksite where the fatality occurred, examined equipment or machinery involved in the incident and how it was used, determined whether safety features on equipment and machinery functioned properly, listed personal-protective equipment used, and identified the deceased's experience level and training along with many other factors. Because the FACE investigations are conducted as scientific, nonregulatory studies, they provide the opportunity to explore facets of fatal incidents that might otherwise be difficult to obtain. For example, FACE investigations of young worker fatalities have identified that youths are often assigned prohibited tasks, lack appropriate training, and have physical and cognitive limitations. For Hispanic workers, language and cultural barriers as well as lack of appropriate training or skills have contributed to the fatal events.

National Traumatic Occupational Fatalities

In 1983, NIOSH developed NTOF by collecting death certificates from State vital registrars in all 50 states, New York City, and the District of Columbia. Demographic information, industry, occupation, and circumstances of death data were abstracted from the certificates. This system was maintained for fatalities occurring in 1980 through 2001. For the first time, NTOF provided a uniform surveillance system of work-related fatal injuries for all industries, including agriculture. The brief information collected on death certificates (often provided by relatives or witnesses to coroners and funeral directors) was not specifically designed for detailed occupational injury research. It was often difficult to identify a fatality as work-related or to determine the deceased's occupation, industry, and activity at the time of death. This has been particularly problematic for agriculture-related fatalities (e.g., fatalities involving part-time farmers, highway incidents, or other incidents that may obscure work-relatedness). Despite the limitations, NTOF filled a critical data need. The AFF Program confirmed that agriculture was a hazardous industry having the fourth highest fatality count and third highest fatality rate per 100,000 workers in 1984 (Figure 3-7) [Stout-Wiegand 1988]. From 1980 to 1985, agriculture had higher fatality rates per 100,000 workers than did the general U.S. workforce [Bell et al 1990]. Agriculture machines were the leading cause of all machine-related deaths for this same period [Etherton 1991]. These initial studies and numerous subsequent reports clarified the magnitude and nature of agricultural fatalities and identified the most prominent hazardous exposures (Figure 3-8). Since its inception, NTOF has been used for setting research and prevention priorities. Selection of FACE program investigation priorities have relied on NTOF data. (Appendices 3.3-03, 3.3-04)



*Transport/PU=Transportation and Public Utilities;
Ag/For/Fishing= Agriculture, Forestry and Fishing
Figure 3-7: Percentage and Rate of Occupational Fatalities by Selected Industry Divisions,* 1984.
Source: NIOSH NTOF

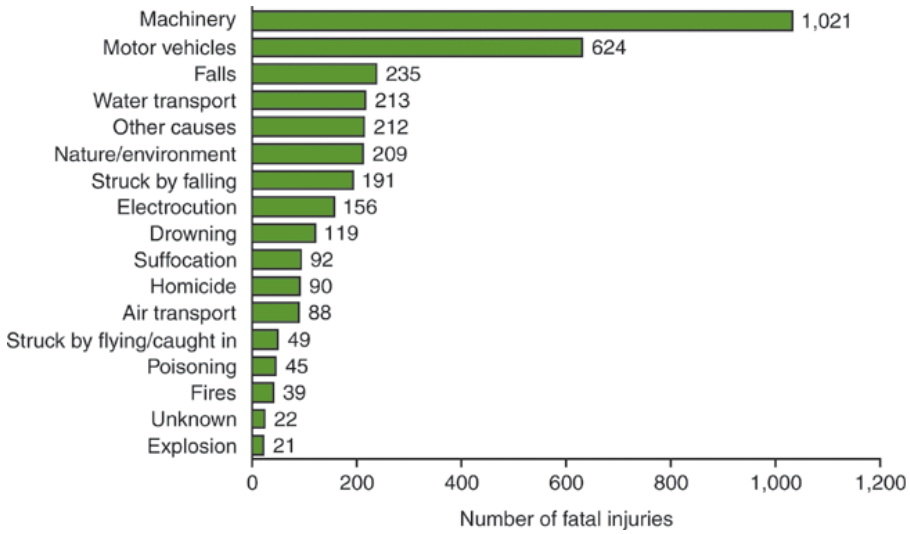


Figure 3-8: Number of Occupational Fatalities in the Agriculture/Forestry/Fishing Industry by Cause of Death, 1992-1997. *Source: NIOSH NTOF*

NTOF data also supported AFF Program focus on machinery-related fatalities in agriculture, particularly from tractor rollovers. The impact of tractor rollovers was reinforced by the BLS Census of Fatal Occupational Injuries (CFOI) data as well (Figure 3-9*).*

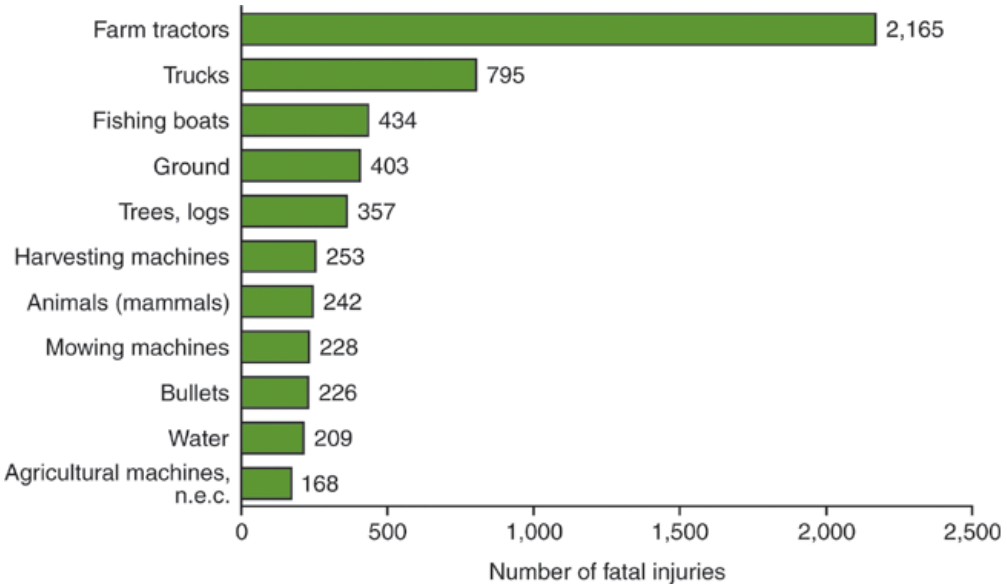


Figure 3-9: Number of Occupational Fatalities in the Agriculture/Forestry/Fishing Industry by Sources of Death, 1992-2001.* *Source: BLS CFOI*
*Fatality data exclude New York City.

NTOF successfully filled a critical data need to drive agricultural safety research. However, well- known limitations are inherent in conducting surveillance based solely on death certificates. This is based on recommendations of the National Academy of Science Panel on Occupational Safety and Health Statistics [Pollack and Keimig 1987]. 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 versus NTOF) and dual confirmation of work-relatedness has provided a better surveillance system (Figure 3-10). After a decade of overlap, the AFF Program discontinued the NTOF data collection at the

Youth farm worker dies after falling into operating feed grinder/mixer – Ohio NIOSH In-house FACE Report 2002-10

end of 2001. We now use CFOI data. We maintain these data as a resource for examination of trends.

3.3c Selected Outputs


Technology News
NIOSH
The Explosion Hazard From Hydrogen Gas Generation Inside Sealed Frames
CDC

All 16 agriculture-related FACE fatality reports can be accessed on the NIOSH FaceWeb at http://www.cdc.gov/niosh/face/default.html.

The AFF Program has published NIOSH Alerts, Hazard IDs, and monographs that focused on agricultural safety issues. NIOSH Alerts have addressed electrocutions from grain augers contacting overhead power lines, suffocation in grain silos and manure pits, scalping from entanglement in tractor power-take-off units and other machinery, and crushing incidents involving skid-steer loaders. A NIOSH Hazard ID alerted implement manufacturers to potential explosion hazards from gases in sealed metal frames. NIOSH combined surveillance data and information from case investigations to publish hazard monographs on confined spaces and electrocutions.

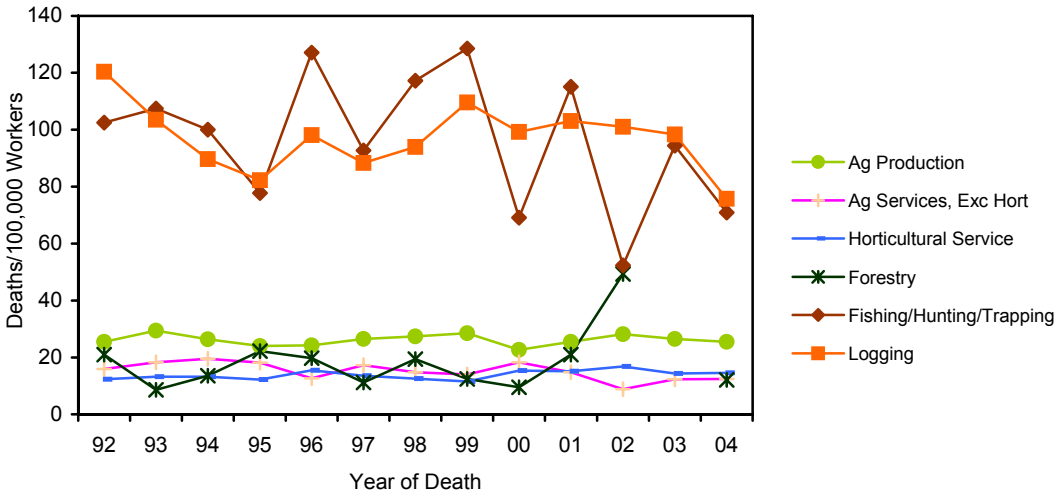


Figure 3-10: Rate of Occupational Fatalities by Detailed Industry Sector, 1992-2004*
Source: BLS CFOI
*2003 forestry sector rate did not meet BLS reporting requirements and all 2004 CFOI fatality counts are provisional.

In 1998, the AFF Program caused manufacturing changes to eliminate a farm equipment hazard after investigating two separate reports of farm workers seriously burned while attempting to drill holes into sealed plow frames. NIOSH published a Hazard ID entitled *Ignition Hazard from Drilling into Sealed Frames of Agricultural Equipment*

(http://www.cdc.gov/niosh/hid4.html). The document not only led to manufacturing changes but caused the publisher of *Successful Farming* to disseminate the safety information to all FFA chapters after the magazine (with no awareness of the hazard) used a cover photograph of two FFA members drilling into a plow frame to install a slow-moving vehicle sign. Penn State University also printed a capsulated version of the Hazard ID in its College of Agricultural Sciences *Agricultural Safety and Health News*. Other NIOSH researchers published a related document entitled *The Explosion Hazard from Hydrogen Gas Generation inside Steel Frames*. After the release of this document and the Hazard ID, NIOSH received notification that similar problems had been identified in pods of dragline mining equipment in Australia and in crane sections in the United States.

Following the investigations of two multiple fatality incidents involving grain augers contacting overhead power lines, the AFF Program developed a NIOSH Alert entitled, *Preventing Grain Auger Electrocutions* in 1986. The Alert and a warning decal were disseminated to farm owners through county extension agents at fairs and community meetings and to implement manufacturers' and dealers' distribution at the point of sale. The popularity of the document resulted in the reprinting of the decal.

In the early 1990s, the AFF Program investigated multiple asphyxiations of workers and would-be rescuers in manure pits, resulting in an Alert that was widely disseminated through county extension agents and from which the recommendations have been incorporated into other organization's safety fact sheets (such as the Iowa State University Extension's Safe Farm fact sheet *How to Respond to Farm Accidents)*.

A complete list of outputs can be found in section 3.4 at the end of this chapter.

3.3d Intermediate Outcomes

The AFF Program partnered with the Agricultural Health Nurse Program of New York State to investigate four incidents involving female victims' hair entanglement around the rotating secondary driveline of hay balling equipment. These FACE investigations resulted in the development of the NIOSH Alert entitled *Preventing Injuries and Other Severe Injuries from Farm Machinery* (1994). The machines involved in these incidents were made by the same manufacturer and contained the same driveline. Although a retro fitted machine guard had been available for nearly two decades from the manufacturer, it was not employed in any of the scalping incidents investigated. After dissemination of the Alert through county extension service agents, equipment dealers, and manufacturers, the manufacturer reported that the entire stock of the retrofit guards had been exhausted and production of the guard had resumed. The Alert had noted that the retrofit guard was available from the manufacturer.

A State FACE investigation in Nebraska revealed that an antibiotic routinely used to treat shipping fever in cattle (micotil) caused the death of a farmer who accidentally injected himself. This finding was communicated widely to the agricultural community, who were

unaware of this hazard. In conjunction with State FACE colleagues, the AFF Program prepared a *Workplace Solutions* document on micotil hazards which will be published in Fiscal Year 2007. In addition, dialogue between the State, NIOSH, the drug manufacturer (Elanco), and FDA have resulted in additional warnings provided by Elanco to all micotil purchasers. These warnings include a "paper shroud" on all micotil bottles. The shroud contains new instructions and warnings affixed to the top of the bottle that must be removed prior to actual use.

3.3e End Outcomes

In conjunction with State FACE colleagues in Minnesota, the AFF Program developed a NIOSH Hazard ID on the fatality risks associated with using tractors to move large hay bales in 2001.The Hazard ID was widely distributed within the state of Minnesota. Since the release of this document, the fatalities assoicated with round bales in this state have decreased from an average of 1.57 deaths per year between 1993 and 1999 to 0.66 deaths annually between 2002 and 2005.

3.3f List of NIOSH projects included in this section

- DSR-9278807-Fatality Assessment and Control Evaluation (FACE) Project (Appendix 3.3-01)
- DSR-9278870-State-Based Fatality Surveillance Using Face Model (Appendix 3.3-02)
- DSR-9278805-National Traumatic Occupational Fatality (NTOF) Surveillance System (Appendix 3.3-03)
- DSR-9278951-Analysis of Surveillance Data for Agricultural Injuries (Appendix 3.3-04)

3.4 Outputs

3.4a Farm Family Health and Hazard Surveillance

Publications

Abend EA, Hallman EM [1997]. Strategies for Effective On-Farm Hazard Surveillance Visits. *J Agromed.* 4(1): 47-53.

Abend E, Stark A, Hwang S, May J [1997]. Tractor and machinery hazard surveillance within the New York FFHHS project. *National Institute for Farm Safety Paper* # NIFS 97-9. Columbia, Missouri.

Bartels S, Niederman B, Waters TR [2000]. Job hazards for musculoskeletal disorders for youth working on farms. *J Ag Safety and Health Aug* 6(3):191-201. (ISI Web of Science: Cited 4 times as of 11/14/06)

Beckett WS, Chamberlain D, Hallman E, May J, Hwang SA, Gomez M, Eberly S, Cox C, Stark A [2000]. Hearing conservation for farmers: source apportionment of occupation and environmental factors contributing to hearing loss. *J Occ & Enviro Med*. Aug 42(8):806-13. (ISI Web of Science: Cited 9 times as of 11/14/06)

Beckett WS, Hallman E, May J, Hwang SA, Gomez M, Eberly S, Cox C [2004]. Follow-up to Farm Family Health and Hazard Survey. J Occ & Enviro Med 46:314-5.

Beseler C, Stallones L [2003]. Safety practices, neurological symptoms and pesticide poisoning. *J Occ & Enviro Med* 45(10):1079-1086. (ISI Web of Science: Cited 1 time as of 11/14/06)

Browning SR, Truszzczynska H, Reed D, McKnight RH [1998]. Agricultural injuries among older Kentucky farmers: the farm family health and hazard surveillance study. *Am J Ind Med* 33(4):341-353. (ISI Web of Science: Cited 29 times as of 11/14/06)

Browning SR, Westneat SC, Donnelly C, Reed DB [2003]. Agricultural tasks and injuries among Kentucky farm children: Results from the *Farm Family Health and Hazard Surveillance Project. Southern Medical Journal* 96(12):1203-1212. (ISI Web of Science: Cited 1 time as of 11/14/06)

Browning SR, Westneat SC, Szeluga R [2001]. Tractor driving among Kentucky farm youth: Results from the Farm Family Health and Hazard Surveillance Project. *J Ag Safety and Health* 7(3):155-167. (ISI Web of Science: Cited 3 times as of 11/14/06)

Browning SR, Westneat SC, Truszczynska H, Reed D, McKnight R [1999]. Farm tractor safety in Kentucky, 1995. *Public health Reports* 114(1): 53-59. (ISI Web of Science: Cited 1 time as of 11/14/06)

Champney M, Stallones L, Blehm K, Tucker A, Merchant D [1996]. A survey of respiratory symptoms in a farming population in Northeastern Colorado. *J Agromed* 3(3):47-57. (ISI Web of Science: Cited 5 times as of 11/14/06)

Choi SW, Peek-Asa C, Sprince NL, Rautiainen RH, Donham KJ, Flamme GA, Whitten PS, Zwerling C [2005]. Hearing loss as a risk factor for agricultural injuries. *Am J Ind Med*. 48(4):293-301.

Choi SW, Peek-Asa C, Zwerling C, Sprince NL, Rautiainen RH, Whitten PS, Flamme GA [2005]. A comparison of self-reported hearing and pure tone threshold average in the Iowa Farm Family Health and Hazard Survey. *J Agromed*. 10(3):31-9.

Crawford JM, Wilkins III JR, Mitchell GL, Moeschberger ML, Bean TL, Jones LA [1998]. A cross-sectional case control study of work-related injuries among Ohio farmers. *Am J Ind Med* 34(6):558-599. (ISI Web of Science: Cited 2 times as of 11/14/06)

Darragh A, Stallones L, Sample P, Sweitzer K [1998]. Perceptions of farm hazards and personal safety behavior among adolescent farm workers *J Ag Safety and Hlth Special Issue* (1):159-161. (ISI Web of Science: Cited 4 times as of 11/14/06)

DeArmond SE, Stallones L, Chen PY, Sintek EE [2006]. Depression and somatic symptoms within the farming community. *J Ag Safety and Hlth* 12(1):5-15.

Elliot M, Heaney CA, Wilkins JR, III, Mitchell GL, Bean T [1995]. Depression and Perceived stress among cash grain farmers in Ohio. Aug; 1(3):177-184. (ISI Web of Science: Cited 1 time as of 11/14/06)

Gomez MI, Hwang SA, Sobotova L, Stark AD, May JJ [2001]. A comparison of self-reported hearing loss and audiometry in a cohort of New York farmers. ournal of Speech, Language, and Hearing Research 44:1201-1208. (ISI Web of Science: Cited 11 times as of 11/14/06)

Gomez MI, Hwang S, Stark AD, May JJ, Hallman EM, Pantea CI. An Analysis of Self-Reported Joint Pain among New York Farmers. Journal of Agricultural Safety and Health. 2003;9(2): 143-157.

Gomez MI, Hwang S, Lin S, Stark AD, May JJ, Hallman EM [2004]. Prevalence and predictors of respiratory symptoms among New York farmers and farm residents. American Journal of Industrial Medicine 46:42-54. (ISI Web of Science: Cited 1 time as of 11/14/06)

Hallman EM [1993]. Structuring a Farm Safety Survey: Research vs. Education. [1993] *National Institute for Farm Safety Paper* # 93-11. Columbia, Missouri.

Hallman EM, Chamberlain DC, May J, Hwang SA [1998]. On-Farm Hazard Data Collection: Strategies and Results from 580 New York State Farms. *National Institute for Farm Safety Paper* # NIFS 98. Columbia, Missouri. (ISI Web of Science: Cited 1 time as of 11/14/06)

Hallman E, Pollock J, Chamberlain D, Heath RL, Browning SR, Reed DB [1998]. Prevalence and risk factors for hypertension among older Kentucky farmers. *J Ag Safety and Hlth.*.

Hwang S, Gomez MI, Sobotova L, et al [2001]. Predictors of hearing loss in New York farmers. American Journal of Industrial Medicine 40:23-31. (ISI Web of Science: Cited 10 times as of 11/14/06)

Hwang S, Gomez MI, Stark AD, et al [2001]. Severe farm injuries among New York farmers. American Journal of Industrial Medicine 40:32-41. (ISI Web of Science: Cited 9 times as of 11/14/06)

Hwang SA, Gomez MI, Stark AD, St John TL [2000]. Pantea CI. Hallman EM. May JJ. Scofield SM. Safety awareness among New York farmers. *American Journal of Industrial Medicine* 38(1):71-81, Jul. (ISI Web of Science: Cited 5 times as of 11/14/06)

Jones ML, Reynolds SJ, Burmeister LF, Lewis MQ, Whitten PS, Scarth RD, Zwerling C [1999]. Application of a subjective health and safety rating system to Iowa farm operations. *Appl occup &Enviro Hygiene* Dec 14 (12):852-67.

Kakefuda I, Stallones L [2006]. Comparisons of Colorado women's cancer screening practices by residence: Metropolitan, nonmetropolitan and farm. Journal of Agriculture Safety and Health 12(1):59-69.

Kettles MA, Browning SR, Prince TS, Horstman SW [1997]. Triazine herbicide exposure and breast cancer incidence: An ecologic study of Kentucky counties. *Environmental Health Perspectives* November 105(11)1222-1227. (ISI Web of Science: Cited 39 times as of 11/16/06)

Kidd PS, Scharf T, Veazie M [1996]. Linking stress and injury in the farming environment.. *Health Education Quarterly* 23: 224-237.

Lewis MQ, Sprince NL, Burmeister LF, Whitten PS, Torner JC, Zwerling C [1998]. Work-related injuries among Iowa farm operators: an analysis of the Iowa FFHHS project. *Am J Industr med* May 33(5):510-7. (ISI Web of Science: Cited 26 times as of 11/16/06)

Merchant DL, Stallones L, Keefer S, Rickard R [1996]. An ecologic analysis of congenital anomalies and agricultural chemicals in Colorado, 1989-1991. *Journal of Agricultural Safety and Health* 2(4):197-206.

Osorio AM, Beckman J, Geiser CR, Husting EL, Inai A, Summerill KF [1998]. California farm survey of occupational injuries and hazards. *J ag safety and health* Special issue (1):99-108. (ISI Web of Science: Cited 3 times as of 11/16/06)

Osorio AM, Geiser CR, Husting EL [1998]. Farm Injury Surveillance in 2 California Counties – General Findings. *J Ag Safety and Health* Special Issue (1):99-108. (ISI Web of Science: Cited 3 times as of 11/16/06)

Park H, Reynolds SJ, Kelly KM, Stromquist AM, Burmeister LF, Zwerling C, Merchant JA [2003]. Characterization of agricultural tasks performed by youth in the Keokuk County Rural Health Study. *Appl Occup Environ Hyg* 18(6): 418-29, Jun. (ISI Web of Science: Cited 1 time as of 11/17/06)

Park H, Sprince NL, Jensen C, Whitten PS, Zwerling C [2002]. Health risk factors among Iowa farmers. *J Rural Health*. 18(2):286-93, Spring. (ISI Web of Science: Cited 1 time as of 11/17/06)

Park H, Sprince NL, Lewis MQ, Burmeister LF, Whitten PS, Zwerling C [2001]. Risk factors for work-related injury among male farmers in Iowa: A prospective cohort study. *J Occup Environ Med*. 43(6):542-47, Jun. (ISI Web of Science: Cited 7 times as of 11/16/06)

Park H, Sprince NL, Whitten PS, Burmeister LF, Zwerling C [2001]. Farm-related dermatoses in Iowa male farmers and wives of farmers: A cross-sectional analysis of the Iowa Farm Family Health and Hazard Surveillance Project. *J Occup Environ Med* 43:364-369. (ISI Web of Science: Cited 2 times as of 11/16/06)

Park H, Sprince NL, Whitten PS, Burmeister LF, Zwerling C. [2001] Risk factors for back pain among male farmers. Analysis of Iowa Farm Family Health and Hazard Surveillance Study. *Am J Industrial Medicine* 40 (6):646-654. (ISI Web of Science: Cited 1 time as of 11/17/06)

Pedersen DH, Wilkins III JR, Bean TL, Mitchell GL, Crawford JM, Jones LA. Agricultural hazard data from a population-based survey of cash grain farms: Ohio observations. *App Occ & Enviro Hygiene.* 1999 May 14(5):299-305.

Reynolds SJ, Merchant JA, Stromquist AM, Burmeister LF, Taylor C, Lewis MQ, Kelly KM [1998]. *J Agric Saf Health Special Issue 1* (May 1998): 79-88.

Scarth RD, Rohrer JE, Burmeister LF, Zwerling C [1998]. Perceptions of access to medical care among Iowa farmers. *Journal of Agromedicine* 5(4): 5-20.

Scarth RD, Stallones L, Zwerling C, Burmeister LF [2000]. The prevalence of depressive symptoms and risk factors among Iowa and Colorado farmers. *Am J Industr Med* 37(4):382-389.(ISI Web of Science: Cited 12 times as of 11/16/06)

Scarth RD, Zwerling C, Lewis MQ, Burmeister LF [1997]. Depression and Risk factors among Iowa farmers. *J Agromed* 4 (3/4):207-216.

Sprince NL, Lewis MQ, Whitten PS, Reynolds SJ, Zwerling C [2000]. Respiratory symptoms: associations with pesticides, silos, and animal confinement in the Iowa Farm Family Health and Hazard Surveillance Project. *Am J Industr Med* 38(4):455-462. (ISI Web of Science: Cited 12 times as of 11/16/06)

Sprince N, Lewis M, Whitten P, Zwerling C. Lung function outcomes from IFFHHS project (in preparation)

Stallones L (editorial) [1996]. Stress among farmers. *Journal of Agricultural Safety and Health* 2(2).

Stallones L, Beseler C [2003]. Farm work practices and farm injuries in Colorado. *Injury Prevention* 9:241-244. (ISI Web of Science: Cited 2 times as of 11/16/06)

Stallones L, Beseler C [2002]. Pesticides and depressive symptoms among farm residents. *Annals of Epidemiology* 12(6):389-394. (ISI Web of Science: Cited 13 times as of 11/16/06)

Stallones L, Beseler, C. Pesticide illness, farm practices, and neurological symptoms. Environmental Research, Section A, 90:89-97. 2002. (ISI Web of Science: Cited 9 times as of 11/16/06)

Stallones L, Beseler C [204]. Safety practices and depression among farm residents. *Annals of Epidemiology* 14:571-578.

Stallones L, Gunderson P [1994]. Epidemiologic perspectives on childhood agricultural injuries within the United States. *Journal of Agromedicine* 1(4):3-18. (ISI Web of Science: Cited 8 times as of 11/16/06)

Stallones L, Keefe T, Xiang H [1997]. Characteristics associated with increased farm-work related injuries among male farm operators in Colorado, 1993. *Journal of Agricultural Safety and Health* 3(3):195-201. (ISI Web of Science: Cited 8 times as of 11/16/06)

Stallones L, Leff M, Garrett C, Criswell L, Gillan T [1995]. Depressive Symptoms among Colorado farmers. *J Ag Safety and Health* 1:37-43. (ISI Web of Science: Cited 11 times as of 11/16/06)

Stallones, L, Xiang H [2003]. Alcohol consumption patterns and work-related injuries among Colorado farm residents. *American Journal of Preventive Medicine* 25 (1): 25-30. (ISI Web of Science: Cited 5 times as of 11/16/06)

Taylor CD, Reynolds SJ, Stromquist A, Merchant J, Zwerling C, Kelly K [1999]. Environmental conditions in the homes of a rural Iowa county. *J Agric Saf Health*. 5(4):407-16.

Thu K, Lasley P, Whitten P, Lewis M, Donham K, Zwerling C, Scarth R. Stress as a Risk factor for agricultural injuries: comparative data from the Iowa Farm Family Health and Hazard Survey (1994) and the Iowa Farm and Rural Lifee Poll (1989). Journal of Agromedicine 4 (3/4):181-191. Published simultaneously in: Donham KJ, Rautiainen R, Schuman SH, and Lay JA. *Agricultural Health and Safety: Recent Advances*. Haworth Medical Press.

Wilkins JR III, Bean TL, Mitchell GL, Crawford JM, Eicher LC [1997]. Development and application of a pen-based computer program for direct entry of agricultural hazard data. *Appl Occup Environ Hyg* 12(2):105-110. (ISI Web of Science: Cited 2 times as of 11/16/06)

Wilkins JR III, Bean TL, Moeschberger ML, Mitchell GL, Crawford JM, Jones LA [1997]. Mixed-Mode Survey of Cash Grain farmers yields mixed response. *J Ag Safety Hlth* Feb 3(1):27-39. (ISI Web of Science: Cited 4 times as of 11/16/06)

Wilkins III JR, Engelhardt HL, Crawford JM, Mitchell GL, Eicher LC, Bean TL, Jones LA [1998]. Self-reported Noise Exposures among Ohio Cash Grain Farmers. *J Ag Saf Health* Special Issue (1):79-88. (ISI Web of Science: Cited 1 time as of 11/16/06)

Xiang H, Stallones L, Chiu Y [1999]. Nonfatal Agricultural Injuries Among Colorado Older Male farmers. *J Aging and Health* 11(1):65-78. (ISI Web of Science: Cited 7 times as of 11/16/06)

Xiang H, Stallones L, Chiu Y, Epperson A [1998]. Nonfatal Agricultural Injuries Among Colorado Female farmers. *J Agromed* 5(4):21-33.

Xiang H, Stallones L, Hariri S, Darragh A, Chiu Y, Gibbs-Long J [1999]. Back pain among persons working on small or family farms – eight Colorado counties, 1993-1996. *MMWR* Apr 23 48(15):301-4. (ISI Web of Science: Cited 1 time as of 11/16/06)

Xiang H, Stallones L, Keefe TJ [1999]. Back pain and agricultural work among farmers: an analysis of the Colorado farm family health and hazard surveillance survey. *Am J Industr Med* 35(3):310-316. (ISI Web of Science: Cited 11 times as of 11/16/06)

Zwerling C, Burmeister L, Reynolds S, Jones M, Lewis M, Popendorf W, Scarth R, Whitten P [1998]. The Iowa FFHHS Project. *J Ag Safety and Health* May 4 (Special Issue 1):13-20. (ISI Web of Science: Cited 1 time as of 11/16/06)

Zwerling C, Burmeister L, Reynolds S, McKnight R, Browning S, Reed D, Wilkins J, Bean T, Mitchell L, Hallman E, May J, Stark A, Hwang S, Division of Surveillance, Hazard Evaluations, and Field Studies, Division of Safety Research, National Institute of Occupational Safety and Health, Division of Unintentional Injury Prevention, National Center for Injury Prevention and Control, CDC [1997]. Use of rollover protection structures (ROPS) - Iowa, Kentucky, New York, and Ohio, 1992-1997. MMWR. 46(36):842-45. (ISI Web of Science: Cited 1 time as of 11/16/06)

3.4b OHNAC and Community Partners for Healthy Farming: Surveillance

Publications

Ballard T, Freund E, Ehlers J, Brandt B, Boyland B, Halperin J [1995]. Green tobacco sickness: Occupational nicotine poisoning in tobacco workers. *Arch Environ Health*; 50(5):384-389. NN: 00229929 (ISI Web of Science: Cited 23 times as of 11/16/06)

Baron S, Estill C, Steege A [2001]. Simple Solutions: Ergonomics for Farmworkers; English and Spanish (Pub. 2001-111). [http://www.cdc.gov/niosh/01-111pd.html]

Boyd J, Hill M, Pollock J, Casey G, Gelberg K, Roering S, Grant A [1997]. Epidemiological characteristics of reported hand injuries - New York State 1991 -1995. *J of Agricultural Safety and Health*.; 3(2):101-7.

Brandt, V, Moon, S, Ehlers, J, Methner, N, Struttman, T [2001]. Exposure to endosulfan in farmers: Two case studies. *Am J Ind Med*; 39(6):643-9. NN: 20023301 (ISI Web of Science: Cited 4 times as of 11/16/06)

Brandt, VA, Struttmann, TW, Morgan, SE, Piercy, LR [2001]. Delivering health and safety education messages for part-time farmers through local businesses and employers. *J. Agromedicine 7*(3), 23-30.

Casey G, A Grant [1997]. Farm worker injuries associated with bulls. *AAOHN J*; 45(8):393-396. NN: 00238204 (ISI Web of Science: Cited 2 times as of 11/16/06)

Casey G, A Grant, et al [1997]. Farm worker injuries associated with cows. *AAOHN Journal;* 45(9):446-50. (ISI Web of Science: Cited 2 times as of 11/16/06)

Centers for Disease Control and Prevention [1992]. Scalping incidents involving hay balers. New York. MMWR July; 41(27):489-91. NN: 00232215 [http://www.cdc.gov/mmwr/preview/mmwrhtml/00017187.htm]

Centers for Disease Control and Prevention [1993]. Tetanus fatality, Ohio, 1991. MMWR; 42(8):148-9. [http://www.cdc.gov/mmwr/preview/mmwrhtml/00019820.htm]

Centers for Disease Control and Prevention. Green tobacco sickness in tobacco harvesters. Kentucky, 1992. MMWR 1993; 42(13):237-39. NN 00235887 [http://www.cdc.gov/mmwr/preview/mmwrhtml/00020119.htm]

Centers for Disease Control and Prevention [1993]. Carbon monoxide poisoning of farmers using gasoline-powered pressure washers in animal buildings – Iowa, January 1992-January 1993. MMWR; 42(40):777-85. [http://www.cdc.gov/mmwr/preview/mmwrhtml/00022020.htm]

Centers for Disease Control and Prevention [1995]. Eye injuries to agricultural workers. Minnesota, 1992-1993. MMWR; 44(18):364-66. [http://www.cdc.gov/mmwr/preview/mmwrhtml/00037037.htm]

Centers for Disease Control and Prevention [1995]. Injuries Associated with Self-Unloading Forage Wagons, New York, 1991-1994. MMWR; 44(32):595-97,603. [http://wonder.cdc.gov/wonder/prevguid/m0038481/m0038481.asp#head001000000000000]

Centers for Disease Control and Prevention [1995]. Agricultural Auger-Related Injuries and Fatalities - MN, 1992-1994. MMWR; 44(36):660-663. [http://www.cdc.gov/mmwr/preview/mmwrhtml/00038801.htm]

Centers for Disease Control and Prevention. Fatalities associated with improper hitching to farm tractors, New York, 1991-1995. MMWR 1996; 45(15):307-11. NN: 00232461 [http://www.cdc.gov/mmwr/preview/mmwrhtml/00040898.htm]

Centers for Disease Control and Prevention [1997]. Outdoor carbon monoxide poisoning attributed to tractor exhaust – Kentucky. MMWR; 46(51):1224-27. NN: 00240362 http://www.cdc.gov/nasd/docs/d001201-d001300/d001212/d001212.html]

Centers for Disease Control and Prevention [1999]. Farm worker illness following exposure to Carbofuran and other pesticides. Fresno County, California 1998. MMWR; 48(6):113-6. NN: 20027440 [http://www.cdc.gov/mmwr/preview/mmwrhtml/00056485.htm]

Donham KJ, Ehlers J, Sheridan C, Willard P, and Chapman R [1997]. Agricultural occupational health nurse training and certification program: fulfilling the needs for occupational health. *J Agromedicine*; 4(3):105-116. (ISI Web of Science: Cited 1 time as of 11/17/06)

Ehlers JK, Connon C, Themann C, Myers J, Ballard T [1993]. Health and safety hazards associated with agriculture. *AAOHN Journal.* Issue dedicated to agricultural health and safety; 41(9):422-428. (ISI Web of Science: Cited 3 times as of 11/17/06)

Estill CF, Tanaka S [1998]. Ergonomic considerations of manually harvesting Maine wild blueberries. *J of Agricultural Safety and Health;* 4(1):43-57. [http://asae.frymulti.com/toc_journals.asp?volume=4&issue=1&conf=j&orgconf=j1998] NN: 20025139 (ISI Web of Science: Cited 1 time as of 11/17/06)

Estill C, Tanaka S, Wild D [1996]. Ergonomic Considerations of Manually Harvesting Maine Wild Blueberries. *Am Ind Hyg Assoc J*; 57(10):946-948. NN: 00233944

Estill CF, Tanaka S, Wild DK [1996]. Ergonomic considerations of manually harvesting Maine wild blueberries (AIHCE extended abstract) *Am Ind Hyg Assoc J* 1996 Oct; 57(10):946-948. NN: 00233944

Gelberg KH, Church L, Casey G, London M, Roering, DS, Boyd, J, Hill M [1999]. Nitrate Levels in Drinking Water in Rural New York State. *Environmental Research*; 80:34-40. (ISI Web of Science: Cited 8 times as of 11/17/06)

Grief AL, Goldenhar, LM, Freund E, Stock, A, Halperin W [1997]. Carbon monoxide poisoning from gasoline-powered engines: risk perception among Midwest food victims [letter to the editor]. *Am J Publ Health;* 87(3):466-467. NN00240940 (ISI Web of Science: Cited 1 time as of 11/17/06)

Guo H, Gilmore R, Waag D, Shireley L, Freund E [1998]. Prevalence of Coxiella Burnetii infections among North Dakota sheep producer. *J Occup Environ Med;* 40(11):999-1006. [http://www.joem.org/wass]. (ISI Web of Science: Cited 3 times as of 11/17/06)

Hartley JW, Colson PH, Fussel NW [1994]. Surveillance and the Georgia healthy farmers project: agricultural occupational health nurses. *J of Agromedicine*;(1)4:81-84.

Hawkes AP, Roy J, Stacey-Scott N, Joy JEA, Bogdan G [1997]. Health and safety issues relating to Maine's fishing industry. *J Agromedicine*; 4(3/4):223-229. NN: 00239234

Hughes J, Hartley J [2000]. Georgia Healthy Farmers Farm Safety Camp: Description and Evaluation of a Model Program. *J of Agromedicine*; 6(3):43-59.

Husting EL, Geiser CR, Summerill KF, Cervantes Y, Moltrum R, Ruiz C, Osorio AM [1997]. Occupational agricultural injury surveillance in California: Preliminary results from the nurses using rural sentinel events (NURSE) project. *J of Agromedicine*; 4(3/4):269-283. NN: 239238 (ISI Web of Science: Cited 2 times as of 11/17/06)

Jones B, Randolph SA [1997]. Reporting occupational illnesses and injuries in North Carolina. *North Carolina Medical J*; 58(5):2-5.

Jones ML, Reynolds SJ, Burmeister LF, Lewis MQ, Whitten PS, Scarth RD, Zwerling C [1999]. Application of a subjective health and safety rating system to Iowa farm operations. *Appl occup &Enviro Hygiene.* Dec. 14 (12):852-67. (ISI Web of Science: Cited 1 time as of 11/17/06)

Jones SK [1993]. Agricultural injury and surveillance: occupational health and nurses role. *AAOHN J*; 41(9), 434-7.

Lexau C, Kingsbury L, Lenz B, Nelson C, Voehl S [1993]. Building coalitions: a community-wide approach for promoting farming health and safety. *AAOHN J;* 41(9):440-9. (ISI Web of Science: Cited 5 times as of 11/17/06)

McIntee K, Garetson [1995]. The status of tetanus in the United States: Implications for occupational health nurses. *AAOHN J*; 43 (12):627-632.

McKnight, R., Levine, E., Rodgers, G [1994]. Detection of green tobacco sickness by a regional poison center. Vet Human Toxicol. 36(6):505-510. (ISI Web of Science: Cited 13 times as of 11/17/06)

Migliozzi AA, Randolph SA [1993]. Editorial: Agricultural Health and Safety. *AAOHN Jl*; 41(9):413. Issue dedicated to agricultural occupational health and safety.

Millard P, Shannon S, Carvette B, Tanaka S, Halperin W [1996]. Maine students' musculoskeletal injuries attributed to harvesting blueberries. *Am J Publ Health*; 86(12):1821-1822. NN: 00235081 (ISI Web of Science: Cited 1 time as of 11/17/06)

NIOSH reprints of five articles plus the guest editorial in dedicated Journal. *AAOHN Journal.* Issue dedicated to agricultural health and safety; 41(9). 2800 distributed.

NIOSH [1992] NIOSH Update: Farm Safety - Danger of Hair Entanglement in Hay Baler Drive Shafts. Pub 93-126: July 1992. http://www.cdc.gov/nasd/docs/d001001-d001100/d001023/d001023.html]. NIOSH Web Link: [http://www.cdc.gov/niosh/93-126.html]

NIOSH [1993]. NIOSH Update: NIOSH Warns Farmers of Deadly Risk of Grain Suffocation. Pub 93-16

NIOSH [1993]. NIOSH Update: NIOSH Issues Warning to Tobacco Harvesters. July 8, 1993. [http://www.cdc.gov/nasd/docs/d001001-d001100/d001025/d001025.html]

NIOSH [1993]. NIOSH Update: NIOSH Warns of deadly carbon monoxide hazard from using pressure washers indoors. April 23, 1993. NN: 00235012 [http://www.cdc.gov/niosh/93-117.html].

NIOSH [1993]. NIOSH Update: NIOSH Warns Farmers of Deadly Risk of Grain Suffocation. [http://www.cdc.gov/niosh/flood.html]

NIOSH [1994]. NIOSH Update: NIOSH Warns of Hazards of Flood Cleanup Work NIOSH Pub 93-128. Revised (1994) 94-123. Disseminated for adding in flood clean-up in the Upper Midwest.

NIOSH [1994]. NIOSH Alert: Preventing Scalping and Other Severe Injuries from Farm Machinery. Publication number 94-105: June 1994. (Related link) NN: 00221250 [http://www.cdc.gov/nasd/docs/d000701-d000800/d000756/d000756.html] NIOSH Web Link: [http://www.cdc.gov/niosh/pto.html]

NIOSH [1995]. NIOSH Update: NIOSH Warns Farmers of Forage Wagon Hazards. Pub 95-118: September 14, 1995. [http://www.cdc.gov/niosh/95-118.html]

NIOSH [1996]. NIOSH, Colorado Department of Public Health and Environment, U.S. Consumer Product Safety Commission, Occupational Safety and Health Administration, U.S. Environmental Protection Agency. (November 1996)

NIOSH Alert: Preventing carbon monoxide poisoning from small gasoline-powered engines and tools.[http://www.cdc.gov/niosh/carbon2.html]

NIOSH [1997]. NIOSH Update: NIOSH Warns: Improper Hitching to Tractors Can Be Fatal. January 14, 1997. NN: 00235897 [http://www.cdc.gov/niosh/tractor1.html]

NIOSH Hazard ID #4: Ignition Hazard from Drilling into Sealed Frames of Agricultural Equipment DHHS (NIOSH) Pub 98-146 (July 1998). [http://www.cdc.gov/niosh/hid4.html]

Osoria AM, Greiser CR, Husting EL, Summerill KF [1998]. Farm injury surveillance in two California counties. general findings, *J of Agricultural Safety and Health*, Special Issue. (1):89-98.

Pavelchak N, Church L, Roerig S, London M, Welles W, Casey G [1999]. Silo gas exposure in New York State following the dry growing season of 1995. *App Env and Occ Hygiene;* 14(1):34 (ISI Web of Science: Cited 2 times as of 11/17/06)

[http://elib2.cdc.gov:2350/media/43wrcgvurh3xr223recn/contributions/d/8/7r/d87rn5q777tkgchf.pdf]

Purschwitz MA [1994]. Equipment engineering issues associated with childhood agricultural injuries. *J of Agromedicine*; 1(4):19-29. (ISI Web of Science: Cited 1 time as of 11/17/06)

Randolph SA, Migliozzi AA [1993]. The role of the agricultural health nurse: Bringing together community and occupational health. *AAOHN Journal*; 41(9): 429-33. (ISI Web of Science: Cited 2 times as of 11/17/06)

Roerig S [1993]. Scalping accidents with shielded PTO units: four case reports. *AAOHN Journal*; 4l(9):437-9. (ISI Web of Science: Cited 1 time as of 11/17/06)

Struttmann TW, Scheerer A, Prince S. and Goldstein L [1998]. Unintentional carbon monoxide poisoning from an unlikely source. *J of the American Board of Family Practice;11:481-484.*

Struttmann TW, Scheerer A, Moon E [1998]. Potentially productive years of life lost in Kentucky due to occupational fatalities. *J of the Kentucky Med Assoc*; 96: 369-73.
Tanaka S, Fairfield-Estill C. (1994). Blueberry Raker's Tendonitis. *The New England J of Medicine*; 331(8):552. NN 00221941

Taylor CD, Reynolds SJ, Stromquist A, Merchant J, Zwerling C, Kelly K [1999]. Environmental conditions in the homes of a rural Iowa county. J Agric Saf Health. 5(4):407-16.

Tanaka S, Fairfield-Estill C [1994]. Blueberry Raker's Tendonitis. *The New England J of Medicine*; 331(8):552. NN 00221941

Zlochower I, Ehlers J [1999]. The danger of drilling into sealed and filled plow frames. *Am J Ind Med*; 36(S1):110-112. NN: 20000844
[http://www3.interscience.wiley.com/cgi-bin/abstract/66002092/ABSTRACT]

Zwerling C, Burmeister L, Reynolds S, Jones M, Lewis M, Popendorf W, Scarth R, Whitten P [1998]. The Iowa FFHHS PROJECT. *J Ag Safety and Health.* May 4 (Special Issue 1):13-20. (ISI Web of Science: Cited 1 time as of 11/17/06)

Zwerling C, Burmeister L, Reynolds S, McKnight R, Browning S, Reed D, Wilkins J, Bean T, Mitchell L, Hallman E, May J, Stark A, Hwang S [1997]. Division of Surveillance Hazard Evaluations, and Field Studies, Division of Safety Research, National Institute of Occupational Safety and Health, Division of Unintentional Injury Prevention, National Center for Injury Prevention and Control, CDC. Use of rollover protection structures (ROPS) - Iowa, Kentucky, New York, and Ohio, 1992-1997. MMWR. 46(36):842-45, 1997. (ISI Web of Science: Cited 1 time as of 11/17/06)

Reports (unpublished)

Auslander M, Struttmann TW, Brandt V, Muehlbauer J, Boylan BS. (1997). Agricultural injury in Kentucky, Kentucky OHNAC Project Review. Monograph based on final report for National Institute for Occupational Safety and Health Cooperative Agreement No. U06/CCU406069-05-1.

Johnson, B and Scott N (November 1993). Report of injuries in the 1993 potato harvest: Aroostook County, Maine. Internal report. University of Maine Cooperative Extension Service, Presque Isle, Maine 04769.

Johnson, B and Scott N (January 1993). Report of injuries in the 1992 potato harvest: Aroostook County, Maine. Internal report. University of Maine Cooperative Extension Service, Presque Isle, Maine 04769.

Maine Department of Labor [MDOL]. (1997). Fatal occupational injuries in Maine 1996. BLS 696. December.

34+ California NURSE Reports in English and Spanish that were case reports of investigations covering a wide range of hazards with recommendations for prevention:

NURSE Report #1: Fatal Electrocution in Poultry Processing Plant
May 1992, CASE 191-006-01 A self-employed electrician was hired by a turkey plant to install an icemaker. The plant program:
[ttp://www.cdc.gov/nasd/docs/d000001-d000100/d000031/d000031.pdf]

NURSE Report #2: Arm Amputated by Tractor Power-Take-Off
May 1992, CASE 191-012-01 A farm laborer was feeding the cows on a dairy farm. BACKGROUND In December, 1991 a California Occupational Safety....
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000032/d00032.pdf]

NURSE Report #3: Tractor Driver Crushed by Scraper-Roller
May 1992: Tractor Driver Crushed by Scraper-Roller: CASE 191-010-01 A tractor driver was towing a scraper and a roller through a walnut orchard.
http://www.cdc.gov/nasd/docs/d000001-d000100/d000033/d000033.pdf]

NURSE Report #4: Lightning Strikes Kill Two Field Workers
May 1992, Cases 291-003-01, 291-003-02, 291-009-01, 291-009-02, 291-009-03. Lightning strikes killed two farm workers who were picking.
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000034/d000034.pdf]

NURSE Report #5: Grape Picker Run Over by Bin Trailer, Breaks Leg
May 1992, CASE 191-011-01 Grape pickers were riding from the vineyard to the road on bin trailers.[http://www.cdc.gov/nasd/docs/d000001-d000100/d000035/d000035.pdf]

NURSE Report #6: Maintenance Worker's Arm Broken by Fruit-Tray Transporter
May 1992, CASE 192-012-01 A maintenance worker in a fruit drying plant was cleaning and oiling a tray transporter:

[http://www.cdc.gov/nasd/docs/d000001-d000100/d000036/d000036.pdf]

NURSE Report #7: Cantaloupe Picker Dies of Heat Stroke
May 1992, CASE 191-002-01 A cantaloupe picker collapsed and died of heat stroke after four hours of work:
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000037/d000037.pdf]

NURSE Report #8: Heavy Equipment Operator Crushed in Roll Over
May 1992, CASE 291-002-01 A vineyard hired a heavy equipment operator to dig irrigation ditches and mix fertilizer:
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000038/d000038.pdf]

NURSE Report #9: Poisonous Spider Bites Vineyard Worker
June 1992, CASE 192-028-001 A farm laborer was working in a vineyard, cleaning weeds away from the base of the grape vines with a shovel:
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000039/d000039.pdf]

NURSE Report #10: Tractor Runs Over Asparagus Sledder
May 1992, CASE 292-008-01 An asparagus sledder was loading bunches of asparagus into large bins. As the tractor moves slowly through the field:
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000040/d000040.pdf]

NURSE Report #11: Foot Amputated by Auger
July 1992, CASE 292-009-01 At a vegetable processing plant, a machine operator's foot was amputated while walking down a trimming:
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000055/d000055.pdf]

NURSE Report #12: Tree Trimmer Electrocuted in Orchard
August 1992, CASE 192-036-01 A tree trimmer was pruning walnut trees in an orchard. At the edge of the orchard, high voltage power lines:
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000056/d000056.pdf]

NURSE Report #13: Tractor Driver Crushed Between Two Tractors
August 1992, CASE 192-129-01 At an onion harvest, a worker was driving a tractor which pulled trailers loaded with onions out of:
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000057/d000057.pdf]

NURSE Report #14: Irrigator Worker in ATV Crash on Dairy Farm
August 1992, CASE 192-110-01 The irrigators on a dairy farm use three-wheel ATVs (All Terrain Vehicle) to move around the farm:
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000058/d000058.pdf]

NURSE Report #15: Tractor Driver Killed by Flying Metal Object
August 1992, CASE 192-040-01 A tractor driver was pulling a mulcher (which cuts wood into smaller pieces) over cut branches in an :
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000059/d000059.pdf]

NURSE Report #16: Lettuce Packer Collapses Due to Heat
September 1992, CASE 292-127-01 Manual lettuce harvesting is often a two-person job. Lettuce Packer Collapses Due to Heat Page 2 The lettuce:
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000060/d000060.pdf]

NURSE Report #17: Irrigator Struck in Face by Pipe Valve
October 1992. CASE 192-114-01 Farm irrigators set up and take apart pipes that carry water to fields. Water pressure from the main water:
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000061/d000061.pdf]

NURSE REPORT #18: Plum Picker Breaks Ankle in Ladder Fall
October 1992. CASE 192-163-01 A farm labor contractor was hired to pick a plum orchard as quickly as possible. The NURSE Senior Safety.
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000062/d000062.pdf]

NURSE Report #19: Dairy Worker Crushed by Field Cultivator
October 1992, CASE 192-164-01 A worker on a dairy farm was waiting behind a field cultivator to attach it to the back of a tractor:
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000063/d000063.pdf]

NURSE Report: # 20: Teenage Irrigator's Finger Mangled by Pipe
October 1992, CASE 192-344-01 A fifteen year-old irrigator was taking apart sprinkler lines in a garlic field with another worker:
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000064/d000064.pdf]

NURSE REPORT #21: Foot Amputated by Fan in Fig Orchard
December 1992. CASE 192-207-01 A farm worker was driving a mechanical harvester in a fig orchard. A metal cover guarded the fan blades,….
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000067/d000067.pdf]

NURSE REPORT #22: Leg Partly Severed by Forklift Prong
December 1992, CASE 292-260-01 In a lettuce cooling plant boxes of lettuce are stacked on forklift pallets. [http://www.cdc.gov/nasd/docs/d000001-d000100/d000068/d000068.pdf]

NURSE REPORT #23: Raisin Picker Breaks Leg While Riding on Bin Trailer
January 1993. CASE 192-382-01. Raisin pickers were riding bin trailers from the vineyard to the road. These bin trailers carry....
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000069/d000069.pdf]

NURSE REPORT #24: Farm Worker's Skull Fractured by Exploding Brake
January 1993, CASE 192-383-01 Workers were harvesting almonds. The injury occurred while the farm worker was attempting to.…
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000070/d000070.pdf]

NURSE REPORT #25: Tractor Driver's Head Crushed by Moving Tractor

March 1993, CASE 192-459-01 During the raisin harvest a farm owner noticed that one of his tractor drivers seemed sick. Tractor...
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000071/d000071.pdf]

NURSE Report #26: Tractor Driver Knocked Off Tractor by Tree Branch
March 1993, CASE 192-548-01 A tractor driver was pulling a disc through an apricot orchard. A tractor driver was knocked off...
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000072/d000072.pdf]

NURSE Report #27: Arm Caught in Mechanical Cotton Picker
March 1993, CASE 192-549-01 A mechanical cotton picker was stopped in a field. A 39 year-old Hispanic male cotton picker driver injured h...
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000073/d000073.pdf]

NURSE Report #28: Machine Operator Electrically Shocked in Transplant Nursery
March 1993, CASE 292-327-01 Some greenhouses grow vegetables from seeds. When approaching the cutting machine, the c...
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000074/d000074.pdf[

NURSE Report #29: Farm Worker Burned in Explosion
October 1993, CASE 193-208-01 A farm worker told the following story. The farm employs 8 full-time workers, 10 casual workers (working 1-12 week...
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000075/d000075.pdf]

NURSE Report #30: Hot Radiator Fluid Scorches Forklift Operator
November 1993, CASE 193-378-01 A forklift driver was moving boxes at a raisin packaging plant....
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000076/d000076.pdf]

NURSE REPORT #31: Worker Scalped in Fruit Packing Plant
January 1994, CASE 193-209-01 Early one morning a worker was setting up her work station in a packing plant. ….
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000077/d000077.pdf]

NURSE REPORT #32: Nectarine Picker Injures Neck in Ladder Fall
February 1994, CASE 193-368-01 A nectarine picker was busy picking in the orchard. When meeting with the farm labor contractor,....
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000078/d000078.pdf]

NURSE REPORT #33: Cotton Harvester Operator Fatally Electrocuted
February 1994, CASE 193-488-01. Four brothers and a father were helping a relative harvest cotton. The cotton is emptied into a ma...
[http://www.cdc.gov/nasd/docs/d000101-d000200/d000127/d000127.pdf]

NURSE REPORT #34: Cotton Harvester Operator's Arm Mangled in Cotton Harvester Spindles May 1994, CASE 193-489-01 A cotton harvester operator was warming up his

cotton harvester before going out ….
[http://www.cdc.gov/nasd/docs/d000001-d000100/d000080/d000080.pdf]
Struttmann TW and Auslander M. (1996). Farm injury surveillance in Kentucky: What have we learned? Kentucky Epidemiological Notes and Reports;31(10):1-4.
Maine Department of Labor [MDOL]. (1997). Report of fatal occupational injuries in Maine 1995. BLS 690. April.

3.4c SENSOR Pesticide

Publications

Alarcon WA, Calvert GM, Blondell JM, Mehler LN, Sievert J, Propeck M, Tibbetts DS, Becker A, Lackovic M, Soileau SB, Das R, Beckman J, Male DP, Thomsen CL, Stanbury M [2005]. Acute illnesses associated with pesticide exposures at schools. JAMA 2005; 294: 455-465. (ISI Web of Science: Cited 10 times as of 11/17/06)

Ballard TJ, Calvert GM [2001]. Surveillance of acute occupational pesticide-related illness and injury: the US experience. Ann Ist Super Sanita (Roma);37:175-179.

Brevard TA, Calvert GM, Blondell JM, Mehler LN [2003]. Acute occupational disinfectant-related illness among youth, 1993-1998. Environ Health Perspect; 111:1654-1659. (ISI Web of Science: Cited 6 times as of 11/17/06)

Calvert GM. Health effects from pesticide exposure (editorial). Am Fam Physician 2004; 69: 1613-1614, 1616.

Calvert GM, Barnett M, Mehler LN, Becker A, Das R, Beckman J, Male D, Sievert J, Thomsen C, Morrissey B. Acute pesticide-related illness among emergency responders, 1993-2002. Am J Ind Med 2006; 49:383-393.

Calvert GM, Mehler LN, Rosales R, Baum L, Thomsen C, Male D, Shafey O, Das R, Lackovic M, Arvizu E [2003]. Acute pesticide-related illnesses among working youths, 1988-1999. Am J Public Health 2003; 93:605-610. (ISI Web of Science: Cited 6 times as of 11/17/06)

Calvert GM, Petersen AM, Sievert J, Ball C, Mehler LN, Das R, Harter L, Romoli C, Becker A, Male D, Schwartz A [in press]. Acute pesticide poisoning in the US retail industry, 1998-2002. Public Health Rep 2006.

Calvert GM, Plate DK, Das R, Rosales R, Shafey O, Thomsen C, Male D, Beckman J, Arvizu E, Lackovic M [2004]. Acute occupational pesticide-related illness in the US, 1998-1999: surveillance findings from the SENSOR−Pesticides Program. Am J Ind Med 2004;45:14-23. (ISI Web of Science: Cited 10 times as of 11/17/06)

Calvert GM, Sanderson WT, Barnett M, Blondell JM, Mehler LN [2001]. Surveillance of pesticide-related illness and injury in humans. In : Krieger R, editor. Handbook of pesticide

toxicology. 2nd ed. San Diego: Academic Press; 2001. p. 603-641. (ISI Web of Science: Cited 6 times as of 11/17/06)
Centers for Disease Control and Prevention [1999]. Farm worker illness following exposure to carbofuran and other pesticides-Fresno County, California, 1998. MMWR 1999; 48:113-116. Reprinted in JAMA 281:981-982.

Centers for Disease Control and Prevention [1999]. Illnesses associated with occupational use of flea-control products-California, Texas, and Washington, 1989-1997. MMWR 1999; 48:443-447. Reprinted in JAMA 282:125-126.

Centers for Disease Control and Prevention [1999]. Surveillance for acute pesticide-related illness during the Medfly Eradication Program - Florida, 1998. MMWR 1999; 48:1015-1018, 1027. Reprinted in JAMA 1999; 282:2204-2206.

Centers for Disease Control and Prevention [2000]. Illnesses associated with use of automatic insecticide dispenser unitsBselected states and United States, 1986-1999. MMWR 2000; 49:492-495. Reprinted in JAMA 284:432-434.

Centers for Disease Control and Prevention [2001]. Nosocomial poisoning associated with emergency department treatment of organophosphate toxicity - Georgia, 2000. MMWR 2001; 49:1156-1158. Reprinted in JAMA 2001; 285:527-528.

Centers for Disease Control and Prevention [2001]. Pesticide-related illnesses associated with the use of a plant growth regulator - Italy, 2001. MMWR 2001; 50:845-847. Reprinted in JAMA 2001; 286:2804-2805.

Centers for Disease Control and Prevention [2003]. Surveillance for acute insecticide-related illness associated with mosquito-control efforts - Nine states, 1999 - 2002. MMWR. 2003; 52:629-634.

Centers for Disease Control and Prevention [2004]. Illness associated with drift of chloropicrin soil fumigant into a residential area – Kern County, California, 2003. MMWR. 2004; 53:740-742.

Centers for Disease Control and Prevention [2005]. Update: Hydrogen cyanamide-related illnesses–Italy, 2002-2004. MMWR. 2005; 54:405-408.

Centers for Disease Control and Prevention [2005]. Unintentional topical lindane ingestions – United States, 1998-2003. MMWR. 2005; 54: 533-35.

Centers for Disease Control and Prevention [2006]. Pesticide-related illness and injury surveillance: a how-to guide for state based programs. 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; 2005 October. DHHS (NIOSH) Publication No.2006-102.

Centers for Disease Control and Prevention [2006]. (CDC authors: Calvert GM, Alarcon WA). A report of three farm workers who gave birth to infants with severe birth defects closely grouped in time and place ─ Florida and North Carolina, 2004-2005. MMWR. 2006; submitted for publication.

NIOSH [1991]. Work-related lung disease surveillance report. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Washington, DC: DHHS (NIOSH) Publication No. 91-113. Song J, Calvert GM. Surveillance of acute occupational pesticide-related illness and injury: the US experience. Korean J Rural Med 2002; 27:1-8.

NIOSH [1992]. Work-related lung disease surveillance report, supplement 1992. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Washington, DC: DHHS (NIOSH) Publication No. 91-113S.

NIOSH [1994]. Work-related lung disease surveillance report 1994. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Washington, DC: DHHS (NIOSH) Publication No. 94-120.

NIOSH [1996]. Work-related lung disease surveillance report 1996. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Washington, DC: DHHS (NIOSH) Publication No. 96-134.

NIOSH [2000]. Work-related lung disease surveillance report 1999. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Washington, DC: DHHS (NIOSH) Publication No. 2000-105.

NIOSH [2003]. Work-related lung disease surveillance report 2002. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Washington, DC: DHHS (NIOSH) Publication No. 2003-111.

3.4d Traumatic Injury Surveillance

Presentations (Published)

Bobick TG, Myers JR, Hard DL, Parker JE [1991]. Musculoskeletal injuries in the major agricultural industries. In: 35th Annual Meeting, Human Factors Society. San Francisco, CA, September, 1991. (ISI Web of Science: Cited 1 time as of 11/17/06)

Bobick TG, Myers JR [1992]. Back injuries in agriculture: occupations affected. In: Third International Symposium: Issues in Health, Safety and Agriculture, University of Saskatchewan. May 10-15, 1992, Saskatoon, Saskatchewan, Canada.

Bobick TG, Myers JR [1992]. Back Injuries in Agriculture: occupations affected. In: National Institute for Farm Safety 1992 Summer Conference, June 14-18, 1992, Myrtle Beach, SC. Paper No. 92-01.

Etherton JR, Myers JR [1990]. The use of rollover protection on farm tractors in West Virginia. B.Das ed., Advances in Industrial Ergonomics and Safety II, Taylor and Francis, Philadelphia, PA. pp. 819-825.

Jensen R, Etherton J, Russell J, Myers J [1994]. Most common compensation claims for farm and ranch employees in the United States: Back injuries from manual materials handling. In: Proceedings of the 12th Triennal Congress of the International Ergonomics Association, August 15-19, 1994, Toronto, Canada, pp.246-248.

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.

Presentations (unpublished

Myers JR. [1993]. Traumatic injury surveillance of farmers. American Society of Agricultural Engineers 1993 Winter Conference, June 20-24, 1993, Spokane, WA.

Myers JR. [1994]. Occupational injury surveillance in agriculture. Agricultural Safety and Health: A National Conference on Detection, Prevention, and Interaction, August 24-26, 1994, Columbus, OH.

Myers JR. [1995]. The Traumatic Injury Surveillance of Farmers survey. National Institute for Farm Safety 1995 Summer Conference, June 18-22, 1995, Saratoga Springs, NY.

Myers JR. [1996]. Results from the Traumatic Injury Surveillance of Farmers survey. Eleventh Annual Agricultural Machinery Conference, May 6-8, 1996, Cedar Rapids, IA.

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 farm worker 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.

Results from both NTOF and FACE have been disseminated through NIOSH publications, scientific journals, and at scientific conferences and professional meetings.

Publications

Bobick TG, Myers JR [1994]. Agriculture-related sprain and strain injuries, 1985-1987. International Journal of Industrial. Ergonomics 14:223-232. (ISI Web of Science: Cited 1 time as of 11/17/06)

Ehlers JK, Connon C, Myers JR, Ballard T [1993]. Health and safety hazards associated with farming. American Association of Occupational Health Nurses Journal 41(9):414-421. (ISI Web of Science: Cited 13 times as of 11/17/06)

Greife A, Halperin W, Groce D, O'Brien D, Pedersen D, Myers J, Jenkins L [1995]. Hazard surveillance: its role in primary prevention of occupational disease and injury. Applied Occupational and Environmental Hygiene 10(9):737-742. (ISI Web of Science: Cited 4 times as of 11/17/06)

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 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 2001-153.

Myers JR [2004]. It's time for change, one way or another. Journal of Agricultural Safety and Health 10(1):3-5.

Myers JR, Snyder KA [1995]. Roll-over protective structure use and the cost of retrofitting tractors in the United States, 1993. Journal of Agricultural Safety and Health 1(3):185-197. (ISI Web of Science: Cited 8 times as of 11/17/06) 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, Hard DL, Snyder KA, Casini VC, Cianfrocco R, Fields J, Morton L [1998]. Statistics and epidemiology of tractor fatalities–a historical perspective. Journal of Agricultural Safety and Health 4(2):95-108. (ISI Web of Science: Cited 5 times as of 11/17/06)

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 TISF project).*

Zwerling C, Burmeister L, Reynolds S, McKnight R, Browning S, Reed D, Wilkins J, Bean T, Mitchell L, Hallman E, May J, Stark A, Hwang S, Ehlers J, Lalich N, Myers J, Foster K. Use of Rollover Protective Structures – Iowa, Kentucky, New York, and Ohio, 1992-1997. MMWR 46(36):842-845. (ISI Web of Science: Cited 1 time as of 11/17/06)

3.4e National Traumatic Occupational Fatalities Surveillance

Publications

Adekoya N, Myers JR [1999]. Fatal Harmful Substances or Environmental Exposures in Agriculture, 1992 to 1996. J Occup Environ Med 41(8): 699-705. (ISI Web of Science: Cited 4 times as of 11/17/06)

Bobick TG, Jenkins EL [1992]. Agricultural-related Fatalities: 1986-1988. Advances in Industries Ergonomics and Safety IV. Book chapter edited by S. Kumar, Taylor & Francis: 121-128. (ISI Web of Science: Cited 2 times as of 11/17/06)

Braddee RW & Myers JR [1997]. Logging-type Fatalities in the U.S. Production Agriculture Industry, 1980-1992. J of Agromedicine 4(3/4): 373-375.

Castillo DN, Malit BD [1997]. Occupational Injury Deaths of 16 and 17 Year Olds in the U.S.: Trends and Comparisons with Older Workers. Inj Prev 3(4): 277-281. (ISI Web of Science: Cited 7 times as of 11/17/06)
Etherton JR, Myers JR, Jensen RC, Russell JC, Braddee RW [1991]. Agricultural Machine-related Deaths. Am J Public Health 81(6): 766-768. (ISI Web of Science: Cited 27 times as of 11/17/06)

Hard DL, Myers JR, Gerberich, SG [2002]. Traumatic Injuries in Agriculture. J Ag Safety Health 8(1): 51-65.

Hard D, Myers J, Snyder K, Casini V, Morton L, Cianfrocco R, Fields J [1999]. Young Workers at Risk When Working in Agricultural Production. Am J Ind Med Suppl 1: 31-33. (ISI Web of Science: Cited 8 times as of 11/17/06)

Hard DL, Myers JR, Snyder KA, Casini VJ, Morton LL, Cianfrocco R, Fields J [1999]. Identifying Work-related Fatalities in the Agricultural Production Sector Using Two National Occupational Fatality Surveillance Systems, 1990-1995. J Ag Safety and Health 5(2): 155-169. (ISI Web of Science: Cited 1 time as of 11/17/06)

Jenkins EL, Hard DL [1992]. Implications for the Use of E codes of the International Classification of Diseases and Narrative Data in Identifying Tractor-related deaths in Agriculture, United States, 1980-1986. Scand J Work Environ Health 18 Suppl 2: 49-50. (ISI Web of Science: Cited 7 times as of 11/17/06)

Myers JR [1990]. National Surveillance of Occupational Fatalities in Agriculture. Am J Ind Med 18(2): 163-168. (ISI Web of Science: Cited 23 times as of 11/17/06)

Myers JR, Hard DL [1995]. Work-related Fatalities in the Agricultural Production and Services Sectors, 1980-1989. Am J Ind Med 27(1): 51-63. (ISI Web of Science: Cited 33 times as of 11/17/06)
Myers JR, Adekoya N [2001]. Fatal On-farm Injuries Among Youth 16 to 19 Years of Age: 1982-1994. J Ag Safety and Health 7(2): 101-112.

Myers JR, Snyder KA, Hard DL, Casini VJ, Cianfrocco R, Fields J, Morton L [1998]. Statistics and Epidemiology of Tractor Fatalities – A Historical Perspective. J Ag Safety and Health 4(2): 95-108. (ISI Web of Science: Cited 5 times as of 11/17/06)

Myers JR, Hard DL, Snyder KA, Casini VJ, Cianfrocco R, Fields J, Morton L [1999]. Risks of Fatal Injuries to Farm Workers 55-Years of Age and Older. Am J Ind Med Suppl 1: 29-30. (ISI Web of Science: Cited 3 times as of 11/17/06)

NIOSH [2004]. Worker Health Chartbook, 2004. DHHS (NIOSH) Pub. No. 2004-146.

Pratt SG, Kisner SM, Helmkamp JC [1996]. Machinery-related Occupational Fatalities in the United States, 1980-1989. J Occup Environ Med 38(1): 70-76. (ISI Web of Science: Cited 16 times as of 11/17/06)

Suruda AJ, Pettit TA, Noonan GP, Ronk RM [1994]. Deadly Rescue: The Confined Space Hazard. J Hazardous Materials 36:45-53. (ISI Web of Science: Cited 1 times as of 11/17/06)

3.4f Fatality Assessment and Control Evaluation Program

NIOSH Numbered Publications

FACE Reports

NIOSH [1986]. 21-Year-Old Electrocuted While Moving Grain Auger 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, FACE Report No. 86-22.

NIOSH [1986]. Three Electrocuted on Farm in Georgia. 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. 86-06.

NIOSH [1986]. Two Electrocuted on Farm in Georgia. 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. 86-07.

NIOSH [1987]. Farm Worker Asphyxiated in Grain Silo 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, FACE Report No. 87-39.

NIOSH [1987]. Farmer Dies 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, FACE Report No. 87-49.

NIOSH [1989]. Five Family Members Die After Entering Manure Waste Pit on Dairy Farm. 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. 89-46.

NIOSH [1989]. Two Farm Laborers Die in Oxygen Deficient Manure Pit. 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. 89-44.

NIOSH [1992]. Farm Owner and Son Asphyxiated in Manure Waste Pit – MN. 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. 92-29.

NIOSH. [1992]. Hog Farm Co-Owner and Employee Die of Hydrogen Sulfide Poisoning in Manure Pit – Minnesota. 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. 92-28.

NIOSH [1993]. Part-Time Farmer Dies in Tractor Rollover – West 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. 93-20.

NIOSH [1998]. 9-Year-Old Child Helping with Blueberry Harvest Dies After Being Run Over by Cargo Truck on Field Road. 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. 98-15.

NIOSH [2000]. A 15-Year-Old 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.

NIOSH [2000]. Sixteen-Year-Old Farmworker Dies in a Cotton Packing Machine After Being Covered with a Load of Cotton – Georgia. 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. 2000-06.

NIOSH [2000]. Worker Dies From Crushing Injuries After Falling into a Baling Machine – 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. 2000-01.

NIOSH [2002]. Youth Farm Worker Dies After Falling into Operating Feed Grinder/Mixer – 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, FACE Report No. 2002-10.

NIOSH [2003]. Female Hispanic Farm Laborer Dies After Falling from the Elevated Forks of a 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. 2003-04.

NIOSH Alerts

NIOSH [1986]. Preventing Grain Auger Electrocutions. 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. 86-119.

NIOSH [1988]. Preventing Entrapment and Suffocation Caused by the Unstable Surfaces of Stored Grain and Other Materials. 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. 88-102.

NIOSH [1990]. Preventing Deaths of Farm Workers in Manure Pits. 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. 90-103.

NIOSH [1994]. Preventing Scalping and Other Severe Injuries from Farm Machinery. 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. 94-105.

NIOSH [1998]. Preventing Injuries and Deaths from Skid-Steer Loaders. 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. 98-117.

NIOSH Hazard IDs

NIOSH [1998]. Ignition Hazard from Drilling into Sealed Frames of Agricultural Equipment – Hazard ID 4. 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. 98-146.

NIOSH [2001]. Hazards associated with using farm tractors to move large bales. 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. 2001-146.

NIOSH Monographs

NIOSH [1994]. Worker Deaths in Confined Spaces – A Summary of Surveillance Findings and Investigative FACE 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. 94-103.

NIOSH [1998]. Worker Deaths by Electrocution- A Summary of Surveillance Findings and Investigative FACE 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.

NIOSH [2000]. Worker Deaths by Falls – A Summary of Surveillance Findings and Investigative FACE 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. 2000-116.

3.5 References Cited

Alarcon WA, Calvert GM, Blondell JM, Mehler LN, Sievert J, Propeck M, Tibbetts DS, Becker A, Lackovic M, Soileau SB, Das R, Beckman J, Male DP, Thomsen CL, Stanbury M [2005]. Acute illnesses associated with pesticide exposures at schools. JAMA 294: 455-465.

Brandt V, Moon S, Ehlers J, Methner N, Struttman T [2001]. Exposure to endosulfan in farmers: Two case studies. Am J Ind Med; 39(6):643-9.

Bell CA, Stout NA, Bender TR, Conroy CS, Crouse WE, Myers, JR. 1990. Fatal Occupational Injuries in the United States, 1980 through 1985. JAMA 263(22):3047-3050.

Centers for Disease Control and Prevention [1998]. Farm worker illness following exposure to carbofuran and other pesticides-Fresno County, California. MMWR 1999; 48:113-116. Reprinted in JAMA 1999;281:981-982.

Centers for Disease Control and Prevention [1998]. Surveillance for acute pesticide-related illness during the Medfly Eradication Program - Florida. MMWR 1999; 48:1015-1018, 1027. Reprinted in JAMA 1999;282:2204-2206.

Centers for Disease Control and Prevention [1999]. Illnesses associated with occupational use of flea-control products-California, Texas, and Washington, 1989-1997. MMWR 48:443-447. Reprinted in JAMA 1999;282:125-126.

Centers for Disease Control and Prevention [2003]. Surveillance for acute insecticide-related illness associated with mosquito-control efforts - Nine states, 1999 - 2002. MMWR 52:629-634.

Centers for Disease Control and Prevention [2004]. Illness associated with drift of chloropicrin soil fumigant into a residential area – Kern County, California. MMWR.53:740-742

Department of Agriculture [2001]. Fruit Fly Cooperative Control Program Final Environmental Impact Statement 2001. [http://www.aphis.usda.gov/ppq/enviro_docs/pdf_files/fffeis.pdf]

Edwards Debra [2006]. Memorandum of July 31, 2006, from Debra Edwards, Director, Special Review and Reregistration Division, Office of Pesticide Programs, Environmental Protection Agency, to Jim Jones, Director, Office of Pesticide. [http://www.epa.gov/REDs/phosmet_ired.pdf].

Environmental Protection Agency [2005]. Pesticide Registration (PR) Notice 2005-1. Notice to Manufacturers, Producers, Formulators, and Registrants, of Pesticide Products. [http://www.epa.gov/opppmsd1/PR_Notices/pr2005-1.pdf]

Etherton JR, Myers JR, Jensen RC, Russell JC, Braddee RW [1991]. Agricultural Machine-related Deaths. Am J Public Health 81(6): 766-768.

Myers JR, Snyder KA [1995]. Roll-over protective structure use and the cost of retrofitting tractors in the United States, 1993. Journal of Agricultural Safety and Health 1(3):185-197.

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 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 2001-153.

Stout-Wiegand N [1988]. Fatal occupational injuries in US Industries, 1984: Comparison of Two National Surveillance Systems. AJPH 78(9): 1215-1217.