NORA Symposium 2006

Research Makes a Difference

April 18-20, 2006

L'Enfant Plaza Hotel

Washington, DC

NORA

CDC Workplace Safety and Health

NIOSH

National Safety Council

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DEPARTMENT OF HEALTH & HUMAN SERVICES
Public Health Service

National Institute for
Occupational Safety and Health
Centers fo Disease Control
and Prevention (CDC)
200 Independence Avenue, SW
Washington. DC 20201

Message from the Director,
National Institute for Occupational Safety and Health

It is my pleasure to welcome you to the NORA Symposium 2006: Research Makes a Difference! As in past years, the NORA Symposium 2006 will showcase the best in occupational safety and health research. Nearly 200 researchers will present their study findings, educational products, and workplace interventions. The NORA Symposium 2006 also marks an important milestone for the program and for future research in occupational safety and health.

Exactly 10 years ago NORA began as an innovative public-private partnership program to stimulate occupational safety and health research for the Nation. During this time NORA team members and researchers have made much progress in advancing etiologic and interventional research, developing products and services, and fostering research partnerships. We will honor these extraordinary accomplishments and contributions at the 2006 Symposium.

In addition, the NORA Symposium 2006 launches an exciting new decade of NORA research. NIOSH, after consulting with partners, has shaped the second decade of NORA around research priorities to be developed by eight sector research councils with a focus on bringing research into practice. Over the past five months, more than 1000 individuals and organizations have contributed to 12 town hall meetings across the U.S. or have electronically provided comments through the NORA Web page. Stakeholder involvement is the key to guiding each sector's research priorities.

This year's Symposium will also feature several highlights, including:

- A commemoration of the 35th anniversary of the Occupational Safety and Health Act.
- The presentation of the NORA Partnership Award for Worker Health and Safety and a new NORA Innovative Research Award for Worker Health and Safety.
- Interactive workshops to discuss sector research priorities.
- Visionary plenary speeches by national and international leaders.

I would like to thank our co-sponsor, the National Safety Council, for their efforts in organizing this year's Symposium. I would also like to thank the many scientific presenters, individuals, and organizations who have made this year's agenda particularly exciting.

The NORA Symposium 2006 is a landmark event. I wish each of you a successful Symposium.

John Howard, MD
Director, NIOSH

Dear Friends in Occupational Safety and Health:

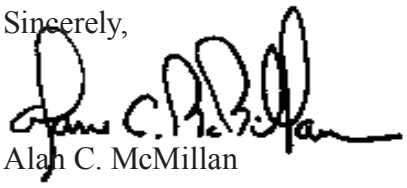
Welcome to NORA Symposium 2006.

Thank you for joining us in recognizing and celebrating the achievements of NORA over the past 10 years. The National Safety Council is honored to join the National Institute for Occupational Safety and Health as a cosponsor for this milestone event.

I applaud the steps NIOSH is taking to build industry sector-based research and field application partnerships. This critical shift will ensure an even greater impact on workplace safety and health across a spectrum of industries.

On behalf of the National Safety Council, thank you for devoting your expertise and energy to this important undertaking. You have been and will continue to be the driving force for NORA as NORA moves into the next decade and beyond.

Sincerely,



Alan C. McMillan
President and CEO
National Safety Council

Alan C. McMillan, President and Chief Executive Officer

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The National Occupational Research Agenda (NORA) Liaison Committee is pleased to present two 2006 NORA Partnering Awards and the NORA Innovative Research Award.

Congratulations to the Winners!

The 2006 National Occupational Research Agenda
Innovative Research Award
for
Reducing the Impact of Green Tobacco Sickness
Among Latino Farmworkers

Goes To:

Thomas A. Arcury, PhD
Professor and Research Director,
Department of Family and Community Medicine,
Wake Forest University School of Medicine

Sara A. Quandt, PhD
Professor,
Department of Epidemiology and Prevention,
Division of Public Health Sciences,
Wake Forest University School of Medicine

Congratulations to the Winners!

The 2006 National Occupational Research Agenda Partnering Award for Slip, Trip, and Fall (STF) Prevention in Health Care Workers

Goes To:

Academia:

Bradley Evanoff, Washington University School of Medicine, St. Louis

Gary S. Sorock, Johns Hopkins University, School of Public Health

Government:

Jennifer L. Bell, National Institute for Occupational Safety and Health

Sharon S. Chiou, National Institute for Occupational Safety and Health

James W. Collins, National Institute for Occupational Safety and Health

Eugene DeMaster, Veteran's Health Administration

Raoul Grönqvist, Finnish Institute of Occupational Health

Mary Matz, Veteran's Health Administration

Audrey Nelson, Veteran's Health Administration

Health Care Industry (private non-profit hospital)

Laurie Wolf, BJC Health Care

Insurance Industry:

Melanye J. Brennan, Liberty Mutual Research Institute for Safety

Wen-Ruey Chang, Liberty Mutual Research Institute for Safety

Theodore K. Courtney, Liberty Mutual Research Institute for Safety

David A. Lombardi, Liberty Mutual Research Institute for Safety

Santosh K. Verma, Liberty Mutual Research Institute for Safety

Helen M. Wellman, Liberty Mutual Research Institute for Safety

Congratulations to the Winners!

The 2006 National Occupational Research Agenda Partnering Award for *Collaborative Partnerships and Products of the NIOSH Hazardous Drug Working Group*

Goes To:

Members of the
NIOSH Hazardous Drug Working Group

Academia:

Melissa McDiarmid, University of Maryland

Accrediting Bodies:

Berek Britton, Joint Commission on Accreditation of Healthcare Organizations

Consultants:

Allan Ader, SafeBridge Consultants, Inc.

Charlotte Smith, PharmEcology Associates, LLC

Sandi Yurichuk, Consultant, Oncology Business Development

Government Agencies:

Edward Burroughs, National Institute for Occupational Safety and Health

Thomas Connor, National Institute for Occupational Safety and Health

Barbara Coyle, Wisconson State Lab of Hygiene

Gayle DeBord, National Institute for Occupational Safety and Health

Robert DeChristoforo, National Institutes of Health
Mandy Edens, Occupational Safety and Health Administration

Caroline Freeman, Occupational Safety and Health Administration

Duane Hammond, National Institute for Occupational Safety and Health

Bruce Harrison, Veterans Affairs Medical Center

Mark Hatch, Occupational Safety and Health Administration

Lee Hathon, Occupational Safety and Health Administration

Amber Hogan, Becton-Dickinson (formerly with OSHA)

Hye-Joo Kim, Food and Drug Administration

Chiu S. Lin, Food and Drug Administration

Barbara MacKenzie, National Institute for Occupational Safety and Health

Ken Mead, National Institute for Occupational Safety and Health

Kristina Meson, Environmental Protection Agency

Martha O'Lone, Food and Drug Administration

Jerry Phillips, Food and Drug Administration

Angela Presson, retired (formerly with OSHA)

Laurence Reed, National Institute for Occupational Safety and Health

Melody Sands, Occupational Safety and Health Administration

Anita Schill, National Institute for Occupational Safety and Health

Teresa Schnorr, National Institute for Occupational Safety and Health

Dionne Williams, Occupational Safety and Health Administration

Health Care Worker Labor Unions:

Bill Borwegen, Service Employees International Union

Jim Lane, Service Employees International Union

Diane Matthew-Brown, American Federation of State, County and Municipal Employees

Home Health Care:

Nancy Kramer, Coram Healthcare

Melissa Leone, Apria Healthcare

Nursing:

Butch deCastro, University of Chicago (formerly with American Nurses Association)

Marty Polovich, Oncology Nursing Society

Pamela Hagen, American Nurses Association

Pharmaceutical Manufacturers:

Marc Abromovitz, Johnson & Johnson (formerly with GlaxoSmithKline)

Lucy O. Crane, Johnson & Johnson

Janice Frobel, Baxter Healthcare

Larry Hecker, Hospira, Inc. (formerly with Abbott Laboratories)

Donna S. Heidel, Johnson & Johnson

David R. Lauper, SuperGen, Inc.

Mary McConnell-Meachen, Boehringer Ingelheim Pharmaceuticals, Inc.

William McGrath, Bristol Myers Squibb Company
Bruce Naumann, Merck & Co.

Denise Proulx, Sanofi-Aventis

Lucy Reinke, Johnson & Johnson

Edward Sargent, Merck & Co.

Charles Sawyer, Eli Lilly and Co.

Debora Van der Sluis, Genentech, Inc.

Oncology Centers:

Philip Dugger, US Oncology

Dori Greene, US Oncology

Pharmacy:

Roger Anderson, Medco Health Solutions, Inc. (formerly with MD Anderson Cancer Center)

Joseph Deffenbaugh, retired (formerly with American Society of Health-System Pharmacists)

L.D. King, International Academy of Compounding Pharmacy

Luci Power, University of California San Francisco Medical Center

Protective Equipment Manufacturers:

Tito Aldape, Microflex

Cliff Colby, Baker Company, Inc.

Agneta Ekblad, Carmel Pharma, Inc.

Larry Griffin, Palestine Regional Medical Center (formerly with Carmel Pharma, Inc.)

William Peters, NuAire, Inc.

Hank Rahe, Containment Technologies Group, Inc.

Dave Stuart, Baker Company, Inc.

NOTES

Biographies

Magdalene O Y Chan, MSc (Occupational Medicine), FFOM (London), FACOM, MBBS, FAMS, has been an occupational health physician for over 30 years and is currently the Director of the OSH Specialist Department in the Occupational Safety and Health Division of the Ministry of Manpower in Singapore. The Division is a WHO Collaborating Centre in Occupational Health and the ILO/CIS National Centre for Singapore.

Dr. Chan serves on various government and quasigovernment committees. In 2003, she chaired the Thirteenth Session of the Joint ILO/WHO Committee on Occupational Health which discussed cooperation in mobilising the international community at all levels to achieve safe and healthy workplaces through an integrated approach to occupational safety and health, as well as strategies to move from knowledge to action.

With over 40 publications in peer reviewed journals, books and reports, her research interests have ranged from mass hysteria in the workplace to sickness absenteeism and the effects of shift work on health and sleep. She has a special interest in promoting workplace health, as well as research, standards and training in occupational safety and health.

Her current focus is in the area of specialist support for OSH policy development in the implementation of a new OSH framework for Singapore. The framework's three core principles of risk prevention and management in addressing systemic issues, stakeholder ownership of safety standards and outcomes, and facilitating improvement in safety management through rigorous auditing and tougher sanctions, have recently been institutionalised through the enactment of the Workplace Safety and Health Act introduced on 1 March 2006. As part of the framework initiatives, a Workplace Safety and Health Advisory Committee spearheaded by industry leaders has been appointed that will facilitate and promote industry self-regulation, enabling industry to develop safer ways to achieve business goals. The Ministry is working closely with industry to enhance accident prevention and safety management capabilities, as well as develop a stronger safety culture.

Larry Chapman is the Senior Scientist in the Biological Systems Engineering Department at the University of Wisconsin. He has conducted research and taught coursework on injury prevention, ergonomics, and neurobehavioral toxicology.

Mr. Chapman has served on the NIOSH NORA Intervention Effectiveness Research team. Since 1990, Mr. Chapman has worked with an interdisciplinary team at Wisconsin to prevent agricultural injury by disseminating information about safer, more profitable practices. This work has served berry, nursery

and fresh market vegetable producers across multi-state regions, as well as dairy producers-the topic of his presentation today.

Most of this work was sponsored by the NIOSH agricultural initiative – initially through the Agricultural Safety Promotion Systems program and later as part of the Community Partners for Healthy Farming program. Some of the work was published in the NIOSH "Simple Solutions: Ergonomics for Farm Workers" publication.

Seong-Kyu Kang is an occupational physician and a family physician. He studied at the Department of Family Medicine in Severance Hospital of Yonsei University in Seoul. He received a PhD for Medical Science in 1993 at the ChungNam National University. He was an Epidemic Intelligence Service (EIS) officer at NIOSH from 1995 to 1997.

Dr. Kang has worked for the Korea Occupational Safety and Health Agency (KOSHA) since 1992. He served as the director of the Center for Occupational Disease Research in KOSHA until 2005. He was responsible for investigating health effects caused by occupational exposure, which was requested by the Ministry of Labor and authorized by the Occupational Safety and Health Act. Dr. Kang has done many epidemologic investigations for occupational diseases.

Dr. Kang is interested in occupational neurotoxicity and biological monitoring of workers exposed to organic solvents. He has published many papers in peer review journals. He serves as an editor of Industrial Health and Journal of Occupational Health. He hosted the 9th International Symposium on Neurobehavioral Methods and Effects in Occupational and Environmental Health in Gyeongju, Korea in September 2005, which was a triennial meeting of the Scientific Committee of Neurotoxicity and Neurophysiology of ICOH (International Commission on Occupational Health). He is also elected as the Secretary of the Committee.

Dr. Kang served as the director of the Department of Occupational Health in KOSHA since 2005. He is responsible to the technical aspects in preventive activities on occupational health in Korea.

Biographies

Antonio Moccaldi graduated in 1965 from the University of Rome La Sapienza where he studied physics. Currently he is the President of the Italian National Institute for Occupational Safety and Prevention (Istituto Superiore per La Prevenzione e la Sicurezza del Lavoro, or ISPESL) which is a technical scientific Body of the Ministry of Health, where he previously served as Director-General from 1983 until 2003.

Mr. Moccaldi is a Professor of Radiation Protection at the School of Engineering, University of Rome La Sapienza, and a Lecturer in several Italian institutions such as: Polytechnic University of Milan, Universities of Turin, Florence, Naples, Rome, and Catholic University. He also has attended several stages in France (Saclay-Cadaracbe) and England (Harwell) to study in detail problems inherent to the safety of the nuclear sector.

Mr. Moccaldi is an author of more than 100 publications concerning ionizing radiation and safety at work. He has presented many papers in national and international conferences.

Mr. Moccaldi also holds positions on many international committees, including:

- Member of the Scientific Committee of INRS (French National Institute for Research in Occupational, Health and Safety);
- Member of the Scientific Committee of Ramazzini Collegium;
- Member of the Steering Council of CEOC (European Conference of the Organism of Certification); and
- Vice-President of the Commission for Machinery Safety of ISSA (International Social Safety Association).

His participation in national committees includes:

- President of the Technical-Scientific Committee of ISPESL;
- Member of the Higher Council for Health (Consiglio Superiore di Sanità);
- Member of the National Commission for Health Researches of the Ministry of Health in charge of elaborating the research projects for the valuation of the scientific activity of the Institutes for hospitalization and treatment having a scientific character;
- Member of the National Toxicological Advisory Commission re-established by Decree of the Minister of Health of March 13, 1989;
- Member of Scientific Committee of SicurAnci, the Italian Association of Municipality;
- Member since 1983 of the Permanent Advisory Commission for the Prevention of Incidents and Hygiene at work of the Ministry of Labour and Social Security;

Biographies

- Member of the General Council of the Italian Welding Institute;
- Member of the Steering Council of UNI (Italian Standard Institute) since 1987;
- Member of the Board of Directors of the Italian Electro Technical Committee (CEI) since 1985;
- Member of the Steering Council of the Italian Thermo Technical Committee;
- President of the Safety Commission of the University of Rome La Sapienza;
- Member of the Safety Commission of the "Roma III" University; and
- President of the Safety Commission of Istituto Superiore di Sanità.

Kenneth Olden PhD, ScD, LHD, is the most recent past Director of the National Institute of Environmental Health Sciences (NIEHS) and the National Toxicology Program (NTP) in Research Triangle Park, North Carolina. He held these positions from 1991 to 2005. He was the first African-American to become Director of one of the 18 institutes of the National Institutes of Health (NIH). He has returned full time to his research position as Chief of the Metastasis Section, Laboratory of Molecular Carcinogenesis at the NIEHS, which he also held while Director.

Dr. Olden received his PhD in Cell Biology/Biochemistry from Temple University. He is the recipient of several honorary degrees; namely, ScD degrees from Metropolitan University, San Juan, Puerto Rico, the University of Medicine and Dentistry of New Jersey, and the University of Rochester. He also holds an honorary LHD from the College of Charleston. After completing his PhD, he was a Research Fellow and Instructor of Physiology at Harvard University (1970-1974), a Senior Staff Fellow and then a Research Biologist at the Laboratory of Molecular Biology, Division of Cancer Biology and Diagnosis, National Cancer Institute, NIH, Bethesda, MD (1974-1979), Associate Director for Research, Howard University Cancer Center, and Associate Professor of Oncology, Howard University Medical School, Washington, DC (1979-1982), Professor of Oncology and Deputy Director Howard University Cancer Center (1982-1985) and Director (1985-1991), and Professor and Chair of the Department of Oncology (1985-1991).

His honors and awards are too numerous to detail, but among them are: the Toxicology Forum's Distinguished Fellow Award, the Presidential Distinguished Executive Rank Award, the Presidential Meritorious Executive Rank Award for sustained extraordinary accomplishments, the HHS Secretary's Distinguished Service Award, and the American College of Toxicology's First Distinguished Service Award. He was unique among Institute Directors in that he was awarded three of the most prestigious awards in Public Health: The Calver Award (2002), the Sedgwick Medal (2004), and the Julius B. Richmond Award (2005). He was elected to membership in the Institute of Medicine, National Academy of Sciences, in 1994. He is on the editorial board of numerous journals, serving in most instances as

Biographies

Associate Editor. He has been cited in Current Contents, Life Sciences for having published two of the 100 most-cited papers in 1978-79, one of which was subsequently designated as a "citation classic." Over 26 visiting fellows or post-docs have trained in his laboratory, and he has published over 120 manuscripts in peer-reviewed journals. In addition, Dr. Olden has published more than 45 review articles and book chapters.

He has chaired/co-chaired numerous national/international meetings, and has been an invited speaker or keynote speaker at over 150 symposia seminars, etc.

Mary Hazel Ross is the Director of the National Institute for Occupational Health in South Africa and has an honorary academic appointment at the University of the Witwatersrand. She is a specialist in Public Health Medicine and in Occupational Health with extensive experience in occupational health at operational, academic, and research levels.

Professor Ross was educated in Zimbabwe, the United Kingdom and South Africa, and her academic background includes:

- BSc (Hons) (1973) and MBChB (1975) University of Birmingham (UK)
- Diploma in Datametrics (1981) University of South Africa
- Fellowship of the College of Public Health Medicine of South Africa (1989)
- Diploma in Health Administration (1985) University of Pretoria
- Diplomas in Tropical Medicine and Hygiene (1987), Public Health (1987) and Occupational Health (1989) University of the Witwatersrand
- Member of the Faculty of Occupational Medicine (UK) 1997
- Member of the Faculty of Public Health (UK) by distinction 1998
- Fellow of the Division of Occupational Medicine of the College of Public Health Medicine of South Africa by peer review (2006)

From 1999 to 2004, Professor Ross was Occupational Health Programme Manager for the Mine Health and Safety Council where she developed the occupational health research programme using the NORA and HSL models and promoted significant health research capacity development. Prior to 1999, she had extensive experience in the fields of public and occupational health at central, provincial and local government levels. She developed the Occupational Health Service for Johannesburg Academic Hospital and specific hepatitis and latex allergy programmes for health workers and conducted research on health workers.

Professor Ross's other activities have included travel medicine surveillance systems and services for expatriate miners, conducting, and advising occupational research projects. Professor Ross obtained WHO

funding to start the first masters course in tropical epidemiology and biostatistics and she also started the travel medicine course which she has coordinated since 2000 at the University of the Witwatersrand, in collaboration with James Cooke University, Australia and the South African Society of Travel Medicine.

Professor Ross is the author of over 50 peer reviewed publications, guides and monographs plus textbook chapters on occupational medicine and epidemiology in South Africa and editor of the handbook on occupational health practice for the mining industry in South Africa.

Professor Ross has served as Deputy Regional Advisor for Faculty of Occupational Medicine (UK); Executive Member of South African Society of Occupational Medicine and the Mines Medical and Other Health Care Professionals Association; Fellow of the Royal Society for Tropical Hygiene and Medicine and is Assistant Editor for the Journal of Travel Medicine.

Roger K. Siemionko, Managing Director, Technology & Innovation, Safety & Protection and Global Technology Director - DuPont Advanced Fibers Systems, received a BS in Chemistry from Fordham University in 1974 and a PhD in Organic Chemistry from Yale in 1979. Dr. Siemionko started as a Research Chemist in the Pioneering Lab at the Experimental Station in December 1978 and worked on liquid crystalline polymers. He held a number of supervisory positions between 1981 and 1987 leading groups at several different locations: basic research at Pioneering, Nomex® end-use research at Chestnut Run, operations support and development for Reemay® and Typar® at Old Hickory, and technical service and product development for Flooring Systems at Chestnut Run.

In 1988, Dr. Siemionko became Staff Assistant to the R&D Director in Textile Fibers Department. In 1989 he moved to Richmond, Virginia as Technical Manager of Tyvek®. In 1992, he returned to Wilmington as Technical Director of Tyvek® and in 1996 became Technical Director of DuPont Nonwovens. Dr. Siemionko was appointed Technology Director of P&IP in August 1998 and in February 2001 assumed the role of Global Technology Director for Advanced Fibers Systems. In September 2005, he was appointed Managing Director, Technology & Innovation, Safety & Protection Platform.

Dr. Siemionko is married and has three children. His daughter, Melissa, is in DuPont Personal Protection, and his son Matt is a graduate of Vassar, and son Andrew is attending Lynchburg College. He and his wife, Susan, live in Midlothian, VA and enjoy traveling, gardening, and activities with the children.

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Biographies

Edward Tenner is an independent writer, speaker, and editor analyzing the cultural aspects of technological change. He was born in Chicago and attended Princeton and the University of Chicago, where he earned the PhD in European history. After membership in the Harvard Society of Fellows, he held teaching and research positions in Chicago (including assisting William H. McNeill with bibliographic research for Plagues and Peoples) until his appointment as science editor at Princeton University Press, becoming executive editor for physical science and history. There he sponsored both monograph series and general-interest books, including Richard Feynman's best-selling Q.E.D. and "The History and Geography of Human Genes," by L. Luca Cavalli-Sforza, "Paolo Menozzi and Alberto Piazza," winner of the R.R. Hawkins Award of the Association of American Publishers for outstanding academic or professional book. He also was a visiting lecturer of the Princeton Council of the Humanities, teaching a course in the history of information in 1990. In 1991, Dr. Tenner received a Guggenheim fellowship and became an independent historian of technology, and has had visiting positions at Princeton, Rutgers, the Institute for Advanced Study, the Woodrow Wilson International Center for Scholars, and the National Museum of American History, where he was a founding advisor of the Lemelson Center for the Study of Invention and Innovation and is a Senior Research Associate. He is author of "Tech Speak (Crown), Why Things Bite Back: Technology and the Revenge of Unintended Consequences," and "Our Own Devices: How Technology Remakes Humanity" (both Knopf and Vintage Books). Dr. Tenner is a contributing editor or advisory board member of Harvard Magazine, the Wilson Quarterly, and Raritan Quarterly Review, and wrote the Megascope column for Technology Review. Website: www.edwardtenner.com.

NOTES

AGENDA

Tuesday, April 18, 2006

11:00 a.m. **Registration** (Authors Set-up Posters)

12:30 p.m. **Introduction and Welcome**
Location: Grand Ballroom

John Howard, MD, MPH
Director, National Institute for Occupational Safety and Health

Julie Louise Gerberding, MD, MPH
Director, Centers for Disease Control and Prevention

Alan C. McMillan
President & CEO, National Safety Council

1:00 p.m. **Keynote Address**
Location: Grand Ballroom

Upright and Laid Back: The Search for Healthy Seating
Edward Tenner, PhD
Jerome and Dorothy Lemelson
Center for the Study of Invention and Innovation

2:00 p.m. **NORA Liaison Committee Awards Presentation**
Location: Grand Ballroom

Update from 2003 Winner: *Evaluation of a Best Practices Back Injury Prevention Program in Nursing Homes*
James Collins, PhD
Associate Director for Science, Division of Safety Research,
National Institute for Occupational Safety and Health

Presentation of 2006 NORA Partnering and Innovative Research Awards
Bonnie Rogers, DrPh
Chair, NORA Liaison Committee

Remarks by the 2006 Winners

2:45 p.m. **Break**

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3:15 p.m. **RAPID Oral Presentations of Posters (Session I)**

Agricultural Exposures, Interventions, and Training
Location: Ballroom A

Construction Injuries, Hazards, and Workforce
Location: Ballroom B/C

Health Care, Physical and Biological Risks, and Interventions
Location: Ballroom D

Surveillance and Tracking, Social and Economic Analyses
Location: Quorum

4:45 p.m. **Poster Session I**
Location: Monet Ballroom, Degas and Renoir

5:45 p.m. **Break** (on your own)

6:30 p.m. **Commemoration of the Thirty-Fifth Anniversary of the Occupational Safety and Health Act and the 10th Anniversary of NORA**
Location: Grand Ballroom

John Howard, MD, MPH
Director, National Institute for Occupational Safety and Health

Marcus M. Key, MD
First Director of the National Institute for Occupational Safety and Health

Buffet Dinner

Presentation of NIOSH Director's Award
John Howard, MD, MPH
Director, National Institute for Occupational Safety and Health

Performance Poetry by Stacy Smallwood

AGENDA

Wednesday, April 19, 2006

8:30 a.m.

Plenary Session: The Many Faces of r2p
Location: Grand Ballroom

An Industry Perspective: Innovation in Health and Safety in the Workplace
Roger K. Siemionko, PhD
Managing Director, Technology & Innovation,
Safety & Protection/AFS

A Theory-driven, Evidence Based Intervention: Seven Years, Four Thousand Businesses, Three Safer Ways to Work
Larry Chapman, PhD
Senior Scientist, University of Wisconsin

Gene-Environment Interactions in Human Health and Disease
Kenneth Olden, PhD
Chief, Metastasis Section, Laboratory of Molecular Carcinogenesis,
National Institute for Environmental Health Sciences

10:00 a.m.

Break

10:30 a.m.

RAPID Oral Presentations of Posters (Session II)

Injuries in Agriculture and Fishing
Location: Ballroom A

Health and Safety in the Service Industries
Location: Ballroom B/C

Health Disparities and Special Populations
Location: Ballroom D

Musculoskeletal Risks and Disorders
Location: Quorum

Intervention Effectiveness; Organization of Work; Training
Location: Caucus

12:00 p.m.

Lunch (on your own)

1:00 p.m.

Poster Session II
Location: Monet Ballroom, Degas and Renoir

AGENDA

2:00 p.m.	**RAPID Oral Presentations of Posters (Session III)** Manufacturing Hazards and Exposures Location: Ballroom A Mining Risks and Control Technology Location: Ballroom B/C Hearing Loss; Traumatic Injuries Across Sectors Location: Ballroom D Toxicological Exposures and Emerging Technologies Location: Quorum
3:30 p.m.	**Break**
4:00 p.m.	**Poster Session III** Location: Monet Ballroom, Degas and Renoir
5:00 p.m.	**Break** (on your own)
5:30 p.m.	**Reception Honoring NORA Team Members** Location: Grand Ballroom Presentation of Awards to NORA Team Members
7:00 p.m.	**Dinner on your own**

AGENDA

Thursday, April 20, 2006

8:30 a.m. - 9:30 a.m. **Plenary Session: NORA's Global Impact**
Location: Grand Ballroom

Magdalene Chan, MD
Director, OSH Specialist Department, Occupational Safety and Health Division, WHO Collaborating Centre in Occupational Health ILO CIS National Centre for Singapore Ministry of Manpower

Seong-Kyu-Kang, MD, PhD
Director of Occupational Health, Korea Occupational Safety and Health Agency (KOSHA)

Antonio Moccaldi, MD, PhD
President, Instituto Superiore per la Prevenzione Sicurezza del Lavoro

Mary Ross, PhD
Director, National Institute for Occupational Health, South Africa

9:30 a.m. - 10:00 a.m. **Break**

10:00 a.m. - 12:00 p.m. **NORA Sector Concurrent Workshops: Priority Research**

Agriculture, Forestry and Fishing
Location: Ballroom A

Construction
Location: Ballroom B/C

Healthcare and Social Assistance
Location: Ballroom D

Manufacturing
Location: Quorum

Mining
Location: Renoir

Services
Location: Monet 3

AGENDA

	Transportation, Warehousing and Utilities Location: Monet 4
	Wholesale and Retail Trade Location: Caucus
12:00 p.m.	**Lunch** (on your own)
1:00 p.m.	**Plenary Session: Summary Presentation of Sector Workshops** Location: Grand Ballroom
2:30 p.m.	**Break**
3:00 p.m.	**Plenary Session: Panel Discussion of Cross-Sector Issues and Grant Funding in the New NORA** Location: Grand Ballroom
4:00 p.m.	**Adjourn**

RAPID Presentations Agenda

Session I

Agricultural Exposures, Interventions, and Training

Poster: 0002

Agricultural Health in a Community-Based Farm Worker Population: The MICASA Study

MB Schenker (1) presenting, MT Marois (1)

University of California, Davis, Davis, CA, United States (1)

Poster: 0003

Use of Agricultural Pesticides And Prostate Cancer Risk in the Agricultural Health Study Cohort and Future Plans For Molecular Studies

M Alavanja (1) presenting, J Coble (1), L Beane-Freeman (1), J Rusiecki (2), M Bonner (3),R Mahajan (1), M Dosemeci (1), C Samanic (1), J Lubin (1), C Lynch (1), C Knott (4), L Moore (1), R Hayes (1), J Hoppin (5), J Barker (6), K Thomas (7), R Allen (8), C Hines (9), D Sandler (5), A Blair (1)

National Cancer Institute, Bethesda, MD, United States (1), Uniformed Services University of Health Sciences, Bethesda, MD, United States (2), State University of New York at Buffalo, Buffalo, NY, United States (3), Battlelle Inc., Durham, NC, United States (4), National Institute of Environmental Health Sciences, RTP, NC, United States (5), IMS, Inc., Bethesda, MD, United States (6), U.S. Environmental Protection Agency, RTP, NC, United States (7), U.S. Environmental Protection Agency, Crystal City, VA, United States (8), National Institute for Occupational Safety and Health, Cincinnati, OH, United States (9)

Poster: 0004

Cancer Incidence Among Pesticide Applicators exposed to Trifluralin in the Agricultural Health Study

D Kang (1) presenting, SK Park (1), L Beane-Freeman (1), CF Lynch (3), CE Knott (4), DP Sandler (2), JA Hoppin (2), M Dosemeci (1), J Coble (1), J Lubin (1), A Balir (1), M Alavanja (1)

NCI, Bethesda, MD, United States (1), NIEHS, Research Triangle Park, NC, United States (2), University of Iowa, Iowa City, IA, United States (3), Batelle/Centers for Public Health Research and Evaluation, Durham, NC, United States (4)

Poster: 0005

Pesticide Exposure Among Children in Farmworker Households in Eastern North Carolina

TA Arcury (1) presenting, DB Barr (2), SW Davis (1), JG Grzywacz (1), SA Quandt (1)

Wake Forest University School of Medicine, Winston-Salem, NC, United States (1), National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, GA, United States (2)

Poster: 0006

Pesticide Exposure Assessment in the AHS: Phase II Update

J Coble (1) presenting, C Samanic (1), JA Hoppin (2), K Thomas (3), M Dosemeci (1), D Sandler (1), A Blair (1), M Alavanja (1), C Hines (4)

National Cancer Institute, NIH/DHHS, Division of Cancer Epidemiology and Genetics, Occupational and Environmental Epidemiology Branch , Rockville, MD, United States (1), National Institute of Environmental Health Sciences, NIH/DHHS, Epidemiology Branch, Research Triangle Park, NC, United States (2), Environmental Protection Agency, National Exposure Research Laboratory, Research Triangle Park, NC, United States (3), National Institute of Occupational Safety and Health, Cincinnati, OH, United States (4)

Poster: 0007

Respiratory Protection Against Bioaerosols in Agriculture

T Reponen (1) presenting, S-A Lee (2), R McKay (1), R Shukla (1), SA Grinshpun (1)

University of Cincinnati, Department of Environmental Health, Cincinnati, OH, United States (1), Feng Chia University, Department of Environmental Engineering and Science, Taichung, Taiwan (2)

Poster: 0008

Ventilation Strategies for Confined-Space, On-Farm Manure Storages

HB Manbeck (1) presenting, DJ Murphy (1), J Zhao (1), EP Pesce (2)

Penn State University, University Park, PA , United States (1), Simpson Strong-Tie, Columbus, OH, United States (2)

Poster: 0009

Assessing Heat Related Illness in Field Crop Workers in North Carolina

J Sabella (1), J Bernhart (2) presenting

NC Agromedicine Institute, Greenville, NC, United States (1), East Carolina University, Greenville, NC, United States (2)

Poster: 0010

The Aging Farm Workforce: Work, Organization, Health, and Social Dimensions

DB Reed (1) presenting, MK Rayens (1), S Westneat (1)

University of Kentucky College of Nursing, Lexington, KY, United States (1)

Poster: 0011

Community Partners for Healthy Farming Intervention Research

JK Ehlers (1) presenting

CDC/NIOSH, Cincinnati, OH, United States (1)

Poster: 0012

Strengthening the Evaluation Skills of Agricultural Health and Safety Practitioners and Researchers

K Bruns (1), T Archer (1), C Heaney (2) presenting

Ohio State University, Columbus, OH, United States (1), Stanford University, Stanford, CA, United States (2)

Poster: 0014

Health and Safety in the Fields: Evaluation of a High School ESL Curriculum

R Baker (1) presenting, S Teran (1), R Strochlic (1)

UC Berkeley, Berkeley, CA, United States (1), California Institute for Rural Studies, CA, United States (2)

Poster: 0015

Ag Safety Days

LE Orr (1) presenting

West Virgina Department of Agriculture, Charleston, WV, United States (1)

Construction Injuries, Hazards, and Workforce

Poster: 0030

Design Decisions as Causal Influences in Construction Fatalities

M Behm (1) presenting, J Gambatese (1)

East Carolina University, Greenville, NC, United States (1), Oregon State University, Corvallis, OR, United States (2)

Poster: 0031

A Pilot Study of Design Professionals' Perceived Feasibility of the Design for Construction Safety Intervention

J Gambatese (1), M Behm (1) presenting

Oregon State University, Corvallis, OR, United States (1), East Carolina University, Greenville, NC, United States (2)

Poster: 0032

The Workplace Solutions and Construction Solutions Databases: Web-based Hazard and Solution Information for the Small Business Community and Construction Industry

P Entzel (1), R Niemeier (2), J Platner (1) presenting, L Welch (1)

Center to Protect Workers' Rights, Silver Spring, MD, United States (1), NIOSH/EID, Cincinnati, OH, United States (2)

Poster: 0033

Designing for Safety in the Construction of Single-Family Homes

BA Fry (1) presenting

The University of Tennessee, Knoxville, TN, United States (1)

Poster: 0034

Health Services Utilization Among Hispanic Construction Workers

X Dong (1) presenting

The Center to Protect Workers' Rights, Silver Spring, MD, United States (1)

Poster: 0035

Safety and Health Training in a Diverse Construction Workforce

E Jorgensen (1) presenting, RK Sokas (1), L Nickels (1), J Gittleman (2), C Trahan (2), W Gao (1), C Beam (1)

University of Illinois at Chicago School of Public Health, Chicago, IL, United States (1), The Center to Protect Workers Rights, Silver Spring, MD, United States (2)

Poster: 0036

Risk Factors for Nail Gun Injuries in Apprentice Carpenters

HJ Lipscomb (1) presenting, JM Dement (1), J Nolan (2), D Patterson (1)

Duke University Medical Center, Durham, NC, United States (1), Carpenters District Council of Greater St. Louis and Vicinity, St. Louis, MO, United States (2)

Poster: 0037

Social/Economic Impact of Injury/Illness in Career Roofers

LS Welch (1) presenting, KL Hunting (1), P Entzel (1)

George Washington University, Washington DC, United States (1), Center to Protect Workers Rights, Silver Spring, MD, United States (2)

Poster: 0038

Construction Safety And Work-Family Balance: A Challenge and Unexplored Frontier

PY Chen (1) presenting, J Rosecrance (1), LB Hammer (2)

Colorado State University, Fort Collins, CO, United States (1), Portland State University, Portland, OR, United States (2)

Poster: 0039

Assessing Fall Risks in Residential Construction

AM Dale (1) presenting, V Kaskutas (1), H Lipscomb (2), J Gaal (3), M Fuchs (3), J Nolan (3), D Patterson (3), B Evanoff (1)

Washington University School of Medicine, St. Louis, MO, United States (1), Duke University, Durham, NC, United States (2), Carpenters' Joint Apprenticeship Program, St. Louis, MO, United States (3)

Poster: 0040

Ladder Fall Prevention Initiative for Construction Industry

J Gittleman (1) presenting, J Nagrod (1), K McGreevy (1)

Center to Protect Workers' Rights, Silver Spring, MD, United States (1), New Jersey State Building and Construction Trades Council, AFL-CIO, Clark, NJ, United States (2), New Jersey Department of Health and Senior Services, Occupational Health Surveillance Program, Trenton, NJ, United States (3)

Poster: 0041

NIOSH-Designed Adjustable Roof Bracket and Safety Rail Assembly

TG Bobick (1) presenting, DM Cantis (1), E McKenzie (1)

NIOSH, Division of Safety Research, Morgantown, WV, United States (1)

Poster: 0042

Dump Truck-Related Deaths in Construction, 1992-2002

M McCann (1) presenting, M Cheng (2)

The Center to Protect Workers' Rights, Silver Spring, MD, United States (1), Professional Environmental Services, Inc., Bronx, NY, United States (2)

Poster: 0043

Validation and Reliability of a Checklist for Evaluating Cab Design Characteristics of Mobile Construction Equipment

NK Kittusamy (1) presenting, PB Aedla (2), MJ Jorgensen (2)

NIOSH-Spokane Research Laboratory, Spokane, WA, United States (1), Wichita State University, Wichita, KS, United States (2)

Poster: 0044

Electrical Arc Injury Parameters and Prevention

M Capelli-Schellpfeffer (1) presenting

CapSchell, Inc., Chicago, IL, United States (1)

Poster: 0045

The Fall Safe Project

B. Takacs (1) presenting

West Virginia University, WV, United States (1)

Poster: 0046

Safety Risks in Modular Home Construction

B Takacs(1) presenting

West Virginia University, WV, United States (1)

Health Care, Physical and Biological Risks, and Interventions

Poster: 0047

Factors Related to Healthcare Workers' Ability and Willingness to Report to Work During Catastrophic Disasters

K Qureshi (1) presenting, RM Gershon (1), MF Sherman (1), T Straub (1), E Gebbie (1), M McCollum (1), M Tan (1), SS Morse (1)

Columbia University, New York, NY, United States (1), Adelphi University, Garden City, NY, United States (2), Greater New York Hospital Association, New York, NY, United States (3), Loyola College, Baltimore, MD, United Kingdom (4)

Poster: 0048

Health and Safety Problems of Older RNs Employed in Hospital Settings

S Letvak (1) presenting

University of North Carolina at Greensboro, Greensboro, NC, United States (1)

Poster: 0049

The Longitudinal Relationship of Extended Work Schedules to Musculoskeletal Problemsin Nurses

A Trinkoff (1) presenting, J Geiger-Brown (1), B Brady (1), J Lipscomb (1)

University of Maryland Center for Occupational and Environmental Health and Justice, Baltimore, MD, United States (1)

Poster: 0050

Duration of Time on Shift Prior to Accidental Blood or Body Fluid Exposure for Housestaff, Nurses and Technicians

J Green-McKenzie (1) presenting, F Shofer (1)

University of Pennsylvania School of Medicine, Philadelphia, PA, United States (1)

RAPID Presentations Agenda

Poster: 0051

The Association of Overtime Work Hours with Ambulatory Blood Pressure Among Female Nurses

J Paik (1) presenting, P Landsbergis (1), K Gurnitz (1), P Schnall (2), T Pickering (3), J Schwartz (4)

Department of Community and Preventive Medicine, Mount Sinai School of Medicine, New York, NY, United States (1), Center for Occupational and Environmental Medicine, University of California, Irvine, Irvine, CA, United States (2), Behavioral Cardiovascular Health and Hypertension Program, Columbia Presbyterian Medical Center, New York, NY, United States (3), Department of Psychiatry and Behavioral Sciences, State University of New York at Stony Brook, Stony Brook, NY, United States (4)

Poster: 0052

Antibacterial, Antifungal, Antiviral, and Anti-spore Bio-Protective Equipment

Y Sun (1) presenting, J Luo (1)

The University of Texas at Austin, Austin, TX, United States (1)

Poster: 0053

Development and Implementation of a Model Surveillance System for Health Care Workers

JM Dement (1) presenting, HJ Lipscomb (1), L Pompeii (1)

Duke University Medical Center, Durham, NC, United States (1)

Poster: 0054

Musculoskeletal Injuries and Disorders Among a Large Cohort of Health Care Workers: Analyses from the Duke Health and Safety Surveillance System (DHSSS)

LA Pompeii (1) presenting, HJ Lipscomb (2), JM Dement (2)

The University of Texas Health Science Center at Houston, Houston, TX, United States (1), Duke University Medical Center, Durham, NC, United States (2)

Poster: 0055

Characteristics of Persons and Jobs with Needle-Stick Injuries in a National Data Set

JP Leigh (1) presenting

University of California, Davis, CA, United States (1)

Poster: 0056

A Safety Information Campaign to Reduce Sharps Injuries: Preliminary Results from the "Stop Sticks Campaign"

RC Sinclair (1) presenting, AG Harney (1), SW Smallwood (1), AL Christianson (1)

NIOSH, Cincinnati, OH, United States (1)

Poster: 0057

Prevalence and Risk Factors for Bloodborne Exposure and Infection in Correctional Healthcare Workers

RG Gershon (1) presenting, CS Mitchell (2), MF Sherman (3), SA Felknor (4)

Columbia University, New York, NY, United States (1), Johns Hopkins University, Baltimore, MD, United States (2), Loyola College, Baltimore, MD, United States (3), The University of Texas, Houston, TX, United States (4)

Poster: 0058

Bloodborne Pathogen Risk in Home Healthcare Workers

CW Winnen (1) presenting, RG Gershon (1), K Qureshi (1)

Columbia University, New York, NY, United States (1)

Poster: 0059

Innovative Health Care Worker Training: Infectious Disease Risk

RG Gershon (1) presenting, H Cole (2)

Columbia University, New York, NY, United States (1), University of Kentucky, Lexington, KY, United States (2)

Surveillance and Tracking, Social and Economic Analyses

Poster: 0060

Nature of Injury Data in the BLS Annual Survey Seriously Underestimate the Medical Burden of Work Injuries

A Oleinick (1) presenting, CR Gandra (1), C Simon (1), RA Werner (1)

University of Michigan, Ann Arbor, MI, United States (1)

Poster: 0061

Workers' Compensation Benefits Adequacy, Equity and Benefits Costs: Evidence from Canada on Two Approaches to Compensation for Permanent Impairment

E Tompa (1) presenting, C Mustard (1), S Sinclair (1)

Institute for Work & Health, Toronto, Ontario, Canada (1), McMaster University, Hamilton, Ontario, Canada (2), University of Toronto, Toronto, Ontario, Canada (3)

Poster: 0062

Beyond Income Losses: The Impact of Occupational Injuries on Wealth, Bankruptcy, Fringe Benefits, and the Use of Government Assistance Programs

M Galizzi (1) presenting, JL Zagorsky (2)

University of Massachusetts Lowell, Lowell, MA, United States (1), The Ohio State University, Columbus, OH, United States (2)

Poster: 0063

The Relationship of Age, Diagnosis and Industry on Cost and Disability: An Analysis Using a Workers' Compensation Database

K Dunning (1) presenting, K Davis (2), G Jewell (3), JL Lockey (4)

Department of Rehabilitation Sciences, University of Cincinnati College of Medicine, Cincinnati, OH, United States (1), Division of Industrial Hygiene, University of Cincinnati College of Medicine, Cincinnati, OH, United States (2), Ohio Bureau of Workers' Compensation, Columbus, OH, United States (3), Division of Occupationaland Environmental Medicine, Department of Environmental Health, University of Cincinnati College of Medicine, Cincinnati, OH, United States (4)

Poster: 0064

Administrative Delay and Secondary Disability Following Acute Occupational Low Back Injury

PL Sinnott (1) presenting

Health Economics Resource Center, VA Palo Alto Health Care System, Menlo Park, CA, United States (1)

Poster: 0065

Early Predictors of Work Disability Associated with Carpal Tunnel Syndrome: A Longitudinal, Population-Based Workers' Compensation Cohort Study

JA Turner (1) presenting, G Franklin (2), R Wu (1), D Fulton-Kehoe (1), J Gluck (1), L Sheppard (1),K Egan (1), T Wickizer (1)

University of Washington, Seattle, WA, United States (1), Washington State Department of Labor and Industries,Olympia, WA, United States (2)

RAPID Presentations Agenda

Poster: 0066

Is the Occupational Fatal Injury Experience in the United States Really Improving?

E Biddle (1) presenting

NIOSH, Morgantown, WV, United States (1)

Poster: 0067

Trends in Health Insurance Coverage in U.S. Worker Groups: The National Health Interview Survey (NHIS)

K Arheart (1) presenting, D Lee (1), LE Fleming (1), K Chung-Bridges (1), SL Christ (2), W LeBlanc (1), A Caban (1), T Pitman (1)

University of Miami, Miami, FL, United States (1), UNC Chapel Hill, Chapel Hill, NC, United States (2)

Poster: 0068

Health Experience of Workers Receiving Lump-Sum Payments from the Maine Workers' Compensation System during the Period 1998-2003 Part I Survey Development

IG Most (1) presenting, SJ Most (2)

University of New England, Biddeford, ME, United States (1), University of Southern Maine, Portland, ME, United States (2)

Poster: 0069

U.S. Worker Dental Care Access and Unmet Dental Needs: The National Health Interview Survey 1997 to 2003

AJ Caban (1) presenting, LE Fleming (1), DJ Lee (1), SL Christ (2), K Chung-Bridges (1), K Arheart (1), GW LeBlanc (1), T Pitman (1)

University of Miami School of Medicine, Miami, FL, United States (1), University of North Carolina Odum Institute, Chapel Hill, NC, United States (2)

Poster: 0070

Prioritizing Industries for Occupational Injury and Illness Research and Prevention

D Bonauto (1) presenting, B Silverstein (1), D Adams (1), M Foley (1)

Washington State Department of Labor and Industries, Olympia, WA, United States (1)

Poster: 0071

Hazard Surveillance – Development and Evaluation of Tools and Methods for a National Survey

JM Boiano (1) presenting, GM Piacitelli (1), JD Catalano (1), N Heyer (1), B Payne (1), WK Sieber (1)

Battelle, Seattle, WA, United States (1)

Poster: 0072

The Need for Workplace Surveillance for Occult Workplace Hypertension

P Schnall (1) presenting, P Landsbergis (1), M Jauregui (1), D Baker (1)

University of California at Irvine, Irvine, CA, United States (1), Mt. Sinai School of Medicine, New York, NY, United States (2)

Poster: 0073

Enhanced Surveillance to Detect Severe Nonfatal Occupational Injuries

PC Dischinger (1) presenting, KM Auman (1), SM Ho (1), ER Braver (1)

University of Maryland Baltimore, Baltimore, MD, United States (1)

Poster: 0074

Evaluation of State-Wide Emergency Department Data for Occupational Injury Surviellance

LK Davis (1) presenting, PR Hunt (1), H Hackman (1), V Ozonoff (1)

Massachusetts Department of Public Health, Boston, MA, United States (1)

Poster: 0075

The Utility of Linked and Transformed Workers' Compensation Data to Study Work Injuries by Occupation among Employees of Ohio For-hire Carriers, 1997-1999

A Oleinick (1) presenting, RA Werner (1), DF Blower (1), C Gandra (1), CD Simon (1)

University of Michigan, Ann Arbor, United States (1)

Poster: 0076

The Prevalence of Recent Skin Examinations in U.S. Worker Groups: The National Health Interview Survey (NHIS)

W LeBlanc (1) presenting, LE Fleming (1), D Lee (1), K Chung-Bridges (1), SL Christ (2), A Caban (1), K Arheart (1), T Pitman (1)

University of Miami, Miami, FL, United States (1), UNC Chapel Hill, Chapel Hill, NC, United States (2)

RAPID Presentations Agenda

Session II

Poster: 0077

An Innovative Approach to Occupational Injury Surveillance in the Developing World

H Marucci-Wellman (1) presenting, TTT Binh (3), NB Diep (3)

Liberty Mutual Institute for Safety, Hopkinton, MA, United States (1), University of Massachusetts Lowell, Lowell, MA, United States (2), National Institute of Occupational & Environmental Health, Vietnam, Hanoi, Vietnam (3)

Injuries in Agriculture and Fishing

Poster: 0016

Deck Safety in the Commercial Fishing Industry: Development of an Emergency-Stop System for a Hydraulic Deck Winch

JM Lincoln (1) presenting, R McKibbin (2)

NIOSH Alaska Fileld Station, Anchorage, AK, United States (1), NIOSH Spokane Research Laboratory, Spokane, WA, United States (2)

Poster: 0017

Stakeholder Input and Cultural Considerations in Addressing Behavioural Factors in a Unique Agricultural Work Population (Commercial Shrimpers)*

J Levin (1) presenting, K Gilmore (1), S Shepherd (1), JT Nalbone (1)

The University of Texas Health Center at Tyler, Tyler, TX, United States (1), The Southwest Center for Agricultural Health, Injury Prevention, and Education, Tyler, TX, United States (2)

Poster: 0018

Unique Occupational Injury Surveillance: Identification of the Total Injury Burden and Risks on Agricultural Operations

SG Gerberich (1) presenting, TR Church (1), BH Alexander (1), AS Masten (1), CM Renier (2), KF Carlson (1), AD Ryan (1), SJ Mongin (1)

University of Minnesota, Regional Injury Prevention Research Center, Division of Environmental Health Sciences, School of Public Health, Minneapolis, MN, United States (1), St. Mary's/Duluth Clinic Health S ystem, Division of Education and Research, Duluth, MN, United States (2)

Poster: 0019

Economic Consequences of Serious Work-Related Injuries in British Columbia Sawmills

H Alamgir (1) presenting, E Tompa (2), A Ostry (1), M Koehoorn (1), P Demers (1)

University of British Columbia, Vancouver, Canada (1), Institute for Work and Health, Toronto, Canada (2)

Poster: 0020

Workers' Compensation Experience of Colorado Agriculture Workers, 2000-2004

DI Douphrate (1) presenting, JC Rosecrance (1)

Colorado State University, Fort Collins, CO, United States (1)

Poster: 0021

Video-based Safety Intervention for West Virginia Loggers - A Success Story

JC Helmkamp (1) presenting, WJ Lundstrom (1), J Goldcamp (1)

Injury Control Research Center, West Virginia University, Morgantown, WV, United States (1)

Poster: 0022

Visual Sensor-Based Mobile Equipment Attitude Estimation for Rollover Prevention

M Kise (1), Q Zhang (1) presenting

University of Illinois at Urbana-Champaign, Urbana, IL, United States (1)

Poster: 0023

Evaluation of the NAGCAT Tractor Guidelines

FA Fathallah (1) presenting, B Marlenga (2), W Pickett (3), JA Miles (1), JM Meyers (1), J Chang (1), J Plasse (1), BJ Miller (1)

University of California, Davis, CA, United States (1), Marshfield Clinic Research Foundation-National Children Center, Marshfield, WI, United States (2), Queen's University, Kingston, Ontario, Canada (3)

Poster: 0024

Changing the Child Labor Laws for Agriculture: Impact On Injury

B Marlenga (1) presenting, RL Berg (1), JG Linneman (1), RJ Brison (2), W Pickett (2)

Marshfield Clinic Research Foundation, Marshfield, WI, United States (1), Queen's University, Kingston, Ontario, Canada (2)

Poster: 0025

Effectiveness of Farm Safety Day Camps: Influence of Camp Characteristics

DM McCallum (1) presenting, SJ Reynolds (2), MB Conaway (1)

University of Alabama, Tuscaloosa, AL, United States (1), Progressive Agriculture Foundation, Birmingham, AL, United States (2)

Poster: 0026

Farm Safety Day Camps - Reducing Children's Exposures to Farm Hazards by Influencing Parents' Attitudes Toward Farm Safety

DB Reed (1), DT Claunch (1) presenting, MK Rayens (1), S Westneat (1)

University of Kentucky College of Nursing, Lexington, KY, United States (1)

Poster: 0027

The Development and Pilot Testing of "First Aid Farm Quest," an Interactive CD Focusing on First Aid and Injury Risk Reduction for Farm Youth

AK Carruth (1) presenting

Southeastern Louisiana University, Hammond LA, United States(1)

Poster: 0028

Youth ATV Behavior

S Burgus (1) presenting, W Sanderson (2), M Madsen (2)

Farm Safety 4 Just Kids, Earlham, IA, United States (1), University of Iowa, Iowa City, IA, United States (2)

Poster: 0029

Do Ergonomic Interventions for Shovels Effectively Mitigate Risk of Injury in Farm Kids?

S Kotowski (1) presenting, K Davis (1), T Waters (2)

University of Cincinnati, Cincinnati, OH, United States (1), National Institute for Occupational Safety and Helath, Cincinnati, OH, United States (2)

Health and Safety in the Service Industries

Poster: 0078

Thermal Stress of Firemen During Training in Realistic Conditions

EA DenHartog (1) presenting, R Heus (1)

TNO Defense, Security and Safety, Soesterberg, Netherlands (1)

Poster: 0079

Acute Respiratory Effects of Smoke Exposure in Wildland Firefighters

DM Gaughan (1) presenting, JM Cox-Ganser (1), K Kreiss (1), PL Enright (2)

National Institute for Occupational Safety and Health, Morgantown, WV, United States (1), University of Arizona, Tucson, AZ, United States (2)

Poster: 0080

Designing EMS Ergonomic Interventions for the Fire Service

KM Conrad (1) presenting, PA Reichelt (1), SA Lavender (2), J Gacki-Smith (1)

University of Illinois at Chicago, Chicago, IL, United States (1), The Ohio State University, Columbus, OH, United States (2)

Poster: 0081

Single Nucleotide Polymorphisms (SNPs) Associated with Decline in Lung Function in Firefighters

M Kurzius-Spencer (1) presenting, B Yucesoy (3), S Guerra (2), ML Kashon (3), VJ Johnson (3), MI Luster (3), JL Burgess (1)

University of Arizona, College of Public Health, Division of Environmental and community Health, Tucson, AZ, United States (1), University of Arizona, College of Public Health and Arizona Respiratory Center, Tucson, AZ, United States (2), Toxicology and Molecular Biology Branch, Biostatistics Branch, Health Effects Laboratory Division, National Institute for Occupational Safety and Health, Morgantown, WV, United States (3)

Poster: 0082

Longitudinal Follow-Up of Patients Evaluated for Complaints Related to Nonindustrial Indoor Environments: Symptoms, Work and Lifestyle Changes

CA Redlich (1) presenting, MR Addorisio (2), KH Dangman (2), P Schenck (2), KD Sircar (3), C Daly (1), E Story (2)

Yale University School of Medicine, New Haven, CT, United States (1), University of Connecticut School of Medicine, Farmington, CT, United States (2), National Institute for Occupational Saftey and Health, Division of Respiratory Disease Studies, Morgantown, WV, United States (3)

Poster: 0083

Issues of Chemical Exposure in Korean-American Drycleaners: Findings of Focus Group

AS Jeong (1) presenting, OS Hong (1)

The University of Michigan, Ann Arbor, MI, United States (1)

Poster: 0084

Cross-Sectional Study of Auto Body Workers Exposed to Diisocyanates: Respiratory and Dermal Exposures Contribute to Immune Response

MH Stowe (1) presenting, AV Wisnewski (1), J Sparer (1), Y Liu (1), SR Woskie (2), CA Redlich (1), MR Cullen (1)

Yale University, New Haven, CT, United States (1), University of Massachusetts, Lowell, MA, United States (2)

RAPID Presentations Agenda

Poster: 0085

Intervention Research in Auto Body Repair and Refinishing Industry: The SMASH Study

Y Liu (1) presenting, MH Stowe (1), JA Sparer (1), D Bello (3), B Cartmel (1), K Ibrahim (1), C Fleming (1), I Collin-Hansen (1), C Daly (1), F Youngs (2), SR Woskie (2), MR Cullen (1), CA Redlich (1)

Yale University School of Medicine, New Haven, CT, United States (1), University of Massachusetts, Lowell, MA, United States (2), Harvard School of Public Health, Boston, MA, United States (3)

Poster: 0086

Workload-Related Musculoskeletal Disorders Among Hotel Housekeepers: Worksite Surveillance Reveals a Growing National Problem

E Frumin (1) presenting, P Vossenas (1), JY Moriarty (1), P Orris (2), J Halpin (2), N Krause (3), L Punnett (4)

UNITE HERE, New York, NY, United States (1), University of Illinois, Chicago School of Public Health, Chicago, IL, United States (2), University of California, San Francisco, Richmond, CA, United States (3), University of Massachusettes, Lowell Department, Work Env., Lowell, MA, United States (4)

Poster: 0087

Using a Programmed Intervention of Intermittent Stretching to Decrease Musculoskeletal Discomfort Associated with Work at a Computer Workstation

AH Marangoni (1) presenting

Wheeling Jesuit University, Wheeling, WV, United States (1)

Poster: 0088

A Randomized Controlled Trial of Ergonomic Interventions in Computer Users

D Rempel (1) presenting, N Krause (1), R Goldberg (1), D Benner (2)

University of California San Francisco, San Francisco, CA, United States (1), Kaiser Permanente, Oakland, CA, United States (2)

Poster: 0089

Occupational Health Hazards of Orchestra Musicians

JH Romeo (1) presenting

MedCentral College of Nursing, Mansfield, OH, United States (1)

Poster: 0090

World Trade Center Evacuation Study: Preliminary Findings

RG Gershon (1) presenting, K Qureshi (1), MF Sherman (2)

Columbia University, New York, NY, United States (1), Loyola College, Baltimore, MD, United States (2)

Poster: 0091

World Trade Center Evacuation Study: Preliminary Disability Data

MS Rubin (1) presenting, RG Gershon (1), MF Sherman (2)

Columbia University, New York, NY, United States (1), Loyola College, Baltimore, MD, United States (2)

Health Disparities and Special Populations

Poster: 0092

Racial and Ethnic Disparities in Work-Related Injuries Among Teenagers

KM Zierold (1) presenting, HA Anderson (2)

Wake Forest University School of Medicine, Winston-Salem, NC, United States (1), Wisconsin Division of Public Health, Madison, WI, United States (2)

Poster: 0093

Antecedents of Youth Work Injury: A Prospective Study

FC Breslin (1) presenting, JD Pole (1), E Tompa (1), B Amick (2), P Smith (1), S Hogg-Johnson (1)

Institute for Work & Health, Toronto, Ontario, Canada (1), University of Texas at Houston, Houston, TX, United States (2)

Poster: 0094

Work Disability Absences Among Young Workers Leads to Persistent Earnings

FC Breslin (1) presenting, E Tompa (1), R Zhao (1), B Amick (2), JD Pole (1), P Smith (1), S Hogg-Johnson (1)

Institute for Work & Health, Toronto, Onario, Canada (1), Univ. of Texas at Houston, Houston, TX, United States (2)

Poster: 0095

Occupational Health Surviellance of Low-Income, Minority and Immigrant Workers Through Community Health Centers

LK Davis (1) presenting, K Souza (1)

Massachusetts Deptartment of Public Health, Boston, MA, United States (1)

Poster: 0096

An Interfaith Workers' Center Approach to Workplace Rights

CC Cho (1) presenting, E Sweitzer (2), J Oliva (2), J Nevarez (1), J Zanoni (1), RK Sokas (1)

University of Illinois at Chicago School of Public Health, Chicago, IL, United States (1), Chicago Interfaith Workers' Rights Center, Chicago, IL, United States (2)

Poster: 0097

A Conceptual Model for Minority Worker Experiences: Identifying Problems of Work Organization

K Fujishiro (1) presenting, B de Castro (1), JL Oliva (2)

University of Illinois at Chicago, Chicago, IL, United States (1), Workers' Centers Network Interfaith Worker Justice, Chicago, IL, United States (2)

Poster: 0098

Understanding the Philosophical, Organizational, and Educational Role of Workers' Centers for Developing and Sustaining Programs on Workplace Health and Safety

LA Nickels (1) presenting, J Zanoni (1), N Remington (1), J Lippert (1)

University of Illinois at Chicago School of Public Health, Chicago, IL, United States (1)

Poster: 0099

Calculation of a Hispanic Obesity Index for Workplace Wellness Programs

JS Spahr (1) presenting, Ty Kau (1)

NIOSH, DSR, Morgantown, WV, United States (1)

Poster: 0100

A Longitudinal Evaluation of the Effectiveness of Minority Worker Health and Safety Training Programs in Eight Communities

SA Corell Sarpy (1) presenting, JD Kaufman (2)

Tulane University, New Orleans, LA, United States (1), Dell, Inc., Austin, TX, United States (2)

Poster: 0101

Depressive Symptoms and the Older US Worker; The National Health Interview Survey (NHIS)

SL Christ (2) presenting, D Lee (1), K Chung-Bridges (1), LE Fleming (1), K Arheart (1), W LeBlanc (1), A Caban (1), T Pitman (1)

University of Miami, Miami, FL, United States (1), UNC Chapel Hill, Chapel Hill, NC, United States (2)

Poster: 0102

Mechanisms of Repetitive Strain Injury in an Aging Model

RG Cutlip (1) presenting, KB Geronilla (1), BA Baker (1), RR Mercer (1), M Hollander (1), SE Alway (2)

NIOSH Health Effects Laboratory Division, Morgantown, WV, United States (1), West Virginia University Laboratory of Muscle Biology and Sarcopenia, Morgantown, WV, United States (2)

Poster: 0103

Aging And Intermittent Work Capacity

MA Nussbaum (1) presenting, Y Yassierli (1)

Virginia Tech, Blackburg, VA, United States (1)

Poster: 0104

The Health Behaviors of the Aging U.S. Worker: The National Health Interview Survey (NHIS)

LE Fleming (1) presenting, DJ Lee (1), AJ Caban (1), WG LeBlanc (1), K Chung Bridges (1), SL Christ (2), KL Arheart (1), T Pitman (1)

University of Miami Miller School of Medicine, Miami, FL, United States (1), University of North Carolina, Chapel Hill, NC, United States (2)

Poster: 0105

New York City Restaurant Health and Safety Project

Sl Jayaraman (1) presenting, C Liu (1), S Siby (1)

Restaurant Opportunities Center of New York, New York, NY, United States (1)

Musculoskeletal Risks and Disorders

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How Well Does the Strain Index Predict Carpal Tunnel Syndrome?

BA Silverstein (1) presenting, ZJ Fan (1), S Bao (1), P Spielholz (1), N Howard (1), C Smith (1), D Bonauto (1)

Washington State Department of Labor and Industries, Olympia, WA, United States (1)

Poster: 0107

Turning the Computer Mouse and Keyboard into Exposure Assessment Devices

PW Johnson (1) presenting, JT Dennerlein (2), C Chang (2)

University of Washington, Seattle, WA, United States (1), Harvard University, Boston, MA United States (2)

Poster: 0108

Reliability Of Observational Posture Assessment Using Multimedia Video Task Analysis

A Dartt (1) presenting, J Rosecrance (1)

Colorado State University, Fort Collins, CO, United States (1)

Poster: 0109

Linking Health and Productivity in Seated Environments: Results of an Intervention

BC Amick (1) presenting, L Bazzani (1), R Harrist (1), K DeRango (3), M Robertson (2)

University of Texas School of Public Health, Houston, TX, United States (1), Liberty Mutual Research Institute for Safety, Hopkinton, MA, United States (2), Upjohn Research Institute, Kalamazoo, MI, United States (3)

Poster: 0110

The Reliability Of An Observational Tool To Assess Personal Computer Keyboarding Style

NA Baker (1) presenting, M Redfern (1)

University of Pittsburgh, Pittsburgh, PA, United States (1)

Poster: 0111

Using a Software as an Exposure Assessment Device to Measure and Detect Computer Users' Muscle Fatigue

CH Chang (1), PW Johnson (2), JT Dennerlein (1) presenting

Harvard School of Public Health, Boston, MA, United States (1), University of Washington, Seattle, WA, United States (2)

Poster: 0112

Occupational Vibration Alters Neuromuscular Control in the Low Back

SE Wilson (1) presenting, L Li (1), M Arashanapalli (1)

University of Kansas, Lawrence, KS, United States (1)

Poster: 0113

The Measurement of Grip and Push Forces Applied to Vibrating Tools Using a Psychophysical Force-Recall Technique

TW McDowell (1) presenting, SF Wiker (2), RG Dong (1), DE Welcome (1)

National Institute for Occupational Safety & Health, Morgantown, WV, United States (1), West Virginia University, Morgantown, WV, United States (2)

Poster: 0114

Biological and Functional Effects of Repeated Vibration Exposures in Muscle Tissue

O Wirth (1) presenting, S Waugh (1), K Krajnak (1)

NIOSH/HELD/ECTB, Morgantown, WV, United States (1)

Poster: 0115

Genes Related to Growth, Inflammation and Degeneration Increase in Muscles in Temporally Different Patterns in a Rat Model of Work-Related Musculoskeletal Disorder

MF Barbe (1) presenting, M Amin (1), AE Barr (1)

Temple University, Dept Physical Therapy, Philadelphia, PA, United States (1)

Poster: 0116

An Experimental Model for Studying the Biodynamic and Physiological Effects of Vibration

K Krajnak (1) presenting, D Welcome (1), S Waugh (1), C Johnson (1), O Wirth (1), RG Dong (1)

NIOSH-Health Effects Laboratory, Morgantown, WV, United States (1)

Poster: 0117

Quantifying the Effects of Precision on Muscle Loading of the Upper Extremity During a Highly-Repetitive Hand Transfer Task

RS Escorpizo (1) presenting, AE Moore (2)

University of Toronto, Graduate Department of Rehabilitation Sciences, Toronto, Ontario, Canada (1), York University, School of Kinesiology and Health Science, Toronto, Ontario, Canada (2), Institute for Work and Health, Toronto, Ontario, Canada (3)

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Two New Methods for Assessing Risk Factors for Occupational Low Back Pain due to Manual Lifting in a Prospective Epidemiological Study

TR Waters (1) presenting, ML Lu (1), LA Piacitelli (1), DM Werren (1)

National Institute for Occupational Safety and Health, Cincinnati, OH, United States (1)

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Can Pain and Inflammation be Prevented in Strain-Injured Skeletal Muscles?

WT Stauber (1) presenting

West Virginia University, Morgantown, WV, United States (1)

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Dynamic Strength and Knowledge of Strength Affect Manual Materials Handling Strategy

X Zhang (1) presenting, DB Bartlett (1)

University of Illinois, Urbana, IL, United States (1)

Intervention Effectiveness; Organization of Work; Training

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Designing Organizations to Promote Successful Return to Work: Pathways to Success

BC Amick III (1) presenting, GS Iha (1), JN Katz (2), R Habeck (3)

University of Texas School of Public Health, Houston, TX, United States (1), Brigham & Women's Hospital, Boston, MA, United States (2), Upjohn Institute for Employment Research, Kalamazoo, MI, United States(3)

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Gender and the Work-Family Interface in the United States

S Schieman (1) presenting

University of Toronto, Toronto, Ontario, Canada (1)

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Work Organization and Employed Women's Post-Partum Health

NL Marshall (1) presenting

Wellesley College, Wellesley, MA, United States (1)

Poster: 0124

Work Organization and Postpartum Health of Employed Mothers Twelve Weeks After Childbirth

P McGovern (1) presenting, D Gjerdingen (1), B Dowd (1), L Ukestad (1), D McCaffrey (1)

University of Minnesota, Minneapolis, MN, United States (1)

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The Role of Psychosocial Work Exposures on Work-Role Functioning after Carpal Tunnel Release Surgery

D Gimeno (1) presenting, BC Amick III (1), RV Habeck (2), J Ossmann (1), JN Katz (3)

The University of Texas School of Public Health, Houston, TX, United States (1), W.E. Upjohn Institute for Employment Research, Kalamazoo, MI, United States (2), Brigham and Women's Hospital, Boston, MA, United States (3)

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The Relationship Between Work Organizational Factors, Physical Symptoms & Psychological Distress Two Years after the World Trade Center Terrorist Attacks

OYO Osinubi (1) presenting, P Ohman (1), S Ghandi (2), N Fiedler (2), M Robson (2), H Kipen (2)

University of Medicine & Dentistry of New Jersey-School of Public Health, Piscataway, NJ, United States (1), University of Medicine & Dentistry of New Jersey-Robert Wood Johnson Medical School, Piscataway, NJ, United States (2)

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Individual Reactions to High Involvement Work Processes

DM DeJoy (1) presenting, RJ Vandenberg (1), MM Butts (1), BS Schaffer (1), MG Wilson (1)

University of Georgia, Athens, GA, United States (1)

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What's Good for Your Eyes? Results From a Field Evaluation of Two Interventions

CK Chaumont-Menendez (1) presenting, BC Amick, III (1), MM Robertson (2), R Harrist (1)

University of Texas at Houston School of Public Health, Houston, TX, United States (1), Liberty Mutual Research Institute for Safety, Hopkinton, MA, United States (2)

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Selling Driver Safety in a Safety Naïve Organisation

RK Howell (1) presenting

AstraZeneca, Macclesfield, United Kingdom (1)

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Community and Workplace-Based Training Program for Occupational Medicine

EA Emmett (1) presenting, J Green-McKenzie (1)

University of Pennsylvania, Philadelphia, PA, United States (1)

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The Use of Recreational Techniques to Raise Awareness and Train Workers in Occupational Risks Prevention

L Margulis (1) presenting, E Erbojo (1)

Provincia ART, Capital Federal, Argentina (1)

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Job Demands and Occupational Health among Immigrant Poultry Processing Workers

JG Grzywacz (1) presenting, TA Arcury (1), ML Coates (1), B Burke (2), L Carrillo (2), A Marin (1), SA Quandt (1)

Wake Forest University School of Medicine, Winston-Salem, NC, United States (1), Centro Latino of Caldwell County, Lenoir, NC, United States (2)

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Recovery Pattern of Neck and Shoulder Pain among Sewing Machine Operators

D Rempel (1) presenting, J Wang (2), B Ritz (2), R Harrison (1), I Janowitz (1)

University of California San Francisco, San Francisco, CA, United States (1), University of California Los Angeles, Los Angeles, CA, United States (2)

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Aerosolization of Microbial Contaminants and Fine Particles from Metalworking Fluids

T Reponen (1) presenting, H Wang (2), SA Grinshpun (1)

University of Cincinnati, Department of Environmental Health, Cincinnati, OH, United States (1), University of Wisconsin at Whitewater, WI, United States (2)

Poster: 0136

Mycobacteria in Metalworking Fluids: Development of DNA-based Methods for Exposure Assessment

J Yadav (1) presenting, S Selvaraju (1), I Khan (1)

University of Cincinnati College of medicine, Department of Environmental Health, Cincinnati, OH, United States (1)

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Machine Safety Evaluation in Small Metal Fabrication Facilities

LM Brosseau (1) presenting, D. Parker (2), Y Samant (2)

University of Minnesota, Minneapolis, MN, United States (1), Park Nicollet Foundation, St. Louis Park, MN, United States (2)

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LM Brosseau (1) presenting, AL Fredrickson (1), MA Casey (1)

University of Minnesota, Minneapolis MN, United States (1)

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Machine Safety in Small Metal Fabrication Businesses

DL Parker (1) presenting, Y Samant (1), L Brosseau (1), W Pan (1), M Xi (1), D Haugan (1)

Park Nicollet Clinic, Minneapolis, MN, United States (1)

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Seasonal Influences on Low Back Pain

EW Wood (1) presenting, KT Hegmann (1), A Garg (1), M Thiese (1), S Oostema (1)

University of Utah, Salt Lake City, UT, United States (1)

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R Dong (1) presenting, J Wu (1), D Welcome (1), A Brumfield (1), T McDowell (1), O Wirth (1), K Krajnak (1)

NIOSH, Morgantown, WV, United States (1)

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Using Workplace Medical Surveillance to Evaluate A New Preventive Program in the Beryllium Industry: A Model for The Manufacturing Sector

KJ Cummings (1) presenting, CR Schuler (1), DC Deubner (2)

National Institute for Occupational Safety and Health, Morgantown, WV, United States (1), Brush Wellman Incorporated, Cleveland, OH, United States (2)

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Development of an Effective Beryllium Safety Model

DC Deubner (1) presenting

Brush Wellman Inc., Elmore, OH, United States (1)

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Practical Impact of Programmatic Research Results in the Beryllium Industry

A Weston (1) presenting, M Stanton (1), K Kreiss (1), C Schuler (1)

National Institute for Occupational Safety and Health, Morgantown, WV, United States (1)

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GS Poplin (1) presenting, HD Miller (2), J Ranger-Moore (1), CM Bofinger (3), M Kurzius-Spencer (1), RB Harris (1), JL Burgess (1)

University of Arizona, Tucson, AZ, United States (1), Colorado School of Mines, Golden, CO, United States (2), University of Queensland, Brisbane, Queensland, Australia (3)

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Injury and Fatalities in the Mining Workplace: Comparing the United States with Other Mining Countries

TM Brady (1) presenting, C Bise (2), CJ Fowler (3)

SRL/NIOSH, Spokane, WA, 99207, United States (1), Pennsylvania State University, State College, PA, United States (2), Johns Hopkins University, Baltimore, MD, United States (3)

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The Oil and Gas Extraction Industry: Recent Fatal Injury Data and Areas for Action

NA Mode (1) presenting, Frederick, JR (1), S Richardson (2)

CDC/NIOSH, Anchorage, AK, United States (1), Bureau of Labor Statistics, Washington, DC, United States (2)

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Using Simulation and Modeling to Study Traumatic Injuries: Case Study Mine Roof Bolting

EF Fries (1) presenting

NIOSH, Pittsburgh, PA, United States (1)

Poster: 0149

Using Simulation and Modeling to Study Traumatic Injuries: Case Study Mine Roof Bolting

EF Fries (1) presenting

NIOSH, Pittsburgh, PA, United States (1)

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Reducing Rock Fall Injuries to Coal Miners Using Roof Screen

GM Molinda (1) presenting, C Mark (1), S Gallagher (1)

NIOSH, Pittsburgh, PA, United States (1)

Poster: 0151

Reducing Injuries in Underground Mining Through the Application of Waterjet Scaling

ME Kuchta (1) presenting, HB Miller (1)

Colorado School of Mines, Golden, CO, United States (1)

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Methods to Characterize Diesel Particulate Matter in Occupational Settings

SE Mischler (1) presenting

NIOSH/PRL, Pittsburgh, PA, United States (1)

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A Person-Wearable Monitor to Continuously Measure Occupational Dust Concentrations

SE Mischler (1) presenting

NIOSH/PRL, Pittsburgh, PA, United States (1)

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Clothes-Cleaning Booth Enables More Effective Removal of Dust from Workers' Clothing

DE Pollock (1) presenting, AB Cecala (1)

NIOSH/PRL, Pittsburgh, PA, United States (1)

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MA Trevits (1) presenting, AC Smith (1), JF Brune (1)

NIOSH, Pittsburgh, PA, United States (1)

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RJ Burgess-Limerick (1) presenting, L Straker (2), C Pollock (2), G Dennis (1), S Leveritt (1), S Johnson (1)

University of Queensland, Brisbane, Queensland, Australia (1), Curtin University of Technology, Perth, Western Australia, Australia (2)

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MJ Jorgensen (1) presenting, M Viswanathan (1), NK Kittusamy (2)

Wichita State University, Wichita, KS, United States (1), NIOSH--Spokane Research Lab, Spokane, WA, United States (2)

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DCR Reinke (1) presenting, DsY Yantek (1), PJ Jurovcik (1)
NIOSH-Pittsburgh, Pittsburgh, PA, United States (1)

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T Pizatella (1) presenting
NIOSH, Morgantown, WV, United States (1)

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DM Freund (1) presenting
USDOT/FMCSA, Washington, DC, United States (1)

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PH Moore (1) presenting
National Institute for Occupational Safety and Health, Morgantown, WV, United States (1)

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DG Anderson (1) presenting, DB Reed (1)
University of Kentucky, Lexington, KY, United States (1)

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JE Swanberg (1) presenting, TK Logan (1)
University of Kentucky, Lexington, KY, United States (1)

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KM McPhaul (1) presenting, K Soeken (1), JV Johnson (1), JA Lipscomb (1)
University of Maryland School of Nursing, Baltimore, MD, United States (1)

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SG Gerberich (1) presenting, TR Church (1), PM McGovern (1), HE Hansen (2), NM Nachreiner (1), MS Geisser (1), AD Ryan (1), SJ Mongin (1), GD Watt (1), A Jurek (1)

University of Minnesota, Center for Violence Prevention and Control, Division of Environmental Health Sciences, School of Public Health, Minneapolis, MN, United States (1), University of Minnesota, School of Nursing, Minneapolis, MN, United States (2)

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M Lanza (1) presenting, J Rierdan (2)

Edith Nourse Rogers Memorial Veterans Hospital, Bedford, MA, United States (1), University of Massachusetts/ Boston, Boston, MA, United States (2)

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J Geiger Brown (1) presenting, C Muntaner (1), J Lipscomb (1), A Trinkoff (1)

University of Maryland, Baltimore, MD, United States (1)

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Violence Prevention in the Mental Health Setting: The New York State Experience

JA Lipscomb (1) presenting, K McPhaul (1), J Rosen (2), K Soeken (1), M Choi (1), V Vignola (2), J Foley (2), P Porter (2)

University of Maryland, Baltimore, MD, United States (1), New York State Office of Mental Health Multi-Union Health and Safety Committee, Albany, NY, United States (2)

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Personal Protective Eyewear and Postural Control

L Wade (1) presenting

University of Mississippi, University, MS, United States (1)

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Predicting Relative Workload During Physically Demanding Work

T Abdelhamid (1) presenting

Michigan State University, East Lansing, MI, United States (1)

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WE Daniell (1) presenting, SS Swan (1), J Camp (1), MM McDaniel (2), M Cohen (1), J Stebbins (3)

University of Washington, Seattle, WA, United States (1), Pacific Hearing Conservation, Seattle, WA, United States (2), Washington Department of Labor and Industries, Olympia, WA, United States (3)

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IJ Busch-Vishniac (1) presenting, JE West (1)

Johns Hopkins University, Baltimore, MD, United States (1)

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RG Gershon (1) presenting, M Barrera (1), M Akram (1)

Columbia University, New York, NY, United States (1)

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DM Raymond (1) presenting, O Hong (2), SL Lusk (2), DL Ronis (3)

Wayne State University, Detroit, MI, United States (1), University of Michigan, Ann Arbor, MI, United States (2), Department of Veterans Affairs, Ann Arbor, MI, United States (3)

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LD Fechter (1) presenting, B Pouyatos (1)

Loma Linda VA Medical Center, Loma Linda, CA, United States (1)

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L Hager (1) presenting, J Voix (1)

Sonomax Hearing Healthcare, Inc., Portland, MI, United States (1)

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Hearing Loss in the Military: The Results of Deployment to a Combat Environment

T Ross (1) presenting, W Daniell (2), A Wiesen (1)

Madigan Army Medical Center, Fort Lewis, WA, United States (1), University of Washington, School of Public Health, Seattle, WA, United States (2)

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D. Henderson, presenting (1)
State University of Buffalo, the State University of New York, Buffalo, NY, United States (1)

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M Yao (1), G Mainelis (1) presenting
Rutgers University, New Brunswick, NJ, United States (1)

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P Wolkoff (1) presenting, JK Nøjgaard (1), C Franck (2), P Skov (3)
National Institute of Occupational Health, Copenhagen Ø, Denmark (1), Slagelse County Hospital, Slagelse, Denmark (2), Roskilde County Hospital, Roskilde, Denmark (3)

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P Wolkoff (1) presenting, CK Wilkins (1), PA Clausen (1), GD Nielsen (1)
National Institute of Occupational Health, Copenhagen Ø, Denmark (1)

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WS Beckett (1) presenting, DC Chalupa (1), MW Frampton (1), MJ Utell (1), G Oberdorster (1), LS Huang (1), D Speers (1)
University of Rochester School of Medicine and Dentistry, Rochester, NY, United States (1)

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NIOSH Nanotechnology Safety and Health Research Program
NIOSH Nanotechnology Research Center (1) presenting
NIOSH, Cincinnati, OH, Morgantown, WV, Pittsburgh, PA, Spokane, WA, and Washington, DC, United States (1)

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AL Miller (1), MD Hoover (2) presenting
NIOSH, Spokane, WA, United States (1), NIOSH, Morgantown, WV, United States (2)

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NIOSH Control Banding Working Group (1) presenting

NIOSH, Cincinnati, OH, Morgantown, WV, Pittsburgh, PA, Spokane, WA, and Washington, DC, United States (1)

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CL Geraci (1) presenting, RD Zumwalde (1)

NIOSH, Cincinnati, OH, United States (1)

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NTP Center for the Evaluation of Risks to Human Reproduction

MD Shelby (2) presenting, GD Jahnke (1), AR Iannucci (1), AR Scialli (1)

Sciences International, Inc., Alexandria, VA, United States (1), NIEHS, Research Triangle Park, NC, United States (2)

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G Huszar (1) presenting

Yale School of Medicine, New Haven, CT, United States (1)

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Mixed Exposures in the Work Environment: A Bilingual Web Tool for Their Management

D Drolet (1) presenting, A Vyskocil (2), F Lemay (1), C Viau (2), G Lapointe (3), R Tardif (2), G Truchon (1), F Gagnon (2), N Gagnon (3), D Bégin (2), M Gérin (2)

IRSST, Montreal, Canada (1), University of Montreal, Montreal, Canada (2), CSST, Montreal, Canada (3)

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RE Savage Jr (1) presenting, E Hack (3), L Haber (3), A Maier (3), G Lotz (1), B Fowler (2), P Schulte (1), A Weinrich (4)

NIOSH, Cincinnati, OH, United States (1), ATSDR, Atlanta, GA, United States (2), TERA, Cincinnati, OH, United States (3), USEPA, Cincinnati, OH, United States (4)

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Methodological Issues Regarding Confounding and Exposure Misclassification in Epidemiological Studies of Occupational Exposures

A Blair (1) presenting, P Stewart (1), JH Lubin (1), F Forastiere (2)

National Cancer Insitute, Bethesda, MD, United States (1), 3Department of Epidemiology, Rome, Italy (2)

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Development of Dermal Uptake Pharmacokinetic Models for Solvents in Rats

PM Hinderliter (1) presenting, AD Woodstock (1), KD Thrall (1)

Pacific Northwest National Laboratory, Richland, WA, United States (1)

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Improved Prediction of Dermal Absorption of Small Doses of Potentially Volatile Chemicals

GB Kasting (1) presenting, MA Miller (1)

University of Cincinnati, Cincinnati, OH, United States (1)

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IRSST Institut de Recherche Robert-Sauvé en Santé et en Sécurité du Travail MISSION VISION IMPACT

DG Gaudet (1) presenting

IRSST, Montréal, Canada (1)

Poster: 0195

Fiber Deposition in the Human Respiratory Tract

WC Su (1) presenting, YS Cheng (1)

Lovelace Respiratory Research Institute, Albuquerque, NM, United States (1)

Poster: 0196

Smoking Prevalence and Healthcare Provider Smoking Cessation Advice Among U.S. Worker Groups: The National Health Interview Survey (NHIS)

D Lee (1) presenting, S Christ (2), K Arheart (1), K Chung-Bridges (1), W LeBlanc (1), A Caban (1), L Fleming (1), T Pitman (1)

University of Miami, Miami, FL, United States (1), UNC Chapel Hill, Chapel Hill, NC, United States (2)

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RAPID Presentations Agenda

Occupational Animal Exposure as a Predictor of Allergy and Asthma Prescription Drug Claims

CV Stanion (1) presenting
University of North Carolina at Chapel Hill, Chapel Hill, NC, United States (1)

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Abstracts

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A Theory-Driven, Evidence-Based Intervention: Seven Years, Four Thousand Businesses, Three Safer Ways To Work

LJ Chapman (1) presenting, KM Pereira (1), AC Newenhouse (1)

University of Wisconsin, Madison, WI, United States (1)

Broad Importance of the Research Problem: In most industries, many managers continue to rely on "older" production practices despite the ready availability of practices that can be more effective, less costly, and less hazardous to the health of the workforce but that, for various reasons, are not yet widely used. Often, what appears to stand in the way is a lack of awareness on the part of firm managers about the existence, value, and ease of use of the improved practices, at least in part attributable to the absence of convincing, comprehensive, and well-targeted interventions to optimize information flow. Our research results provide evidence that better information flow can be associated with increased adoption of safer production practices.

Purpose: Dairy work is especially hazardous compared to agricultural work overall. Previous research shows that agricultural managers resist adopting safer practices because they face few penalties for unsafe work and because many safer practices reduce profits compared to traditional practices. Consistent with production theory in economics, agricultural managers are known to adopt more profitable practices quickly.

Methods: Our intervention promoted three practices that were more profitable than traditional practices and reduced safety hazards:

- Barn lights improve both milk production and workplace visibility and reduce risks of falls and animal contact injuries versus poorly lighted barns.
- Bag silos require less work to store and access feed and reduce fall, asphyxiation, and machinery injury hazards versus traditional tower silos.
- Calf feeding systems reduce feeding time and musculoskeletal injury hazards versus traditional feed carrying and lifting to calf hutches.

We used diffusion of innovation theory to increase information flow about the three practices in the sources dairy managers were known to rely on (i.e. other farmers, trade publications, farm shows and field days, etc.). We conducted and evaluated the intervention throughout Northeast Wisconsin (4,300

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operations in 1998) and used mail questionnaires to annually evaluate independent, rolling, probability samples (n=300-600) including a baseline sample before the intervention. After the second intervention year, we also evaluated comparison samples of Maryland (later New York) dairies likely exposed to only the trade publications and Internet aspects of our intervention.

Findings: Univariate analysis suggested that our intervention's information reached managers because they reported seeing, reading, or hearing about both barn lights and bag silos more often in print media, at public events and from equipment dealers after the seven year long intervention than before. Logistic regression analyses (that controlled for farm manager age, experience, education, operation size, debt load) indicated that dairy farm managers were significantly more likely, after the intervention, to be aware of the barn lights and the calf feeding practices and more likely to have adopted all three practices.

How the Findings Advance the Field: This work exemplified good intervention evaluation practice bypromoting engineering controls, intervening with a large population of thousands of operations, minimizing information access costs via existing farmer information channels, and evaluating the intervention at baseline and after each year over a multi-year time frame.

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Poster: 0002

Agricultural Health in a Community-Based Farm Worker Population: The MICASA Study

MB Schenker (1) presenting, MT Marois (1)

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Hired farm workers provide the majority of the workforce for California's labor-intensive agriculture, yet they also suffer the greatest health burden. There has also been very little research on the health status of this population, which numbers ~1 million in California alone and is a NORA targeted industry sector. We have established a population-based cohort of 400 hired farm worker families in Mendota, California to follow-up on our previous cross-sectional studies, improve understanding of incident health risks and to provide a basis for the design of effective public health interventions. This approach allows us to address a wide range of factors affecting the health of this population including work, home environment, personal behaviors and health care access. The community has a large proportion of immigrants from Mexico and Central America, and a high proportion of agricultural workers.

Without a basic understanding of the nature and magnitude of health risks in these growing populations, effective public health interventions cannot be implemented. The evolving demography of immigrants and differences between urban and rural immigrant populations requires that information be obtained for rural Hispanic immigrants to understand and decrease the prevalence of occupational and environmental health (O/E) risks and other associated illnesses. Therefore, the overall goal of this project is to assess O/E factors related to respiratory disease, injuries and other health outcomes for hired farm workers and their families.

The sampling frame includes approximately 400 families residing in Mendota, California and eligible participants include men and women between the ages of 18-55 years who self-identify as Mexican or Central/South American, have been engaged in farm work for at least 30 days in the last year, and reside in Mendota, California. A two-stage sampling process was employed including the identification of eligible census tracts and door-to-door enumeration. In the first stage, a list of blocks within the two census tracts was compiled. In cases where the block had less than 40 households according to 2000 census data, adjacent blocks were combined to provide at least 40 households per cluster. A random sample of these block clusters was selected providing 20 block clusters with 1100 housing units and 1011 Hispanic families according to census data. Enumerators then created a universal list of all dwellings within these selected block clusters in Mendota using a door-to-door enumeration procedure. Once dwellings were mapped, enumerators returned and enumerated the people living in the household. At this stage, we obtained relationship to head of household, age, gender, ethnicity, involvement in farm work, and years of residence in Mendota.

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All data collection is done in the community by a local field team. An interviewer-administered questionnaire is completed in the home or at the project facility by the head of the household and spouse. An interviewer-administered questionnaire assesses information on demographics, O/E risk factors, acculturation, smoking status and health outcomes.

2441 adults were enumerated residing in 751 households. 66% were male and 85.8% of enumerated individuals had engaged in farm work in the last year. 54.6% were Mexican born, 35% were Central/South American, and 10% were U.S. born. Mean age was 34 years, with 46.7% of adults between 17-30 years. Average length of residence in Mendota was 11.7 years. 10% reported living in Mendota for one year or less and 27.9% had resided there for 2-5 years. Household composition varied in this population. Among households with married couples, 9% had two or more couples residing there, 10% had a sibling, and 26% had two or more budgetary units at the same address. 24% of households were composed of solo males, with 88% of these having separate budgetary units.

California's hired farm workers face increased risks of morbidity and mortality from respiratory disease, musculoskeletal problems, certain cancers, infectious diseases, stress-related mental health disorders, and these health problems may be related not only to the type of work they engage in but also to the environment in which they live.

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Poster: 0003

Use of Agricultural Pesticides and Prostate Cancer Risk in the Agricultural Health Study Cohort And Future Plans For Molecular Studies

M Alavanja (1) presenting, J Coble (1), L Beane-Freeman (1), J Rusiecki (2), M Bonner (3), R Mahajan (1), M Dosemeci (1), C Samanic (1), J Lubin (1), C Lynch (1), C Knott (4), L Moore (1), R Hayes (1), J Hoppin (5), J Barker (6), K Thomas (7), R Allen (8), C Hines (9), D Sandler (5), A Blair (1)

National Cancer Institute, Bethesda, MD, United States (1), Uniformed Services University of Health Sciences, Bethesda, MD, United States (2), State University of New York at Buffalo, Buffalo, NY, United States (3), Battlelle Inc., Durham, NC, United States (4), National Institute of Environmental Health Sciences, RTP, NC, United States (5), IMS, Inc., Bethesda, MD, United States (6), U.S. Environmental Protection Agency, RTP, NC, United States (7), U.S. Environmental Protection Agency, Crystal City, VA, United States (8), National Institute for Occupational Safety and Health, Cincinnati, OH, United States (9)

The role of specific agricultural chemicals in relation to prostate cancer risk and other cancers has not been firmly established due to lack of precise exposure data in previous studies. We comprehensively examined the relationship between 50 common agricultural pesticides and prostate cancer incidence at two points in time (i.e., 2003 and 2005) in a prospective cohort study of 55,332 male applicators from Iowa and North Carolina (the Agricultural Health Study) without prior history of prostate cancer. In both periods of time, a significant excess risk of prostate cancer was observed. Farmers and commercial pesticide applicators had an SIR for prostate cancer of 1.23 (1.18-1.33). Significant exposure-response relationships and/or interaction odds ratio between specific pesticides (butylate, chlorpyrifos, coumaphos, fonofos, phorate, and pyrethrin) among those with a family history of prostate cancer but not among those without a family history of prostate cancer risk were observed, confirming earlier observations. These pesticide-family history interactions suggest gene-environment interactions, but alternative explanations related to clustering of occupational exposures are also possible. A nested case-control study of selected metabolic and DNA repair gene polymorphisms and several biomarkers of genetic and epigenetic damage is planned to clarify the mechanisms that may be responsible for the observed association in our cohort analysis. Specifically, we will assess whether markers of oxidative stress, inflammatory response, genetic and epigenetic damage is observed more frequently in highly exposed subjects compared to those with low exposure over a working lifetime. Histological and molecular tumor tissue characteristics among high and low exposed cases will also be compared.

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Poster: 0004

Cancer Incidence among Pesticide Applicators exposed to Trifluralin in the Agricultural Health Study

D Kang (1) presenting, SK Park (1), L Beane-Freeman (1), CF Lynch (3), CE Knott (4), DP Sandler (2), JA Hoppin (2), M Dosemeci (1), J Coble (1), J Lubin (1), A Balir (1), M Alavanja (1)

NCI, Bethesda, MD, United States (1), NIEHS, Research Triangle Park, NC, United States (2), University of Iowa, Iowa City, IA, United States (3), Batelle/Centers for Public Health Research and Evaluation, Durham, NC, United States (4)

Trifluralin, α,α,α-trifluoro-2,6-ninitro-N,N-dipropyl-p-toluidine, is a herbicide widely used to control annual grasses and broadleaf weeds in agricultural settings. Of 24,000 tons produced worldwide in 1998, about 64% was used on soybeans, and 19% was used on cotton. Although the U.S. EPA classified trifluralin as a possible human carcinogen, this classification is based entirely on animal studies as there have been no epidemiologic studies on the carcinogenic effects of trifluralin. The association between trifluralin use and common cancer incidence was evaluated among 50,127 private and commercial pesticide applicators in the Agricultural Health Study (AHS), a prospective cohort study of licensed pesticide applicators and their spouses in Iowa and North Carolina enrolled between 1993-7. Poisson regression was used to examine internal dose-response relationships, while controlling for important lifestyle factors and other agricultural exposures. Two metrics of exposure (lifetime days and intensity weighted lifetime days) were used in exposure- response analyses. The intensity weighted days accounts for differences in mixing and application practices which may influences total pesticide exposure. Both were examined using non-exposed applicators, as well as those in the lowest tertile of exposure, as the reference group. Incident cancers were identified through state tumor registries from enrollement in 1993 through 2002. Among private and commercial applicators, 51% (n=25,712) reported having ever used trifluralin. Although trifluralin exposure was not associated with cancer incidence overall, there was an excess of colon cancer in the upper exposure category (odds ratios (OR) of 1.76 (95% CI 1.05-2.95) using the non-exposed as a referent and 1.93 (95% CI 1.08-3.45) using those with the lowest tertile of exposure as the referent). For neither, however, was there a clear, monotonic exposure-response trend. There was also a non-significantly elevated risk for kidney cancer in the highest exposure group. This is the first report of a possible link between trifluralin exposure and colon cancer risk in humans. Although this could be a chance finding, the dose response trends and the consistency of findings with different referent groups is consistent with the animal literature in suggesting that trifluralin is a possible human carcinogen.

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Poster: 0005

Pesticide Exposure among Children in Farmworker Households in Eastern North Carolina

TA Arcury (1) presenting, DB Barr (2), SW Davis (1), JG Grzywacz (1), SA Quandt (1)

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Importance of Research Problem: Organophosphorus (OP) pesticide exposure among migrant and seasonal farmworker families, particularly among children, is a growing concern. OP pesticide exposure can cause immediate health problems, ranging from nausea and dermatitis to coma and death. Additionally, the delayed effects of OP pesticide exposure, particularly among children, can also have great impacts, including increased risk for retarded neurobehavioral development and for cancer. The levels and predictors of OP pesticide exposure among farmworker children must be delineated to inform procedures for minimizing children's OP pesticide exposure.

Objectives of this Study: This study (1) describes the urinary OP pesticide metabolite levels among children living in Latino farmworker households located in eastern North Carolina, (2) compares the OP metabolite levels of these children with national reference data, and (3) delineates the relative importance of risk factors for urinary OP pesticide metabolite levels among these children based on a systematic model of pesticide exposure.

Summary of Methods: This analysis uses urine samples collected from 60 1- to 6-year old children living in eastern North Carolina farmworker households during the 2004 agricultural season. Mothers completed interviews assessing risk factors and collected first morning voids from their children. Urine samples were frozen and shipped to the Pesticide Laboratory, National Center for Environmental Health, CDC, in Atlanta, Georgia, for analysis. Samples were analyzed for six dialkylphosphate metabolites of organophosporus pesticides. Predictors investigated in the analysis include measures of para-occupational exposure and residential exposure, as well as safety behaviors, child characteristics and mother characteristics.

Summary of Findings: The urine samples from all 60 children had OP pesticide metabolites. Median levels were 2.75µg/L for DMP, 6.72µg/L for DMTP, 0.67µg/L for DMDTP, 5.97µg/L for DEP, 0.79µg/L for DETP, and <LOD for DEDTP. OP pesticide metabolite levels for these children compared to national

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reference data had greater values at the 50th percentile for 5 of the metabolites, at the 95th percentile for 3 of the metabolites. No specific factors account for the variability in the metabolite levels, indicating the need for more detailed investigation of exposure.

How Findings Advance Research: Children living in North Carolina farmworker households have relatively high levels of OP urinary metabolites. However, like other exposure research, this analysis could not determine factors related to the levels of OP urinary metabolites among children. These findings argue for more detailed measurement of pesticide exposure and risk factors to delineate the causes of pesticide exposure among children.

How Findings can be used to Improve Workplace Safety and Health: Children in farmworker families experience pesticide exposure. These results suggest that improvements are needed in workplace process and hygiene to reduce take-home pathways of pesticide exposure and drift from pesticide application. Training for growers and workers must address procedures to reduce take-home pesticide exposure.

How the Findings relate to a Particular Industry Sector: These findings address issues for the Agriculture, Forestry and Fishing Sector. They also have implication for nursery and greenhouse workers, landscape workers, and golf course workers, all of whom work with pesticides.

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Poster: 0006

Pesticide Exposure Assessment in the AHS: Phase II Update

J Coble (1) presenting, C Samanic (1), JA Hoppin (2), K Thomas (3), M Dosemeci (1), D Sandler (1), A Blair (1), M Alavanja (1), C Hines (4)

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Pesticide exposure assessment for epidemiology studies is challenging due to the wide variety of pesticides used and changes over time in the use of specific pesticides. The Agricultural Health Study (AHS) is a large prospective cohort study of over 52,000 private (primarily farmers) and commercial pesticide applicators from Iowa and North Carolina enrolled between 1993 and 1997 (Phase I). A unique characteristic of the AHS is the detailed information on the lifetime use of specific pesticides. Information on pesticide use was updated during Phase II of the AHS, conducted between 1999 and 2003, during which computer aided telephone interviews were conducted with 35,347 pesticide applicators (68%) to obtain information on their current use of pesticides, along with information on health and lifestyle factors. Phase II participants were asked to report all the pesticides they had personally mixed, handled or applied during the most recent year in which they had mixed or applied pesticides, along with information on the application methods they used, their use of personal protective equipment when mixing and when applying pesticides, and other factors thought to affect exposure intensity. Of the Phase II participants interviewed, 26,757 (80%) reported that they had actively farmed and mixed or applied pesticides since enrollment. Information on the frequency of use for specific pesticides was obtained for 96% of these participants. The median number of pesticides reported was 5 (range 1-43), and 85% of applicators reported using less than 10 different pesticides. The average annual days of use for any pesticide was 12.5 (14.6) and 16.5 (23.6) in IA and NC, respectively. Use of one or more herbicides was reported by 93% of applicators; the most frequently reported herbicides were glyphosate, 2,4-D and atrazine. Use of one or more insecticides was reported by 45% of applicators; the most frequently reported insecticides were malathion, chlorpyrifos and carbaryl. Use of fungicides was reported by 16% of applicators; the most frequently reported fungicides were mancozeb, metalaxyl and captan. Less than 1% of applicators reported use of fumigants.

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The percentage of applicators who reported use of herbicides was higher in IA than in NC (98 vs. 81) , while the percentage of applicators who reported use of insecticides (49% vs. 44%), fungicides (24% vs. 13%) and fumigants (4% vs. 1%) was higher in NC than in IA. For five herbicides and three insecticides, over 500 applicators reported use during Phase II but not at enrollment. In addition, 2 of the top 10 most frequently reported herbicides and 3 of the top 10 most frequently reported insecticides during Phase II were not included on the enrollment questionnaire. The changes identified in the specific pesticides used during Phase II compared with the enrollment questionnaire will be valuable to update lifetime exposure information for the epidemiologic
analysis of the AHS cohort.

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Poster: 0007

Respiratory Protection against Bioaerosols in Agriculture

T Reponen (1) presenting, S-A Lee (2), R McKay (1), R Shukla (1), SA Grinshpun (1)

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Background: Agricultural workers can be exposed to high concentrations of airborne microorganisms and thus have an increased risk for developing respiratory diseases. Respirators, when properly selected and used, can decrease agricultural workers' exposure.

Objective: In this study, a new field-compatible method was developed to dynamically measure the protection provided by respirators against dust and bioaerosols in agricultural environments. A pilot study was performed in agricultural environments to evaluate the method in field conditions.

Methods: This method includes filter sampling to determine the protection provided by respirators against biological particles (fungal and actinomycete spores, bacteria). The new method was evaluated first in the laboratory under controlled conditions. After that, it was tested in the field while workers (n=6) were using N95 filtering-facepiece respirators during different agricultural operations: animal feeding (dairy, swine and poultry), grain harvesting and unloading, and routine checking of animals in confinements (swine and poultry). The number concentration and size distribution of particles were measured with an optical particle counter. Microorganisms were collected onto a polycarbonate filter and analyzed by microscopic counting and cultivation.

Results: Extensive laboratory evaluation confirmed that the sampling system can detect changes in the protection factors caused by variation in faceseal leaks, human activity, and breathing pattern in both manikin-based and human tests. It was found that the sampling flow was least affected by the inhalation flow when the sampling probe was imbedded on the respirator surface. Leak location, leak size, breathing patterns, and exercises did affect the measurement of the protection factors obtained by a N95 filtering facepiece respirator because of the differences in the in-mask airflow dynamics contributed by the leak, filter material, sampling probe, and inhalation. The field-testing showed that rable fungi was significantly greater than for total culturable bacteria. With respect to microorganisms, the WPFs for Cladosporium and total fungi were significantly correlated with the WPFs for particles of the same sizes. As compared to the WPFs for dust particles, the WPFs for bioaerosols were found more

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frequently below 10, which is a recommended assigned protection factor (APF) for N95 filtering facepiece respirators. More than 50% of the WPFs for microorganisms (mean aerodynamic diameter < 5 µm) were less than the proposed APF of 10.

Conclusions: The new method is a promising tool for further epidemiological and intervention studies in agricultural and other occupational and non-occupational environments contaminated with airborne dust and bioaerosols. Based on the pilot WPF data, the APF 10 seems to be inadequate for microorganisms with particle size <5 µm. This finding, however, needs to be confirmed in a full-scale field study.

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Poster: 0008

Ventilation Strategies for Confined-Space, On-Farm Manure Storages

HB Manbeck (1) presenting, DJ Murphy (1), J Zhao (1), EP Pesce (2)

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There are many reports of farmers and farm workers succumbing to the noxious gases in confined-space, on-farm manure storages. Often, multiple deaths occur when family members or friends attempt to rescue the first to succumb to the noxious gases. There is a need to develop engineering standards for the design and installation of ventilation systems to remove noxious gases from such storages prior to entry. The overall objective of the reported research is to develop guidelines and standards to reduce risks associated with entry into confined on-farm manure storage facilities.

A test facility, in which the spatial and temporal distribution of noxious gases in confined space manure storages can be measured, has been constructed and instrumented. In the test facility, distribution of gas concentrations can be measured prior to agitation, during agitation and during force air ventilation at the conclusion of agitation. Ventilation strategy screening experiments have been completed for a prismatic-shaped, confined manure storages with totally slotted, partially slotted and solid covers. Gas decay data have been collected and analyzed for a range of ventilation strategies which include two air exchange rates and five fan locations for each floor type.

Based primarily on the times required to reduce hydrogen sulfide and ammonia concentrations to below Permissible Exposure Limits (PEL) and time to reduce gas concentrations to 10% of initial (T10) gas concentration levels, the best location and air exchange rates for ventilation fans for confined storages with totally slotted, partially slotted and solid covers have been identified. The gas decay curves generally were nonlinear in semi-log space. This outcome strongly suggests that the gas emissions from the manure surface significantly impact ventilation performance.

Experiments have been conducted at the confined space manure storage test site specifically to quantify the emission rates of hydrogen sulfide from the stored manure. Emission rate data were collected while the manure was quiescent, during agitation of the manure, and while the manure was quiescent, but with air movement across the manure surface. Air movement across the surface during experiments was similar to that occurring when ventilating the manure storage to remove noxious gases. Gas concentration data

were collected during cold, warm and hot weather. The following trends were observed: the higher the temperature, the higher the emission rate; the higher the air flow across the manure surface, the higher the emission rate; and the higher the gas concentration in the space above the manure surface, the lower the emission rate. Emission rates are presented as a function of ventilation time, temperature, and gas concentration.

Computational fluid dynamics modeling of the best ventilation strategies identified in the screening studies and using the measured emission rates is underway. The goal is to use the experimental data to validate the CFD modeling protocols. After validation, a wide range of confined manure storages will be simulated to identify satisfactory ventilation strategies for each.

The findings of this research form the technology basis upon which ventilation standards can be developed for evacuating noxious gases from on-farm, confined-space manure storages. Having such standards will provide industry with guidelines for designing and installing appropriate ventilation s ystems in confined space manure storages. Subsequently the risk to farm workers and families from death or serious injury from entering confined space manure storages during maintenance and repair activities will be greatly reduced.

The NORA research focus addressed in the research is: Work environment and workforce - special populations at risk in agriculture, forestry and fishing.

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Poster: 0009

Assessing Heat Related Illness in Field Crop Workers in North Carolina

J Sabella (1), J Bernhart (2) presenting

NC Agromedicine Institute, Greenville, NC, United States (1), East Carolina University, Greenville, NC, United States (2)

North Carolina's excessively hot and humid summers challenge individuals to stay cool when working outside. Exposure to direct sun with limited convection and evaporation increases body heat production. Heat-related illness can range from minor to life threatening conditions. Agricultural field workers are especially vulnerable. Approximately 240 persons die of exertional heat-related disorders in the United States each year. Over the past several years in North Carolina, three reported events related to heat stroke have resulted in one Hispanic farm worker dying; one living in a vegetative state and returning to Mexico; and one who has recovered from his illness. Concerned by these reports of heat related illness, researchers from the N.C. Agromedicine Institute, located in Eastern North Carolina, along with a team of data collectors, conducted a study to assess the effects of environmental heat on the health status of farm workers, primarily Hispanic, in Eastern North Carolina. The study was funded jointly by the United States Department of Agriculture (USDA) and the National Institute for Occupational Safety and Health (NIOSH). This presentation will outline the study protocols and present study results including correlation of physiological data to environmental field conditions and variations in workers demographics and health status.

The study took place over a four year period. Data has been collected in cucumber and tobacco operations for 220 field worker days. The research team was comprised of a nurse, a bilingual interpreter, an environmental engineer and a trained physical assessment assistant. Measurements were collected before the workday begins, every two hours throughout the day and at the end of the workday. Field temperature, humidity and heat index were obtained from environmental instruments at three locations in the field. Physiological measures include temperature, pulse, respirations, blood pressure (supine and standing), and cognitive function. Worker productivity was measured by tracking the number of buckets picked per two hour measurement periods.

The maximum air temperature during the study field days ranged from 101 to 114 degrees Fahrenheit. The maximum heat index in the field ranged from 91 to 95 which were often as much as 5 degrees Fahrenheit above temperatures reported by the National Weather Service. Baseline physiologic

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measurements were obtained before work began in the morning at approximately 6 AM, with subsequent measurements at 2 hour intervals there after. Core body temperature estimated with a tympanic ear monitor increased significantly at each measurement time, with mean increases of 1, 1.3, 1.9 and 2.3 degrees centigrade respectively. Mean increase of pulse rates over baseline at each observation time was 6.8, 9.3, 17.5, and 23.4 beats/min ($p<0.05$) respectively. Mean increase of respiratory rate over baseline was 1, 3, 2, and 5, breaths/min respectively, with the last three means significantly higher than baseline. The orthostatic changein blood pressure was also compared to baseline. Mean systolic change over baseline at each observation time was 2.9, 2.8, 3.9, and 1.9 mm Hg ($p<0.05$) respectively. Worker productivity was correlated with the change in core body temperature over the day. Workers with the largest increase in core body temperature had the highest productivity, while those with the smaller increase had the lowest productivity.

The value of this correlation was 0.60 ($p<0.05$).

Poster: 0010

The Aging Farm Workforce: Work, Organization, Health, and Social Dimensions

DB Reed (1) presenting, MK Rayens (1), S Westneat (1)

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The average age of the nation's workforce is 38, but the average age of its farmers is 55. Half of America's farms are operated by persons age 55 and over; 17% are operated by persons over age 70. Despite the rapid aging of the agricultural worker, little is known about their work, work organization, or why they remain in this hazardous occupation. There are no guidelines on farm practices for senior aged farmers. The purpose of this study is to provide data that can be used to develop interventions to optimize healthy and safe working conditions for older farmers and provide a better understanding of what motivates them to remain in their vocation. A cohort of farmers age 50 and over and their spouses (n=1,143) were enrolled in a four year study that elicited data on farm type, current work, work organization, health status, and sociologic work items. Four mailed and telephone surveys were conducted (response rate 67.6%) and three rounds of focus groups (total n=122) were conducted from 2003-2005. Data collection intervals ensured capture of seasonal variation in farm work. Farm type was predominantly mixed livestock/crop farms (63%). Average age of the respondent was 65, and gender was split equally, with 80% White and 20% Black. One-third reported being in excellent/very good health, and averaged two health conditions. Three-fourths took at least one prescription medication daily, 28% reported difficulty being on their feet for two hours, and 40% admitted difficulty stooping or kneeling. Despite these limitations, subjects scored high in measures of self-efficacy, and only 12% scored >16 on the standard CES-D depressive symptoms scale, better than the general elderly population. "Health" was defined as the ability to work by 40% of the sample. This was reflected in the type and amount of work they reported. Males reported performing 11 farm tasks in the past 12 months, with a mean of 19.2 hours worked in the past week. As age increased, ground tillage and hand harvesting decreased, but no change was detected in work associated with livestock or business decisions. Over half the respondents held a concurrent off-farm job. Over half did not foresee passing on farm management or farm work or changing farm type in the next 5 years. Most (60%) reported great satisfaction from their farm work; satisfaction increased with age. Focus group data supported that technology and production modifications were used to remain in physical production process while decreasing time demands. Participants planned to work until health forced them from the fields. When discussing retirement more attention was placed

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on the future of the farm than on health or desire to retire. Work was portrayed as stress relief, something to be enjoyed, a measure of health status, and self-identity. The findings illuminate the need to provide appropriate health and work counseling for older farmers in order to optimize healthy and safe work conditions. While other industries provide retirement benefits that make it attractive to stop working, farmers perceive work as its own benefit.

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Poster: 0011

Community Partners for Healthy Farming Intervention Research

JK Ehlers (1) presenting

CDC/NIOSH, Cincinnati, OH, United States (1)

Agriculture is among the most hazardous industries with an unintentional death rate in 2001 of 21.0 per 100,000 workers for agriculture vs. 3.6 for workers in all industries (National Safety Council, 2002). Agriculture varies in terms of farm size, hazards, labor regulations, and owner autonomy. Although many intervention strategies have been tried, knowledge about what works best is limited. The purpose of the Community Partners for Healthy Farming Intervention Research (CPHF-IR) program is to implement and evaluate existing or new interventions for reduction of agriculturally-related injuries, hazards, and illnesses. Consistent with the objectives, synergistic partnerships between experienced researchers and stakeholders, e.g. communities, workers, managers, agricultural organizations, agribusinesses and media, provided their unique resources for accessing the target populations, guidance throughout the research process, dissemination, and building infrastructure for further promotions of agricultural safety and health.

Specific intervention projects and target populations were selected from responses to three requests for proposals. Accomplishments have included: improved ergonomics for small vegetable growers and harvesters of grapes and berries; engineering controls, training, and promotional materials related to tractors; 1,292 safety improvements made voluntarily by farmers in the Certified Safe Farm project; and, in collaboration with lay health advisors (Promotores), reduced eye injuries among Latino workers. Musculoskeletal pain was reduced five-fold with no significant change in productivity by decreasing the weight of grape-filled tubs from 57 to 46 lb. Management and workers enthusiastically adopted the smaller, lighter tubs with the only incentive being the improved working conditions. This was the first field study validating the NIOSH-lifting-equation.

Such partnerships between researchers and stakeholders produce not only sustainable interventions, but products and models with the potential to expand geographically and into other sectors. Without additional funding from the Community Partners program, the eye-injury prevention project was replicated by a community coalition with the largest citrus grower in FL decreasing injuries 75%. The development and dissemination of interactive, narrative materials for promoting the use of roll-over protective structures (ROPS) on tractors has resulted in multiple outcomes: increased sales and use of ROPS and recognition by non-researchers about the value of evaluation to enhance support for useful intervention programs.

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The model and materials have been utilized for primary prevention among healthcare workers and adolescents, and for introducing public health or economics in high school social studies and language classes and in college agricultural business and economics classes. NIOSH is utilizing the model created for Simple Solutions: Ergonomics for Farm Workers, a document incorporating the format and portions of three CPHF-IR projects, for a comparable document for the construction industry in English and Spanish. Products of every project are being widely disseminated electronically, in trade publications and professional journals, and otherwise among agricultural workers and those who influence them. The third series of projects (funded 2003-2007) targets ergonomic interventions among tree-fruit harvesters and nursery workers, computer-based training for non-English speaking vineyard workers, and expansion of the Certified Safe Farm project to include medical claims data in their evaluation.

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Poster: 0012

Strengthening the Evaluation Skills of Agricultural Health and Safety Practitioners and Researchers

K Bruns (1), T Archer (1), C Heaney (2) presenting

Ohio State University, Columbus, OH, United States (1), Stanford University, Stanford, CA, United States (2)

In response to the continuing high rates of injury among agricultural workers, many injury prevention programs have been developed and conducted. Unfortunately, several reviews of injury and illness prevention efforts in agriculture have concluded that there is little evidence for the effectiveness of specific preventive intervention efforts and little empirical guidance for choosing one type of intervention over another. This lack of empirical guidance is partially due to a dearth of program evaluation activity among agricultural health and safety professionals and researchers. The Great Lakes Center for Agricultural Safety and Health (GLCASH) Fellows Program was developed to strengthen the evaluation skills of these occupational safety and health (OSH) professionals.

OSH practitioners and researchers were recruited from throughout the GLCASH region to be Fellows in the program. The components of the program include: a web-based educational program on designing, implementing, analyzing, and reporting the results of evaluation studies of agricultural health and safety programs; ongoing contact and support with program faculty through the course's web interface; mentors who interact with the Fellows on a regular basis to help the Fellows design and conduct their own evaluation studies; and modest monetary support for the Fellows' projects. Rather than "reinventing the wheel", the web-based education program incorporates existing high quality web resources. Adult learning principles (such providing opportunities to integrate new knowledge with current activities and giving the learner control over the educational experience) guided the development of the program. Aspects of the on-line program will be demonstrated at the conference.

Eleven Fellows and seven mentors were successfully recruited and have been participating in the program for one year. Quantitative and qualitative formative evaluation data is collected in several ways. The extent and quality of the Fellows' learning is assessed through the assignments that they submit online, the entries on the web-based discussion boards, the nature of chat room discussions, and progress on their evaluation projects. The quality of the educational program is assessed through structured online surveys of the Fellows. The 6-month and 12 month assessments indicated that the Fellows were highly satisfied with the online modules. They rated them as relevant, useful, and effective (mean ratings

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between good and excellent). However, they reported feeling somewhat isolated in their learning and found it difficult to keep their motivation high. Changes in the mentor process and initiation of scheduled on-line chats were made in response to these and other formative results. In addition, a second version of the on-line learning modules is in development. This version contains the same content as the first version, but is being developed to be more user-friendly and more visually stimulating for the independent learner.

Fellows are developing, with the guidance of their mentors, a diverse array of evaluation studies. These include evaluating the effectiveness of: a women's health and safety coalition; integrated pest management and pesticide safety training sessions; and an injury prevention program for teen drivers. Progress on projects varies among the Fellows. Some are in the data collection phase and others are s till in development. Summaries of the projects and fellows' progress to date will be provided at the conference. The effectiveness of the program will ultimately be measured by the quality of the Fellows' evaluation studies and their motivation and self-efficacy for conducting evaluations in the future.

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Poster: 0014

Health and Safety in the Fields: Evaluation of a High School ESL Curriculum

R Baker (1) presenting, S Teran (1), R Strochlic (1)

UC Berkeley, Berkeley, CA, United States (1), California Institute for Rural Studies, CA, United States (2)

Children and adolescents working in agriculture face significant health and safety risks and experience work-related injuries and illnesses at a higher rate than youth working in other industries. Most research has focused on youth on family farms, and very little data is available on hired teens. This presentation will describe the findings of research carried out to evaluate a school-based intervention reaching hired teen farmworkers. Specifically, the intervention consisted of implementing a high school ESL curriculum designed to provide teen agricultural workers with the knowledge and tools to protect their health and safety in the fields.

The specific aims of the study were to: 1) assess whether students who participated in the curriculum would demonstrate an increase in knowledge and improved attitudes and behaviors regarding health and safety, as compared to a comparison group; 2) assess whether a community-based intervention, in the form of workshops on health and safety for parents, would affect outcomes even further; and 3) explore and pilot other community-based outreach and education methods that could be successful in reaching teen farmworkers.

Using a quasi-experimental design, the research included three study groups consisting of over 2,000 students. One intervention group consisted of students receiving the curriculum. Another intervention group included students who received the curriculum and whose parents/guardians attended community-based workshops on health and safety. A comparison group consisted of students enrolled in ESL classes but who did not receive any intervention. Changes in knowledge and attitudes were evaluated by means of pre- and post-tests. Knowledge retention and behavior change were measured via a follow-up survey conducted with intervention and comparison group students who worked in the fields the summer following the curriculum. The quantitative data was complemented with qualitative data gathered from focus groups and interviews.

The study found that a school-based ESL curriculum is an effective intervention to reach and educate teen farmworkers. The research findings reveal that the curriculum has had a number of impacts with respect to the three principal outcomes. There was a significant impact in terms of increases in knowledge

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among students who received the curriculum, particularly in terms of their awareness of laws that protect workers' health and safety, and their ability to identify a greater number of specific health and safety problems and solutions. In terms of attitudes toward health and safety, the percentage of intervention group students who answered all attitude questions correctly increased from 37% at pre-test to 53% at post-test, with a more modest increase (37% to 42%) among the comparison group. Nearly half of the intervention group reported implementing new behaviors to protect their health and safety, compared with 33% of those in the comparison group. One student commented, "because of the classes, I spoke to my dad, and my dad spoke to the foreman and they improved the conditions in the bathrooms." Another said, "I used to get on tractors for fun, but now I don't anymore, because it's dangerous." With respect to the second impact of assessing the impact of community workshops for parents, the findings reveal virtually no association between parent participation in the workshops and student outcomes. However, parents responded to the workshops with enthusiasm and the majority reported talking to their children about what they had learned. Finally, the curriculum had spill-over effects in the broader community, as the majority of students reported sharing the new information with others.

Hired teen farmworkers form a group of workers that is difficult to identify and reach in sizeable numbers. This study demonstrates that school-based ESL classes can serve as a much needed access point for young farmworkers. The fact that teachers are willing to teach new curriculum and received it enthusiastically indicates the model could be broadly disseminated. The need for this information is also evident. Only one-fourth of all students reported getting information about health and safety through other venues, such as classes, work or in the community.

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Poster: 0015

Ag Safety Days

LE Orr (1) presenting

West Virgina Department of Agriculture, Charleston, WV, United States (1)

Ag Safety Days is a series of safety training programs provided to the agricultural community. These programs are designed to satisfy OSHA and EPA regulations, but will also provide assistance to those operations that do not have employees. Topics covered range from chemical and pesticide safety, equipment safety, machinery safety, respirator training and fit-testing, 1st aid/CPR, portable fire extinguisher training, and other training as needed. In addition, assistance is provided on labor related issues.

The primary goal of this program is to increase the capacity and knowledge of workplace safety within the agricultural community. Through this outreach program individuals are exposed to safety training and safety programs, often for this first time. This type of outreach activity is vital in generating interest in workplace safety.

Agricultural continues to remain outside of many workplace safety regulations. There is also little data available on accurate injury and fatality rates for Agriculture. Many labor statistics do not include data for direct family members or individuals under the age of 16, which are both common in agriculture. Ag Safety Days works to address this problem by increasing the overall safety capacity of the agricultural community.

Success of Ag Safety Days is difficult to determine with agriculture remaining outside of many workplace regulations including injury and illness recordkeeping. Currently, the success of the program is based on attendance and program requests. Ag Safety Days continues to remain a popular program and cooperation continues to grow among governmental agencies involved with agriculture.

In addition to providing safety training the Ag Safety Days program allows direct contact to be made with State and Federal regulatory industries. This contact allows all those involved in agricultural safety to communicate concerns about agricultural safety issues.

With safety training not being as common a component in agriculture as other industries, outreach is vital in communicating the importance of safety.

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Poster: 0016

Deck Safety in the Commercial Fishing Industry: Development of an Emergency-Stop System for a Hydraulic Deck Winch

JM Lincoln (1) presenting, R McKibbin (2)

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Research Problem: The deck of a commercial fishing vessel is an unstable work platform that is constantly moving and often congested with machinery and equipment. Much of the machinery on commercial fishing vessels is rudimentary and has inadequate safety controls. The NIOSH Alaska Field Station (NIOSH AFS) has found that unlike fatalities in the fishing industry which are usually due to the loss of a vessel (87% nationally, 86% Alaska) (Lincoln and Conway 1999; Dickey 2003), most (67%) severe non-fatal injuries occur on deck during the deployment and retrieval of fishing gear (Lincoln and Conway 1999; Thomas, Lincoln et al. 2001). There were 574 severe non-fatal injuries that occurred in the commercial fishing industry during 1991-1998. This is equivalent to an annual rate for serious hospitalized injuries of 410/100,000 full-time fishermen. Machinery and fishing equipment accounted for 40% of non-fatal injuries, while another 27% were due to falls. These machinery-related injuries resulted from cables, chains, lines, winches, pot launchers and other deck equipment. Being trapped in a winch caused 35% of these machinery injuries (Thomas, Lincoln et al. 2001). Deck machinery and gear is also a factor in many fatal injuries aboard fishing vessels. The USCG has documented that from 1994-2000, 37 (8%) of all fishing related fatalities nationally were a result of either getting caught in gear, or getting struck by gear while operating machinery. (Dickey 2003). At least eight of these fatalities were due to winch entanglements. These fatalities can be prevented when practical engineering solutions can be developed.

Purpose: The purpose of this study was to take epidemiological data to industry to learn about hazards on deck and then to work with engineers to design out the identified hazards.

Methods and Findings: In November 2004, NIOSH AFS partnered with the NIOSH Spokane Research Laboratory to develop an engineering intervention to improve safety on the deck of fishing vessels, particularly to reduce the hazard posed by the deck winch. Staff met with vessel owners, fishermen, and winch manufacturers to discuss various design options. Challenges to the design of a control technology included the requirement that fishermen be very near the turning winch, the line be

wrapped on the winch by hand while it is turning, the diversity of deck layouts, and the harsh environmental conditions.

Findings: The final design, an emergency-stop (e-stop) system, incorporates a momentary contact switch mounted directly on the winch, and the adjunct electro-hydraulic control circuitry. Hitting the switch mounted to the winch, stops the winch from rotating and prevents the entanglement. The prototype e-stop was installed on a fishing vessel and successfully tested during the summer 2005 fishing season in Alaska. Additionally, the system was presented to fishermen at a large industry trade show, where it received very favorable review by the industry. The system is currently being refined in preparation for additional testing in 2006.

How to Improve Workplace Safety: By using injury epidemiology to identify problems, industry to provide practical input and engineering design to control hazards, effective safety interventions can be implemented. This r2p approach should prove to be effective in providing a tool for this dangerous industry to prevent injuries on deck.

Dickey, D. (2003). Analysis of Fishing Vessel Casualties, A Review of Lost Fishing Vessels and Crew Fatalities, 1994-2000. D. o. Transportation, United States Coast Guard Office of Investigation and Analysis.

Lincoln, J. M. and G. A. Conway (1999). “Preventing commercial fishing deaths in Alaska.” Occupational & Environmental Medicine 56(10): 691-5.

Thomas, T. K., J. M. Lincoln, et al. (2001). “Is it safe on deck? Fatal and non-fatal workplace injuries among Alaskan commercial fishermen.” American Journal of Industrial Medicine 40(6): 693-702.

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Poster: 0017

Stakeholder Input and Cultural Considerations in Addressing Behavioural Factors in a Unique Agricultural Work Population (Commercial Shrimpers)*

J Levin (1) presenting, K Gilmore (1), S Shepherd (1), JT Nalbone (1)

The University of Texas Health Center at Tyler, Tyler, TX, United States (1), The Southwest Center for Agricultural Health, Injury Prevention, and Education, Tyler, TX, United States (2)

Agriculture is among the most hazardous of industries with a high risk for fatal and non-fatal injuries and work-related disease conditions. One hundred ten (110) American farm workers are crushed to death annually by tractor rollovers and over 100 children are killed on farms. The commercial fishing trades are one component of American agriculture and are among the most dangerous jobs in the world. Casualties that occur in these jobs are often the result of a combination of human factors, machinery and equipment, and the environmental elements at sea. Human factors like fatigue, inexperience, and behavioural components such as non-use of safety practices and equipment are particularly important in morbidity and mortality outcomes in the commercial fishing trades. For select groups, these human spects may be strongly influenced by cultural factors.

Studying these groups and designing interventions which can change some of these behavioural elements and provide for the transfer of research findings into effective prevention practices requires an approach which relies heavily on the development of community trust and stakeholder input, while considering the cultural factors which may significantly impact success. Such an approach is formative and often slow and incremental, but more likely to yield desired outcomes.

An example of such a study population is the fleet of shrimpers in the Gulf Coast port region of Galveston, Texas. This group is different in several respects from commercial fishermen in other U.S. Coast Guard regions including being comprised primarily of Vietnamese. Working closely with representatives of the U.S. Coast Guard, a convenience survey of these shrimpers was undertaken to characterize the population, followed by a series of focus groups to address potential approaches for educational interventions which might influence safety behaviours. Key findings revealed in excess of 50% of those surveyed speaking little or no English with over half the group considering the job to be very safe to neutral and 85% identifying important personal behaviours as potential contributors to accidents. The focus groups demonstrated the importance of conducting hands-on training in Vietnamese by experienced fisherman with a focus on vessel captains as workgroup leaders. These findings illustrate

the importance of securing stakeholder input and considering cultural factors in the design of workplace interventions which focus on changes in safety behaviours.

This presentation will illustrate some of the dynamics which must be considered among unique agricultural work populations as illustrated by the experience of the Southwest Center for Agricultural Health, Injury Prevention, and Education relative to the Galveston shrimpers. Preliminary findings among the shrimpers of the port of Galveston region will be presented.

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Poster: 0018

Unique Occupational Injury Surveillance: Identification of the Total Injury Burden and Risks on Agricultural Operations

SG Gerberich (1) presenting, TR Church (1), BH Alexander (1), AS Masten (1), CM Renier (2), KF Carlson (1), AD Ryan (1), SJ Mongin (1)

University of Minnesota, Regional Injury Prevention Research Center, Division of Environmental Health Sciences, School of Public Health, Minneapolis, MN, United States (1), St. Mary's/Duluth Clinic Health S ystem, Division of Education and Research, Duluth, MN, United States (2)

Agriculture has consistently been identified as one of the most hazardous occupations in the United States (U.S.); rates of morbidity and mortality greatly exceed those for all occupations combined. Currently, no systems exist that can provide accurate data on the incidence and severity of, and risk factors for agriculture-related injury, or how they change over time -- information integral to the u ltimate control of this problem.

The purpose of this effort was to utilize a unique model for conducting surveillance among agricultural operation households that enabled monitoring for changes, between 1999 and 2001, in the incidence and consequences of both agricultural activity-related injuries and those incurred from other activities, by all ages. It also enabled identification of risk factors for agricultural activity-related injuries incurred by children less than 20 (<20) years of age, by comparing exposures between injured and uninjured children.

For each year, data were collected from the same base population, in an identical manner, using randomly selected cohorts in Minnesota, Wisconsin, North Dakota, South Dakota, and Nebraska (total n=16,000), from the U.S. Department of Agriculture (USDA), National Agricultural Statistics Service's (NASS), Master List Frame of Farming Operations. Data were collected for the two six-month periods of 1999 and 2001, using a specially designed computer-assisted telephone interview instrument, to identify all injury events and relevant demographics for all household members; data pertinent to numerous exposures of interest were collected for those <20 years of age, through the application of a simultaneous nested case-control study. Univariate and multivariate analyses were used; relevant adjustment methods addressed eligibility, non-response and other potential biases.

Response rates for both years were similar In 1999 and 2001, respectively: 8,288 (51.8%) and 8,652 (54.1%)

of operation households were not eligible, based on screening criteria; for each year, 4,402 (27.5%) and 4,408 (27.5%) were eligible, and 3,765 (85.5%) and 3,655 (82.9%) participated in the full studies. Respective refusal rates were 24.5% and 19.3%. For 1999 and 2001, respectively, 16,538 and 16,064 persons incurred 2,586 and 2,459 injury events; annualized injury rates per 1,000 persons for <20 and 20+ year age groups were: 146.0 and 176.0; 144.8 and 168.6. Primary sources of agriculture-related injuries, for each age group, by year, were: animals (41% and 32%; 32% and 37%) and falls (31% and 23%; 32% and 24%). These age groups, by year, identified >7 days of lost agricultural work time, associated with agriculture-related injuries (16% and 15%; 19% and 14%), and all other injuries (17% and 19%; 15% and 26%).

Based on multivariate analyses of case-control data, for those <20 years, risk factors for agricultural injury appeared to be similar for both 1999 and 2001; respective Odds Ratios [OR] and 95% Confidence Intervals [CI] are presented. Increased risks were identified in both years for operating or riding in a motor vehicle (OR = 3.7, CI = 2.2-6.2; OR = 2.8, CI = 1.7- 4.8) and riding on (OR = 1.8, CI = 1.2-2.6; OR = 1.3, CI = 0.9-1.9) or operating a tractor (OR = 1.6, CI = 1.02-2.5; OR = 2.0, CI = 1.2-3.1). Risk of injury was increased in 2001 for those who operated either large or small equipment (ORs and CIs = 1.6, 1.0-2.6 and 1.7, 1.1-2.7, respectively); ORs for these exposures were also elevated in 1999, but not to the same degree (1.5, 0.9-2.3; 1.4, 0.9-2.1). In both 1999 and 2001, increased risks were identified for those who worked with horses (2.3, 1.5-3.4; 2.0, 1.3-3.0), sheep (2.3, 1.2-4.3; 2.0, 1.2-3.3), and beef cattle (2.0, 1.4-2.9; 2.1, 1.4-2.9); exposure to dairy cattle also was associated with increased risks (1.4, 0.9-2.2; 1.5, 0.9-2.5). Risks associated with exposures to swine (1.6, 0.98-2.7; 1.4, 0.8-2.4) and poultry (1.2, 0.6-2.4; 2.7, 1.7-4.5) were more variable between these two years.

This effort enabled identification of the incidence and consequences of agricultural injuries, in concert with the burden of all injuries on the agricultural operation, for all household members, and the risk factors for agriculture-related injuries among children <20 years of age. This was accomplished through a unique surveillance application that incorporated a nested case-control design. Most importantly, these data serve as a basis for development of prevention and control strategies essential for the reduction of morbidity and mortality from injuries incurred by children and adults residing on agricultural operations.

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Poster: 0019

Economic Consequences of Serious Work-Related Injuries in British Columbia Sawmills

H Alamgir (1) presenting, E Tompa (2), A Ostry (1), M Koehoorn (1), P Demers (1)

University of British Columbia, Vancouver, Canada (1), Institute for Work and Health, Toronto, Canada (2)

Objective: The objective of this study is to estimate the costs of work-related injuries requiring hospitalisation in a cohort of sawmill workers in British Columbia and to determine the magnitude and proportion of these costs not paid for by the workers' compensation system.

Methods: Hospital discharge records were extracted from 1989 to 1998 for a cohort of 5,876 actively employed sawmill workers. Injury cases were identified as work-related from these records using ICD-9 external cause of injury codes that indicate place of occurrence and the responsibility of payment schedule, which identifies workers' compensation as being responsible for payment. The workers' compensation claim records for these hospitalisations were extracted by matching injury and admission dates, and ICD-9 diagnosis codes. For each injury claim, comprehensive compensation costs data were collected for 7 years. For the uncompensated cases (work-related hospitalisations not linked with a claim), costs were imputed from the compensated cases using comparable types of injury. Costs for short term and long term disability and vocational rehabilitation were aggregated into non-healthcare costs. All costs were expressed in 1995 Canadian dollars using the provincial consumer price index and a 5% discounting rate (1 Canadian Dollar ~ 0.85 US Dollar). Costs were calculated from the workers' compensation system perspective.

Results: Among 5,876 sawmill workers, there were 173 work-related injuries requiring hospitalisation during the ten-year follow-up period – an injury rate of 5.4/1,000 person years. Thirty-seven (21%) of these injuries did not match up with an accepted workers' compensation claim.

For each work-related injury, the median non-health care costs were $16,559 and the healthcare costs were $4,377. The most costly injury by cause was struck by falling objects with median non-healthcare and healthcare costs of $32,398 and $8,625 respectively; while the least costly was overexertion with median costs of $7,801 and $2,710 respectively. By nature of injury, the most costly was open wounds with median non-healthcare and healthcare costs of $51,517 and $9,967; and the least costly was superficial and crushing injuries with costs of $4,203 and $2,644, respectively.

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The total costs for the 173 work-related injuries were $10,374,115 for non-healthcare costs and $1,764,137 healthcare costs. These costs translated into non-healthcare costs of $326/person-year and health care costs of $55/person-year. The 37 work-related hospitalisations without workers' compensation claims were associated with $874,871 (8.4% of total) of non-health care costs and $200,588 (11.4% of total) of healthcare costs.

Conclusion: Our findings indicate that some of the burden of work-related injuries may be shifted to other parts of the social safety net (e.g., the publicly funded health care system) or to individual workers. In British Columbia sawmills – a large, high-risk, and unionised industrial sector, about 10% of the costs associated with work-related serious injuries appear to be not paid for by the workers' compensation system.

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Poster: 0020

Workers' Compensation Experience of Colorado Agriculture Workers, 2000-2004

DI Douphrate (1) presenting, JC Rosecrance (1)

Colorado State University, Fort Collins, CO, United States (1)

Background: Agriculture is among the most hazardous of occupations in which injuries are important contributors to mortality and morbidity. The lack of information regarding agriculture injuries or fatalities long has been recognized as an obstacle for effective injury prevention.

Purpose: The objectives of this study were: 1) to determine injury rates among different Colorado agriculture occupations, 2) to determine the distributions of mechanisms, types and locations of agriculture injuries among those filing agriculture injury claims, and 3) to determine the costs of agriculture injuries in Colorado.

Methods: This investigation involved the analysis of workers' compensation claims data for non-fatal injuries among agriculture workers in the State of Colorado. A total of 3,093 Colorado workers' compensation claims from 5,661 policies between the years of 2000 to 2004 were analyzed. Specific agriculture occupations included cattle dealers, dairy farmers, cattle/livestock raisers, bean sorters/handlers, hay grain feed dealers, grain millers, and grain elevator operators. Injury incidence rates, injury characteristic frequencies and injury costs were calculated.

Results: The annual injury incidence rate (claims/200,000 work hours) for all agriculture sectors combined was 8.7. The highest estimated injury incidence rates were among cattle dealers (12.4), dairy farmers (9.0), and cattle or livestock raisers (8.5). The average age of the injured worker was 37.6 years and the mean work duration prior to injury was 3.2 years. Approximately 19.5% of injury claims were caused by strains and 17.7% of claims were attributed to animals. Contusions accounted for 34.2% of all injury types and upper extremity injuries accounted for 33.5% of all injury locations. Vehicular-related injuries were the most costly mechanism of injury. Dislocation injuries were the most costly injury type while injuries to the spine/back were the most expensive injury location.

Conclusion: This study provided a unique opportunity to investigate the workers' compensation claims experience of agriculture workers in Colorado. The farm work environment is characterized by a wide variety of tasks as well as hazards for injury. Understanding the occurrence of injuries among

agriculture workers is critical to implementing and evaluating effective intervention programs. Results of this study will direct attention to the development of safety interventions that address the worker-animal interface, fall protection systems, agriculture machinery usage, and overexertion prevention strategies.

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Poster: 0021

Video-based Safety Intervention for West Virginia Loggers - A Success Story

JC Helmkamp (1) presenting, WJ Lundstrom (1), J Goldcamp (1)

Injury Control Research Center, West Virginia University, Morgantown, WV, United States (1)

Importance of the Research Problem: Logging is one of the most dangerous industries in the U.S. with timber cutting and logging occupations identified as having extraordinarily high lifetime fatality risk and significantly higher costs of occupational injury and illness. The 2000-2004 logging fatality rate was significantly higher in West Virginia (386.5 per 100,000) compared to the national rate (154.9). Innovative intervention approaches must be integrated with training in order to provide timely and useful information to make workers more aware of workplace safety.

Objective: As a result of field investigations conducted by the WV Fatality and Assessment and Control Evaluation (FACE) Program and allied projects with the West Virginia University Division of Forestry and Appalachian Hardwood Center, a Logger Intervention Research Project was undertaken to develop a safety video to be used in WV Division of Forestry (DOF) required logger training classes.

Methods: The resulting video, Some Mistakes Last Forever, and the Logger's Safety Field Guide were used in WV DOF training sessions from April 2002 - March 2005. At the beginning of the 1-hour training module, research staff asked loggers to complete a questionnaire designed to determine current perceptions, facts, and safety attitudes about logging. After completion of the baseline survey, a video intervention was conducted. Following the video, each logger was asked if their perceptions and attitudes had changed as a result of the video. Approximately 6 months after training, each logger was contacted by phone and queried about the use and helpfulness of the videos and field guides.

Results: Data from the first 80 training sessions (over 1,500 loggers), indicated that viewing the video resulted in significant changes in knowledge and attitude about logging field safety. Follow-up with l oggers showed positive self-reported worksite behavior changes. These results were published in Injury Prevention 2004; 10:233-238. Since then, an additional 900 loggers were trained in 60 sessions and analysis of survey data showed similar results.

Importance of Research/Improving Workplace Safety and Health: Since the end of the research project, the use of the video, field guide, and supplemental Logger Fatality Investigation Modules has

become routine practice during WV logger training. This project has been acknowledged by the NIOSH 'r2p' Office as a clear example of the 'research to practice' paradigm. Forestry officials in Kentucky and Pennsylvania, familiar with our video safety module, have expressed strong interest in our logger training efforts and inquired about using the video and field guide in their own training curriculums (this is the subject of a proposal to NIOSH through the Great Lakes Center for Agricultural Safety and Health). The extension of our successful video-based logger safety intervention program to Kentucky and Pennsylvania -- states with similar logging-related death and injury rates – is reasonable, feasible, and warranted. Thousands of field guides have been used by WV agencies including the Department of Transportation, Office of Miner's Health and Safety Training, and Bureau of Employment Programs. Federal agencies including the USDA Forest Service and the Mine Safety and Health Administration have also requested copies.

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Poster: 0022

Visual Sensor-Based Mobile Equipment Attitude Estimation for Rollover Prevention

M Kise (1), Q Zhang (1) presenting

University of Illinois at Urbana-Champaign, Urbana, IL, United States (1)

The Rollover Protective Structures (ROPS) technology has been recognized as the most effective device to prevent mobile equipment-related fatalities from rollover. However, the ROPS provides only a passive protection for reducing rollover-caused fatalities, and the most effective way of eliminating the rollover-caused fatalities should be the prevention of rollover from occurring. The research proposed the use of a visual sensing-based online mobile equipment attitude estimator to provide rollover precautions based on estimated look-ahead vehicle pose and motion status. A stereovision camera is used as the visual sensor for the system to create a three dimensional virtual terrain map on which a virtual vehicle will travel to estimate the roll, pitch angles and rates progressively for providing rollover precautions. A series of field tests on various terrains were conducted to evaluate the dynamic performance of the attitude estimator in actual field environment. The validation test results proved that the visual sensor-based vehicle attitude estimator could predict the pose and motion status of the mobile equipment about 8.0 m ahead of its actual position with favourable and consistent accuracy at all test sites. Such information can be used as the precaution warning signal to prevent rollover occurring.

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Poster: 0023

Evaluation of the NAGCAT Tractor Guidelines

FA Fathallah (1) presenting, B Marlenga (2), W Pickett (3), JA Miles (1), JM Meyers (1), J Chang (1), J Plasse (1), BJ Miller (1)

University of California, Davis, CA, United States (1), Marshfield Clinic Research Foundation-National Children Center, Marshfield, WI, United States (2), Queen's University, Kingston, Ontario, Canada (3)

Work-related injuries may occur because children are assigned hazardous farm jobs that are beyond their physical and mental capabilities. The North American Guidelines for Children's Agricultural Tasks (NAGCAT) were developed to assist parents in assigning appropriate and safe jobs to their children 7-16 years. Farm tractors account for the majority of deaths and major portions of non-fatal trauma among children on North American farms. Because of this high frequency of tractor involvement in childhood fatalities and other traumatic farm injuries, NAGCAT have a heavy emphasis on safe operation of farm tractors in different work situations. This study aims to build upon the NAGCAT project by providing a field test of the NAGCAT tractor guidelines. The objective of this study is to systematically assess the most common tractors operated by children with respect to dimensional and operational characteristics in order to identify any potential strength and anthropometric mismatches between the physical characteristics of children and adolescents of ages 12 to 16 years (ages recommended for tractor operation by NAGCAT) and the tractors they are operating.

Tractors were identified from a national survey of the most used tractors throughout the US, and the type of tractors used by children (Marlenga, 2002). Several tractor dealers and farmers offered their tractors for the study in California and Wisconsin. The data collection phase of 86 tractors of varying size and age has been completed (Figure 1).

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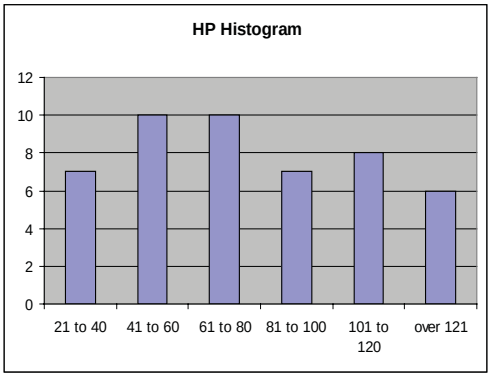

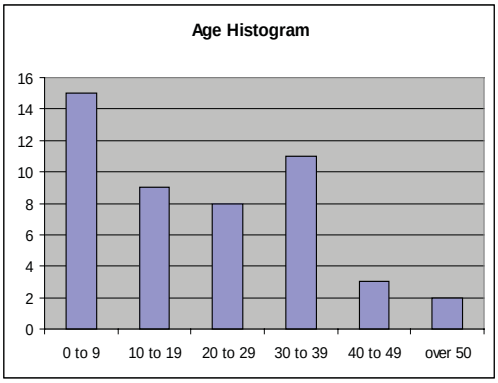

Figure 1. Size (horse power- HP) and age histograms of the first 51 tractors collected.

The methodology involves assessing tractor operational requirements which are divided into two main categories: geometrical requirements and force requirements. Geometrical requirements are examined by capturing three-dimensional (3D) characteristics of the tractor and the location of various controls. These characteristic are identified by a technique called photogrammetry. Specialized removable markers are attached on tractors, and then a series of photographs are captured to build a digital 3D model with the aid of a commercial software (PhotoModeler™, EOS Sys., Vancouver, Canada). The tractor 3D model is then imported into 3D digital ergonomic evaluation tools (SAMMIE and ManneQuin) to identify operator's anthropometric and visual mismatches between the tractor and the chosen operator (e.g., 25th percentile 14 year old female).

The tractor spatial and force requirements are compared to existing anthropometric and physical capability databases of adolescent of various gender, ages and percentiles (e.g., Anthrokids- Snyder, 1977; Childata- Norris, 2000). The evaluation of the collected tractors will focus on seat dimensions and characteristics; control reach and clearance requirements; control force activation requirements; monocular, binocular, and ambinocular fields of view; and entry/exit characteristics.

Summary of results from this dataset will be presented and their implications to children and adolescents of various age, gender, and anthropometric characteristics will be discussed. This information will be incorporated into modified NAGCAT tractor guidelines.

Poster: 0024

Changing the Child Labor Laws for Agriculture: Impact on Injury

B Marlenga (1) presenting, RL Berg (1), JG Linneman (1), RJ Brison (2), W Pickett (2)

Marshfield Clinic Research Foundation, Marshfield, WI, United States (1), Queen's University, Kingston, Ontario, Canada (2)

Background: Agriculture is the most hazardous industry in the United States for youth workers with a risk for fatal injury that is three to four times that of youth workers in other occupational settings. The child labor laws are intended to protect working youth from the most dangerous jobs. However, children who work on their parents' farms, where the preponderance of these fatal injuries occur, are exempt from the child labor laws.

Purpose: The purpose of this study was to review existing cases of traumatic pediatric farm injury and: 1) estimate the proportion of work-related injuries that could potentially be prevented by removing the family farm exemption from the Federal Child Labor Laws, Hazardous Occupations Order for Agriculture (Hazardous Orders); and 2) estimate the proportion of work-related injuries that could potentially be prevented if the age standard for the Hazardous Orders was changed from 16 to 18 years.

Methods: A retrospective case series of 1193 pediatric farm injury cases from the U.S. and Canada was assembled from fatality, hospital discharge, and national survey records. Pediatric farm injuries were defined as injuries to children younger than 18 years that occurred at the farm work site. Using a standard protocol, two investigators independently abstracted information pertaining to each case. All cases were classified according to data source, demographics, activities leading to injury, and whether victims were engaged in agricultural work. The Hazardous Orders were retrospectively applied to individual cases and preventability was estimated. Analyses were descriptive and standard summary measures are presented.

Results: A total of 286/1193 (24%) cases involved family members engaged in farm work. If implemented and enforced on family farms, the Hazardous Orders could have prevented 33% (71/213) of pediatric work injuries to children <16 years. If the age restriction for hazardous work was changed from 16 to 18 years, 36% (26/73) of the work injuries to 16-17 year olds could have been prevented. Thirty-seven cases resulted in a fatal injury to family members < 18 years of age who were engaged in farm work, with 59% (22/37) involving work deemed hazardous under the Hazardous Orders.

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Conclusion: Removal of the family farm exemption from the Hazardous Orders and raising the age restriction for hazardous work both have the potential to prevent substantial proportions of the most serious work injuries to children on farms. If implemented and enforced, these changes could lead to injury rate reductions among youth that meet or exceed national health objectives for the agricultural sector outlined in the Healthy People 2010 initiative. Beyond the Hazardous Orders, study results suggest a need for other measures that address the physical safety of children on farms. The majority of injuries experienced by children on farms were to those who were present in the worksite, but were not themselves engaged in farm work. New occupational policies and other preventive initiatives are needed to address these injury patterns, which are heavily concentrated in the very young.

Poster: 0025

Effectiveness of Farm Safety Day Camps: Influence of Camp Characteristics

DM McCallum (1) presenting, SJ Reynolds (2), MB Conaway (1)

University of Alabama, Tuscaloosa, AL, United States (1), Progressive Agriculture Foundation, Birmingham, AL, United States (2)

Importance: Farming is unique among work settings in level of risk for children and youth. Exposures to agricultural hazards occur through play, work, and observation of adult work. In response to these risks, communities offer a variety of educational programs, including farm safety day camps conducted for prevention of childhood agricultural injury. Hundreds of farm safety day camps are attended each year by thousands of children in rural communities across North America. Although significant financial and human resources are devoted to these camps, the impact and effectiveness of the programs have not been systematically demonstrated. Additional research is needed to evaluate the camps as a method for teaching safe behaviors to children exposed to agricultural hazards.

Purpose: Data presented here are part of a larger evaluation of a North American farm safety day camp program. Changes in knowledge and self-reported behaviors of camp participants were assessed to determine the impact of the camps. In addition, various camp characteristics, such as size and type of camp and number and length of teaching sessions, were investigated to determine their relative effectiveness.

Methods: Written pre-tests and post-tests completed before and after camp, 3-month, and one-year follow-up telephone interviews were administered to a sample of camp participants, ages 8-13. A random sample of 624 participants was selected from 28 of the 250 camps held in 2002. Questionnaires contained behavior and knowledge questions on topics that may be covered at farm safety day camps, including safety around animals, ATVs, tractors, and fire safety.

Findings: Safety knowledge increased from pre-test to post-test, and the gain was sustained on the 3-month and one-year follow-up measures. Self-report of safe behaviors increased from pre-test to 3-month follow-up. The increase was sustained for some behaviors, while declining for other behaviors by the one-year follow-up. The losses, however, did not reach the level of the pre-test. Comparisons across camps showed that there was little effect for number of teaching sessions offered or length of

teaching sessions. Participants in smaller, community-based camps showed slightly greater improvements in knowledge than larger, school-based camps, while those in the larger camps tended to report greater behavior change. Older children retained slightly more knowledge at the one-year follow-up, but more risk behavior, compared to younger children.

Advancing the field: Results from this study contribute to the small, but growing body ofresearch on the effectiveness of farm safety day camps and other similar safety programs for children exposed to the hazards of agriculture.

Improving workplace safety and health: Farm safety day camps are a relatively low cost, effective intervention for teaching safety to children. There are many variations in the camps, even within a single program. These results indicate that the variations in length and number of sessions may not be of great importance in terms of overall learning.

Industry sector: These findings relate specifically to the Agriculture, Forestry, and Fishing sector, as the day camps being evaluated are designed for children living in agricultural settings. Many of the participants live and work on family farms or ranches, while others may be visitors to such operations.

Poster: 0026

Farm Safety Day Camps - Reducing Children's Exposures to Farm Hazards by Influencing Parents' Attitudes Toward Farm Safety

DB Reed (1), DT Claunch (1) presenting, MK Rayens (1), S Westneat (1)

University of Kentucky College of Nursing, Lexington, KY, United States (1)

Agriculture still ranks among the four most hazardous occupations in the United States. As many as 32,000 non-fatal and 100 fatal farm injuries occur each year to children. Whether or not a child performs farm tasks, children are exposed to farm hazards by being part of the farm environment.

This three-year study examined changes in knowledge, attitude and behavior toward farm risk based on a cohort of children who attended a farm safety camp and their parents. While some literature supports safety knowledge improvements for children who attend safety day camps, less is known about the potential effect of the camps on parents of these children. Parents are in better positions to protect children from harm, thus this study examined what effects, if any, the camps had on parental behavior toward farm safety.

A quasi-experimental, no control group design used a purposively sample of six Farm Safety 4 Just Kids (FS4JK) safety day camps in Kentucky, Colorado, Iowa, North Carolina, and Wisconsin to examine effects of instruction about tractors, powered equipment, and large animals. Data were collected from 544 farm and nonfarm children who attended the camps and their parents (who did not attend) in the 18 months following the camp. Telephone and mailed surveys were completed at 1, 6, 12, and 18 months post camp.

Results indicate parents were strongly influenced by their child's camp experience even though the parents did not attend the camps. Ninety percent of the parents reported their child talked to them about safety messages learned. These discussions led parents to implement new and/or more stringent safety rules for their children, increase supervision, improve animal confinement areas, and to repair/or replace safety shields on machinery and equipment. Three-fourths of the parents reported their knowledge of children's farm safety increased. Half reported they made new safety rules for their children, including prohibiting certain farm work by children. At one month post camp 5% of the respondents indicated they allowed the child to do more on the farm. In addition to protecting children, some parent respondents (15.7%) made changes in their own safety behaviors.

Abstracts

These research findings illustrate the importance of developing accurate safety messages and ensuring the messages are delivered appropriately in an intervention program. Further, it supports that children are effective carriers of farm safety messages. Findings from this study were used by FS4JK to develop guidelines for conducting farm safety day camps that can also be implemented by other intervention programs to evaluate the effectiveness of their programs. Parents seem to benefit from messages delivered at the camps. Future camps should examine ways to include parents in the camp and improve home delivery of camp messages.

As parents absorb the safety messages and make positive changes to enhance the safety of their children, farm-related injuries to both children and adults can be reduced. While farmers are oftennot receptive to regulations and policies, indirect safety messages through their children may be influential and cause parents to make positive changes.

Poster: 0027

The Development and Pilot Testing of "First Aid Farm Quest," an Interactive CD Focusing on First Aid and Injury Risk Reduction for Farm Youth

AK Carruth (1) presenting

Southeastern Louisiana University, Hammond LA, United States(1)

Farmers are among the highest risk groups for occupational injury and illness. Because youth work side-by-side with adults, they may be called upon to activate EMS and provide lifesaving skills till help arrives. Needs survey of 657 farm women in southeast Louisiana revealed that only 21% attended first aid classes in the previous year. Focus group interviews confirmed that women believe there is a need for first aid training of all family members but few opportunities to attend training sessions. To address the expressed need for training and the concern for unintentional injuries among farm youth and friends, an interactive CD titled "First Aid Farm Quest" was developed targeting, 5th and 6th graders, by a partnership of rural university health professionals, communication/graphic artists, agricultural extension professionals, and farm women and children. Development of the CD not only sought to demonstrate first aid skills but also to introduce hazards that potentially lead to injury or harm. First aid skills are reinforced with multimedia computer-based games. Injury prevention messages are integrated throughout the program. Raising awareness and reinforcing safe behaviors and situations is the focus of the last module titled "Safety Countdown." An age appropriate on-line pre/post test has been developed and instructions to teachers/parents who wish to participate in the evaluation process have been completed. Pilot data, from one junior high school, has been completed with additional pilot sites planned. Forty 5th grades completed the testing, and the viewing of the CD. Preliminary data indicate an increase in percentages in all items that reflect knowledge and anticipatory action. One question was asked to ascertain the frequency they think and one question asked the frequency of how often they talk about safety (pre-think 40%: post-think 64.3%: pre-talk 28.9% post-talk 46.1%). A comparison group will be recruited to assess test effect. Additional data will be available for analysis and presentation early 2006. The presentation will outline the challenges as well as capacity building among a professionals and community members with vastly different backgrounds in developing the CD and a kid friendly-interactive pre/post test.

Abstracts

Poster: 0028

Youth ATV Behavior

S Burgus (1) presenting, W Sanderson (2), M Madsen (2)

Farm Safety 4 Just Kids, Earlham, IA, United States (1), University of Iowa, Iowa City, IA, United States (2)

ATV use is on the rise. With this increase in use comes a greater number of injuries involving ATVs. Nearly half of all injured ATV riders are under the age of sixteen. The estimated number of children injured in ATV-related incidents increased 94% from 1993 to 2001 and 95% of children that were injured were riding an ATV larger than recommended for their age. Over 2500 children are hospitalized each year due to ATV-related incidents which represents a 79% increase from 1997 to 2000. Approximately 1% of ATV-related hospitalizations resulted in death.

Objective: The objective of this project was to increase adolescent awareness about the importance of wearing helmets, not allowing extra riders, and participating in training before operating ATVs. During a large national conference attend by rural and agricultural youth, we documented current training, helmet use, and behavior of youth using ATVs.

Methods: A survey questionnaire was developed to determine ATV use among youth. The survey measured characteristics of the youth including where they lived, age, gender; characteristics of the ATVs they drove or rode as passengers such as size; and factors associated with their riding behavior, including age of first riding an ATV, helmet use, allowing extra riders, and riding on paved roads. The survey also asked youth about whether they had received safety training on the use of ATVs and whether they would like to receive such training. Youth at the National FFA convention in Louisville, KY were asked to participate in the survey. This conference was selected as a sight for reaching a large number of adolescents.

Results: A total of 623 surveys were completed by youth from 43 states, ages 12 to 20 who indicated they rode ATVs; 44% of the respondents were female and 56% were male. The survey found that approximately 26% of the youth never wear a helmet when they ride an ATV and farm youth are less likely to wear helmets than youth who do not live on a farm. Girls are more likely to wear helmets when riding ATVs, but they are also more likely to allow passengers. Only 22% of the youth had received ATV safety training, and more boys had received safety training (26%) than girls (16%). But, girls were more

receptive to attending a future training course (47%) than boys (37%). Boys were more likely to ride paved roads than girls. Approximately 30% of the youth had been injured in an ATV incident, with more boys having been injured (37%) than girls (20%).

Application to field practice: With the increase in ATV use among youth there is a need to document the characteristics of their use by this vulnerable population. Their attitudes about allowing extra riders, using helmets, riding on paved surfaces, receptiveness toward training will influence future intervention aimed at youth ATV safety.

Abstracts

Poster: 0029

Do Ergonomic Interventions for Shovels Effectively Mitigate Risk of Injury in Farm Kids?

S Kotowski (1) presenting, K Davis (1), T Waters (2)

University of Cincinnati, Cincinnati, OH, United States (1), National Institute for Occupational Safety and Helath, Cincinnati, OH, United States (2)

Background: Farming remains to be a significant and important industry sector in the United States' economy with respect to the number of workers, health hazards, and production. Another key component to the farming industry is the large number of youth who work in the industry and may need special considerations with respect to the development of low back disorders (LBDs). Farming is a physically demanding profession for both adult and youth farmers. Several researchers have identified a number of farming tasks as being risky for LBDs, which include shoveling, pushing wheelbarrows, weeding, handling animals, and lifting material. Youth may have an even greater risk of injury due to utilizing equipment designed for adult farmers.

Purpose: The current study determined whether an "ergonomically" - designed intervention for shoveling was effective in reducing the risk of developing LBDs.

Methods: The intervention evaluated was the addition of add-on handles to the traditional adult-sized scoop shovels. Six different shovels were tested: traditional plastic and aluminium scoop shovels with and without two different types of add-on handles. Eight female and six male farm youth preformed a shoveling task that simulated cleaning out a farm stall. During each lift, the trunk kinematics and static moment were measured and then input into a LBD risk model that predicts the probability of "high" risk group membership.

Results: Overall, there was a very slight increase (not statistically significant) in LBD risk for both interventions as compared to the regular handled scoop shovels, with the probability of risk being approximately ~55%, or medium risk. However, there was a large difference between genders although the general trend stayed the same. The LBD risk was nearly 10% less for females than males (53% versus 61%, respectively). While the interventions were effective in reducing sagittal flexion approximately 6o, there was a tradeoff with increased lateral and twisting motions. Thus, the overall risk values remained unchanged for the interventions as compared to the traditional shovels.

Discussion: The first lesson that can be learned from the results of this study is that youth using

adult-sized equipment are already at considerable risk for injury even without any interventions. A second lesson is that the "ergonomic" interventions proved ineffective in mitigating risk of injury for farm use, potentially increasing the LBD risk.

Limitations: Further quantification, such spinal loading, is needed to fully understand the effectiveness of the interventions. Understanding the kinematics and associated risk of injury is just one method of risk evaluation and should be supplemented with additional risk measures before definitive conclusions can be made. Also, this study only focused on youth and therefore it is unknown whether the interventions might be more effective for an adult population.

Conclusion: Add-on handles may not be an effective method of reducing the risk of injury in youth performing farm shoveling tasks when using adult-sized shovels. Based on the high risk of LBDs when shoveling and the ineffectiveness of the add-on handles there still remains a need to develop other intervention alternatives such as changes to shovel design or making youth-sized shovels.

Abstracts

Poster: 0030

Design Decisions as Causal Influences in Construction Fatalities

M Behm (1) presenting, J Gambatese (1)

East Carolina University, Greenville, NC, United States (1), Oregon State University, Corvallis, OR, United States (2)

Each day, on average, three workers die as a result of a traumatic injury in the construction industry. Research and practice have demonstrated that decisions made upstream from the construction site can influence construction worker safety, both positively and negatively. Globally, the concept of incorporating safety into the design phase of construction projects has gained momentum as a practical and meaningful intervention implemented upstream of the work to improve worker safety. However, in the United States, inherent barriers (i.e., regulatory, legal, contractual) exist that preclude this concept from becoming part of standard practice. Conventional safety management practices are focused on the constructor; therefore, the implementation of safety preparations is typically delayed until the construction phase begins or until the bid is decided. Thus, the efficacy of early intervention in a project's life cycle to design to eliminate, avoid, and reduce recognized hazards is not fully realized.

The purpose of this research was to determine the relationship between the concept of designing for construction safety and the various causes of construction fatalities. A safety-through-design incident investigation model was developed, validated, and utilized in this research. Two-hundred and twenty-four construction fatality investigation reports from the National Institute for Occupational Safety and Health Fatality Assessment and Control Evaluation program's database were reviewed and a contributory association with the design for construction safety concept was established. The results reveal that 42% of the fatalities were linked to the concept; the associated risk that contributed to the incident would have been reduced or eliminated in 42% of the cases had the design for construction safety concept been utilized. Specific project characteristics, such as type of project, designer discipline, and design element being constructed at the time of the fatality were evaluated to determine which are most frequently associated with the concept. Most notably, designing for construction safety can minimize the risks associated with falls and the hazards posed by site conditions in relation to the specified work. These findings advance the concept of safety through design in construction in two main ways: 1) by developing a greater awareness of the consequences of ignoring the recognizable and manageable design influences that can positively affect construction safety, and 2) by identifying specific design suggestions that, when implemented, will generate the greatest impact in reducing risks associated

with traumatic injuries.

Design for safety implementation tools exist both globally and domestically; they have been utilized and proven to reduce risk during construction. These tools need to be better understood and implemented by policy makers, researchers, and the U.S. construction industry. The results of this research provide a rationale for these stakeholders to develop methods, incentives, and guidance documents, and to increase research, with the intent of removing the systemic barriers so the concept of designing for construction safety can become a standard practice to reduce overall project risks.

Abstracts

Poster: 0031

A Pilot Study of Design Professionals' Perceived Feasibility of the Design for Construction Safety Intervention

J Gambatese (1), M Behm (1) presenting

Oregon State University, Corvallis, OR, United States (1), East Carolina University, Greenville, NC, United States (2)

Research studies have identified the design of projects as being a significant contributing factor to construction site accidents. Designing to eliminate or avoid hazards prior to exposure on the jobsite is listed as the top priority in the hierarchy of controls common to the safety and health professions. Widespread implementation of the design for construction safety intervention in the U.S. by engineering and architecture firms, however, is lacking due to perceived industry and project barriers. Given its absence from standard design practice, a question arises as to the feasibility of designing for safety as a practical intervention in the construction industry. Design professionals are a key component in determining how this intervention can be most effectively utilized within the constraints of the U.S. construction industry. This research presents a pilot study that was conducted to investigate the practice of addressing construction worker safety when designing a project and to determine its feasibility and practicality.

Nineteen design professionals were interviewed to determine their knowledge of safety through design, their willingness to implement the intervention, their opinion on various design suggestions, and overall worth of incorporating safety through design in the construction industry. The results of this research indicate that designing for safety is a viable method to enhance construction worker safety and an intervention that can be utilized by design professionals. The outcomes of implementation provide design professionals with sufficient motivation to apply the intervention in practice. However, the study results suggest that several key changes are needed for widespread implementation of safety through design to transpire in practice which include: a change in designer mindset toward safety; clear establishment of a motivational force to promote designing for safety; increase designer knowledge of the intervention; incorporate construction safety knowledge in the design phase; utilize designers' knowledge about design-for-safety modifications; make design for safety tools and guidelines available for use and reference; and mitigate designer liability exposure.

The study results help move the intervention forward in practice by understanding design professionals'

apprehensiveness toward designing for construction safety and by identifying specific aspects of the design and design process where the intervention can be utilized given the existing barriers. However, additional implementation strategies need to be developed as the design for construction safety intervention is still slow to be adopted as a standard practice among U.S. design firms. Moreover, additional research is necessary, particularly through case studies, to demonstrate the effectiveness of designing for construction safety as a method to reduce risk on construction sites. Itis not until a more holistic view of construction safety, which includes upstream design decisions, is realized and practiced, that the construction industry will begin to reduce the steady rate of fatalities and serious injuries that has plagued the industry in recent decades.

Abstracts

Poster: 0032

The Workplace Solutions and Construction Solutions Databases: Web-based Hazard and Solution Information for the Small Business Community and Construction Industry

P Entzel (1), R Niemeier (2), J Platner (1) presenting, L Welch (1)

Center to Protect Workers' Rights, Silver Spring, MD, United States (1), NIOSH/EID, Cincinnati, OH, United States (2)

Research to date has demonstrated the range of occupational hazards, characterized the levels of exposure for some specific workers and tasks, and validated some of the many available control strategies. Additionally, various efforts have been made to collect and disseminate information on new and innovative control technologies. The Workplace Solutions and Construction Solutions database projects will take the critical next step of organizing and presenting this information in a clear and simple web-based format easily-accessible to employers and workers.

The goal of the Workplace Solutions internet site is to enhance the NIOSH small business resources site to transfer the results of current research, solution information and technology transfer information to small business workplaces. Information presented on the Workplace Solutions site will include hazard information, training materials and evidence-based solutions targeted to specific small business segments. The complimentary Construction Solutions site will present simple overviews of hazards and risks associated with core job tasks in fifteen different construction trade groups. For each task/hazard pair, the Construction Solutions database will identify and describe a range of currently-available solutions, including control technologies and techniques aimed at architects, manufacturers, contractors and workers. Where available, productivity and return-on-investment considerations will be included in solution information developed for both projects.

An interdisciplinary pool of subject matter experts will provide all database content, drawing on material from a variety of sources. Individual hazard and solution records will be peer reviewed for accuracy, clarity and transparency, and website users will be invited to provide their own online reviews of all solution ideas. Browsers of either site will be encouraged to submit new solutions ideas for inclusion in the databases. To assess usage and perceived impact of the Construction Solutions database, periodic electronic surveys will be conducted with OSHA 500-certified construction apprenticeship instructors.

Abstracts

By improving access to simple and reliable hazard and control information for specific small business segments and core construction job tasks, the Workplace Solutions and Construction Solutions internet sites will help employers and workers identify high-risk tasks and evidence-based solutions. Having access to a centralized solution database will also enable industry innovators and health and safety researchers to rapidly share new solution ideas and avoid duplication in effort. Finally, systematically organizing existing exposure and control information will highlight gaps in information and technology, including tasks in need of assessment, controls in need of evaluation, and hazards lacking effective or feasible solutions.

Abstracts

Poster: 0033

Designing for Safety in the Construction of Single-Family Homes

BA Fry (1) presenting

The University of Tennessee, Knoxville, TN, United States (1)

Among the nine major industrial groups in the United States the construction industry typically ranks among the top three for having the highest annual fatality rate. Falls from or through roofs have been the leading causes of these fatalities for the past two decades. The research I am currently involved in consists of analyzing narrative descriptions of fatality investigations of all fatal events associated with the construction industry. The primary purpose of the analysis is to provide the agency sponsoring the research with information associated with the proximal cause of the incident as well as offer suggestions as to how these situations may be avoided in the future. In addition the knowledge gained as a result of this research provides information which leads to customized training programs for the industries workers as well as the responsible writing of new safety standards and codes that are to be enforced and adhered to on construction sites.

Currently I am involved in a study assessing the proximal cause of fatalities occurring during the construction of single-family homes. The study encompasses not only new construction but also fatalities which may occur in association with re-modelling or additions to existing single-family homes. An examination of more than seventy case files selected from a three year time period indicated that the leading causes of fatal events for this type of construction are various types of falls, electrocutions, and crushing incidents. In addition we determined that nearly every incident reviewed could have been avoided provided the proper preventative measures were taken. Potential preventative measures may be but are not limited to the provision of adequate safety and training courses, the existence of a competent person on site, or the proper use of safety equipment.

Beyond offering more specific training and the writing of new safety standards I feel it may prove to be beneficial to investigate how the designs of our single-family homes can be improved upon in order to create a safer work environment. I believe that increased communication among builders, architects, engineers, contractors, owner representatives, union representatives as well as safety, health and insurance professionals is needed if we are to see fewer fatalities on construction sites. Increasing communication of site related issues and scheduling details such as the arrival and placement upon arrival of materials may potentially lessen the occurrence of fatal incidents. All of the previously mentioned disciplines could

participate in and benefit from practicing increased communication whether it is the architect creating an additional drawing locating where materials are to be placed within the site or the general and trade contractors being held responsible for obtaining additional permits.

Understanding the issues related to the fatal incidents occurring during the construction of single family homes is helpful in understanding the fatal incidents occurring throughout the construction industry. Studies show that in the construction industry falls from or through roofs rank number one among all fatality causes and account for 11% of all fatal events. Beginning to understand the circumstances related to these incidents and considering alternative preventative measures within on specific building disciple will help us to understand them in a larger context. Our hope is that through investigation, analysis, understanding, alternative considerations, increased communication and raising awareness we can work with the agency supporting this research to improve the health and safety in construction and lessen the number of fatal incidents.

Abstracts

Poster: 0034

Health Services Utilization Among Hispanic Construction Workers

X Dong (1) presenting

The Center to Protect Workers' Rights, Silver Spring, MD, United States (1)

In light of demographic changes in the United States, the construction industry is characterized by a large, young, and quickly growing Hispanic workforce, coupled with a sizable and persistent difference in occupational fatalities between Hispanic and non-Hispanic construction workers. Protecting safety and health of Hispanic workers is a critical challenge facing the construction industry.

To address the NIOSH research priorities and examine this important focus area in construction safety and health research, we conducted targeted health services research on Hispanic construction workers using national survey data. The specific aims of this project include: 1) examine health status and health services utilization among Hispanic construction workers; 2) identify disparities in health and health services utilization between Hispanic construction workers and their white, no-Hispanic counterparts; 3) identify major socioeconomic and work organization factors underlining the disparities; and 4) develop intervention strategies to reduce/eliminate the disparities and improve health of Hispanic construction workers and the entire construction workforce as well.

A large national population-based health survey — Medical Expenditure Panel Survey was used for this study. To increase statistical reliability, MEPS data from 1996 through 2002 were combined for the data analyses. The initial findings show that, Hispanic construction workers are more likely to be uninsured, and less likely to be satisfied with the health services they received than their white, non-Hispanic counterparts. They are also less likely to have regular place to go for their health problems and more likely to use emergency room when they are ill or injured. The major demographic and socioeconomic factors contributing to the difference include: years in the U.S., union status, educational attainment, and employment status. Descriptive and multivariate analyses have been done with SUDAAN.

Abstracts

Poster: 0035

Safety and Health Training in a Diverse Construction Workforce

E Jorgensen (1) presenting, RK Sokas (1), L Nickels (1), J Gittleman (2), C Trahan (2), W Gao (1), C Beam (1)

University of Illinois at Chicago School of Public Health, Chicago, IL, United States (1), The Center to Protect Workers Rights, Silver Spring, MD, United States (2)

Overall, mortality rates for Hispanic workers are higher than for all U.S. workers, although this excess mortality occurs exclusively among foreign-born Hispanic workers, who were one-third more likely to die on the job than U.S. workers as a whole, while fatal occupational injury rates for U.S-born Hispanic workers were virtually identical to all U.S. workers from 1995 - 2000. Construction work consistently ranks among the three industry sectors with the highest rates of fatal occupational injury, and accounts for the greatest number of deaths. Falls from heights are the leading cause of death among construction workers.

The purpose of this study is to characterize baseline knowledge, attitudes, behaviors and experiences of apprentices and journeymen in a construction union prior to participation in an OSHA 10 hour course that uses a standardized training program. Specific questions targeted fall hazards.

An English/Spanish baseline survey was developed and pilot tested with input from master trainers, outreach trainers, and professionals in the training and research arm of the building trades. Following a protocol approved by the human subjects protection board of the academic partner, participation was solicited immediately prior to the safety and health training session and written informed consent was obtained from study particpants. The survey was then administered in a group setting before the the class started. An investigator read the survey to the subjects in English, and bilingual facilitators were available for individuals who had questions about completing an item. Subjects were invited to complete the survey at their own pace, within a 30 minute time limit.

Surveys were administered to 8 different classes of the regional Roofers Joint Apprenticeship and Training Program, which served as the setting for both apprentice training and for journeyman upgrade training. Classes were taught on Saturdays between November 2004 and November 2005. One class was comprised of apprentices only and the other classes included both apprentices and journeymen. Participation rate was 71%, for a total of 156 participants, of whom 141 completed responses regarding

ethnicity and place of birth.

Data were entered and analysed using a SAS program.

Subjects included one Polish-born worker, who was subsequently excluded from this analysis, 80 U.S.-born non-Hispanic workers (UNH), 22 U.S.-born workers who self-identified as Hispanic or Latino (UH) and 38 foreign-born Hispanic workers, primarily from Mexico (FH). U.S.-born Hispanic workers tended to be more likely to be apprentices with fewer years in the trade than either U.S. non-Hispanic workers or Foreign born Hispanic workers.

Preliminary analysis identified several differences among groups, including recognition of hazards on a worksite. Logistic regression of the group as a whole identified prior training as a significant factor for identifying workplace hazards, with an odds ration of 5.65, confidence interval 2.22 – 14.9. After using the Mantel-Haenszel adjustment for demographic group, the odds ration remains high (5.61, CI 2.11 – 14.9) and there is no effect measure modification or statistical interaction. Introduction of the demographic group did not change the positive effect of prior safety and health training.

The findings suggest that at least one important aspect of worksite safety, recognition of hazards, may be improved by training, and that this is as true for foreign-born and for U.S.- born Hispanic workers as it is for U.S.-born non-Hispanic workers. The role of unionization and formal training as a protective factor for foreign-born Hispanic workers deserves further study. This is particularly important in the construction sector, which has an increasing number of Latino workers.

Abstracts

Poster: 0036

Risk Factors for Nail Gun Injuries in Apprentice Carpenters

HJ Lipscomb (1) presenting, JM Dement (1), J Nolan (2), D Patterson (1)

Duke University Medical Center, Durham, NC, United States (1), Carpenters District Council of Greater St. Louis and Vicinity, St. Louis, MO, United States (2)

Pneumatic nail guns have increased productivity in wood frame construction but not without cost. Injuries from these tools are among the most common in residential construction and apprentice carpenters are at particularly high risk. These injuries have been portrayed as freak "accidents" in the press in recent years. This project was designed to more clearly document the magnitude of this injury problem among apprentice carpenters and to evaluate the effect of training in tool use and tool design on injury risk. Questionnaire data were collected from 732 apprentice carpenters enrolled in two training schools in the Midwest between January and July 2005. The carpenters were asked about heir injury experience, training, work hours, and tool use. Each carpenter was asked specifically to estimate hours of nail gun use in a typical week. Injured carpenters (n=216; 63% of injured) participated in a detailed surveillance interview conducted by experienced journeymen carpenters to capture information on the circumstances surrounding their injuries.

Injury rates were considerably higher than recognized; injuries resulting in medical care or lost time from work occurred at a rate of 10 per 200,000 hours worked. Almost half (45%) of apprentices had at least one nail gun injury before finishing their 4-year apprenticeship program with the majority being un-reported. Twelve percent (12%) of the injuries were inflicted by a co-worker. Those with less than one year in the trade were at particularly high risk as were those without training in tool use. Although most of the apprentices reported training in nail gun use the training often did not occur before they were injured. Even after adjusting for experience and training, injury rates were twice as high with the use of a contact trip trigger mechanism compared to the sequential trigger mechanism. The latter was designed to prevent unintentional firing of the gun by requiring that the nose element of the tool be depressed prior to pulling the trigger. Nearly two-thirds of the hours of tool use were with the more dangerous trigger mechanism.

Because these tools are easy to operate their use is assumed to be an unskilled task and, consequently, they are often given to inexperienced workers. To prevent these very common injuries of residential carpenters training in tool use is needed and it is needed very early in a carpenter's career. From the

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detailed interviews a number of factors contributing to these injuries were confirmed such as inappropriate placement of hand/body in relationship to the firing end of the tool, penetration of the wood surface, projectile or ricocheting nails, lack of eye protection, and by-passed safety mechanisms. However, the largest number of injuries in this population would be prevented through the switch to tools with the safer sequential trigger mechanism.

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Poster: 0037

Social/Economic Impact of Injury/Illness in Career Roofers

LS Welch (1) presenting, KL Hunting (1), P Entzel (1)

George Washington University, Washington DC, United States (1), Center to Protect Workers Rights, Silver Spring, MD, United States (2)

As the U.S. population ages, public policy needs to address ways to keep these workers employed. In order to look at the interaction of age and injury on social and economic factors, we have enrolled 989 actively working roofers in a longitudinal study. We will present results of the baseline survey. The baseline interview included questions on: (1) serious medical and musculoskeletal conditions in the past two years, (2) missed work and job accommodations related to these conditions, (3) frequency and duration of musculoskeletal symptoms, and (4) functional status and economic status. Preliminary results show that 69% percent of respondents had experienced at least one target medical or musculoskeletal condition in the previous two years. The vast majority of musculoskeletal conditions were linked to work-related injuries. Nearly one-third (31%) of all respondents reported missing time from work in the prior two years due to a target medical condition or MSD. Fourteen percent of workers with a condition of any type indicated a limitation in three or more work activities, compared to only 4% of respondents with no condition; workers with both medical and musculoskeletal conditions had the highest levels of impairment overall. Seventeen percent (17%) of roofers an MSD and a medical condition felt they could not take care of their families “like they used to” often or almost always, as opposed to 2.4% of those without a condition.

Of those roofers with an MSD and a medical condition, 38.5% had dipped into savings in the past year, significantly higher than the 24% among the participants without a medical condition or an MSD. Among those who had missed work due to any condition, 43% had dipped into savings. The prevalence of medical conditions, and the impact of those conditions, increased significantly with age. This presentation will present a detailed analysis of the interaction of aging, disease and injury and describe the impact of diseases of aging on work ability among roofers.

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Poster: 0038

Construction Safety and Work-Family Balance: A Challenge and Unexplored Frontier

PY Chen (1) presenting, J Rosecrance (1), LB Hammer (2)

Colorado State University, Fort Collins, CO, United States (1), Portland State University, Portland, OR, United States (2)

Significance and Background: Few industries are plagued by more workplace injuries than the construction industry, which had the highest death rate in 2004 when compared to other occupations (BLS, 2004). Compared to other occupations, construction workers also have the highest rate of mental health problems that manifest themselves in either alcohol or substance abuse (Foster & Vaughn, 2005), which would inevitably affect workers' safety and health. Although the physical environments (e.g., hazardous work conditions) have been improved, the unique nature of construction work requires special attention to the human-related systems such as the interaction between work and family. We see work-family conflict as an important but neglected safety hazard. Specifically, we argue that when workers are preoccupied with concern and thoughts about their work and family, they are more likely to get injured due to distraction. An additional issue related to work-family conflict and safety in the construction industry, is that construction workers are rarely permanent employees because they work for different contractors for different jobs at different time. Thus, supportive organizational work-family policies are virtually non-existent due to the nature of the job. Workers often leave home very early, work longer hours, and travel away from home for weeks or months without any clear attachment to an employer. Foremost, this newly-recognized challenge is unlikely in practice addressed by safety and technical trainings, enforcement of safety policies, or provisions of personal protected equipment.

Aims: To address the above challenge, we examined two essential questions as the first step to explore this new frontier. First, how would conflict between work and family (i.e., conflicting roles pressure from work and family) predict workers' mental and physical health, injuries and pain reports? Second, how would family support that workers received predict the above outcomes? Both questions would help us substantiate the roles of work and family interface in construction safety and health.

Method: A UA Local office manager first randomly selected 243 pipe-fitter journeymen qualified for the current study, and then invited them to participate in this pilot study. Ninety-three male journeymen (mean age of 48) completed the survey, which contains scales assessing conflict between work and family lives, family support, mental health, physical health, injuries, and pain. All scales were modified based

on existing scales which have previously demonstrated excellent reliability and validity.

Findings: Two major findings were revealed. First of all, conflict from work to family (e.g., overtime at work restricted time to spend with family), rather than conflict from family to work (e.g., time spent on taking care of sick family members), significantly predicted workers' poor mental and physical health, frequent injuries and chronic pains at work (R2 ranged from 0.12 to 0.28). We conducted a similar regression analysis to investigate how two forms of family support, engaging conversation about negative aspect of respondents' work and about positive aspect of respondents' work, predicted the outcomes of interest. The data suggested that engagement of negative conversation significantly predicted poor mental and physical health, frequent injuries and chronic pains at work (R2 ranged from 0.11 to 0.23). However, engagement of positive conversation did not seem playing the expected role in safety and health. Although the results seemed counterintuitive, a similar finding based on white-collar temporary workers was reported elsewhere (Chen, Popovich, & Kogan, 1999).

Conclusions: The findings suggested that pressures brought from work to family play a vital role in predicting workers' health and safety. Furthermore, engagement of negative conversation with their family exhibits detrimental impacts on workers' safety and health. Because work-to-family conflict and family-to-work conflict are significantly related to each other, a reciprocal effect is plausible. Overall, the current study suggests that there is a pressing need to develop evidenced-based strategies which can help workers and their families to resolve conflicts between work and family. Although organizational and personal strategies to reduce work and family conflict have been proposed (e.g., flexible working hours, limiting travel), they were primarily developed for stationary workers, and don't seem applicable for construction workers, given the nature of their work and their connection to any one organization. Finally, while this pilot study was conducted based on a sample of pipe-fitters, it could extend to other construction trades.

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Poster: 0039

Assessing Fall Risks in Residential Construction

AM Dale (1) presenting, V Kaskutas (1), H Lipscomb (2), J Gaal (3), M Fuchs (3), J Nolan (3), D Patterson (3), B Evanoff (1)

Washington University School of Medicine, St. Louis, MO, United States (1), Duke University, Durham, NC, United States (2), Carpenters' Joint Apprenticeship Program, St. Louis, MO, United States (3)

Falls are a leading cause of mortality and morbidity in construction. Residential carpenters work on small, often-dispersed worksites making it particularly challenging to understand their work exposures and subsequent risk. Surveillance data lack enough detail to allow clear delineation of these workers. As part of a comprehensive needs assessment designed to improve training of residential carpenter apprentices we conducted a series of activities to identify essential training elements for the prevention of falls among apprentices, their attitudes towards fall risk and safety measures, training they receive, and fall hazards to which they are exposed. Initially, we reviewed published literature on falls in residential carpentry, NIOSH FACE investigations, and reports of 850 falls from height among residential carpenters in North Carolina, Missouri, and California captured through workers' compensation reports and active surveillance. We conducted a series of focus groups with carpenter apprentices (n=36) at various stages of their training and held discussion groups with apprenticeship trainers. Audits were conducted on 70 residential sites designed to identify fall hazards and how hazards were abated.

These data show that carpenters fall from or through a wide variety of work surfaces including ladders, scaffolds, foundations, trusses, joists, roofs, tops of framed walls, floor openings, windows, stairs, decking, and vehicles. Most falls would be prevented through the use of current fall prevention strategies. Falls were sometimes related to skill levels but also building practices, speed of work, weather, lack of equipment, and failure to ask for necessary help. In focus groups apprentices articulated risk for the majority of these conditions, but reported varying levels of attention to prevention activities on work sites. They described issues that are important in understanding fall prevention. Worksite observations provide useful data but each audit can only capture one stage of construction. Ladders, which are ubiquitous on residential sites, are able to be observed on almost all site visits, while setting of trusses is rarely observed without targeted audits. Despite this challenge, residential audits identified areas where fall protection practices can be improved. For example, controlled access zones (CAZs) were rarely used appropriately (~10% of the time), while wall guardrails were appropriately in place nearly two-thirds of the time.

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Extension ladders were secured only 25% of the time and step ladders were used inappropriately 30 to 50% of the time. Despite 93% of the carpenters interviewed stating that fall arrest equipment was available at their worksite, use of equipment was only observed at 7% of the sites and the lanyard was often set-up improperly. Carpenters report fall prevention training occurs frequently on worksites, but apprentices report performing work at heights prior to adequate training, and audit results demonstrate that fall prevention behaviors are practiced inconsistently. These data reflect the diverse nature of residential carpentry work and document the challenges in designing effective interventions to reduce falls.

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Poster: 0040

Ladder Fall Prevention Initiative for Construction Industry

J Gittleman (1) presenting, J Nagrod (1), K McGreevy (1)

Center to Protect Workers' Rights, Silver Spring, MD, United States (1), New Jersey State Building and Construction Trades Council, AFL-CIO, Clark, NJ, United States (2), New Jersey Department of Health and Senior Services, Occupational Health Surveillance Program, Trenton, NJ, United States (3)

Introduction/Broad objectives: Ladder safety in the construction industry is an important public health issue in need of attention. Fatalities and injuries from ladder falls have been on the rise across the U.S. in recent years. According to the Bureau of Labor Statistics' 2004 Census of Fatal Occupational Injuries there was a 17% increase between 2003 and 2004, with 114 fatal ladder falls reported in 2004. Since ladder falls are entirely preventable, proper training on ladder safety techniques is essential to address this public health issue with the ultimate goal of prevention.

Purpose: The objectives of this collaborative initiative are to develop a ladder fall prevention film and several fact sheets to be administered to construction workers, and to evaluate the impact of these tools. Pilot testing of the film was conducted during its development to evaluate the tool's effectiveness and identify areas in need of improvement.

Methods: Pilot tests were conducted with 25 union laborer apprentices and electrician journey-workers. Pre and post tests were administered to each participant assessing their knowledge, attitude, and behavior regarding ladder safety before and after viewing the twelve minute film. An open discussion followed to gather information about participants' impressions of the film. Pre and post tests were analyzed using the Wilcoxon Signed Rank test and McNemar's test for discordant pairs to test for statistically significant changes in outcomes after viewing the film.

Findings: Overall, viewing the film appeared to improve participants' knowledge and attitudes regarding preventing ladder falls. Specifically, after viewing the film, participants were more likely to report disagreeing with the belief that one can catch oneself if falling from a ladder. Similarly, participants were more likely to report agreeing with the idea that physical strength will not do much to reduce the impact of a fall. Participants in the study were statistically significantly more likely to report that they would inform their supervisor of a ladder safety issue after viewing the film. The analysis indicated the film positively changed the participants' ways of assessing proper ladder angles, and reduced

the intended incidence of undesirable behaviors like carrying loads up the ladder by hand, standing on the top of a stepladder, or climbing the back of a step ladder.

These results indicate a short educational film presenting easy-to-understand safety tips and emotional appeals from real workers and their families can have a powerful impact on intended safety practices. The pilot test results from the film were used to improve and modify particular parts of the film, as well as the survey instrument and fact sheets. In 2006, we will conduct a pilot test of these improved tools with 350 building and construction workers on New Jersey construction jobsites, aiming to expand the initiative into a national campaign targeting the construction industry.

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Poster: 0041

NIOSH-Designed Adjustable Roof Bracket and Safety Rail Assembly

TG Bobick (1) presenting, DM Cantis (1), E McKenzie (1)

NIOSH, Division of Safety Research, Morgantown, WV, United States (1)

Importance of problem: Fall-related fatalities and serious injuries are still prevalent in the U.S. construction industry. The primary cause is roof-related and includes falls from roof edges, or through roof holes and skylight fixtures. Bureau of Labor Statistics data indicate that for 1992-2000, an average of 208,000 roofers were employed each year. Other construction trades also work at elevations and all are exposed to situations where they could fall, resulting in a fatality or a serious injury involving days away from work (DAFW). For 1998-2003, BLS data reveal that a yearly average of 147 workers were killed and 3,657 workers were seriously injured after falling from roof edges or through roof holes and skylights. Roof-related fall injuries are among the most severe cases, as measured by median DAFW. Compared to all types of fall-to-lower-level cases in U.S. private industry, falls from roofs and falls through roof holes and skylights were two to four times more severe than all other fall-to-lower-level cases.

Objective of study: The objective was to develop a highly adjustable, securely fastened, durable worker-support bracket and safety rail assembly to provide a guardrail system to protect workers from sliding off roof edges, or falling through unprotected roof/floor holes, stairwells, balconies, and existing skylights.

Methods: Two methods were used to evaluate the prototype design of the bracket-rail assembly. A manikin, weighing 220 pounds, was supported on a hinged metal structure that permitted it to fall onto the top rail of the guardrail system to evaluate whether the OSHA requirement of supporting a 200-lb outward/downward point-load force to the top rail would be met. Second, a unique test fixture was developed that pulled the guardrail assembly to failure to determine the maximum force the supporting bracket-rail assembly could withstand.

Findings: Iterative testing resulted in four major improvements to the adjustable bracket-safety rail assembly. The guardrail system supported a drop load from the manikin that exceeded twice the OSHA 200-lb point-load force requirement. The bracket-rail assembly was able to withstand the maximum pulling force of the hydraulic pull-to-failure fixture, which was approximately 800 pounds force. Most

importantly, the NIOSH-designed bracket-rail assembly has received "patent-pending" status. The research team is working to secure the partnership of a roofing-products manufacturer to turn the prototype design into a commercially available product.

How Findings Advance Research: Designs of other existing roof brackets include only two different roof-pitch adjustments, and are normally limited to a maximum pitch of 12:12 (45°). This new design is adjustable from flat to 24:12 (63°) pitch, with seven different roof-pitch adjustments between the two extremes. The last three pitches are greater than 45° (51°, 56°, and 63°). This prototype design will provide the construction work force with a safety product that will be easy to install and maintain, and will provide the required protection.

How Findings will Improve Safety: This design of roof protective system, if used routinely and properly, should prevent dozens of deaths and hundreds of serious injuries to construction workers who are required to work at elevations.

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Poster: 0042

Dump Truck-Related Deaths in Construction, 1992-2002

M McCann (1) presenting, M Cheng (2)

The Center to Protect Workers' Rights, Silver Spring, MD, United States (1), Professional Environmental Services, Inc., Bronx, NY, United States (2)

Dump trucks are used extensively in construction and other industries to remove debris from construction sites and to deliver materials. They are a continual presence on construction sites during the early stages of construction and can make many trips during the days from the site to a dumping place. The purpose of this study was to examine the causes of dump truck-related fatalities in construction in order to develop interventions to make it safer to work on or around dump trucks.

Dump truck-related deaths were identified by selecting all records from 1992-2002 with source or secondary codes of "dump truck" (8252) from the Bureau of Labor Statistics database, the Census of Fatal Occupational Injuries. The records were analyzed for causes of death, worker activity and occupation.

A total of 525 dump truck-related deaths were identified from 1992-2002, an average of about 50 per year. Major causes of death were struck by dump truck (41%), highway accidents (30%), and caught in between (9%). Major worker activities at the time of death were worker on foot in the proximity of a dump truck (42%), dump truck operator in or around the truck (39%), and worker maintaining a dump truck (10%). Half of the 220 workers on foot killed were struck by dump trucks backing up. Three-quarters of 27 operators on foot killed were run over by their own dump truck. Sixty percent of the 204 dump truck operators killed were involved in highway accidents; collisions with trains accounted for 17% of these deaths. At least one-quarter of the 122 operators killed on the highway did not have their seat belts fastened. Twenty- eight (53%) of the workers killed while maintaining or repairing dump trucks were caught between the dump truck frame and a falling dump body.

Recommendations include: 1) spotters or mechanical devices to alert dump truck operators to the presence of workers on foot in their blind spots should be used; 2) dump truck operators should slow down at every railway crossing; 3) dump truck operators should be required to set parking brakes and shut off the motor if they get out of the truck; and 4) workers maintaining dump trucks should be required to lock out raised dump truck beds to prevent them falling.

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These findings show that dump-truck-related deaths in construction have a variety of causes that can be individually addressed in interventions to make the construction workplace safer both for dump truck operators and those workers around dump trucks. These findings would also have relevance to industries other than construction that use dump trucks, such as mining and general industry.

Abstracts

Poster: 0043

Validation and Reliability of a Checklist for Evaluating Cab Design Characteristics of Mobile Construction Equipment

NK Kittusamy (1) presenting, PB Aedla (2), MJ Jorgensen (2)

NIOSH-Spokane Research Laboratory, Spokane, WA, United States (1), Wichita State University, Wichita, KS, United States (2)

Operators of heavy mobile construction equipment often incur high rates of musculoskeletal disorders (MSDs). This is contributed to, in part, by exposure to awkward postures during the operation of the equipment which are a consequence of the design of the cab, location of controls, and work procedures. However, there is a lack of valid methods capable of describing postural stresses among these operators. The objectives of the study are: 1) to validate a cab design checklist by: a) collecting postural data among operators of ten different types of heavy construction equipment, b) analyzing postural data using video analysis, and c) assessing correlations between scores from the checklist and the postural analysis for specific joints; and 2) assess the reliability of the checklist by: a) collecting data using cab design checklist, and b) assessing the inter-rater reliability of the raters administrating the checklist. Results from the correlation analysis showed that shoulder flexion posture was correlated with scores from the cab design checklist (left shoulder flexion r=0.81, p=0.004; right shoulder flexion r=0.52, p=0.073). However, results of the cab design checklist were not significantly correlated with shoulder abduction (left, r=0.26, p=0.249; right, r=-0.17; p=0.330), neck flexion (r=0.34, p=0.185), neck lateral bending (r=0.01, p=0.492), neck twist (r=0.32, p=0.201), nor any torso postures (flexion, r=-0.49, p=0.88;,lateral bending, r=0.14, p=0.359; twist, r=-0.15, p=0.347). The inter-rater reliability assessment resulted in kappa coefficients ranging from 0.52 to 1.0 (good to excellent reproducibility) across the ten different pieces of construction equipment rated, and an overall kappa coefficient of 0.77 (excellent reproducibility) when considering all equipment ratings together. The results suggest that the cab design checklist can be used as a screening tool to provide an assessment of cab design characteristics that contribute to awkward postures of shoulder, and may be useful for identifying cab design characteristics for further improvement. Additionally, the strength of the inter-rater reliability assessment suggests that outcomes of the cab design checklist administered by different individuals will be consistent independent of the type of equipment being assessed.

Abstracts

Poster: 0044

Electrical Arc Injury Parameters and Prevention

M Capelli-Schellpfeffer (1) presenting

CapSchell, Inc., Chicago, IL, United States (1)

Research progress in the Electrical Arc Injury Parameters and Prevention study is influencing U.S. medical, electrical engineering, and electrical safety management. By encouraging multi-disciplinary, cross-functional, and inter organizational acknowledgment of the "multi-hazard nature" of an electrical arc incident, the basic science appreciation of injury as a resultant of energy transfer to the body is linked to electrical inputs and outputs in an electrical event. The findings relate to construction injury and fatality experience: While comprising about 7% of the U.S. workforce, construction workers sustained 44% of electrical fatalities. Our study has developed conceptual and three-dimensional computational models for electrical arc events and their use in severity rating blast conditions.

In the study, we 1) Conceptually and mathematically modelled exposure to multiple hazards at the time of an electrical arc event including the acoustic forces which may result in barotraumas; 2) Simulated in 3D the potential blast explosion heat and acoustical force exposure at the time of an electrical arc event in different geographic / geometric settings; and 3) Compared the results with a. known thresholdsfor injury from acoustic forces, vibration, and acceleration-deceleration events; and b. recent experimentally acquired acoustic force measurements.

The results of our numerical simulation show the influence of near-field and far-field reflecting surfaces on the strength and timing of the temperature and shock waves. Simulated locations of the waves of pressure and temperature can be identified by their gradients with their magnitude graphically visualized as keyed by a color bar. During an electrical arc accident, a worker can experience an acceleration-deceleration of the head and neck from exposure to the propagating shock front created with the arc's blast effect.

Blast effects explain in part why electrical injury patients without external signs of electrical contact or burns may present with nervous system or hearing impairment.

At the construction site, these study findings create awareness of an electrical arc as an "electro thermal chemical" or ETC event. The findings improve construction workplace safety and health by emphasizing programmatic focus on classical considerations of industrial hygiene principals regardielectrical energy

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dosimetry, inclusive of the energy frequency spectrum, dose magnitude, and transfer rate. In prevention, these results can be used to specify performance characteristics of protective materials, as well as to influence the selection of barrier protection/PPE, and decision-making in electrical design, construction, and maintenance.

Abstracts

Poster: 0045

The Fall Safe Project

B. Takacs (1) presenting

West Virginia University, WV, United States (1)

Broad Importance of the Research Problem: Falls are the leading cause of fatalities and major cause of injury in construction work. While the construction workforce represents 5% of the nation's workforce, it accounts for 49.6% of fall fatalities. The construction safety profession recognizes available engineering controls, work practices, and personal protection, which are effective in preventing construction falls. However the equipment and practices are not consistently used in the industry. Fall Safe developed and tested a fall prevention system for control of construction fall hazards. This system establishes a partnership between the university and construction contractors. The partnership is established by a contractual relationship through which contractors obtain "Fall-Safe" status by implementing a fall hazard management system.

Purpose or Objectives of the Study: By implementing a fall hazard management system, contractors should improve fall hazard performance.

Summary of Methods: The research methodology for this project employs a quasi-experimental model comparing outcome measures in an intervention group of contractors with measures in a control group. The outcome measures include surveys of employers, supervisors, and employees, audits of construction site fall prevention plans, audits of site fall hazard control efforts, and analysis of fall-related claims to workers' compensation systems.

Summary of Findings: Intervention effectiveness was evaluated using analysis of variance (ANOVA) to determine if intervention/control status accounted for a significant difference at baseline and through the six quarters of the pilot study audits. The two groups were shown not to be statistically different ($p<0.05$) in either program management or field audit scores at baseline. However, there was a statistically significant difference ($p<0.05$) between baseline and the average of the means for quarter 1 through quarter 6 for both the control and intervention group with regard to both the program management and field audit score. Both groups showed improvement.

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How the Findings Advance the Particular Research Field: The construction safety profession recognizes available engineering controls, work practices, and personal protection, which are effective in preventing construction falls. However the equipment and practices are not consistently used in the industry. Contractors maintained Fall-Safe status by maintaining a minimum score on site program and site fall hazard control audits conducted by West Virginia University. The audits also act as a service to the contractor by providing the safety director feedback to assist in the control of fall hazards on the jobsite.

How the Findings can be used to Improve Workplace Safety and Health and Related Outcomes: The audits are conducted using a PocketPC with custom written audit software. The auditor collects data on every fall hazard on the job site and measures to what degree it was controlled or protected. The audit tool also has a management portion that collects data on how fully the company has implemented the management portion of the program. The audit provides a detailed report back to the company for continued improvement and also provides measurable data to track individual company improvement and differences in the intervention and control group. It appears that the conducting an audit and the reporting of results contributes to improvements in contractor control of fall hazards. While originally conceived as a limited tool designed to assist in the evaluation of a single intervention research project, it appears that dissemination of the Fall-Safe audit by itself, may have merit as an intervention.

How the Findings Relate to a Particular Industry Sector: The Fall-Safe research is applicable to organizations working in the areas of occupational safety and health, construction safety, intervention research, workforce development, PDA software development and technology transfer.

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Poster: 0046

Safety Risks in Modular Home Construction

B Takacs(1) presenting

West Virginia University, WV, United States (1)

Broad Importance of the Research Problem: The process of installing (setting) a modular home is an entirely different process from that of a traditional stick-built house. The safety hazards that are created from these activities alone create a high hazard site. Of all of the industrialized housing market segments, modular home production has seen the greatest growth, although it currently holds the smallest percentage. Of particular interest is that modular homes were used extensively in rebuilding efforts of the Gulf Coast. Modular building production is not exclusive to residential construction. Modular manufacturers build everything from storage outbuildings to large hotel resorts.

Purpose or Objectives of the Study: While conducting safety training for a modular home installer, researchers recognized the unique and serious safety hazards involving modular home installations. The purpose of this study on the installation of modular homes was to identify problems, make recommendations for improvement and suggest further research that is needed.

Summary of Methods: The pilot study concept is a basic premise and is a tool used by all researchers to demonstrate new research needs. Researchers conducted Job Safety Analyses on four separate modular home installations. Employees and employers completed questionnaires to obtain data about the experience and knowledge of the workers and companies involved in the pilot study. Researchers also interviewed the companies' on-site personnel to better determine the industry relationships and how they all interact.

Summary of Findings: This pilot study accomplished its goal of determining the hazards of this process and recommending controls that could reduce the risk of injury or death to a construction worker in this industry.

How the Findings Advance the Particular Research Field: Safety Hazards to Workers Installing Modular Homes represents a new area of occupational research.

How the Findings can be used to improve Workplace Safety and Health and Related Outcomes: The results of this research has interested research and regulatory agencies while addressing safety and health concerns for workers.

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How the Findings Relate to a Particular Industry Sector: The research is applicable to all health professionals. The publication of a document titled "Safety Hazards to Workers in Modular Home Construction," research and regulatory agency interest was generated. Currently, researchers are working on a grant funded by the Occupational Safety and Health Administration to develop training materials for workers installing modular homes. The training material will be made available electronically to be used by workers and companies to train on hazards and safe work practices.

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Poster: 0047

Factors Related to Healthcare Workers' Ability and Willingness to Report to Work During Catastrophic Disasters

K Qureshi (1) presenting, RM Gershon (1), MF Sherman (1), T Straub (1), E Gebbie (1), M McCollum (1), M Tan (1), SS Morse (1)

Columbia University, New York, NY, United States (1), Adelphi University, Garden City, NY, United States (2), Greater New York Hospital Association, New York, NY, United States (3), Loyola College, Baltimore, MD, United Kingdom (4)

New emerging infectious diseases have the potential to create significant surge capacity needs across the U.S. healthcare system. Unlike the military, private sector healthcare workers (hcw) can rarely be forced to report to work. Understanding the factors that may influence a hcw's choice as to whether or not to report to duty during a catastrophic disaster is important. We conducted a survey of staff from 47 hospitals, community health centers and long term facilities in the New York metropolitan region regarding their ability and willingness to report to duty during a variety of catastrophic events. This presentation will focus on these findings as well as results from secondary analysis of data from this same study. We found that ability and willingness to report to work varied by type of event, where hcw's were least willing to report to work for SARS events, and most willing to report during a snow storm, and most able to report during a mass casualty incident and least able during a snow storm). Overall, ability and willingness was influenced by a variety of factors including the presence of responsibility for children, elders, or pets, and own personal health concerns. We also found that there is a strong relationship between specific fear or concern for personal safety during biological and chemical incidents and a decreased willingness to report to duty during the catastrophic disasters presented. We are currently evaluating ability and willingness of hcw to report in relation to the necessity for crossing a geographical barrier (such as a river or mountain) via bridge or tunnel to get to work. Preliminary data suggests that those that must cross a geographical barrier are less willing to report during a catastrophic disaster. The final results will be presented at the conference. These findings are important because knowledge regarding factors that influence a hcw's ability (or capability) and willingness (or personal decision) to report to work is essential for effective health services preparedness and planning. In addition, it is essential that the needs and concerns of hcw are taken into account (and addressed) so that an attempt can be made to mitigate the adverse psychological impact caused by catastrophic disasters while enhancing overall ability and willingness to report. For instance, where hcw's are influenced by fear of becoming ill

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or injured, supply of appropriate personal protective equipment with adequate training can serve to reduce fear and anxiety and increase the likelihood of responding to duty. While this study focused specifically on the personnel from the healthcare industry, these findings suggest that this issue should be examined in other industry sectors as well.

Poster: 0048

Health and Safety Problems of Older RNs Employed in Hospital Settings

S Letvak (1) presenting

University of North Carolina at Greensboro, Greensboro, NC, United States (1)

Background: The nursing profession is experiencing an unprecedented aging of its workforce, with the average age of a practicing nurse being 44.5 years. This aging is contributing to a serious nursing shortage, which is especially acute in hospital settings. If we are to retain older nurses it is imperative that information about their health and problems concerns be identified.

Study Purpose: The purpose of this study was to determine the relationships between demographic variables, job satisfaction, physical and mental health, and job related injuries and health problems of nurses over the age of 50 employed in hospital settings.

Methods: A random sample of 600 nurses over the age of 50 who lived in two southeast states were mailed an anonymous survey. The survey measured demographic variables, health (SF-36), job satisfaction, and self reported occupational injuries and occupational health problems. 308 complete surveys were returned for a response rate of 53%. 187 of the respondents were employed in direct patient care in hospital settings.

Findings: A majority of respondents were female (93%). Ages ranged from 50 to 71 years (x=55.7). Respondents had worked an average of 26 years as registered nurses (SD=8.6). One in three (36%) reported an occupational injury within the past five years, with needlesticks (n=31) and back injuries (n=18) being the most frequent injuries. Forty percent reported a health problem related to working as a nurse, with back pain (n=49), anxiety (n=21), and depression (n=11) being most frequently reported. RN age was negatively correlated with hours worked per week and ability to meet demands of the job. Occupational injuries were correlated with the following variables: gender (p=.021), race (p=.004), years worked as a RN (p=.015), type of unit worked (p=.048), shift worked (p=.028) and hours worked per week (p= .001). Occupational health problems were correlated with hours worked per week (p=.022) and job satisfaction (p=.014). Variables predictive of overall health included marital status and job satisfaction (R = ..303, p< .05). Predictors of mental health included age, race, marital status, and job satisfaction (R=.278, p< .05).

Abstracts

Implications: Findings from this pilot study demonstrate significant health and safety problems for the aging RN workforce. Despite increased efforts by NIOSH, nurses continue to suffer from needlesticks and back injuries. Of concern, those RNs with more years of experience suffered higher rates of occupational injury and older RNs reported decreased ability to meet job demands and decreased mental health. Research is needed on the specific workplace changes needed to assure the health and safety of aging workers. Specifically, further research is urgently needed if we are to maximize older RN health and safety because the healthcare system cannot afford to lose them.

Abstracts

Poster: 0049

The Longitudinal Relationship of Extended Work Schedules to Musculoskeletal Problems in Nurses

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Importance: Nurses are at high risk for work-related musculoskeletal injury/disorders (MSD). Because of the movement by health care organizations to reduce costs, generally by downsizing the nursing workforce, the occurrence of unhealthy scheduling practices has been increasing.

Purpose: Therefore, the purpose of this study was to examine the relationship of extended work schedules in nurses to the incidence of MSD.

Methods: Using a longitudinal, three wave survey of a probability sample of 2617 registered nurses, we related Wave 1 work schedule data to neck, shoulder and back (MSD) cases occurring in Waves 2 or 3.

Findings: Adverse schedules were significantly related to nurse MSD. Schedule characteristics increasing MSD risk included 13+ hour/days; off-shifts (other than days); weekend work; working while sick, on days off, or without breaks; on-call hours, and mandatory overtime. These increases in MSD risk were not explained by psychological demands, but were largely explained by physical demands of the job.

Advances: Our research was the first to examine the impact of mandatory overtime, being on-call, working while sick or on a day off, and with less than 10 hours off, on nurse health. All of these scheduling practices were related to increased risk of MSD.

Use of Findings to improve Workplace Safety and Health: Based on these findings, preventive efforts should focus on adopting more healthful scheduling practices. Healthier schedules, including minimizing or eliminating mandatory overtime hours, and reducing work on scheduled days off would lower MSD risk and promote recovery from symptoms.

Health Care Sector Implications: Although schedule modifications may initially require additional nursing staff, retention of a stable and healthier workforce has been shown to reduce employer costs, while greatly benefiting nurses and patient care quality.

Abstracts

Poster: 0050

Duration of Time on Shift Prior to Accidental Blood or Body Fluid Exposure for Housestaff, Nurses and Technicians

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Shiftwork has been found to be associated with an increased rate of errors and accidents among health Care Workers (HCWs), but the effect of shiftwork on accidental blood and body fluid exposure (BBFE) sustained by HCWs has not been well characterized. Shiftwork is an occupational stressor, and has been linked to various social, psychological, and medical problems. Shift work has also been shown to lead to fatigue and disruption of the circadian clock. Housestaff and nurses routinely perform shiftwork, working extended hours and performing work outside of typical daytime hours. The objectives of this study are to determine if the duration of time on shift prior to accidental BBFE is similar for housestaff, nurses and technicians, and to compare the proportion of housestaff and nurses who sustain BBFEs.

This retrospective, descriptive study consisted of a data review of all accidental percutaneous or permucosal BBFEs reported to the Occupational Medicine (OM) Clinic or to the Emergency Department (ED) by HCWs over a 24-month period at a large urban teaching hospital. Data were abstracted from The Employee Report of Injury or Disease form (EROID), completed by housestaff, nursing staff, and technicians upon presentation to the OM clinic or to the ED. Standard descriptive statistics were used to characterize the 3 groups, analysis of variance was used to test for differences between groups with regard to time to BBFE, and the chi-square test was used to compare groups with regard to seasonality, shift, and number of hours on duty. A p-value < 0.05 was considered significant.

The majority of the accidental exposures were percutaneous. Housestaff were on duty significantly longer than both nursing staff ($p=0.02$) and technicians ($p<0.0001$) prior to accidental BBFE. Half of BBFEs sustained by housestaff occurred they had been on duty 8 hours or more, and 24% were sustained after they had been on duty 12 hours or more (compared to 6% by nursing staff was after they had been on duty 12 hours or more). Three percent of all HCWs reported an accidental BBFE with specific rates of 7.9% in nurses, 9.4% in housestaff and 3% in phlebotomists.

Abstracts

Housestaff sustained the highest incidence of accidental BBFEs compared to the other groups, with phlebotomists sustaining the lowest incidence (similar incidence to the general HCW population). Housestaff were also significantly more likely to have longer duration of time on shift prior to accidental BBFE compared to the other groups, and sustained more BBFEs after 12 hours on duty than the other groups. These findings provide a step toward a better understanding of the effect of duration of time on \shift on the incidence of accidental BBFEs. Interventions such as reducing housestaff duty hours, and decreasing the workload of HCWs should help to further reduce the incidence of accidental BBFEs in HCWs.

Abstracts

Poster: 0051

The Association of Overtime Work Hours with Ambulatory Blood Pressure Among Female Nurses

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Background: A stressful organization of work has been associated with a variety of common illnesses, including cardiovascular disease (CVD), psychological disorders and musculoskeletal disorders. CVD presents a major public health burden because it is the leading cause of morbidity and mortality for both men and women. Previous studies have shown associations between work stressors, such as long work hours and job strain (high demand-low control work), CVD and elevated blood pressure in men, but few studies have included women.

Objectives: To study the association between overtime work hours and ambulatory blood pressure (AmBP) among female nurses and nurse aides.

Methods: The sample consists of 97 female nurses and nurse aides participating in the Work Site Blood Pressure Study, a prospective cohort study, in 1995 and 2000. The nurses and aides wore ambulatory blood pressure monitors for a 24-hour period, including a work shift. Overtime work hours were obtained from hospital records. Regression models controlled for shift worked, hours worked on shift, job physical exertion, age, race, education, body mass index, smoking, alcohol, and marital status.

Results: (a) Significant positive associations with overtime worked on the day the monitor was worn were found for work systolic and diastolic blood pressure in 2000. For every additional hour worked over eight hours, there was an increase of 2.3 mmHg in work systolic blood pressure ($p=0.083$) and 2.1 mmHg in work diastolic blood pressure ($p=0.024$). (b) For nurses who worked the evening shift (vs. day shift), substantial elevations in work, home and sleep blood pressures (ranging from 0.3 to 20.4 mm Hg systolic

and –2.0 to 10.7 diastolic) were found both in 1995 and 2000, which reached statistical significance for home blood pressure. However, no substantial or significant elevation in blood pressure occurred in nurses who worked the night (vs. day) shift. (c) There was some evidence of an association between overtime worked during the 2-week pay period the monitor was worn and the previous two pay periods and home systolic blood pressure in 2000. A similar pattern emerged when the sample was limited to RNs only. However, such associations were not observed in 1995. (d) A significant interaction between overtime work during the 2-week pay period the monitor was worn and job strain in predicting work blood pressure was also observed in 2000. For nurses and aides reporting job strain, each overtime hour worked was associated with 0.4 mm Hg difference in work SBP and 0.1 mm Hg difference in work DBP. However, for those not reporting job strain, each overtime hour was associated with declines of –1.2 mm Hg for work SBP and -1.1 mm Hg for work DBP. The p-values of the interaction terms were .043 (work SBP) and .046 (work DBP). Such interactions were not found in 1995, nor for home or sleep blood pressures.

Conclusion: These results provide limited evidence of associations between overtime hours (especially in the presence of job strain), evening shift work, and blood pressure elevation in women. These findings add to the evidence that work stressors increase the blood pressure of women workers, and that various work stressors may interact with each other in increasing blood pressure. Therefore, programs to reduce work organization stressors, such as job strain and excessive overtime, particularly among nurses and nurse aides, should be implemented. These findings are specific to the health care and social assistance sector. Further research is needed to determine to what extent the findings apply to women workers in other sectors.

Abstracts

Poster: 0052

Antibacterial, Antifungal, Antiviral, and Anti-spore Bio-Protective Equipment

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Broad importance of the research problem: The importance of bio-protective equipment for healthcare workers, emergency responders, and other related personnel cannot be overemphasized; this is the last safeguard protecting the human body from exposure to bio-hazardous agents. The currently used equipment can largely prevent the penetration of biological agents, but it cannot destroy these agents. Studies have shown that a wide range of bio-agents including bacteria, fungi, viruses and spores have strong abilities to survive and grow on the surfaces of bio-protective equipment. Therefore, the equipment could be heavily contaminated and become important sources of cross-contamination. Furthermore,in the case of a leakage or "strike through" of biological agents (which is not uncommon in real uses), the barrier function of the protective equipment would be lost and the users would face great danger.

Purpose of the Study: The purpose of this study is to introduce potent antibacterial, antifungal, antiviral and ant-spore functions into bio-protective equipment. The new equipment is expected to be able to significantly improve the occupational safety of healthcare workers, emergency responders, and other related personnel.

Summary of Methods: Bio-protective clothing and face masks were used as typical examples of bio-protective equipment. Methacrylamide (MAA) was grafted onto the equipment materials. Upon hypochlorite bleach treatment, the amide groups in the grafted MAA side chains were transformed into stable acyclic N-halamines. The biocidal functions of the new materials were challenged with gram-negative bacteria, gram-positive bacteria, fungi, viruses and spores.

Summary of Findings: The treated materials provided a total kill of 108-109 colony forming units/mL of E. coli (gram-negative bacteria), S. aureus (gram-positive bacteria), and C. tropicalis (fungi) in 3 min, 106-107 plaque forming units/mL of MS2 virus in 5 min, and 106-107 spores/mL of Bacillus subtilis spores in 4h. The antibacterial, antifungal, antiviral, and anti-spore activities were stable for longer than 4 months under normal lab conditions (20 oC, 35%-90% RH). More importantly, at the time when the biocidal functions started to decrease due to prolonged storage, they could be fully regenerated with another bleach treatment. The recharging has been repeated or more than 30 times without affecting

the original biocidal activities of the materials.

Impacts of this study: To the best of the researchers' knowledge, this is the first study demonstrating that potent, durable and rechargeable antibacterial, antifungal, antiviral and anti-spore functions can be introduced into bio-protective clothing and face mask materials through covalent binding of N-halamine functionalities. The same technology can also be employed to treat other protective equipment such as gloves and shoe covers. The use of the new equipment may significantly improve the occupational safety of healthcare workers, emergency responders, and other related personnel. The transfer of the new technology into manufacturing processes may also markedly enhance the growth and competitiveness of the industries in the fields of protective equipment.

Abstracts

Poster: 0053

Development and Implementation of a Model Surveillance System for Health Care Workers

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Workers in the health care industry may be exposed to a variety of work related stressors including infectious, chemical, and physical agents; ergonomic hazards; psychological hazards; and workplace violence. In addition, workplace and personal risk factors may act in combination to increase or exacerbate risks. The primary objective of this project was to develop and implement a model system for surveillance of potential exposures and health outcomes among health care and related employees. A surveillance system was developed which maximizes use of existing data sources and current coding schemes for important variables such as departments, jobs, and work locations. Workers' compensation claims, health insurance claims, health risk appraisals, and population-based surveys provide the primary health outcome data in the system. Exposures are defined by job and work location. The system can be viewed as a 'data warehouse', consisting of risk factor and health outcome data tables which can be linked to extract individual level variables of interest to form specific analysis datasets. The major surveillance system data elements are updated at least annually, more frequently if needed for specific projects, and provide for cross-sectional and longitudinal analyses to identify populations at risk and to evaluate intervention and prevention programs. Examples of analyses using data from the surveillance system are presented including: 1) risk factors for blood and body fluid (BBF) exposures and 2) work-related stress and personal risk factors as predictors of health care utilization.

For the BBF analyses, a population of 24,425 health care workers (HCW) employed in jobs with potential BBF exposures was followed for BBF exposure events from 1998 to 2002. The study population reported 2,730 BBF exposure events during the study period, resulting in an overall annual rate of 5.5 events/100 FTEs and a rate of 3.9 for percutaneous exposures. Higher rates were observed for males, persons employed less than 4 years, Hispanic employees, and persons less than 45 years of age. Much higher rates were observed for house staff, nurse anaesthetists, inpatient nurses, phlebotomists, and surgical/operating room technicians.

The objective of the work stress analyses was to investigate the effects of self-reported work stress on outpatient health care utilization, while controlling for several potential confounders. For these analyses, we linked outpatient health claims, health risk appraisals (HRAs), and human resources data including workers' demographics, occupation, and work location. These analyses were restricted to workers who

completed an HRA in 2000 or 2001 and participated in one of the employer health insurance plans in 2001. Negative binomial regression models found that, after controlling for age, race, sex, and other covariates (e.g., tobacco use, elevated cholesterol, low physical activity, high body mass index, hypertension, history of diabetes, and elevated family related stress) in the regression models, elevated work stress was found to be significantly associated with higher rates of outpatient health care utilization (RR=1.2, 95% CI=1.1–1.4).

These analyses demonstrate the ability of the surveillance system to integrate data across data sources at the individual level for identification of groups at elevated risk and for evaluation of interventions to reduce risks. Data from the surveillance system also provide a unique opportunity to integrate occupational health and safety and worksite health promotion efforts. The system is currently being used to investigate the prevalence and impact of hypertension, obesity, and diabetes among health care workers for purposes of designing, implementing, and evaluating worksite interventions.

Abstracts

Poster: 0054

Musculoskeletal Injuries and Disorders Among a Large Cohort of Health Care Workers: Analyses from the Duke Health and Safety Surveillance System (DHSSS)

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Health care workers are at risk for musculoskeletal (MSK) injuries and disorders due to a variety of physically demanding tasks that they perform. Because these conditions often lack a discrete onset they may be more difficult to capture using standard surveillance methods. To more comprehensively evaluate the burden of these conditions among a large cohort of workers employed at a tertiary care medical center, we are using data that combines workers' compensation (WC) records, private outpatient health care claims, and human resources data.

Between 1997 and 2003, 21,393 employees reported a total of 3103 musculoskeletal injuries through the WC system. Claims were more likely to be filed by female workers (77%), and those between the ages of 30 to 49 (64%). Claims filed by African-American employees were disproportionate to their representation in the workforce; 46% of claims were filed by these workers who represent 26% of the workforce. Back (43%), shoulder (11%) and knee (8%) injuries were the body sites most frequently reported to be injured. Patient handling tasks were responsible for 46% and 34% of back and shoulder injuries, respectively, while falls (mostly from slips and trips) accounted for a little more than half (52%) of all knee injuries.

Using full-time equivalent (FTE) information for person-time at risk, we calculated rates (#claims/FTE*100) of MSK injuries for selected demographic and occupational groups. The overall rate of MSK injuries for this cohort was 2.9 per 100 FTEs. Skilled craft workers (rate = 18.4), nurses' aides (rate = 12.2), housekeepers (rate = 8.9), radiology technicians (rate = 7.5) and inpatient nurses (rate = 6.7) were the occupational groups with the highest injury rates. Multivariate analyses revealed elevated an risk of back and shoulder injuries due to patient handling activities among nurses' aides (RR: 13.6; 95% CI: 13.0, 14.0), inpatient nurses (RR: 8.4; 95% CI: 8.1, 8.7) and radiology technicians (RR: 5.5; 95% CI: 5.2,5.9) compared to all other workers, while the handling of work materials and equipment were responsible for the elevated risk of back injury among skilled craft workers (RR: 5.4; 95% CI: 5.0, 6.0) and housekeepers (RR: 3.8; 95% CI: 3.6,4.0).

The overall rate of private health care utilization for MSK injuries and disorders for this cohort was 30.6 claims per 1000 person-months of insurance eligibility. Similar to our WC analysis, skilled craft workers (rate = 33.9), inpatient nurses (24.9) and nurses' aides (rate = 24.7) were among the occupational groups with the highest utilization for care of low back pain. Outpatient nurses, who were not among those at highest risk for back pain reported through WC, had among the highest rates of private utilization for these disorders (rate =23.5). This finding may reflect their migration out of the more physically demanding work required for inpatient care nursing.

The patterns of workers' comp claims and private utilization are consistent with work exposures of these occupational groups. These data indicate that workers not typically considered in the health care industry, such as skilled craft workers and housekeepers, are at risk for MSK injuries. With this in mind, the development of prevention strategies within this environment need to be trade specific. Racial differences are, in large part, a reflection of different job exposures with more African-Americans in heavier exposure jobs such as nurses' aides and housekeepers. These findings provide some insight into disparities in health related to their work. The magnitude of morbidity, as well as insight into possible causal paths of these conditions, may not be fully appreciated through analyses of workers' compensation data alone.

Abstracts

Poster: 0055

Characteristics of Persons and Jobs with Needle-Stick Injuries in a National Data Set

JP Leigh (1) presenting

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Importance and Objectives: Fear of needle-stick injuries is widespread among physicians, dentists, nurses and other health care workers. In recent years in the US, roughly 385,000 needle-stick injuries occurred annually among health care workers in hospitals alone. Roughly 400, 800, and 4 of these needle-stick injuries lead to hepatitis B, hepatitis C and HIV infections. We seek to describe the demographic and job characteristics of injured persons in a national data set never before analyzed for this purpose.

Method: The U.S. Bureau of Labor Statistics (BLS) collects nationally representative data on occupational injuries. The BLS data largely reflect workers' compensation records. The BLS has two categories of interest: "needles and syringes" and "needle-sticks." We note advantages and disadvantages for both of these categories. We analyze data from 1992 through 2003.

Findings: Needle-stick injuries resulting in at least one day of lost work numbered, on average, 300 to 800 per year from 1992 through 2003. Whereas all occupational injuries showed a downward trend from 1992 to 2003, no trend was apparent for needle-sticks. Women comprised 77% and men, 23% of persons injured. For those reporting race: white, non-Hispanic comprised 80%; black, non-Hispanic 10%; Hispanic 10%; and Asian 2%. Roughly 65% of injuries occurred among persons age 25 to 44. The "top four" occupations with greatest frequencies were: registered nurses; nursing aides; laboratory technologists and technicians; and maids and housemen. The three occupations with the highest rates (injuries per person per year) were: dentists, maids, and janitors. The average needle-stick injury appeared to be less serious than all other occupational injuries and illnesses. Whereas needle-stick injures had 5% of cases with 31 or more days lost, all other occupational injuries and illnesses had 19% with 31 or more days lost. In recent years, the percentages for needle-stick and "all other" with 31 or more days lost have been increasing.

Advance Field: No prior study used a national data set. These findings are more representative of the nation than any prior study.

Abstracts

Improve Safety: Well-defined groups of people and occupations can be more effectively targeted for interventions.

Industry: Findings are relevant for hospitals, offices of physicians and dentists, medical laboratories, skilled nursing facilities and animal agriculture.

Conclusion: Characteristics involving age, race, sex, occupation, and length of time away from the job for persons with needle-stick injuries in a national data set were described.

Abstracts

Poster: 0056

A Safety Information Campaign to Reduce Sharps Injuries: Preliminary Results from the "Stop Sticks Campaign"

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CDC estimates that more than 350,000 contaminated needlesticks occur every year among hospital workers in the U.S. As many as half of those injuries are not reported to the employer. The risk of acquiring a bloodborne pathogen infection from needlestick injuries varies according to a number of factors and the type of pathogen. Nevertheless, every injury may cost both the employee and the employer time and money for employee testing, post-exposure prophylaxis, and stress from the fact that illnesses resulting from such infections are serious and sometimes life-threatening. Needlestick injuries occur with many occupational groups in hospitals. Although most occur among clinical-care workers, non-clinical workers such as housekeepers, maintenance workers, and laundry workers may also be injured.

Sharps devices with safety features are a major component of most needlestick prevention programs. Frontline workers with patient care responsibilities must be involved in the trial and selection of the most appropriate devices for each procedure in each facility. However, comprehensive exposure control plans, adequately-sized and placed sharps disposal containers, improved work practices, diligent injury reporting, and post-exposure follow-up are important parts of the prevention effort. Training and information activities are critical for maintaining prevention awareness and skills among all health care workers.

Although the health care industry has substantial infrastructure for conducting training and awareness activities, the primary focus is frequently on patient care and safety rather than both that and worker health and safety. Clinical training and information staff are often inexperienced at communicating about worker safety and health. Occupational safety and health staff may be inexperienced at communicating about clinical issues. Our research investigated methods of increasing sharps injury prevention behaviors among health care workers using information and training activities and both occupational safety and health and clinical expertise. We were interested in learning:

- What are the most effective ways to conduct communications activities around this issue in health care facilities?
- What are the best predictors of safer clinical behaviors?

We conducted a five-year, community-focused information campaign in a U.S. city of under one million population. Training and information activities were conducted at various health care facilities in the community using campaign blitz tactics. Blitzes lasted four to six weeks and included the use of multiple media (posters, demonstrations, safety device fairs, information sessions, games, promotional items) multiple times to cover a small group of repeated messages that were determined by an analysis of sharps injuries at the facility. Pre and post tests were collected from convenient samples of employees. Five blitzes were conducted in high-injury departments (usually OR). One blitz was conducted at the community's largest hospital. One was conducted at a state-run nursing care facility.

We found that, while reported exposure to safety messages increased, safety attitudes and knowledge did not change over time. Posters were the most-remembered channel of safety information in all cases but one, but remembering other channels varied due to differences across blitzes. Some safety behaviors increased (self-report), and virtually no safety behaviors decreased. Our most important findings were a) that safety behaviors improved most after blitzes conducted at the department (rather than facility) level, and b) that a perceived positive safety climate was, overall, the best predictor of safety behaviors. We conclude that clinical-care and occupational safety and health staff should collaborate to conduct sharps injury prevention training and awareness blitzes, and that the scope of the blitz should be matched to available resources. Focus blitzes in high-risk departments if there are insufficient resources to adequately cover the entire facility. Employers can best influence safety behaviors by cultivating a positive safety climate.

Abstracts

Poster: 0057

Prevalence and Risk Factors for Bloodborne Exposure and Infection in Correctional Healthcare Workers

RG Gershon (1) presenting, CS Mitchell (2), MF Sherman (3), SA Felknor (4)

Columbia University, New York, NY, United States (1), Johns Hopkins University, Baltimore, MD, United States (2), Loyola College, Baltimore, MD, United States (3), The University of Texas, Houston, TX, United States (4)

Objective: To determine prevalence and risk factors for bloodborne exposure and infection in correctional healthcare workers (CHCWs).

Design: Cross-sectional confidential questionnaire and serological testing.

Setting: Correctional systems in three states.

Results: Among 310 participating CHCWs, the rate of percutaneous injury (PI) was 36/100 person years overall and 42/100 for CHCWs with clinical job duties. Most (52%) PIs were not reported. Independent risk factors for experiencing PI included age >45 years (adjusted odds ratio [AOR] 2.41, P< .05) and job duties involving needle (AOR 3.70, P<.05) or blood (AOR 5.05, P< .05) contact. Overall, 72% (n=222) reported a primary hepatitis B vaccine series; of whom 68% (n=150) were anti-HBs positive, with negative results significantly associated with receipt of last dose >5 years previously. Serologic markers of hepatitis B virus (HBV) infection were identified in 31 (10%) individuals and the prevalence of hepatitis C virus (HCV) infection was 2% (n=7). The high HB vaccination rate limited ability to identify risk factors for infection, but HCV infection correlated with community risk factors only.

Conclusion: While the wide coverage with HB vaccination and the rate of HCV infection falling within general population estimates is encouraging, the high rate of exposure in CHCWs and the lack of exposure documentation is a concern. Continued efforts to develop interventions to reduce exposures and encourage reporting should be implemented and evaluated in correctional health care settings. These interventions should address infection control barriers unique to the correctional setting.

Abstracts

Poster: 0058

Bloodborne Pathogen Risk in Home Healthcare Workers

CW Winnen (1) presenting, RG Gershon (1), K Qureshi (1)

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Background: Home health care workers (HHCWs) are at risk for a wide range of occupational health hazards, including bloodborne pathogen exposure, violence, and injury. This proposal is an extension of our previous pilot study of non-hospital-based healthcare workers, with a sample size of 1156 RNs, which included a subset of 72 HHCWs. Sixty-four percent (N=46) of the respondents reported one or more needlestick injuries during their careers. Forty percent of the needlesticks involved safety devices, despite 100% of RNs reporting having received training on such devices. Forty percent of HHCWs with a bloodborne pathogen exposure in the past year did not fill out an incident report and 60% were not seen by a health care professional.

Purpose: The purpose of this four-year collaborative epidemiologic study of HHCWs is: to determine prevalence of blood/body fluid exposures; to characterize risk factors for exposure incidents and adverse mental health outcomes associated with exposures and post-exposure follow-up; to determine the availability and use of medical safety devices; to identify barriers to safe work practices; and to identify opportunities to reduce the risk of exposure in HHCWs using innovative participatory action research (PAR) teams.

Methods: Both qualitative and quantitative methodologies are being used. The qualitative phase has been completed, in which shadowing, in-depth interviews, and focus groups occurred. The quantitative methods will consist of questionnaire administration.

Findings: Qualitative data from our current study (N=53 RNs) indicated that blood glucose monitoring, administering injections, and disposing of used sharps are the most common exposure-prone activities of home healthcare (HHC) RNs. Nineteen percent reported at least one needlestick injury during their career in HHC. Lancet needles were the most common type of needle involved. Other causes were distraction by family/pets, no sharps container readily available, and improper disposal of needles. Overall, there were inconsistencies reporting, follow-up, and counseling procedures. Back injuries, especially related to the weight of the equipment bag, and environmental concerns such as unknown neighborhoods, temperature extremes, vermin, clutter, and interpersonal violence were other reported risk factors.

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Conclusions: The HHC workforce continues to grow to meet demands of the rapidly increasing HHC patient population and the acuity of care in the home setting is increasing. Based on qualitative findings, the following areas for improvement were noted: post-exposure management and counseling procedures, availability of safety devices, and assessment of other types of occupational hazards as needed.

Next Steps: Three thousand HHCWs, including both RNs and aides from geographically dispersed HHC facilities will be recruited to complete a survey. In the final year of the study, PAR teams comprised of representatives from collaborating agencies, front-line workers, and occupational health specialists will be formed to review the data, seek solutions, and discuss opportunities for risk reduction. Best practices/ recommendations tailored to each work setting will be provided to collaborating agencies.

Poster: 0059

Innovative Health Care Worker Training: Infectious Disease Risk

RG Gershon (1) presenting, H Cole (2)

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Health care workers, including nurses, are at risk for a wide range of occupational health hazards, including the risk from infectious diseases such as bloodborne pathogens and tuberculosis. To reduce morbidity and mortality associated with occupationally acquired infections, a number of risk management strategies have been developed. Although safety training programs are acknowledged as an important part of an overall risk management strategy, there are a number of challenges to effective health and safety training, especially in the health care work setting. To address this problem, a multidisciplinary team of researchers partnered with two large medical centers and a professional nurses' association to evaluate an innovative approach to safety training for nurses. Simulation exercises,shown to be an effective safety training method in other occupational settings, were developed using a participatory action research format. The exercises, which target bloodborne pathogens, were formatted into a computerized, interactive, Web-based program and administered to 130 volunteer registered nurses who were recruited with assistance from our partner collaborators. Participants received Continuing Education Unit credits as an incentive for participation. The exercises were evaluated by multiple measurements using a risk behavior, theory-driven questionnaire. Exercises and questionnaires were completed online at the study's Web site. Baseline measures of employee knowledge, perceptions, attitudes, behavioral intentions, current safety practices, and recent past history of exposures were collected from participants and followed by a post test. Analyses were directed towards change in pre- and post-risk behavior determinants as well as nurses' satisfaction with simulation exercises and with computer-based training formats. The results of this study indicate that the training did not result in increase in knowledge, or more protective behaviors. This may be a result of the finding that the baseline measures for these constructs were already exceptionally high; most of the participants who completed the exercise were nurse trainers assessing the program for their nurse populations. Overwhelmingly, the participants were extremely satisfied with the web-based format and with the simulation approach to learning. The web-based program has been widely distributed and is now available through various agencies and organizations, including NIOSH.

Abstracts

Poster: 0060

Nature of Injury Data in the BLS Annual Survey Seriously Underestimate the Medical Burden of Work Injuries

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NORA Priority Areas: Risk Assessment Methods, Musculoskeletal Disorders, Traumatic Injuries
Industry Sectors: All Industries, Transportation Industry

Background: The BLS Annual Survey is the current source of national and state data on work injuries. Nature of injury is generally coded from a lay narrative by a lay coder using a quasi-medical taxonomy that requires that the case be coded to the most serious injury, if possible. There have been no published comparisons of the BLS taxonomy with the ICD-9-CM clinical diagnosis taxonomy at the state or national level.

Study Objectives: To compare nature of injury data from the nation and Great Lakes states with diagnoses accepted for payment by the Bureau of Workers Compensation in Ohio, where by statute the BWC is the exclusive provider of workers' compensation insurance for about 70% of the state workforce, with the exception of those employers who qualify to self-insure.

Methods: The Ohio BWC provided a data extract for all approved claims from employees of the for-hire carrier industry during the period 1997-1999 with follow-up through March, 2002. The extract included 34,165 medical diagnoses approved for payment in 23,491 claims for 20,802 individuals over the three year period. Software was developed to map potential work injury and illness diagnoses in the ICD-9-CM to the functional area affected by the diagnosis, to classify diagnoses within functional area by severity using pathology and clinical management criteria and to classify each diagnosis by proximity to any index functional area. Results were compared with the percent distributions of nature of injury by comparable part of body at the BLS national and regional level for all occupations and truck drivers.

Results: The mapping software captured 93.60% of the medical diagnoses in the study cohort and 100% of the diagnostic information for 92.82% of cases, with 83.34% of the uncategorized diagnoses in two groups, soft tissue and miscellaneous injuries of the trunk, for which a category was not created. Analyzing all diagnoses approved for payment indicates that BLS nature of injury data seriously underestimate the relative frequency of the severely disabling injury group consisting of dislocations,

dorsopathies and enthesopathies of the back, shoulder and knee (43.63% of the case-functional area combinations created by the software) by as much as an order of magnitude. Using all diagnoses to evaluate injury severity reveals that many serious injuries of the back, shoulder and knee are associated with concurrent injury morbidities in the same functional area or in proximal or distal functional areas.

Conclusions: Diagnoses accepted for payment give a more accurate picture of the medical burden of work injuries and make it feasible to apply to population data the results of studies in the medical literature classified by diagnosis. Since the software is independent of the particular cohort, far more accurate pictures of the medical, social and economic burden of work injuries in the priority areas specified should be available with further work as a basis for understanding them and setting research priorities.

Improving Worker Safety and Health: While translational research is required before this work will directly improve worker safety, having medical diagnoses along what is often a continuum of pathologic response to injury forces should facilitate field ergonomic studies to identify risk factors as a basis for prevention.

This grant was supported by NIOSH Grant R01 OH03804-01A2.

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Poster: 0061

Workers' Compensation Benefits Adequacy, Equity and Benefits Costs: Evidence from Canada on Two Approaches to Compensation for Permanent Impairment

E Tompa (1) presenting, C Mustard (1), S Sinclair (1)

Institute for Work & Health, Toronto, Ontario, Canada (1), McMaster University, Hamilton, Ontario, Canada (2), University of Toronto, Toronto, Ontario, Canada (3)

Importance of Research: Work disability is one of the most costly and prevalent health issues in North America, yet few studies have investigated the labor-market earnings recovery of individuals who have sustained permanent impairments from work accidents. Fewer still have investigated the adequacy, equity, and cost of wage-loss compensation provided by workers' compensation. In this study we investigate these issues using two samples of individuals sustaining a permanent impairment from a work accident and receiving benefits from two markedly different permanent disability programs in Ontario. The older program is a single benefit, impairment-based pension program. The more recent program is a dual award program that provides benefits based on loss of earnings capacity, and a non-economic loss award for pain, suffering and loss of enjoyment of life based on a permanent impairment rating.

Study Objectives: There are three related objectives in this study: 1) to determine whether there are significant differences in labor-market earnings experiences post-accident between individuals receiving benefits from an impairment-based benefits program and a loss of earnings capacity based benefits program; 2) to evaluate the adequacy and equity of benefits provided by the two programs; and 3) to compare the relative cost of providing benefits based on the two approaches to benefits determination.

Summary of Methods: We utilized the unique linkage of two administrative data sources. Administrative data records from the Ontario Workplace Safety & Insurance Board were the source of information on injured workers with permanent impairments arising from a work accident. This information was linked to the Longitudinal Administrative Databank, a 20% sample of Canadian tax filers. We compared long-term, post-accident, labor-market earnings of claimants from the two programs with those of a sample of uninjured individuals with similar socio-demographic characteristics and earnings profiles prior to the accident year. The evaluation of benefits adequacy, equity, and costs was based on one-year cohorts from each of the two samples and on benefits receipt in the sixth year post-accident.

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Summary of findings: We found that the percentage of permanent impairment significantly underestimates the percentage of earnings losses of claimants in both samples. Further, we found that the loss of earnings capacity based benefits program was more adequate and equitable than the impairment-based benefits program, and that benefit costs were lower for the former program.

Conclusions: This study is relevant to disability income policy development in jurisdictions across Canada and the United States. Most jurisdictions share several common goals: 1) to provide fair, adequate and prompt payment of benefits; 2) to administer the program at low cost; and 3) to encourage early and safe return to work. Many jurisdictions have experimented with different benefits determinations formulae in an effort to achieve these goals, but most have had modest success. Our findings suggest that permanent disability benefits based on percentage of total bodily impairment, a common approach to benefits determination, is less desirable than loss of earnings capacity based benefits, on the grounds of adequacy, equity, and benefit costs.

Abstracts

Poster: 0062

Beyond Income Losses: The Impact of Occupational Injuries on Wealth, Bankruptcy, Fringe Benefits, and the Use of Government Assistance Programs

M Galizzi (1) presenting, JL Zagorsky (2)

University of Massachusetts Lowell, Lowell, MA, United States (1), The Ohio State University, Columbus, OH, United States (2)

This presentation refers to the NORA Priority area titled Social and Economic Consequences of workplace illness and injury. While previous studies have focused on the effect of work related injuries on labor income, this research focuses on one neglected area of workers' compensation research, the effect of injury and illness on wealth, fringe benefits and the potential use of additional government assistance programs. Changes in individuals' net worth, in sources of income support, and for example in health insurance are important to understand because they are highly correlated with individuals' economic and psychological well being. At the same time, published estimates of the cost of occupational injuries usually do not include these potential effects.

This analysis first explores different theories that could predict not only earnings but also these additional economic losses after an occupational injury. Then the research tracks injuries, net worth, fringe benefits (among which health insurance), participation in government programs (AFDC/TANF, UI, SSI, Food Stamps), and episodes of bankruptcy for U.S. young baby boomers participating in the National Longitudinal Survey of Youth 1979 cohort, or NLSY79. Respondents are tracked from 1988, when the youngest was just 23 years old till 2000, when the oldest was 43, a time span covering their peak working years. The study tracks the experience of injured workers against a comparison group of uninjured employees. We find that the incidence of on-the-job injuries and illnesses peaks when workers reach the age of thirty. The typical young baby boomer that is never injured has both much higher absolute wealth and wealth growth rates than boomers who are ever injured. Also, on average 85 percent of NLSY79 baby boomers are covered by health insurance, but the percentage drops to 75 percent for workers who suffered occupational injuries.

To examine the wealth effects we use a Generalized Estimation Equation framework to adjust for geographic clustering. Our results to date show that for young baby boomers injuries do reduce wealth especially among workers who reported wage losses because of the accidents. We are also planning to present results from logit models assessing the probability of filing for bankruptcy, losing fringe benefits

and using additional government programs.

Our findings on the impact of injuries on wealth suggest that work related injuries end up affecting possibly no longer only employers and employees, but also creditors or service providers who can not be repaid. This increases the urgency of designing workers' compensation benefits that must be both adequate and promptly delivered as well as early return to work programs.

Abstracts

Poster: 0063

The Relationship of Age, Diagnosis and Industry on Cost and Disability: An Analysis Using a Workers' Compensation Database

K Dunning (1) presenting, K Davis (2), G Jewell (3), JL Lockey (4)

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Background: Given the aging demographics of the United States, many companies will be faced with an aging workforce. A limited number of studies have investigated the effect of age by industry. The interaction of diagnosis on this relationship has not been investigated. In addition, much of this research was conducted prior to recent economic changes resulting in baby boomers remaining in the workforce longer than expected.

Purpose: The current analysis examined the effect of age among workers' compensation claims (between different industries) with respect to disability and cost for musculoskeletal disorders of the upper extremity and back.

Methods: The Ohio Bureau of Workers' Compensation (OBWC) provides workers' compensation to over two-thirds of the Ohio work-force. Claims submitted to the OBWC from 1999-2002 relating to the diagnoses of lumbar spine, shoulder and carpal tunnel (based on ICD-9 codes) were analyzed. Construction, manufacturing and service industries were categorized using NCCI codes resulting in a total of 126,585 claims. Age was categorized into: 16-24, 25-34, 35-44, 45-54, 55-64, 65+ years. Outcomes included: percent claims with indemnity; average cost per claim (indemnity and medical); disability as measured by average days lost per claim.

Results: Percent of claims with indemnity was similar between industries (approximately 29%), but average costs and days lost differed: manufacturing - $7,125 and 137 days; service - $11,683 and 243 days; construction - $8,922 and 150 days. Disability increased with age among manufacturing claims; disability varied with age among service and construction claims. In general, cost increased with age for all industries but, within each industry, this relationship depended on diagnosis. Among manufacturing

claims: shoulder and lumbar spine diagnoses showed increased cost with age; carpal tunnel diagnoses showed varied cost with age, with the highest group being 35-54 year olds. Among service claims, cost increased with age but for carpal tunnel and shoulder claims only from 16-54 years of age; cost decreased for workers 55 and older. Construction claim costs increased with age from 16-54 for all three diagnoses; cost decreased for workers 55 and older.

Discussion: Based on costs and lost days, there appears to be a potential difference with respect to the influence of the aging process across different industries. There may be several factors responsible for age to have different relationships to disability and cost across industries. One explanation might be that different demands exist between the industries that influence the impact of age on the development of MSDs. Another explanation might be a "healthy worker effect" in the service and manufacturing industries where individuals were able to remain on the job longer but suffered more severe MSDs later in their work life.

Conclusion: These results indicate there may be certain industries and diagnoses that are more susceptible to an aging workforce than others. Further investigation should be conducted to determine which industries are most susceptible in order to initiate appropriate prevention programs.

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Poster: 0064

Administrative Delay and Secondary Disability Following Acute Occupational Low Back Injury

PL Sinnott (1) presenting

Health Economics Resource Center, VA Palo Alto Health Care System, Menlo Park, CA, United States (1)

Background and Significance: Occupational low back injury is a pervasive disorder and extensive research has failed to explain a wide variation in outcomes. The purpose of this study is to identify whether a component of the administrative system not studied before, the practice of delaying claim acceptance, has a significant influence on injured worker disability.

Methods: The data are 1993 – 2000 claim files provided by the California Workers' Compensation Institute, and estimated to include approximately 50% of all claims for low back injury filed in California during that period. Cases with at least one day of temporary disability paid were selected for the analysis (N=32,584). Logistic regression predicted the influence of administrative delays to claim acceptance on whether a case would become chronic (took more than 91 days of temporary disability) controlling for individual, economic, diagnostic severity and physician experience variables.

Findings: Those cases with delays greater than 14 days experienced increasing risk of becoming chronic with each two week interval that passed, the largest increase occurring between two and four weeks. At 14 days after the injury, compared to the least severe cases, the moderately severe cases had more than double the probability of becoming chronic and the most severe cases had almost triple the probability of becoming chronic.

Conclusion: Delays in claim acceptance for injured workers are associated with increased probabilities of an occupational injury becoming chronic, that is, taking more than 91 days of temporary disability off work. Longer delays are associated with increasing probabilities of becoming chronic. Findings suggest that employer and insurer control of administrative delays has the potential to minimize long term consequences for their injured workers. The influence of delays in claim acceptance is previously unstudied. This study expands the conceptual framework for the development and evaluation of effective treatment models for occupational injuries.

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Poster: 0065

Early Predictors of Work Disability Associated with Carpal Tunnel Syndrome: A Longitudinal, Population-Based Workers' Compensation Cohort Study

JA Turner (1) presenting, G Franklin (2), R Wu (1), D Fulton-Kehoe (1), J Gluck (1), L Sheppard (1), K Egan (1), T Wickizer (1)

University of Washington, Seattle, WA, United States (1), Washington State Department of Labor and Industries, Olympia, WA, United States (2)

Work-related upper extremity musculoskeletal disorders such as carpal tunnel syndrome (CTS) are associated with high rates of chronic work disability and substantial costs relative to other work injuries. A minority of workers account for a large proportion of the costs. If workers at high risk for chronic disability could be identified early, they could be targeted for special treatment. The identification of modifiable risk factors could also guide treatment to address those factors. We therefore assessed worker and job characteristics early after submission of claims for CTS-related work disability to identify predictors of work disability one year later. We examined whether worker job perceptions and job physical demands predicted work disability after controlling for demographics and CTS symptom severity/functional limitations.

All individuals with new Washington State Workers' Compensation CTS claims July 2002 – May 2004 were approached. Study participants completed telephone interviews 18 days (median) after claim submission. We excluded from analysis claims with no disability compensation. The primary outcome ("work disability") was receipt of disability compensation for >180 days as of one year after claim submission.

899 workers (62% female, 78% white, age mean = 44 years) enrolled. 210 (23%) had >180 work disability days [median (IQR) number of disability days = 279 (221-352)]. 689 (77%) had <180 days of work disability [median (IQR) number of disability days = 48 (26-87)].

In bivariate logistic regression models predicting work disability (< vs > 180 days), workers <44 years, with less than high school education, with income < $45,000, not offered job accommodations, and with higher CTS symptom severity and functional limitations scores had significantly higher odds of >180 work disability days. Job physical demands associated bivariately with work disability were frequent forearm twisting, pinching fingers, lifting >10 pounds, and whole body vibration. Worker negative job

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perceptions were also associated bivariately with work disability (very hectic, very fast, excessive work, breaks not allowed when desired, supervisor not willing to listen, overall job dissatisfaction, low recovery expectations).

In multivariate logistic regression models, no job physical demands assessed remained significantly associated with work disability after controlling for demographics, symptom severity/functional limitations, and offer of accommodation. However, certain negative job perceptions (job requires working very fast, low recovery expectations) remained significantly associated with work disability even after controlling for demographics, symptom severity/functional limitations, job physical demands, and offer of accommodation.

This study, the largest to date of early risk factors for chronic CTS-related work disability, adds to the sparse literature in this area. No offer of job accommodation, perception one's job requires working very fast, and low recovery expectations early after claim submission appear to be strong predictors of chronic work disability. We plan to develop a brief instrument that could be used to identify high-risk workers early after claim initiation, so that appropriate clinical resources could be allocated to at-risk workers.

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Poster: 0066

Is the Occupational Fatal Injury Experience in the United States Really Improving?

E Biddle (1) presenting

NIOSH, Morgantown, WV, United States (1)

Problem Background: Each year more than 4 million injuries occur that are associated with workplace events-a rate of nearly five per 100 full-time workers. Individuals affected often become unable to work, their ability to work is limited by physical impairment, or more tragically they die. On a typical day, more than 15 U.S. workers die from an injury on the job. In recent years, the number and rate of work-related fatal injuries has been declining. However, frequency and rate are not the only measures of human loss nor are they the only means to direct efforts to reduce the number of occupational incidents. Economic loss is another perspective that provides an alternative outcome measure that can assist in directing scarce research resources.

Objectives: The objective of this study was to determine if different impact or outcome measures produce a different picture of the U.S. occupational safety experience over time.

Methods: This study uses occupational fatality surveillance data from the Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) for the period 1992 through 2001. This system compiles data from 50 States (excluding New York City) and the District of Columbia using multiple sources. The cost of a workplace fatality to society was estimated using the cost-of-illness approach, which combines direct and indirect costs to yield an overall impact of an occupational fatal injury on the Gross Domestic Product (GDP). Unlike most estimates of the cost of occupational incidents, this approach calculates the cost of each fatal injury based on the characteristics of each decedent. Those individual costs are aggregatedto derive societal cost-total, mean, and median costs.

Results: Over the ten-year period of 1992 through 2001, the number of fatal occupational injuries declined from 5,833 to 5,664 after having reached the peak of 6,303 in 1994. The estimates of the total cost of fatal occupational injuries derived in this study rose by 4%; from a $4.8 billion in 1992 to a high of just under $5.0 billion in 2001. The mean cost also increased over this time period from $819,735 to $880,805 per fatality-an increase of 7%. More importantly, the impact of these fatalities does not effect subpopulations equally. During this same period the total cost of fatal occupational injuries occurring in the mining industry increased by 6%, the mean cost increased by 12%, but the number of fatal injuries decreased by 5%. The total cost of occupational fatalities in the construction industry increased by 34%

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while the cost within the retail trade industry declined by 24%. The mean cost of a fatal occupational fall increased only slightly, 3%, while the number increased by 38%. The mean cost of an occupational fatal assault or violent act increased by 13%, while the number decreased by 25%. The number and mean cost of all fatal injuries in a work-related transportation incident increased by 3% and 8% respectively. The largest increase in mean cost in that category occurred in nonhighway incidents, 16%, yet the number of fatalities declined by 12%.

Conclusion: To fully understand the impact of occupational fatal injuries and the successes of safety promotion and prevention activities, more than one measure should be examined.

For the first time, this research provides societal costs of occupational fatal injury over time, allowing for trend analysis of not only magnitude and rate, but the impact on national income and the GDP. Considering the cost or economic impact of an occupational fatality in conjunction with other outcome measures will help focus efforts to improve worker conditions in all industry sectors.

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Poster: 0067

Trends in Health Insurance Coverage in U.S. Worker Groups: The National Health Interview Survey (NHIS)

K Arheart (1) presenting, D Lee (1), LE Fleming (1), K Chung-Bridges (1), SL Christ (2), W LeBlanc (1), A Caban (1), T Pitman (1)

University of Miami, Miami, FL, United States (1), UNC Chapel Hill, Chapel Hill, NC, United States (2)

Objectives: Many American workers and their families obtain medical insurance through their employers or unions. Increasing health care costs, rising health insurance costs, and globalization are pressuring industry and unions to enact cost-cutting policies. These policies include: raising the cost of medical insurance beyond what some workers can afford, or dropping medical insurance benefits entirely. The purpose of this study was to examine trends in health insurance coverage in U.S. worker groups.

Methods: Using the nationally representative 1997-2003 National Health Interview Survey (NHIS), the reported medical insurance prevalence among current U.S. workers by occupation was evaluated by gender, race, and ethnicity. Prevalence estimates were weighted to represent the U.S. workforce.

Results: The study population represented an estimated 126,970,317 U.S. workers annually between 1997-2003. Overall, the annual prevalence of having medical insurance among all U.S. workers was 83%. From 1997-2003, there was a statistically significant downward trend in the prevalence of medical insurance among all U.S. workers. Among workers in 41 occupations, the majority (80%) had downward trends over the 6 year period with workers in 8 (24%) occupation categories having statistically significant negative trends (including Construction and extractive workers going from 64% to 55%, and Cleaning and building services from 71% to 66%). White collar and unionized occupations (e.g. 98% of Managers and administrators, and 98% of Police and fire fighters) tended to report higher annual prevalences of medical insurance, while non-unionized blue collar worker occupations (e.g. 51% of Construction laborers, and 50% of Farm workers and other agricultural workers) had lower prevalences of medical insurance. There were substantial variations in the prevalence of medical insurance when the data were grouped by gender, race, and ethnicity among the different U.S. worker subpopulations.

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Discussion and Recommendations: Medical insurance and access to medical care are significant factors in the health of U.S. workers and their families. In particular, inadequate medical insurance coverage and the lack of access to medical care (especially preventive care) can lead to higher rates of acute and chronic disease. Furthermore, decreasing access to medical insurance is concentrated among some of the most hazardous occupations and among subpopulations of the U.S. workforce, many of which also provide relatively low wages to their workers and their families. This has significant implications for the health of these workers and their families, and the ultimate cost of their medical care for U.S. society.

Poster: 0068

Health Experience of Workers Receiving Lump-Sum Payments from the Maine Workers' Compensation System during the Period 1998-2003 Part I Survey Development

IG Most (1) presenting, SJ Most (2)

University of New England, Biddeford, ME, United States (1), University of Southern Maine, Portland, ME, United States (2)

This project developed a survey to evaluate health, financial status, and post-settlement employment experience of workers that have received a lump-sum settlement for injuries compensated by Workers' Compensation insurance. The period 1998 to 2003 was selected to limit group size and to gain current information. Legislation enacted in 1992 by the Maine state legislature required the Workers' Compensation Board (PL 1991) to evaluate employee's post-injury earnings as well as their future employment prospects.

Lump sums are awarded to expedite claims, to limit exposure and to allow recipients to manage their own transition back to the working world. Lump–sum payments require the worker to exit the workers' compensation system. The purpose of this survey is to evaluate how effective this policy has been.

Two focus groups were envisioned. One session was planned for the Bangor area and one was planned for the Portland area, the two largest population centers in the state. Using a freedom of information request a list of about 250 names were received within a 50-mile radius of Portland and a like number were received for the Bangor area. Individuals were chosen from those receiving lump-sum payouts since 1998. There have been 14,685 lump-sum cases since 1/1/98.

A small group of lump sum recipients agreed to assist in the project and actually signed an informed consent form. A survey was designed using affected parties and worker advocates to help develop questions. This active research approach has been used in the past with health and safety committees in state government to develop work place surveys that reflect needs of particular agencies. The survey will also determine whether these individuals returned to work and how their employment history has been impacted by their work injury. The experience gained in developing the survey has influenced the method to be used in conducting the survey in phase II of this effort.

It is hypothesized that workers can make decisions about their future care and rehabilitation better than an outside agency. The objective will be to determine their health, post-settlement employment experience,

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financial status, and how well their care has been managed. The draft survey has been developed and will be tested by Maine Workers' Compensation Board staff and other individuals involved in the worker's compensation system that signed informed consent forms. This survey will measure how effective this policy intervention has dealt with workers' suffering from long-term job related injuries.

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Poster: 0069

U.S. Worker Dental Care Access and Unmet Dental Needs: The National Health Interview Survey 1997 to 2003

AJ Caban (1) presenting, LE Fleming (1), DJ Lee (1), SL Christ (2), K Chung-Bridges (1), K Arheart (1), GW LeBlanc (1), T Pitman (1)

University of Miami School of Medicine, Miami, FL, United States (1), University of North Carolina Odum Institute, Chapel Hill, NC, United States (2)

Objectives: The Oral Health Care Objectives of Healthy People 2010 indicate a need to increase the proportion of adults who use the oral health care system each year. Millions of Americans suffer from periodontal diseases and other oral conditions, and more than 17 million Americans (including 10 million Americans 65 years or older) have lost all of their teeth. Given the dependence of the U.S. population on employer-provided medical and dental care, it is important to evaluate the access to dental care and the extent of unmet dental needs of U.S. workers. The objective of this study was to determine the proportion of U.S. workers meeting select Healthy People 2010 oral health care objectives.

Methods: The National Health Interview Survey (NHIS) is a continuous multipurpose and multistage probability area survey of the U.S. civilian non-institutionalized population living at addressed dwellings. Each week, a probability sample of households is interviewed by trained personnel to obtain information about the characteristics of each member of the household. Gender and race-specific analyses by occupation were conducted on >135,000 U.S. worker participants in the 1997-2003 NHIS Surveys. Participants were asked: "About how long has it been since you last saw or talked to a dentist? Include all types of dentists such as orthodontist, oral surgeons, and all other dental specialists as well as dental hygienists." Participants were also asked: "During the past 12 months, was there any time when you needed dental care (including check-ups) but didn't get it because you couldn't afford it?"

Results: Among the 66,616 male and the 68,388 female worker NHIS participants, the prevalence of no dental visit in the previous 12 months ranged from 19-58% and 18-50%, by 41 occupational groups, respectively. Occupations in which the majority of male workers had not seen a dentist in the past year included: Forestry and fishing occupations, Construction laborers, and Farm workers and other agricultural workers, Food service workers, and Freight and stock material handlers. Nearly 10% of male Farm workers reported never having seen a dentist. Half of the female Construction laborers reported no dental care access in the previous year; nearly 4% of female Farm workers reported never

having been to the dentist. Occupations for female workers with reported highest rates of unmet dental needs ranging between 19-27% included: Construction and extractive trade workers (26.8%), Construction laborers (24.2%), and Food service workers (19.8%). The highest rates of reported unmet dental needs among male workers were reported by Health service workers (17.1%), Food service workers (14.8%), and Forestry and fishing occupations (13.8).

Conclusion: Among 68,293,862 male and 58,676,455 female U.S. workers employed between 1997-2003, dental care access is sub-optimal and unmet dental needs are significant for several major U.S. worker groups. Strategies to increase regular dental visits, as well as bridge the gap of unmet dental needs, among U.S. worker groups are paramount. Continued surveillance of unmet dental needs and oral health care utilization using the NHIS is needed to identify worker groups and other sub-groups of the U.S. population who continue to fall well below Healthy People 2010 objectives for Oral Healthcare. Such surveillance is also essential for providing information to both employers and health care policy analysts seeking to improve access to oral health care for all Americans.

Poster: 0070

Prioritizing Industries for Occupational Injury and Illness Research and Prevention

D Bonauto (1) presenting, B Silverstein (1), D Adams (1), M Foley (1)

Washington State Department of Labor and Industries, Olympia, WA, United States (1)

Broad Purpose: Provide information to Washington State occupational safety and health stakeholders and policy makers to make informed decisions about directing occupational safety and health resources.

Objective: Identify high risk industry groups for occupational safety and health prevention and research activities.

Methods: We used all compensable Washington State workers' compensation claims for a seven year time period, 1998-2004, to rank North American Industry Classification System (NAICS) industry groups according to the 'Prevention Index' (PI). The PI is the average of the rank orders of an industry group's claim count and claim incidence rate. Industries were also ranked by PI for seven common high cost compensable workers' compensation claims.

Results: Of the 274 NAICS industry groups ranked by PI, these NAICS industry groups (4-digit NAICS) ranked the highest by Prevention Index: Foundation, Structure, & Building Exterior Contractors; General Freight Trucking, Couriers, Residential Building Construction, Scheduled Air Transportation, Building Finishing Contractors, Specialized Freight Trucking, Waste Collection, Psychiatric & Substance Abuse Hospitals, and Grocery & Related Product Wholesalers.

The seven most common occupational injury and illness workers' compensation claim 'type' groups, work-related musculoskeletal disorders of the neck, back and upper extremity, lower extremity work-related musculoskeletal disorders, 'fall from elevation', 'fall on same level', 'struck by/against', 'vehicular', and 'caught in/under/between', account for over 86% of all compensable claims, 92% of the $6.5 billion in direct workers' compensation costs and 95% of all time loss days. Prevention index rankings by industry for injury type groups differ but both NAICS 5621 Waste Collection and NAICS 4841 General Freight Trucking rank in the top 25 across all injury 'type' groups. Some industry groups have a high prevention index rank for only one injury type, e.g. NAICS 7221 Full Service Restaurants and NAICS 7222 Limited Service Restaurants for 'Fall on Same Level' compensable claims.

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Conclusions and Relevance: The prevention index is a potential model for determining which industries are at high risk for occupational injury and illness. By combining claim count and claim rates into a single measure, occupational health and safety resources may be targeted where they have the potential for greatest impact. If prevention resources are solely allocated on the basis of relative risk, the risk for injury may be concentrated in a small industry and may yield a small reduction in the number of injuries. If prevention resources are solely allocated on the count of claims, the claims may be distributed across a large number of worksites but there may be little risk of injury at any one worksite. Few data driven approaches for prioritizing industries for prevention activities exist from a well-defined population based dataset.

Directing resources for prevention must also consider additional factors that are not reflected in claim counts and claim rates, including emerging occupational safety and health exposures, underreported occupational diseases, and opportunities for low cost technology transfer to prevent occupational injury and illness.

Poster: 0071

Hazard Surveillance – Development and Evaluation of Tools and Methods for a National Survey

JM Boiano (1) presenting, GM Piacitelli (1), JD Catalano (1), N Heyer (1), B Payne (1), WK Sieber (1)

Battelle, Seattle, WA, United States (1)

Current hazard surveillance data on the magnitude and distribution of workplace hazards, use of exposure controls, and management and worker health and safety practices, by facility type and size are lacking for all NORA industry sectors. If available, this information could be used for self-assessment, benchmarking and setting priorities for targeted research studies and intervention efforts. The feasibility of collecting self-reported surveillance information on health and safety (H&S) hazards from workers in a national establishment-based survey was evaluated by pilot testing web-based and paper modes and selected survey distribution protocols within the health services sector (NAICS 62). Feasibility was evaluated in terms of response rates, data quality, employer burden and logistical considerations. Successful survey methods, tools and data dissemination could serve as a model for other industry sectors.

In this pilot study, meetings with healthcare stakeholders identified H&S issues of concern and interest, specific types of data to collect, preferred survey instrument modes, and ultimate uses of the data. Based on this information, employee and management questionnaires were developed and refined via cognitive testing by front-line healthcare workers and managers. The employee questionnaire consists of a core module (to be completed by all employees) addressing broad-based healthcare issues (e.g., stress, violence, work hours) and ten targeted hazard modules addressing selected chemical agents (hazardous drugs, aerosolized medications, high-level disinfectants, chemical sterilants, anesthetic gases, surgical smoke and cleaning agents). The employee questionnaire was available both on the web and in paper format. The management questionnaire (one per facility, paper only) elicits information about facility-wide H&S resources, programs, policies, and practices relative to the broad-based and targeted hazards included in the employee questionnaire. The paper questionnaire consisted of separate modules; the web version is seamless with respect to the modules.

The results from two pilot tests indicate that: 1) a priori targeting of employees for distributing specific hazard modules based on job title is too time-consuming and problematic for matching appropriate hazard module(s) with workers; 2) higher response rates were observed when employees initially receive a paper survey versus only a letter which provides instructions on how to request a paper survey or

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complete a web-based survey; 3) employees tended to select the web survey versus the paper survey when given a choice to select either mode; 4) higher completion rates were observed for the seamless web survey compared to the multi-module paper survey; and 5) from post-survey validation interviews, either mode of these self-reported questionnaires resulted in accurate information on job practices, engineering controls and use of personal protective equipment. These results suggest that the collection of surveillance data on health and safety hazards using multi-modal, self-administered survey questionnaires is feasible in a national establishment-based survey within the health services sector.

Poster: 0072

The Need for Workplace Surveillance for Occult Workplace Hypertension

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There is a large body of empirical evidence implicating workplace exposures (particularly work stressors) in the etiology of hypertension and ischemic heart disease (IHD). The theoretical constructs of how workplace factors affect the development of hypertension and IHD, together with a rich store of mediating biological mechanisms by which work stressors are perceived and processed by the central nervous system, and can lead to cardio-deleterious changes, provide convergent validation for the conclusion that workplace stressors play an important role in the development of these cardiovascular diseases (CVD).

An outgrowth of this understanding of the work-related etiology of hypertension is the importance of assessing cardiovascular function during work. Thus, in contradistinction to well-known entities such as "white-coat" hypertension, the prognostically important finding of Occult Workplace Hypertension (elevated ambulatory blood pressure (AmBP) at work along with normal casual clinic blood pressure) is just beginning to attract clinical and research attention. Ambulatory (work time) blood pressure (AmBP) measurement is a more reliable and valid measure of true blood pressure than "casual" measurements taken in a clinic or doctor's office as it allows for more blood pressure determinations of individuals in real life circumstances.

The low reliability of office casual blood pressures results in two kinds of serious clinical misdiagnoses. The first is the problem of false positives – the over diagnosis of hypertension based on elevated clinic blood pressures but normal blood pressure at work when assessed with an AmBP monitor. The second is the problem of false negatives – that is, Occult Workplace Hypertension. These findings help explain the long standing and puzzling observation in longitudinal CVD studies (e.g., the Framingham Heart Study) that about 40% of the mortality occurs among participants with "normal" (i.e., <140/90) office blood pressures. The evidence suggests that many of the subjects with "normal" blood pressure have elevated blood pressure in the workplace, and thus are at increased risk for stroke and heart attacks.

In each of two studies, the NYC Worksite Ambulatory Blood Pressure study (1985-2001) and a recently completed study of warehouse workers, we found that 15-20% of the workforce had occult or hidden

hypertension: [i.e., casual clinic BP < 85 mm Hg and Worktime AmBP > 85 mm Hg.] These findings are consistent with other recently published study results. Occult Workplace Hypertension is a serious condition carrying with it the same risk for atherosclerosis and left ventricular hypertrophy as those subjects with both elevated clinic and worktime blood pressure (true hypertensives) (Liu et al Ann Int Med 1999;131:564)

Measurement of blood pressure is inexpensive, easy to accomplish, and can be done at the workplace using protocols to obtain "point estimates" of an employee's blood pressure. The research findings indicate a need for routine workplace-based blood pressure surveillance for the purpose of identifying those individuals with Occult Workplace Hypertension. A national program of workplace surveillance will result in the early identification of millions of individuals at increased risk for stroke and heart attack who are currently unrecognized, provide them with the opportunity to obtain appropriate treatment, and promote efforts to reduce risk factors for hypertension, such as stressful working conditions.

Poster: 0073

Enhanced Surveillance to Detect Severe Nonfatal Occupational Injuries

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Importance: Although there have been many studies of fatal occupational injuries, relatively few surveillance efforts have included the most severe nonfatal occupational injuries, including hospitalizations.

Purpose: This project seeks to develop and evaluate a model surveillance system to identify the entire spectrum of injury severity occurring in occupational settings and describe the specific types of injury and their circumstances. The first step was the creation of a comprehensive database to examine the incidence of occupational injury statewide.

Methods: Work-related injuries were detected in a variety of ways: mechanism of injury (for example, falls from heights >15 feet), location (farm, mine, quarry), emergency/hospital treatment in which the payor was Workers' Compensation, and sources that explicitly identified occupational etiology such as death certificates and the state trauma registry. Commercial motor vehicle crashes also were identified. Using probabilistic linkage techniques, databases were joined and a final incident-specific database was created for 2001.

Findings: Table 1 describes the data sources used by number injured and the percent that were work-related (WR).

Table 1: Data Sources for Linkage		Total Injured	% WR
Emergency Department	5	26,718	8
In-Hospital Discharges		43,396	5
State Trauma Registry		16,965	8
Death Certificates		3,566	2
Police Crash Reports		38,827	3
Ambulance Transports		102,076	3
Total Linked Records		576,013	8

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Overall, 44,555 injured workers were identified in 2001. Over 60% were younger than 40. Teenagers comprised 6% and 20-29 year-olds comprised 26%. About 70% were male. Falls were more common among those > age 50.

About 5 percent of all injury hospitalizations were for occupational injury, resulting in 2,364 admissions. A total of 1,293 workers were treated in trauma centers, suggesting a large number of high-energy events. Among this group, falls and motor vehicle crashes were the predominant mechanisms of injury.

Table 2 displays the percentage of all injured workers and hospitalized workers by specific body regions. Among all injured workers, upper extremity, lower extremity and back were the top three injured regions. Hospitalized workers had a different pattern, with a higher proportion of head, thorax, abdominal, and lower extremity injuries. For upper extremity injuries, ED visits primarily involved finger lacerations whereas those who were hospitalized commonly had forearm fractures. For lower extremity injuries, ankle fractures were the most common injury among hospitalized workers, but knee sprains were the most frequent ED-treated injury.

Table 2: Percentage of Injured Workers by Body Region

	Head	Face	Neck	Thorax	Abdomen	Back	Upper Extrem	Lower Extrem
All	3	10	<1	2	1	12	42	24
In-Hospital	13	12	<1	10	6	13	31	36

How Findings Advance Research: This study is one of the most comprehensive efforts to conduct a statewide surveillance of occupational injury using multiple data sources. Data on the entire spectrum of injury severity previously were sparse, particularly for moderate to severe WR injuries.

Implications for Improving Workplace Safety: Many of the more severe injuries incur high medical costs and long-term disability. Greater priority should be placed on preventing such injuries.

Poster: 0074

Evaluation of State-Wide Emergency Department Data for Occupational Injury Surviellance

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State-wide databases of emergency department (ED) discharges now available in some states potentially provide useful information about the nature and extent of occupational injuries at state and local levels, augmenting surveillance data based on employer record-keeping. This study evaluated the feasibility of using electronic ED records reported to the state health department for occupational injury surveillance. Key aims were to: estimate the sensitivity and predictive value of two indicators of work-relatedness in the ED data; assess the availability of information about employer, industry and occupation in medical charts and the electronic data systems; and estimate the accuracy of external cause of injury codes (E-codes) for work-related injuries.

Electronic medical records for all injury related discharges (ICD-9-CM codes 800-999) were collected from a state-wide sample of nine EDs. Probable work-related (PWR) injuries were defined as injuries for which either workers' compensation (WC) was designated as expected payer and/or the IAW field was coded "yes." Medical charts were reviewed for a stratified random sample of 1002 PWR and 250 probable non-work-related (PNWR) injury cases. Chart abstractors recorded information on patient employment, injury circumstances and codes, and payment. Abstractors also assessed "work-relatedness" of injury based on narrative information in the chart, independent of payer and the IAW field. E-codes were assigned by an expert E-coder based on the narrative injury descriptors.

The WC indicator captured 83% (sensitivity) of cases identified as work-related based on chart information; 87% (predictive value positive) of cases with the WC indicator were confirmed as work-related in the charts. The low predictive value was primarily due to lack of information necessary to determine work-relatedness in approximately 12% of he medical records. Use of the IAW field was infrequent and inconsistent across hospitals.

Employer name was available in the charts for 89% of PWR and 42% of PNWR cases. Although electronic data on employer name was not reported to the state health department, all participating hospitals indicated that employer name was included in their electronic records. Industry information, separate from employer name, was available in the charts for 13% and 4% of PWR and PNWR cases,

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respectively. Information on patients' occupations was available for 34% and 18% of PWR and PNWR cases, respectively. E-codes were found to be accurate to 4 digits for 65% of PWR cases and 57% of PNWR cases. Using the broad cause of injury categories typically used for injury surveillance, E-codes were correct for 84% and 85% of PWR and PNWR cases, respectively.

State-wide ED data bases are a powerful tool for surveillance of work-related injuries. They capture a large number of medically treated injuries, both work-related and non-work related, across the state population into a data set with considerable analytical flexibility. Payment by WC appears to be a reasonable but conservative indicator of work-relatedness, and E-codes are adequate for surveillance purposes. Improvements in the attribution of work-relatedness and the accuracy of E-codes would further enhance the value of the data. As follow-up, new approaches for accessing and using available employer information to increase the usefulness of the data for targeting interventions are being explored.

Poster: 0075

The Utility of Linked and Transformed Workers' Compensation Data to Study Work Injuries by Occupation among Employees of Ohio For-hire Carriers, 1997-1999

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NORA Priority Areas: Risk Assessment Methods, Low Back Disorders

Background: Truck drivers have an increased risk of back disorders and back pain. Damage due to mechanical overloading and/or excessive muscular fatigue as a result of prolonged exposure to whole body vibration during driving have been suggested as possible causes. The absence of chronic radiologic overload changes in the spinal column in drivers suggests that excessive muscular fatigue together with the heavy lifting tasks associated with loading and unloading large trucks may be causative.

Objectives: To determine the strength of the association of demographic factors, carrier firm operating characteristics, and occupational group in for-hire carrier firms with the occurrence of back or intervertebral disc work injuries accepted for payment by a state agency that insures approximately 70% of a state's employed population.

Methods: The Ohio Bureau of Workers' Compensation provided a data extract from its relational database for all claims approved for payment for for-hire carrier employers during 1997-1999. Employer information was linked to operating fleet characteristics information in the federal Motor Carrier Management Information System database. Software classified medical diagnoses by functional area affected, severity and the presence/absence of concurrent injury comorbidities. Operating fleet characteristics were dichotomized into long-haul and short haul firms and then further dichotomized by average annual driver miles. There were 20,794 first claims in the study period, of which 6,321 claims had at least one back injury diagnosis. Of all first injuries, 8,561 claims involving 2,605 back injuries were matched to federal files with interstate carrier data.

Results: The age distribution of all injured truck drivers is shifted to the right of the age distributions for laborers, clerical workers and nonclassifiable workers, probably reflecting the underlying age distribution for all truck drivers. The age distribution for all back injuries combined (83.7% sprains, 7.3% disc injuries) is similar to that for all injuries in all occupational groups. However, the age

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distributions for disc injuries show further shifts to the right for both truck drivers and laborers. Indirect age standardized age distributions document that truck drivers have a greater risk of all back injuries and a much greater risk of disc injuries than the other occupational groups. Compared to laborers, the increased risk of back injuries in truck drivers appears attributable to vehicular accidents, but that is not the case for disc injuries. Truck drivers are also more likely to have concurrent injuries with a back injury than are other occupations. Without age adjustment, firm average miles driven do not explain the observed differences, while drivers in short haul firms seem to be at greater risk of back injuries. Modeling results are being obtained.

Conclusions: For all back injuries, the lack of a distinctive age distribution, the absence of a difference between drivers with high and low average annual miles driven and the fact that vehicular accidents explain a large part of the observed difference argue for acute damage. For disc injuries, the simultaneous age distribution shift for disc injuries among truck drivers and laborers also suggest acute injury.

Improving Worker Safety and Health: While most back and disc injuries in truck drivers appear to be produced by the usual causes, the delivery of preventive services to the widely dispersed truck driver population will present special problems. This grant was supported by NIOSH Grant R01 OH03804-01A2.

Poster: 0076

The Prevalence of Recent Skin Examinations in U.S. Worker Groups: The National Health Interview Survey (NHIS)

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Objectives: Research has demonstrated that even among U.S. workers with access to medical care, most healthcare providers do not evaluate occupational exposures and their potential impact on the health of U.S. workers. Substantial evidence has shown a link between ultraviolet (UV) light exposure (both occupational and recreational) and various forms of skin cancer. Furthermore, regular skin examination can serve as a preventive health message, as well as a method of detecting early skin cancers for which removal can be curative. This study explored the prevalence of reported skin examination among U.S. workers with access to medical care, particularly among occupations with high occupational UV exposure.

Methods: Using the nationally representative National Health Interview Survey (NHIS), the 2000NHIS Cancer Control Module was used to determine the reported prevalence of receiving a skin examination among current workers who had visited a healthcare provider in the past 12 months. This was examined by occupation and evaluated by gender, race, and ethnicity.

Results: The NHIS study population represented an estimated 126,970,317 U.S. workers annually between 1997-2003. Among the U.S. workers participating in the 2000 NHIS Cancer Care Module, the annual reported prevalence of visiting a healthcare provider during the past 12 months was 63%. Among workers who did visit a healthcare provider in the past 12 months, on average 13% (range 4%-29%) reported receiving a skin examination. Among all workers in 41 occupations, the groups with typically elevated occupational exposure to UV light were less likely to have received a skin examination than the average U.S. worker. In particular, Farm operators and managers (10%), Farm workers and other agricultural workers (6%), Forestry and fishing occupations (5%), Construction and extractive trades (7%), and Construction laborers (4%) had a decreased prevalence of skin examination, while white collar workers (e.g. Health diagnosing professions 29%) with less occupational UV exposure risk reported substantially increased access to skin examination. There were also variations in the reported access to skin examination by gender, race, and ethnicity among the different U.S. worker subpopulations.

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Discussion and Recommendations: Regular skin examination by a healthcare provider, particularly among highly UV exposed workers, can be preventative and curative for skin cancer. The low reported prevalence of skin examination among some of the most highly exposed workers who did have health care system contact is a reflection of the lack of knowledge on the part of healthcare providers. Furthermore, 37% of workers reported no contact with the health care system in the previous 12 months. Decreasing access to medical insurance among U.S. workers may serve to further lower skin examination rates and other preventive health services in the coming years. This example of lack of preventive care among U.S. workers has substantial implications for their occupational health and for the ultimate cost of their medical care for U.S. society.

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Poster: 0077

An Innovative Approach to Occupational Injury Surveillance in the Developing World

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Vietnam's rapid transition to a market economy while stimulating strong economic growth has been offset with a dramatic increase in injury. An active surveillance study has been initiated in one community of Vietnam to pilot methods for comprehensive capture of occupational injuries in Vietnam. The data collected includes both formal and informal sectors.

The Xuan Tien commune, Nam Dinh Province was chosen as an appropriate community for tracking the incidence of injuries because: 1) Xuan Tien with approximately 2,400 households and 10,500 individuals is a feasible size for 100% sample; 2) Xuan Tien has a stable but developing industrial base with some medium and large enterprises and many family owned businesses. Many rural communes in Vietnam are expected to develop similarly; 3) All formal health care for residents of Xuan Tien is delivered through one hospital and one commune health station; and 4) The district hospital and commune health station doctors have a very good working relationship with the provincial medical center in Nam Dinh and have a personal interest in injury themselves.

Reporting logs of all injuries occurring in the Xuan Tien commune over a one-year period are being collected bi-weekly from all active formal and informal treatment options including: the district hospital, commune health station, pharmacies, and healers. In addition to this 10 health volunteers already working in their villages to administer vaccines and aids prevention activities have been trained to report injuries in a log book. Finally, first aid boxes have been placed in all medium, large and a sample of small enterprises, innovatively collecting reports of injuries because treatment requires entry onto a reporting form.

A household survey was administered to all residents of Xuan Tien to collect data for the denominators in incidence rate calculations. Each household was asked to delineate all people living in the household as well as report on all work (paid and unpaid) in the year prior to the survey. Work questions differentiated between work inside or outside the home, and work for themselves or an outside employer.

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Reporting logs were designed to "over capture" injuries in that informal reporting guidelines include a broad definition of "hurts." The word "hurt" is used instead of "injury" in all instruments. All reported hurts are collected by the commune health station doctor biweekly. The doctor decides if each log entry should be considered a "potential injury case," i.e. if the hurt can be classified into ICD-10 groups: XIX Injury poisoning, and certain other consequences of external causes or XIII Diseases of the musculoskeletal system and connective tissue. All those qualifying will be followed –up with a questionnaire about the injury including information on: how the injury occurred, the work-relatedness, treatment details and consequences of the injury including lost work time. Case definitions will be developed for an injury and a work related injury. Whether the case was an injury or a work-related injury will be decided by two separate coders. Incidence rates for injuries and work-related injuries will be computed by basic demographics such as age and gender as well as workers, jobs and total person hours overall and also broken down by ILO classification for industry. Alternative inclusion/exclusion criteria for case definitions and capture of injuries by each data source will be evaluated extensively.

Poster: 0078

Thermal Stress of Firemen During Training in Realistic Conditions

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It seems a logical combination: fire fighters and heat. However, fire fighters are only 5% of their working time exposed to heat and flames. Wearing their thick protective clothing, this means that they are almost always very warm and during actual fire fighting they encounter additional problems of skin burns. In hot conditions this is accompanied by the sweat production as a potential risk for skin burns the so-called "steam burns." During realistic training, fire fighters are regularly exposed to high temperature environments. In these activities thermal, physical and mental stress can be (very) high. To study these risks on skin burns, we carried out measurements of various physical parameters during realistic training conditions. During various training sessions we recorded body core temperatures, skin and clothing temperatures, heart rate and in some cases relative humidity within the clothing. We collected data on four fire fighters each day over two (separate) weeks without interfering with their training.

Results show that physical and thermal stress varies a lot between different sessions and become very high in some cases. Critical temperatures for potential skin burns (above 40°C) were only seen in some of the exercises on the third and fourth day of the training week. These were exercises with complex situations in which some of the fire fighters were inside the building, near the fire for more then 30 minutes and during which skin temperatures were above 40ºC for about 5 minutes. Also, on the last two days of the training week more fire fighters complained about the high temperatures and one of the fire fighters got hurt because of steam coming from outside (from the water extinguishing the fire) through the openings of his trousers. During the very last exercise, one of the fire fighters was fully exhausted and was almost unable to report his findings to the researchers. It took more then 20 minutes in a cold environment (about 5°C) to get him on his feet again. Physical and thermal load varied largely between the exercises. In general, the average intensity was not too high, but sometimes very high peaks in the workload were observed. Thermal stress with risks of skin burns were seen during fires in complex buildings. In some cases the fire fighters reported steam and the skin burns and a Coolpack was used to relieve the pain. During the week fire fighters got more and more exhausted, but his was not clearly reflected by the rest heart rates, because every day another group of subjects was followed. These data give directions to how integration of smart fabrics may help in improving protection of fire fighters, and help in decreasing injuries. Furthermore, collecting data during such realistic training provides us with insight how future smart clothing products may be of benefit to fire fighters during activities other than fire fighting.

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Poster: 0079

Acute Respiratory Effects of Smoke Exposure in Wildland Firefighters

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Background: Respiratory problems are estimated to affect 5% to 10% of wildland firefighters. The National Institute for Occupational Safety and Health assessed the acute respiratory effects of smoke exposure in 56 members of two National Park Service Interagency "Hotshot" Crews.

Methods: We collected questionnaire and spirometry data during two preseason training sessions in May 2004 and May 2005, for 8 days during a wildfire in Alaska in July 2004, 3 days during a wildfire in Wyoming in July 2005, and 8 days during a prescribed fire in Yosemite National Park in October 2005. The most recent observations were used for individuals who fully participated both years.

Results: Forty two individuals participated in one or more preseason and one or more fire assessments. The cohort was comprised primarily of white males (88%). The median age was 26 years and the median time spent as a firefighter was 7 months. At the baseline assessment, 13 participants reported a history of asthma. Three of the 5 with current asthma were diagnosed after becoming a firefighter. All 5 had normal spirometry but three were taking asthma medication. Two prevalent cases of abnormal spirometry were observed among participants with no history of respiratory disease: one participant had borderline obstruction and another had a mildly low vital capacity. For all 42 firefighters, the mean preseason FEV1 was 4.5L. At the fires, the mean FEV1 decreased 0.10L (95% CI, 0.04L - 0.17L; $p < 0.01$). The mean cross-shift change in FEV1 was a 0.04L decline (95% CI, 0.01L - 0.06L; $p < 0.01$).

Conclusions: Wildland firefighters may experience acute reductions in lung function while fighting fires and during the firefighting season. More studies are needed to determine if some of these respiratory effects persist or accumulate from year-to-year.

Poster: 0080

Designing EMS Ergonomic Interventions for the Fire Service

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Research Problem: Musculoskeletal injuries consistently account for about half of all injuries to firefighter/paramedics engaged in emergency medical services (EMS) operations as well as to EMS workers in the private sector. These injuries result in lost work time, permanent disability, and high worker compensation costs. The tasks performed during EMS runs that place these workers at risk for serious sprain and strain injuries include lifting and carrying patients for transport to the hospital. This problem becomes more serious as the population becomes more obese and the weight of the load increases. In previous research conducted by us with funding from NIOSH, we identified and quantified the most high risk EMS job tasks in need of ergonomic intervention. These tasks involved transporting patients down stairs and lateral patient transfers.

Purpose of the Study: The purpose of our current NIOSH-funded R01study is to design, build, and evaluate EMS ergonomic interventions that reduce biomechanical loads on the back and are considered worthy of adoption for use by firefighter/paramedics that transport patients during EMS operations. We are using a participatory ergonomic process, engaging fire chiefs and firefighter/paramedics throughout the study. The goal of our work is to translate the product of this research into practice.

Methods and Findings by Phase of Study: In Phase 1 of this four-phase study, we conducted focus groups with firefighter/paramedics to generate concept ideas for EMS transport/transfer devices and task method changes to address the problematic job tasks identified in our earlier research. The focus group participants specified the criteria for what would be considered a useable product and brainstormed concepts while an industrial designer sketched their ideas. Of the 24 concepts presented, the voted top 10 were considered in the following phase. In Phase 2 of the study, prototype EMS devices were produced by us, acquired from inventors, or purchased and modified. Lab testing of simulated stair-descent and lateral transfer tasks was conducted in Phase 3 with 11 two-person teams of firefighter/paramedics. Measures included levels of muscle use (EMG for 8 trunk muscles), heart rate, spine postures and movements, and ratings of perceived exertion. In this phase, we used a repeated measures experimental design to examine the relative effectiveness of eight new EMS devices compared to the

existing approaches in reducing biomechanical loads. The sequencing of the experiments was randomized for team as was the sequencing of the experimental versus control condition. Four of the 5 EMS devices that we designed showed positive EMG results that were statistically significant; one of two prototype devices acquired from other inventors showed positive results; non-significant results were found for the EMS device we purchased and the task method change. Results for other outcome measures showed similar patterns to the EMG results. We are currently in Phase 4 where we are pursuing commercialization opportunities for those EMS devices that we designed and that showed a biomechanical advantage in our lab tests. We seek continuing stakeholder input during this phase as we plan focus groups to gather information on how to facilitate dissemination and adoption of new EMS devices into practice.

How the Findings Advance the Research: Other than the work we have conducted, little research exists documenting the specific job tasks that pose risk for serious musculoskeletal injury associated with EMS transport of patients. Our research suggests ergonomic interventions that may help reduce the risk of injury to this worker population and offers ideas and suggestions for further research.

How the Findings Relate/Can Improve the Workplace Safety of Firefighter/Paramedics and EMS Workers: By sharing our results with the end users and pursuing the commercialization of the promising EMS devices that we designed, we hope to have a direct impact on reducing the risk for musculoskeletal injury in our target population. Unlike health care workers in an institutional setting, firefighter/paramedics and other EMS workers work in an uncontrolled environment where engineering controls are less feasible. Finding simple ergonomic solutions that can be stowed in a small space on an ambulance, are affordable, are quick to assemble and easy to carry and clean are features identified as essential by this public safety services group. Our EMS devices were developed with these criteria in mind.

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Poster: 0081

Single Nucleotide Polymorphisms (SNPs) Associated with Decline in Lung Function in Firefighters

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Firefighters are routinely exposed to respiratory toxicants, including smoke. While assiduous use of respiratory protection has resulted in improvements in pulmonary function compared with historical findings, there are still many firefighters who experience an accelerated rate of decline in lung function, defined as a decline in forced expiratory volume in one second (FEV1) exceeding 60 ml/yr, averaged over a minimum of 5 years. Understanding factors associated with increased loss of lung function should help determine the best means of prevention. Our study objectives were to assess the evidence for genetic involvement in the rate of lung function decline in a population of firefighters.

Pulmonary function data from 1988 to 2003 were retrieved from the Phoenix Fire Department's medical monitoring database. Information on date of birth, gender, race/ethnicity, history of smoking, and history of asthma was also collected. Rate of decline in FEV1 was calculated for each firefighter who had a minimum of 3 measures over 5 years of pulmonary function testing, by regressing the annual FEV1 values over age at testing. Blood or buccal cell samples were obtained from 451 firefighters. The samples were genotyped for 7 SNPs from genes thought to be involved in chronic obstructive pulmonary disease (COPD) or asthma, based on prior studies. Using the slope of FEV1 as the dependent variable, oneway analysis of variance was conducted to determine whether the mean slope differed by genotype. Stratified analyses were then used to evaluate whether differences in mean slope by genotype were consistent among ethnic/racial groups and between ever- and never-smokers. Lastly, multiple linear regression models were run to evaluate the relationship between slope and each SNP separately after adjusting for other variables related to decline in lung function and potential confounders. These included baseline FEV1, smoking, race/ethnicity, gender, age at last pulmonary function test, and number of years of follow-up.

The mean initial age of firefighters was 32 years. Sixty-six (17.6%) had an annual rate of decline in FEV1 of >60 ml/yr. All of the SNPs were in Hardy-Weinberg equilibrium. Two SNPs in the coding region for

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Interleukin-1β and IL-1 receptor antagonist (IL-1β 3953 T/C, p=0.015; IL-1 RA 2018 C/T, p=0.040) and two SNPs in the promoter region of the gene for Tumor Necrosis Factor-□ (TNF-□ -238 A/G, p=0.048; TNF-□ -308 G/A, p=0.009) were significantly associated with an increased rate of decline in FEV1 in multivariate analyses. Transforming Growth Factor-□ (-509), IL-8 (-251), and IL-13 (1055) SNPs were also analyzed, but no association with decline in FEV1 was found. These results suggest that IL-1β 3953, TNF-□ -238 and -308, and IL-1RA 2018 variants may influence individual susceptibility for accelerated declinein lung function in firefighters.

Determining risk factors associated with decline in lung function is critical to the prevention of respiratory impairment including COPD. Firefighters are an ideal population to study because of routine annual surveillance of pulmonary function. Future studies in firefighters have been proposed to evaluate the interaction between exposure to products of combustion and genetic polymorphisms in relation to decline in lung function.

Poster: 0082

Longitudinal Follow-Up of Patients Evaluated for Complaints Related to Nonindustrial Indoor Environments: Symptoms, Work and Lifestyle Changes

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Broad Importance of the Research Problem: The majority of United States workers are employed in non-industrial indoor work environments. Increased risk of nonspecific symptoms, asthma and lost work productivity has been associated with such work environments, with much focus on causative factors. Little is known about the longer-term health and socioeconomic outcomes of patients with symptoms or diseases associated with their indoor work environments. This study describes longitudinal symptoms, health and lifestyle changes in patients seen at two occupational and environmental health clinics in Connecticut.

Purpose and Methods: We performed a retrospective longitudinal study of patients who presented with symptoms related to a non-industrial work environment to characterize health, work, quality of life and socioeconomic outcomes. 130 patients seen at Yale University or University of Connecticut Occupational Health Clinics between 1997 and 2002 completed a telephone questionnaire to assess current symptoms and health, home and work modifications, and job status. Clinic medical record abstractions were also completed. Participants were characterized as asthmatic or non-asthmatics based on medical record information and self report. Chi-squared analysis was used to test if frequencies were statistically different and ANOVA was used to test if means were statistically different.

Summary of Findings: The office workers were predominantly white female, had a mean age of 49.7 and were well educated (66% having a bachelor's degree or higher). They were interviewed a mean of 3.6 years after initial evaluation. 55% had self reported current asthma, 71% of whom were diagnosed after the triggering event. The most common presenting symptoms were respiratory and irritant (>90% patients) and neurologic (60% patients). Over 75% patients reported onset of symptoms following a specific office renovation or move. Although 70% reported their overall health had improved at follow-up, over 70% had persistent symptoms that interfered with activities. Of note, substantial modifications

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to lifestyle, work and home environments were made in about 80%, and despite modifications, it often took several years for symptoms to improve (mean 5.8 yrs). Asthmatics were more likely to be atopic and report more respiratory symptoms. There were no statistical difference between asthmatics and non-asthmatics in terms of age, years with employer and current employment status. Asthmatics had a statistically higher prevalence missed days of work and fair or poor general overall health compared to non-asthmatic workers. They were statistically more likely to make some modifications to their lifestyle than non-asthmatics.

How the Findings Advance the Research Field: These findings demonstrate that patients who present with building-related complaints have symptoms, modified lifestyles, and work changes which can persist long after the initial event, and that the adverse impact of such indoor work environments may be greater in asthmatics compared to non-asthmatics.

Improving Workplace Safety and Health: These findings, which suggest that triggering Events in indoor work environments may be associated with persistent symptoms and modifications at home and work, identify potential targets for preventive strategies that may improve the health, lifestyles and productivity of workers in non-industrial indoor environments. Such preventive strategies may be particularly benefit asthmatic workers.

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Poster: 0083

Issues of Chemical Exposure in Korean-American Drycleaners: Findings of Focus Group

AS Jeong (1) presenting, OS Hong (1)

The University of Michigan, Ann Arbor, MI, United States (1)

Background: Numerous health and safety risks in the dry cleaning industry have been identified by many researchers. Major health and safety issues identified include exposure to chemicals, mainly to exposure to perchloroethylene (PERC), personal protective equipment (PPE), ergonomics, and burns. The most significant hazards for workers in dry cleaning shops are exposure to PERC, a primary solvent used for dry cleaning. PERC has been identified as a harmful agent that develops health problems in various parts of the human body such as the central nervous system, respiratory system, liver, kidneys, and skin. The harmful effects of chemical exposure can be avoided by installing effective ventilation and using new safer dry cleaning equipment as well as by adequate work practice and use of personal protective equipment (PPE) by individuals.

Korean-Americans own almost 50% of all dry cleaning shops and are a major workforce in the dry cleaning industry in the United States (Federal Korean Drycleaners Association, 2005; EPA, 1995). However, there is no research investigating Korean-American drycleaners' knowledge and concerns regarding health and safety issues related to their work. The purpose of this study was to obtain qualitative data on Korean-American dry cleaners' concerns about work-related health and safety and their attitudes toward the use of PPE through focus group interviews.

Method: Two focus group discussions were conducted with convenient samples of Korean-American drycleaner owners and workers residing in Detroit area, in Michigan. The focus groups were held through October and November, 2005. The study recruited drycleaners through the Korean American Drycleaners' Association in Michigan and invited those who have been working in dry cleaning for at least one year. A total of 12 individuals participated in two focus groups. All participants are both owners and workers. The main questions that we asked were major health and safety issues (PERC, Burns, Ergonomics, etc.) and protective behaviour (using PPE).

Result: Study participants had concerns as both owner as well as worker. As an owner, they were concerned mostly about compliance of environmental regulation and business. As a worker, they expressed they knew very little about the hazards of chemical exposure and showed vague concerns

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about chemical exposure and their health. The participants were more concerned about long working hours without rest or break and job stress than hazards of chemical exposure. The majority of participants currently do not use PPE and have no intention of using it in the future because of their limited knowledge about the hazardous nature of chemical exposure and discomfort. Participants believed using PPE was only for emergencies such as chemical spills.

Conclusion: Korean-American drycleaners participating in our focus groups do not have an accurate perception of the hazards due to chemical exposure including PERC. These qualitative data will provide useful information to Korean-American drycleaners, safety and health professionals, and researchers. The findings will be used to guide the development of an intervention for drycleaners to increase their knowledge of chemical exposure and use of PPE.

Poster: 0084

Cross-Sectional Study of Auto Body Workers Exposed to Diisocyanates: Respiratory and Dermal Exposures Contribute to Immune Response

MH Stowe (1) presenting, AV Wisnewski (1), J Sparer (1), Y Liu (1), SR Woskie (2), CA Redlich (1), MR Cullen (1)

Yale University, New Haven, CT, United States (1), University of Massachusetts, Lowell, MA, United States (2)

Broad Importance of the Research: Diisocyanates are potent sensitizing agents and a common cause of occupational asthma in industrialized countries. However, the health and immunologic effects of diisocyanates under current working conditions and risk factors remain poorly defined. Although respiratory exposure has been shown to induce asthma, the role of dermal exposure remains unclear.

Purpose and Methods: A cross-sectional epidemiologic study of 262 body shop workers from 36 shops, Survey of Painters and Repairers of Autobodies by Yale (SPRAY), was performed to characterize diisocyanate exposures and their effects on body shop workers, using questionnaires, physiologic and immunologic assessment of the workers. Individual respiratory exposure was estimated based upon total reactive diisocyanante concentration from air sampling and personal worker activity diaries. Dermal exposure was modeled on frequency of positive skin and surface wipe samples and use of personal protective equipment recorded in worker diaries. Multiple linear regression was employed to determine the contribution of respiratory and dermal exposure estimates to the natural log of HDI-specific IgG level. Other parameters entered in the models included race, gender, respiratory symptoms, atopy, HDI-specific IgE level and job category.

Summary of Findings: Airborne exposures were primarily polymeric HDI (hexamethylene diisocyanate), highest when spraying paint (358.5 ugNCO/m3 for clearcoat) and lowest in the office (0.05 ugNCO/m3). Twenty-three percent of dermal wipe samples were positive - highest when mixing/spraying paint (34%), lowest with non-paint related tasks (6%).

A low prevalence of asthma (3.1%) using spirometry, methacholine challenge, symptoms and peak flows was noted, but isocyanate-specific immunologic responses were present in 26% of workers. HDI-specific IgG was present in 10.5% of hispanic workers and in 23.3% of other workers.

Estimated dermal exposure was found to be a significant predictor of natural log of HDI-IgG ($p=0.003$), in addition to estimated respiratory exposure ($p=0.002$). Being of hispanic ethnicity predicted lower levels

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of HDI-IgG (p=0.023) and workers classified as auto body technicians were more likely to have high IgG titres (p=0.042). Among hispanic workers, the association between HDI-IgG and estimated dermal exposure was stronger and estimated respiratory exposure, less important. HDI-specific IgE was present in 6 workers (3%), 5 of whom also had HDI-specific IgG, only one of whom had work-related asthma symptoms.

How the Findings Advance the Research Field: These findings demonstrate on-going respiratory and dermal exposure to diisocyanates exists in the auto body repair industry. HDI-IgG is present in a substantial proportion of non-asthmatic HDI-exposed workers and is associated with current respiratory diisocyanate exposure. Furthermore, dermal exposure to diisocyanates may contribute to HDI-specific IgG immune responses, independent of respiratory exposure, and there may be racial differences in these relationships.

Improving Workplace Safety and Health and Related Outcomes: These results demonstrate substantial on-going HDI polyisocyanate respiratory and skin exposures in end-use operations such as auto body shops. Industrial hygiene interventions, such as increased use of spray booths and improved personal protective equipment, can hopefully reduce respiratory and skin diisocyanate exposures and prevent the development of isocyanate asthma.

Poster: 0085

Intervention Research in Auto Body Repair and Refinishing Industry: The SMASH Study

Y Liu (1) presenting, MH Stowe (1), JA Sparer (1), D Bello (3), B Cartmel (1), K Ibrahim (1), C Fleming (1), I Collin-Hansen (1), C Daly (1), F Youngs (2), SR Woskie (2), MR Cullen (1), CA Redlich (1)

Yale University School of Medicine, New Haven, CT, United States (1), University of Massachusetts, Lowell, MA, United States (2), Harvard School of Public Health, Boston, MA, United States (3)

The auto body repair and refinishing industry is composed of small family-owned businesses that employ 168,000 to 205,000 workers nationwide. Workers in this industry are exposed to a variety of respiratory and dermal chemicals including isocyanates and organic solvents that can potentially cause occupational asthma, skin diseases and other health problems. Little is known about the effectiveness of exposure control strategies in the industry. The purpose of this study was to implement an intervention program that included educational training, engineering control, administrative changes and behavioral modifications, and to evaluate the effectiveness of each intervention component.

Auto body shops randomly selected in the southern Connecticut area were classified into intervention and control groups, and followed up for one year. Intervention shops received the intervention program in the first 6 months and control shops in the second 6 months without behavioral modification. Safety videos, handbooks and posters were developed and used in training. Personal protective equipment (PPE: respirators, gloves and coveralls) and surface and skin decontamination products were provided for 6 months. Intervention effectiveness was assessed at baseline, 6 months and 12 months by respirator fit testing and workplace performance testing, shop and worker forms for engineering control change and behavioral improvement, worker questionnaires for opinion changes and subjective evaluation of intervention measures and safety products.

A total of 102 workers - 34 painters, 59 body technicians, and 9 managerial employees – from 14 shops (7 in each group) participated in this study. Preliminary findings show that overall pass rate on respirator fit tests (N=71) increased from 85% to 94% after training. Polyisocyanates in the paint were found to remain on skin or work surfaces for many hours after contamination. Positive rate of isocyanate skin exposure decreased from 42% (N=69) on bare skin to 3% (N=319) when gloves were used and 1% (N=208) when coveralls were used. The use of decontamination products significantly ($p<0.001$) reduced total isocyanate reactive groups (µg NCO/inch2, geometric mean) from 1.90 to 0.01 on

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surfaces and 0.03 to 0.00 on skin areas. Decontamination products used in shops and those we recommended were equally effective in reducing isocyanate exposures. Training and behavioral modification significantly ($p<0.05$) reduced the rate of unsafe work practices: not painting in the booth (43% to 15%), not using nitrile gloves (54% to 4%) and no respirator used for painting (22% to 11%). A large majority (85%) of workers accepted nitrile gloves as comfortable and protective, and most (91%) workers considered them to be more protective than latex gloves. Regular Tyvek suits did not receive a high evaluation on comfort or perceived protection, but acceptance was poorer for coated Tyvek suits due to complaints regarding heat.

This study provides isocyanate exposure intervention effectiveness data that were not previously available. Educational training, use of safety products and behavioral modification appear to be effective in reducing exposures to isocyanates and other respiratory and dermal chemicals in this industry.

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Poster: 0086

Workload-Related Musculoskeletal Disorders Among Hotel Housekeepers: Worksite Surveillance Reveals a Growing National Problem

E Frumin (1) presenting, P Vossenas (1), JY Moriarty (1), P Orris (2), J Halpin (2), N Krause (3), L Punnett (4)

UNITE HERE, New York, NY, United States (1), University of Illinois, Chicago School of Public Health, Chicago, IL, United States (2), University of California, San Francisco, Richmond, CA, United States (3), University of Massachusettes, Lowell Department, Work Env., Lowell, MA, United States (4)

The hotel industry employs over 1.4 million people. Hotel workers, in general, are 40% more likely to be injured on the job than the typical worker in the service sector. Over 400,000 of these are maids and housekeepers -- the largest job classification within hotels -- who are particularly at risk. Of all U.Ss private sector job categories, they rank near the top (20th) annually in the number of disabling injuries reported by the Bureau of Labor Statistics. Most of these workers are women, many are immigrants, and typically are paid $8.00/hour. Work-related pain and injury among housekeepers have been shown to be under-reported, making early detection, adequate treatment, and prevention of injuries and associated disability difficult.

New analyses of workplace surveillance data include 1) formally-reported injuries/illnesses, 2) informally-reported prevalence of pain and 3) trends in working conditions (i.e. new equipment, limitations in available break time, inadequate supervision and training). The most frequent workplace stressors associated with disabling conditions involve bodily exertion, awkward position, repetitive work and musculoskeletal and psychological strain. These studies have identified a variety of health and safety risk factors, and offer compelling reasons for employers, labor unions, workers and insurance carriers to direct their attention to prevention efforts.

Recent industry trends in room design and work organization increased housekeeper workloads significantly, through the introduction of heavier mattresses and bedding, additional room amenities requiring manual cleaning, and frequent travel between floors. Additional factors include the growth of hotel chains, hotel employer policies on cleaning standards and restricted duty assignments, the lack of ergonomically sound equipment, and the design, purchasing and installation of room equipment and materials without input from worker representatives.

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We will present the results of recent multi-city surveys on work intensification and health, and will discuss 1) implications for employers and workers, and 2) how to improve the effectiveness of workplace surveillance to identify intervention priorities and strategies.

Poster: 0087

Using a Programmed Intervention of Intermittent Stretching to Decrease Musculoskeletal Discomfort Associated with Work at a Computer Workstation

AH Marangoni (1) presenting

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Importance: The National Occupational Research Agenda has identified musculoskeletal disorders of the upper extremities with associated prevention strategies and intervention effectiveness as priority areas. The effect of poor computer workstation design and the associated musculosketal discomfort (MSD) is often found to be of concern to those who utilize this technology and unless specific programs are put into place, ergonomic modifications to workstations are not used as intended. In 1997 the cost to the U.S. economy for painful conditions while at work was estimated to be $20 billion per year, by 2003 the cost estimate had increased to over $60 billion per year. The Bureau of Labor Statistics reported in 1998 that twelve percent of injured workers attributed their injuries to typing.

Purpose: The goal of this study was to evaluate the effects of an intervention of regular stretching while seated at a computer workstation and to ascertain whether such a programcould bring about a significant reduction in MSD.

Summary of Methods: The effect of regular stretching on musculoskeletal discomfort (MSD) associated with the use of computers was studied in 68 university and federally sponsored employees for 15 to 17 workdays in three equivalent groups. The average age of the subjects was 43 years. Eighty-eight percent (60) of the participants were female. At intake, seventy two percent of the subjects complained of cervical (neck) pain followed by right shoulder (44%) and left shoulder (40%) pain.

Stretching programs were assigned to two groups that differed only in the media used for presentation. One group received a computer program that delivered both video and audio instructions. One group was given a hardcopy version that incorporated a written text with pictures of the stretches and a kitchen timer. A third group was assigned as the non-treatment control. The two versions of the stretching program delivered 35 different stretches; one every 6 minutes during the workday.

Summary of Findings: A pretest-posttest-control group design incorporating an ANOVA analysis was used to evaluate visual analogue pain scales and “visual pain spots” (developed as part of the study). Qualitative data was used to triangulate the findings.

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The ANOVA analysis of evaluation tools found a significant reduction in MSD (p = .000) of 72% for the computer-generated stretching program, and a reduction of 64 % (p = .000) using the hardcopy version of the intervention.

Advancing the Field: Prior literature did not reveal an effective way to treat computer workstation related MSD without significant expense.

Improving the Workplace: Data supported that regular stretching decreased MSD significantly, that improvements in MSD occurred without changes to the ergonomic setup of the workstations, and that there was no statically significant difference in the outcomes of the different media used in the delivery of the intervention.

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Poster: 0088

A Randomized Controlled Trial of Ergonomic Interventions in Computer Users

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Introduction: Customer service work at computers is associated with elevated rates of upper body musculoskeletal disorders and pain. The purpose of this study was to determine whether two simple workstation interventions would reduce the incidence of upper body musculoskeletal disorders and pain severity among computer users.

Methods: This was a one year, randomized controlled intervention trial among 182 customer service operators at 2 call centers of a large HMO. Participants used a computer for at least 20 hours per week and did not have an active workers' compensation claim. Participants were randomized to receive (1) ergonomics training only, (2) training plus a trackball, (3) training plus a forearm support, or (4) training plus a trackball and forearm support. Outcome measures were weekly pain severity scores and diagnosis of incident musculoskeletal disorder in the upper extremities based on physical examination performed by a physician blinded to intervention. Analyses using Cox proportional hazard models and linear regression models were adjusted for demographic factors, baseline pain levels, and psychosocial job factors.

Results: Post-intervention, 63 participants were diagnosed with one or more musculoskeletal disorders. Adjusted hazard rate ratios show a protective effect of the armboard for neck-shoulder disorders (HR = 0.49, 95% C.I. = 0.24 to 0.97). The armboard also significantly reduced neck/shoulder pain (p=0.01) and right hand/wrist/forearm pain (p=0.002) in comparison to the control group. The effect of the trackball was mixed. A return-on-investment model predicted a full return of armboard costs within 10.6 months.

Conclusions: Providing a large forearm support combined with ergonomic training is an effective intervention to prevent upper body musculoskeletal disorders and reduce upper body pain associated with computer work.

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Poster: 0089

Occupational Health Hazards of Orchestra Musicians

JH Romeo (1) presenting

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The phrase "occupational health", invokes visions of steel workers with back injuries, computer operators with carpal tunnel syndrome, and construction workers with asbestiosis. Seldom does "occupational" health conjure up a picture of a violinist with hearing impairment, a trumpet player with a focal dystonia, or a musician with severe depression. With approximately 62 million individuals in the US earning their living playing a musical instrument, the occupational health concerns of this special population deserves evaluation and study. The very real challenges of this most highly competitive environment, the isolation and loneliness of solitary practice, the stresses of extensive travel, and performance anxiety have been well documented. The gap in the research literature relates to the occupational hazards of the orchestral musician. The purpose of this population study is to begin the compilation of the occupational hazards specific to full time work as a musician in an orchestra.

Methodology: The data for this study were gathered by means of a survey questionnaire on occupational hazards specific to the professional classical orchestra musician. The questionnaire was sent to 1193 full time musicians holding positions in ten US orchestras accorded world-class status by the American Symphony Orchestra League. A 78.1% response rate was received. Zero order correlations were computed to examine the general pattern of relationships among the study variables. Data analyses performed included descriptive statistics, reliabilities, intercorrelations among variables, and moderated multiple regression using the hierarchical approach to assess the potential moderating effectof instrument group on the relationships of specific variables.

Summary of Findings: A 78.1% survey response rate was obtained with an additional 93 musicians from 7 of the surveyed orchestras volunteering for personal interviews. Results from data analysis demonstrated a 51% rate of numbness or tingling in fingers, hands, or arms; 20% rate of numbness or tingling in the face or lips; 58% rate of stiffness or pain in the neck, 72% rate of stiffness or pain in the shoulders; 28% rate of dizziness or lightheadedness during or immediately after playing a wind instrument; and 34% rate of skin rashes, sores, marks on the face, chin, neck, hands, or arms. Also reported were symptoms congruent with focal dystonia. A most significant and unexpected finding was that 63% of the musicians responding experienced depression significant enough to interfere with

their playing, and 93% of surveyed violinists experienced depression on a regular basis that interfered with their performance and playing. Concerns related to the specific work environment of an orchestra musician were also found and included the noise levels associated with orchestral playing, concert stage lighting, backstage safety, cramped/unnatural playing position, boredom, and stress.

Implications: This study advances the field in that the study data included concerns not previously reported in the literature, and highlighted the lack of integration with the worker's compensation system. Many of the playing related health problems could best be treated by rest from playing, which is not usually an option for the professional musician who often has no healthcare insurance. Data analysis also highlights several relatively simple and cost-effective means in which the work environment may be modified to decrease the occupational hazards related to orchestral playing. The nature of musicians' occupational health issues related to the stage/backstage as a workplace environment have not been formally investigated. This study provides the pilot data for a new avenue for occupational health research.

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Poster: 0090

World Trade Center Evacuation Study: Preliminary Findings

RG Gershon (1) presenting, K Qureshi (1), MF Sherman (2)

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Purpose: This CDC-funded study was designed to identify the individual, organizational, and environmental (building) factors that affected the evacuation from the Work Trade Center Towers (WTC) 1 and 2 on September 11, 2001. The overarching purpose of this study was to inform policy and practice with respect to evacuation of employees from high rise occupancies.

Design: This recently completed three-year, five-phase study utilized both qualitative and quantitative data collection methodologies. A convenience sample of evacuees was recruited after recreating the master sample frame of approximately 500 employers leasing space at the WTC 1 and 2. Approximately 10% of the 15,000 employees who were at work on September 11, 2001 participated in this study (N = 1767, of whom 1435 actually evacuated the building). The study questionnaire, available as an on-line version or hard copy, included a new emergency preparedness safety climate scale.

Results: Important individual factors that affected either the initiation or progression of evacuation included lack of familiarity with: the building, the fire stairs, the evacuation protocol, and terminal egress points out of the building. Delays were also related to: attending to last minute tasks, waiting for permission from supervisors before evacuating, concerns related to one's ability to descend multiple floors (health status), and waiting for instructions and directions. At the structural level, stairwell width, lack of communications, locked doors on egress route, and structural damage to stairwells were related to delays. At the organizational level, there was evidence that employees were unprepared to undergo a full scale evacuation. Training and educational programs on evacuation and emergency preparedness in general were either absent or minimal; more than 50% of the respondents did not know that there were 3 stairwells located in each building, 50% were unaware that the roof could not be used as emergency egress, 74% stated that they were not provided with written fire safety plans, and of the 80% stating that they had participated in fire drills, only 10% said that they had ever entered a stairwell as part of the drill.

Conclusions: A set of recommendations is currently under development for high rise occupancy employers. These include: delineation of responsibilities for fire safety and evacuation (e.g., among building owners, building management, tenants, employees, etc.), preparedness planning for total

building evacuation, including orientation of employees to the building and the safety features of the building, back-up communication systems, training and training evaluation, preplanning for disabled individuals, and identification of evacuation leaders. Next steps involve the development and evaluation of a model high rise emergency evacuation plan, which is scheduled for 2006.

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Poster: 0091

World Trade Center Evacuation Study: Preliminary Disability Data

MS Rubin (1) presenting, RG Gershon (1), MF Sherman (2)

Columbia University, New York, NY, United States (1), Loyola College, Baltimore, MD, United States (2)

Purpose: Persons with disabilities (PWD) may be at increased risk of morbidity and mortality during emergency situations that require evacuation. In this study, designed to identify the individual, organizational, and environmental (building) factors that affected the evacuation from the Work Trade Center Towers (WTC) 1 and 2 on September 11, 2001, we examined the relationship between disabilities and the evacuation process. This information may be helpful to emergency planners.

Design: The World Trade Center Evacuation Study (WTCES) utilized both qualitative and quantitative data collection methodologies. A convenience sample of evacuees was recruited; there were 1435 participants who evacuated either WTC 1 or WTC 2 on September 11, 2001. The study questionnaire, available as web-based or hard copy version, included a number of items that addressed disabilities, disability preparedness, and co-workers' awareness of disability planning for emergencies.

Results: Of the 1435 evacuees who participated in the study, 21% (n=297) reported that they had a disability or medical condition that was diagnosed by a physician. Disabilities included: 27% breathing problems, 16% mental health, 12% heart conditions, 5% vision, 3% hearing, and 7% other. Of those reporting a disability, 28% reported that the disability limited their ability to walk down a large number of stairs. PWD were nearly twice as likely to delay the initiation of their evacuation once they determined they needed to evacuate compared to non-disabled workers (OR = 1.55, 95% CI 1.03-2.33). PWD were wice as likely to be injured during their evacuation as non-disabled employees (OR = 2.04, 95% CI 1.59-2.62). Knowledge of preparedness for PWD was low among evacuees. Although 34% of evacuees reported having a PWD on their floor, only 13% reported that a plan for the evacuation of PWD was in place, only 12% reported that co-workers were designated to assist PWD, and only 11% were aware that there was special equipment available to assist disabled co-workers.

Conclusions: PWD may be at increased risk during emergency situations that require evacuation. Preplanning therefore, is especially important to ensure safe and effective evacuation of PWD. Preparedness training for PWD should be conducted at all levels (e.g., individual, co-worker, employer, tenant, building owner, security personnel, etc.).

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Poster: 0092

Racial and Ethnic Disparities in Work-Related Injuries Among Teenagers

KM Zierold (1) presenting, HA Anderson (2)

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Broad Importance of the Research Problem: The occurrence of injury among teen workers is approximately two times greater thantwice that of adult workers. However, no information exists on the racial and ethnic differences among teens injured at work. Researchers have speculated that the racial and ethnic differences in adult occupational injury exist because minority workers tend to be employed in more hazardous occupations. While numerous studies have documented work-related injuries in teens, the majority lack evaluation of the roles of race/e and ethnicity in occupations, job characteristics, and injury.

Purpose of the Study: The purpose of this study was to investigate the differences in work-related injuries and job characteristics among white teens, African-American teens, and Hispanic teens.

Summary of Methods: An anonymous questionnaire was administered in May 2003 investigating employment, injury, work-related habits, and school performance among teen workers throughout the five public health regions of Wisconsin, was administered in May 2003. To Logistic regression, adjusted for age and gender, was used to compare differences in the work characteristics and injury characteristics among by races/ethnicity ies, logistic regression was used to determine odds ratios and 95% confidence intervals. The logistic models were adjusted for age and gender.

Summary of Findings: There were 3,574 teens that who worked during the school year, Overall, 71% were white, 9% were African-American, and 6% were Hispanic. The distribution of occupations among white teens by race/ethnicity was , African-American teens, and Hispanic teens was similar; , as the majority worked in restaurants and fast food establishments and were employed for in individuals in their homes. Slight differences were detected in: construction, where ~7% of Hispanic teens, 4% of white teens and <2% of African-American teens worked and non-family farming, where ~3% of white teens, ~3% of Hispanic teens, and <1.0% of African-American teens worked. Teens reported working from less than 5 hours per week to more than 23 hours per week. Most (65%) of the teens reported working less than 17 hours a week; however African-American and Hispanic teens were significantly more likely to work 23 hours or more

during the week (AOR=2.12, 95% CI=1.50-2.82 for African- American teens; AOR=1.52, 95% CI=1.05-2.18 for Hispanic teens). Additionally, compared to white teens, Hispanic and African-American teens were more likely to work after 11:00 pm.

A large disparity in the prevalence of injury by race/ethnicity was found. African-American and Hispanic teens were significantly more likely to report being injured compared with white teens (AOR=2.20, 95% CI=1.64-2.95 for African-American teens, AOR=1.93, 95% CI=1.36-2.74 for Hispanic teens). In addition, African-American and Hispanic teens were significantly more likely to report sustaining a severe injury compared to white teens (AOR=3.51, 95% CI=2.24-5.49 for African-American teens; AOR=2.59 95%CI=1.47-4.54 for Hispanic teens).

How the Findings Advance the Particular Research Field: This study is the first to document the differences in work-related injuries among minority teen workers. The findings of this study indicate that African-American and Hispanic teens are more likely to experience work-related injures and more severe injuries compared with white teens, even though they are employed in the same types of industry.

How the Findings can be used to Improve Workplace Safety and Health: By understanding the characteristics that are associated with workplace injury for minority teens, employers can increase efforts to overcome the characteristics that put the safety of the minority teens in jeopardy. For example, employers can alter the schedules of the teens, so that they are not working past 11:00 pm.

Poster: 0093

Antecedents of Youth Work Injury: A Prospective Study

FC Breslin (1) presenting, JD Pole (1), E Tompa (1), B Amick (2), P Smith (1), S Hogg-Johnson (1)

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Importance of Research and Study Objectives: Adolescent and young adult workers are a particularly vulnerable population, with consistently higher rates of nonfatal occupational injuries than older individuals. Complicating the identification of risk factors is the heterogeneity of jobs young people hold and the multiple job transitions both young men and women experience early in their work careers.

The purpose of this study is to examine the relative contribution of individual factors (e.g., gender), job characteristics (e.g., job type) and temporal factors (e.g., job tenure) to the likelihood of lost days of work due to a work disability (i.e., work disability absence) among adolescents and young adults.

Summary of Methods: Our analyses used a longitudinal survey on the labor market experiences in a representative sample of Canadians where 2 to 6 years of information was available. We selected respondents who were between the ages of 16 and 24 years old and who were employed at some point during the observation period.

The outcome was the first occurrence of losing 5+ days of work due to a work disability/illness for each job episode a person had in the follow-up period. We used a hazard modeling approach with the following predictors: age, gender, job type (manual, non-manual, and mixed), hours worked, highest education achieved, multiple concurrent job, job tenure, school activity, and living in a rural or urban area.

Summary of Findings: In the fully adjusted model, males were 0.76 times more likely to have a work disability absence compared to females (95%CI: 0.47-1.22). Manual jobs were 2.65 times more likely (95%CI: 1.59-4.41) and manual/non-manual jobs were 1.70 times more likely (95%CI: 0.78-3.68) to have a work disability absence compared to non-manual jobs. Hours worked was positively and linearly associated with the likelihood of a work disability absence, with more than 40 hours/week being especially risky. Education level was inversely associated with likelihood of work disability absences.

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Conclusion: Young workers holding manual jobs and those working long hours were at increased risk for work disability absence compared to young workers with non-manual jobs. In addition, low education level was associated with the increased likelihood of a work disability absence. After controlling for other potential risk factors, no gender difference was observed.

To decrease work disability absence among young people, the main focus should be on job characteristics such as the physical demands of a job. Also, while a relationship between work hours and work disability absence is expected, policies that limit overtime work among teenagers may decrease the occurrence of work disability absences. Finally, young workers with less education appear to be a particularly vulnerable population, possibly due to inadequate job skills or particularly dangerous jobs (i.e., residual confounding of hazard exposures). Consequently, job training and injury prevention programs targeting this subgroup of workers may be warranted.

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Poster: 0094

Work Disability Absences Among Young Workers Leads to Persistent Earnings

FC Breslin (1) presenting, E Tompa (1), R Zhao (1), B Amick (2), JD Pole (1), P Smith (1), S Hogg-Johnson (1)

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Importance of Research and Study Objectives: A work injury resulting in disability early in one's work life may have a substantial impact on one's overall career and earnings trajectory. Fifteen to 26% of injured young workers report a permanent impairment or ongoing medical problems. Further, studies of adult workers find that even temporary work disability due to injury can result in long-term earnings losses. Long-term economic losses from a temporary disability due to a work injury could arise for a variety of reasons: a) there may be stigma associated with work absences due to work injuries; b) the work absence, especially in a short-tenure job, could have led to missing valuable work experience; c) a limit in the ability to do certain types of work (e.g., physically demanding work no linger an option); and/or d) a long-term physical disability might have ensued, but was not deemed compensable according to the workers' compensation system;

Our objective in this study was to evaluate the earnings losses that young workers may experience in the 12 months after returning to work. Assessing the short-term economic losses of young people after a work injury provides an indication of whether work injuries do influence the initial earning trajectory.

Summary of Methods: We selected workers aged 16 to 24 years from a longitudinal survey on the labor market experiences of a representative sample of Canadians. We had a minimum of three years and a maximum of six years of information on these respondents. Young workers who lost 5+ days of work due to a work disability/illness (i.e., work disability absence) were matched to uninjured controls based on age, gender, pre-injury earnings, and student status. This matching procedure resulted in 174 cases and 813 controls.

Summary of Fndings: The outcome measure was earnings in the year after the work disability episode, which was compared to the uninjured controls. An analysis of variance indicated that young workers experiencing a work disability absence had significantly less earning than their controls in the year after the absence ($p < .05$).

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How the Findings Advance Research and Improve Workplace Safety and Health: We are not aware of any study to date that has estimated the impact of work-related disability on earnings trajectories among young workers. Our findings indicate that long-term earnings losses can occur to young workers even during their transition into the labor market. Documenting the economic impacts of work injuries early in one's work life can inform policy debates on the allocation of resources to control workplace hazards where teenagers and young adults work and on the determination of fair and adequate benefits for young workers.

Poster: 0095

Occupational Health Surviellance of Low-Income, Minority and Immigrant Workers Through Community Health Centers

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There is increasing evidence that racial and ethnic minorities, including immigrants, are disproportionately exposed to health and safety hazards in the workplace. Information about non-fatal occupational injuries and illness among minority and immigrant workers in Massachusetts is limited. Community Health Centers (CHC), which provide medical care and other services to low income residents, potentially serve as important points of access to these worker populations. This study was conducted to examine the feasibility of collecting data on the occupational health experience of low income, minority and immigrant workers through CHCs and to evaluate CHCs as potential partners in occupational health surveillance. Specific aims were to: administer a waiting room survey about occupational health experience to a sample of working adults seeking care at CHCs; evaluate this method for routine or periodic collection of occupational health data; and assess whether CHCs currently collect data on work that can be used for occupational health surveillance.

With input from community stakeholders, we developed a questionnaire regarding occupation, industry, working hours, health and safety training at work, exposure to potential hazards, knowledge of key occupational health resources, recent occupational injuries or illnesses, and demographics. The questionnaire was translated into five languages and administered orally by trained interviewers at five CHCs. Of 1,799 CHC patients approached, 82% agreed to participate; 17% were ineligible, leaving 1,428 who completed the survey (65%).

The CHC patients surveyed were 64% female and had a mean age of 35 years; 66% were born outside mainland United States. The occupational distribution of the respondents closely resembled the employment profile of immigrant workers in Massachusetts, with 31.5% working in service occupations. Approximately 20% reported experiencing a health condition (injury, illness or other condition) in the last year that they believed to be due to work. Less than half reported receiving workplace safety training; 39% reported that they had not heard of workers' compensation, and 63% reported that they had not heard of OSHA.

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CHC providers, public health staff and administrators had few resources to provide occupational health care to patients and were largely unaware of state occupational injury and illnesses reporting requirements. CHCs collected little information about patients' work.. Nevertheless, CHC providers expressed interest in providing better occupational health services to their patients

Survey findings, while based on a convenience rather than representative sample, provide scarce local data on the occupational health experience of low-income minority and immigrant workers and underscore the need to address the occupational health concerns of these underserved workers. Findings also highlight theimportance of community-based providers in occupational health care, as well as the need for new approaches to occupational health surveillance. Results have prompted development and dissemination educational materials for CHC patients and providers. The study has also led to new Massachusetts project implementing occupational health surveillance in several CHC through modifications to clinical records systems in conjunction with provider education to institutionalize capacity for occupational health surveillance and services.

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Poster: 0096

An Interfaith Workers' Center Approach to Workplace Rights

CC Cho (1) presenting, E Sweitzer (2), J Oliva (2), J Nevarez (1), J Zanoni (1), RK Sokas (1)

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Immigrant working populations experience higher fatal occupational injury rates than U.S. born workers and are more likely than U.S.-born workers to be employed at worksites that routinely violate two or more labor laws.

This report provides a quantitative description of the population served by an innovative approach that encourages immigrant workers to access federal and state occupational safety and health programs through an interfaith workers' rights center. Workers are initially targeted through outreach training programs that take place in community-based institutions, such as churches and schools. Outreach programs focus on labor rights, including the right to minimum wage, overtime pay, workers compensation, and to a safe and healthy working environment. Workers who have specific concerns are encouraged to explore them in greater depth at the center, preferably with any similarly affected co-workers. At the center, trained volunteers obtain intake information and work with the client(s) to identify worker-centered goals. The workers' center may facilitate direct action (for example, calling or meeting with an employer to obtain back wages) or may triage specific complaints to a regional initiative roundtable led by federal agencies in collaboration with state and non-governmental organizations. The goal of the roundtable is to address wage and hour, safety and health, worker's compensation and discrimination through referral to appropriate agencies. A unique feature of this relationship is that the workers' center Is recognized as the worker representative for purposes of filing complaints, assuring worker confidentiality.

Following expedited approval for human subjects protection, existing data obtained by volunteers at time of intake were redacted, verified and recorded in an Excel file. Data were then imported into SAS for analysis.

A total of 934 individual records were reviewed, although for any given item missing data was a limitation. Among the 780 reporting primary language, 76% spoke Spanish, 19% Polish, 4% English,

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and 1% other (including Russian, Romanian, Arabic, French, Portuguese and Ukranian). Of the 491 reporting country of origin, 58% reported Mexico, followed by Poland (29%), Guatemala (3%), the U.S. (2%), Ecuador (1%) and other. The following total numbers of formal complaints were filed with each of the following agencies: 110 referred to the state Department of Labor, 123 to federal EEOC, 65 concerning federal wage and hour violations, and 47 OSHA complaints. Unlike the other referrals, the majority (35) of the OSHA complaints were made concurrent with ones to other agencies.

Outreach training generates significant interest from immigrant workers. Concerns about pay and discrimination exceed those about occupational safety and health hazards.

These findings suggest that alternative approaches to traditional workplace safety and health surveillance may include increased reliance on community-based non-governmental organizations that are trusted within the immigrant community. The prototype developed or collaboration with appropriate federal and state enforcement agencies may also enhance opportunities for targeted interventions. Finally, the disparity between identification of health and safety hazards compared to wage and other complaints may represent an opportunity for improvement in initial case identification.

Poster: 0097

A Conceptual Model for Minority Worker Experiences: Identifying Problems of Work Organization

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Racial and ethnic minorities have among the highest risk for exposure to adverse workplace conditions that lead to injury and illness. Language barriers, education level, social class, immigration status, scarce cultural resources, power imbalances, discrimination, and racism are factors creating this disparity. These factors also limit job availability, directing them to low paid, dangerous, and exploitive employment where worker safety and health are neglected.

While the risk of occupational exposures for racial and ethnic minority workers is well recognized, the mechanisms by which work organization influences their vulnerability for injury and illness has not been adequately examined. A primary challenge is finding reliable access to these workers for datacollection. Collaboration with community-based organizations that advocate for vulnerable workers can be an effective approach to uncovering these workers' problems.

The purpose of this study is to identify and conceptualize the way work organization affects well-being. It uses complaints reported to a metropolitan workers' rights center that serves primarily immigrant workers. We develop a model based on qualitative data that illustrates racial and ethnic minority workers' particular work experience. The model suggests critical pathways for potential interventions to addressing workers' needs.

Content analysis was conducted on 457 case records of worker complaints obtained at a workers' rights center. Volunteers asked a series of questions to determine workers' needs. Case records of these interviews were coded by type of complaint as well as context. Relationships between major complaint and context categories were explored. Inter-coder agreement was calculated to determine the reliability of the coding strategy.

Preliminary results show worker perceptions of work organization and management practices associated with exploitation, discrimination, and harassment. The wide range of complaints included the following; exposure to occupational hazards, lack of training, long working hours, withheld wages,

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job loss, failure to pay for treatment of work-related injuries, and unwillingness to provide job accommodation. Although these case records were kept primarily to resolve personal work-related problems, they provide rich information for developing a model that portrays the work organization commonly experienced by minority workers.

Study findings reveal violations of the rights of racial and ethnic minority workers, who tend to be taken advantage of. These workers' occupational experience has been understudied despite their rapid growth in the US workforce. Our model will guide future research questions specific to this population. Findings also suggest that with a well-planned interview protocol, workers' rights centers can serve as a valuable station for collecting data from marginalized workers.

This study demonstrates that partnerships between occupational health researchers and workers' rights centers can provide non-traditional sources of surveillance data for hard-to-reach working populations. Continued collaboration will enhance data collection as well as improve workers' access to occupational safety and health services. It also encourages the evolution of occupational research and practice that focuses on minority workers.

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Poster: 0097.5

Occupational Injuries and Illnesses Among Latino Poultry Workers in Western North Carolina: Workplace Safety Climate

SA Quandt (1) presenting, JG Grzywacz (1), B Burke (2), ML Coates (1), A Marin (1), L Carrillo (2), TA Arcury (1)

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Importance of Research Problem: Poultry is the largest and fastest growing segment of the U.S. meat products industry, which is vertically integrated and dominated by a few large corporations. 250,000 workers are employed in poultry processing; most are minority and immigrant (from Mexico, Guatemala, Southeast Asia, and the Pacific). Poultry processing is dangerous work, and immigrant workers have little control over their work environment. Bureau of Labor Statistics data are thought to underestimate occupational injury and illness among poultry workers. Community-based participatory research is an appropriate framework for occupational health research that cannot be conducted in the workplace and that seeks to study workers who are not enumerated.

Objectives of this Study: This study (1) describes the most common types of occupational injuries and illnesses reported by poultry workers; (2) investigates the association of illness and injury rates and worker perceived safety climate across processing plants; and (3) recommends policy changes to reduce health disparities in occupational injuries in this vulnerable population.

Summary of Methods: This community-based participatory research project was conducted by a partnership of university-based scientists and health care providers and a community-based organization in a six-country area of western North Carolina. A representative sample of 200 current workers (101 men and 99 women) employed at three companies was recruited from enumerated neighborhoods for survey interviews. Questionnaires included measures of physical and mental health, work safety culture, and job content. In-depth interviews with 26 workers provided supplemental data on knowledge and experiences of workers.

Summary of Findings: Most sampled workers were <35 years of age and had been in the US <10 years. Half were from Mexico; most of the others were from Guatemala. 47% self-report “fair” or “poor” health. Incidence rates of injuries in past month were high—e.g., musculoskeletal injuries to arm/hands (46%)

and neck/back (36%), skin conditions (22%), and respiratory problems (15%). Few sought medical care or missed work due to injuries. Significant differences in injury incidence existed between companies, which were consistent with the reports of safety climate, provision of personal protective equipment (PPE), and safety training provided.

How Findings Advance Research: There are virtually no published data that systematically document immigrant poultry workers' occupational injuries and the perceived safety climate in which they work. These findings demonstrate that safety climate varies among companies and that it is reflected in injury rates. These findings argue for a systematic assessment of occupational injuries and illnesses with physical examinations to confirm self-reports of such health indicators. Reasons for failure to seek medical care for work-related injuries should be investigated.

How Findings Can Be Used to Improve Workplace Safety and Health: These findings suggest that immigrant workers experience higher rates of occupational injuries and illnesses than are reported. Existing occupational safety regulations should be enforced across all employers. Ergonomics programs should be implemented to reduce musculoskeletal injuries. Reasons for under-reporting should be investigated and access to appropriate medical care increased as needed.

Industry Sector: These findings address issues for the Manufacturing sector.

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Poster: 0098

Understanding the Philosophical, Organizational, and Educational Role of Workers' Centers for Developing and Sustaining Programs on Workplace Health and Safety

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The phenomenon of immigrant and low wage workers' centers, whose mission it is to organize workers to improve the working conditions of low wage immigrant workers, is increasing in North America. These workers face significant occupational safety hazards due to language barriers, economic necessity, and fear of deportation. Immigrant workers are at risk because of the nature of the work they do, lack of accountability of the employers and lack of knowledge about their rights. The goal of this project was to understand the educational role the workers' centers play in supporting workers' efforts to improve their work environments and increase access to occupational health information and services in a large urban center. The project seeks to increase and sustain the exchange of information and resources for preventing work related injuries and illnesses at and between the workers' centers.

Specific research objectives were to 1) understand educational philosophy of workers' center staff, worker leaders or volunteers at 4 worker centers; 2) document methods of identifying workplace exposures and actions for reducing exposure; 3) explore potential intervention strategies for implementation through the worker centers; and 4) describe a framework for increasing access to occupational health information and services.

The methodology was based on NIOSH's safety intervention effectiveness evaluation model (Robson et al, 2001) and used participatory action research for the collection and analysis of data. Partners, which included 2 university researchers, 2 master's level research assistants, and the paid directors of four workers' centers, developed interview/focus group questions, conducted observations and reviewed documents. Data were analyzed for intra-center and inter-center themes related to organizational structure, educational philosophy and perceptions of workers' center staff of current access to occupational health information and services. Also identified were potential strategies for increasing occupational health information and services within each and across centers. A framework for increasing access to occupational health information and services was defined.

This project resulted in a description of the shared and unique organizational, philosophical, and educational role of four workers' centers. Workers' centers are complex organizations which share

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a commitment to supporting the implementation of their membership's ideas. Staff at the centers universally described their role as organizers and facilitators of workers' democratic agenda for justice and economic progress. Additionally, there are important inter-center themes such as access to emergency and primary healthcare. Health and safety was also an important issue at each center. While the centers shared a similar philosophy of worker directed activity, they had unique organizational structures to support their work. Intra-center issues included unique ways of reaching workers and developing intervention strategies. Briefly, unique features included reaching membership through outreach at soup kitchens and churches, fixed site worker "hiring hall", and referrals from CBOs. Identification and documentation of workplace exposures was extensive at one center, which has a specific program to record work related problems. Other centers used oral histories for identifying and addressing hazards. Most significantly this project documented existing learning methods in eachof the centers that informed the development of strategies for increasing integrated and sustainable health and safety activities. These learning methods included the use of videotapes, "charlas" (conversations), worker stories of experiences, informal educational programs, informal peer education, and posters and written material.

The outcomes for this project documented the workers' center staff and organizational role in supporting low income and immigrant day laborers and for the development of intervention programs to reduce worker's exposure to workplace hazards and for increased access to occupational health information and services. Content area experts provided technical support to worker center staff, worker leaders, volunteers and workers on health and safety issues as needed. Ultimately the project will use this framework to implement and evaluate the effectiveness of intervention strategies for improving work environments for immigrant and low wage workers who participate in the workers' centers.

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Poster: 0099

Calculation of a Hispanic Obesity Index for Workplace Wellness Programs

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NIOSH, DSR, Morgantown, WV, United States (1)

The Body Mass Index (BMI) is used as an indicator of adiposity because it is simple, requires no technical equipment or special training, and is generally not affected by observer bias. Nutritionists consider BMI (weight/(height)2) as the international standard because it has been shown to have an acceptable, but not perfect, correlation with hydrostatic and skin-fold measurements, and to correlate with mortality risk. BMI is not universally successful in gauging an individual's fat-mass because it is influenced by body proportion (relative leg length or trunk length) and can over-estimate body weight by as much as 5 percent in short-legged individuals, and under-estimate weight in those with taller stature. It is affected by the location and degree of fat deposits in women. When applied to Hispanic body composition, BMI is influenced by their short stature, short-leg length, long torso, large waist-to-hip ratios, and the location and distribution of upper body and lower body fat layers. The result is that the traditional BMI index may consistently over-estimate actual body fat weight among Hispanics in both genders.

Due to the increasing numbers of Hispanics in the US workforce, their relatively high injury/fatality rates, the increasing prevalence of obesity, and its associated disease and mortality risk, having an indicator of adiposity specific to Hispanics is important in occupational health and clinical practice. The purpose of this research was to provide a body composition calculation specific for Hispanic workers that includes Mexican, Cuban and Puerto Rican Americans.

To make assessment as accurate as possible, an "adjusted" weight-to-height index method is presented based on the method of RT Benn - the Obesity Index (weight/(height)P) where "P" is the regression coefficient of the log (weight in kg) regressed against by the log(height in cm) of data observed for a given population and gender. The P (power) index is thought to be better than standard BMI since it is more independent of height. Using adult body measurements from the Hispanic Health and Nutrition Examination Survey, "P" values were determined for: Mexican (male:2.04 & female:1.38); Cuban (male:1.79 & female:1.63); and Puerto Rican (male:1.70 & female:1.35) Americans. Other tables are presented which describe the changing trend in BMI levels among Hispanics. Lastly a table describing body composition measurements, their application in the workplace, and their outcome value for workplace wellness programs is presented.

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By studying different populations it is possible to generate different "P" values that better reflect the variations in racial/ethnic body-fat distribution, body-segment length, height, weight, gender, and age groups - including occupational groups. This research presents for the first time an alternate obesity index for Hispanic occupational groups, which is specific for both genders. This information will be beneficial in wellness-at-work programs provided where Hispanics compose a high proportion of the workforce. Industries with high percentage of Hispanic workers include: Agriculture (20%), Construction (16%), and Manufacturing (Food processing 25%, Apparel manufacturing 25%). Better precision in estimating adiposity may reduce the onset of costs associated with obesity treatment and aid wellness programs in conducting fitness-for-work determinations.

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Poster: 0100

A Longitudinal Evaluation of the Effectiveness of Minority Worker Health and Safety Training Programs in Eight Communities

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Although recognized as a priority area under the National Occupational Research Agenda, there continues to be a need for comprehensive systematic evaluation research on the effectiveness of minority health and safety training programs. More specifically, few long-term studies exist with respect to evaluating training and communication approaches and other prevention strategies to identify those that are most effective for disadvantaged minority youth. In response, a comprehensive evaluation process was developed to address this important area of research.

A research and development institute of the Building and Construction Trades contains training components for two minority worker training programs, both funded by the National Institute of Environmental Health Sciences (NIEHS): Minority Worker Training (MWT); and Brownfield Minority Worker Training (BMWT). The MWT program, established by the Environmental Protection Agency (EPA), emphasizes delivering comprehensive training to disadvantaged minority inner city youth (ages 18-25) to prepare them for employment in the fields of environmental restoration and hazardous materials. The MWT program provides pre-employment job skills training (e.g., life skills), environmental preparation, construction skills training, environmental worker training (e.g., hazardous waste worker courses), and safety and health training. The BMWT program broadens the scope of the EPA's MWT program to include disadvantaged residents living in communities impacted by the Brownfield sites.

The present study describes an evaluation process designed to assess three MWT and five BMWT program's effectiveness with respect to the NIEHS worker training program criteria (e.g., recruitment; training). In addition, each of the BMWT/MWT programs was evaluated according to their overall performance as well as impact of the program on its community and field of environmental work. These results were then used to develop best practices that indicate the program strategies that produce superior performance on each of the five NIEHS criteria as well as greatest impact on the community and the field of environmental work. In subsequent years, we evaluated the extent to which the best practices enhanced program effectiveness.

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The evaluation process utilized a comprehensive integrated programmatic assessment, which incorporates elements of both process and impact evaluations. Results suggest that most programs are successfully meeting the five NIEHS criteria. Further, across sources, most programs received relatively high ratings of impact on their respective communities, the field of environmental work, and overall effectiveness. Collectively, these results suggest that these programs are not only demonstrating high levels of ffectiveness but also positively influencing their communities and the field of environmental work. Further, preliminary results suggest that the identified best practices were implemented across programs and improved program performance.

This study represents eight communities nationwide and has far reaching implications including identifying training, communication and other prevention strategies that are most effective for minority workers and community-based programs. Further, these results begin to address the issue of the role that various stakeholders, including unions, government, businesses, academic institutions, and the community at large play in the development and implementation of health and safety programs, particularly with respect to those that involve the construction industry sector.

Poster: 0101

Depressive Symptoms and the Older U.S. Worker: The National Health Interview Survey (NHIS)

SL Christ (2) presenting, D Lee (1), K Chung-Bridges (1), LE Fleming (1), K Arheart (1), W LeBlanc (1), A Caban (1), T Pitman (1)

University of Miami, Miami, FL, United States (1), UNC Chapel Hill, Chapel Hill, NC, United States (2)

Objectives: World-wide, major depressive disorder is considered to be the second most disabling condition in the adult population. Lost productivity due to depression in U.S. workers is estimated to cost seven billion dollars annually. Workplace stress has been associated with an increased risk of depression and some studies suggest that depressive symptoms decline following retirement. However, the association between depressive symptoms and occupation in older adults is poorly understood. The number of U.S. workers continuing to work past the traditional age of retirement is increasing. These older adults may be forced to work out of financial necessity, or they may work voluntarily for the social and personal benefits. This study assessed the association between employment status, occupational classification and depressive symptoms in the older (65 years and older) U.S. population.

Methods: Using a subsample of respondents aged 65 and older from the nationally representative 1997-2000 National Health Interview Survey (NHIS), reported depressive symptom levels were compared across older workers and older non-workers controlling for age, gender, race/ethnicity, and education. Depressive symptom levels were also compared across occupational category. Depressive symptoms were estimated with a confirmatory factor analysis model, which measured reported depressive symptoms based on four depressive symptom indicators removing random measurement error. All analyses were completed with adjustments for sample weights and design effects using the M-Plus statistical package, version 3.13.

Results: Overall, controlling for age, gender, race/ethnicity and education, older U.S. workers reported lower levels of depressive symptoms than older non-workers. Among older U.S. workers (controlling for age, gender, race/ethnicity and education), report of depressive symptoms was lowest among: 1) Farmers, forestry, and fishing workers, 2) Precision production, craft, repair workers, and 3) Protective service workers. Report of depressive symptoms was highest among 1) Private household workers, 2) Machine operators, assemblers, inspector workers, and 3) Technicians and related support workers.

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Discussion and Recommendations: This study found that older U.S. workers reported fewer depressive symptoms than older non-workers. However, certain older U.S. worker groups were more affected than others. Since report of depressive symptoms has been associated with significant morbidity and mortality for all older adults in the U.S., the understanding of the social conditions (including work), that affect report of depressive symptoms is necessary for the diagnosis and prevention of depression.

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Poster: 0102

Mechanisms of Repetitive Strain Injury in an Aging Model

RG Cutlip (1) presenting, KB Geronilla (1), BA Baker (1), RR Mercer (1), M Hollander (1), SE Alway (2)

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There are approximately 700,000 lost time incidents per year in the United States construction, mining, agriculture and manufacturing sectors that are due to musculoskeletal overexertion and repetitive strain injury. In addition, credible epidemiological evidence suggests a higher incidence of pain, injury, and lost time from work in jobs that require high levels of physical exposure. Of additional concern, the 55-64 year old demographic is now the fastest growing sector of the labor force in the United States. It is projected by 2006 that 20% of the labor force will be comprised of workers over the age of 55. However, a research gap exists regarding soft tissue injury mechanics and the effect of aging on injury susceptibility and adaptation to repetitive physical exposures. Thus, we propose to conduct studies that characterize the quantitative dose-response of skeletal muscle due to repetitive mechanical exposures, particularly in an aging model via functional, physiological, and molecular changes.

Goal: The goal of this research is to investigate the conditions which increase susceptibility to occupationally-related repetitive motion injuries and to identify how those conditions are altered by aging.

Methods: In the present study, an animal model for aging was used to study chronic contraction-induced adaptation and injury to quantify muscle performance changes associated with repeated exposures of repetitive muscle actions. We have developed an in vivo animal model to study the effects of work exposures (i.e., muscle force, type of muscle action, velocity, number of repetitions, work-rest cycles, and duration of exposure) on resultant histopathology and biochemical responses in the muscle tissue, and have refined this model to study response to chronic exposures involving repetitive muscle contractions in a highly-controlled fashion. Dorsiflexor muscles of young (12 weeks) and old (30 months) male F344xBN F1 rats were exposed three times per week for 4.5 weeks to a protocol of 80 maximal stretch-shortening cycles per exposure in vivo. Twenty-four hours after the final exposure, the rats were euthanized and the tibialis anterior was excised for analyses. The analyses included morphological and histological changes, biomarkers of oxidative stress, inflammation, and apoptosis.

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Results: Results from this study have shown that age profoundly affects the ability to adapt to repetitive mechanical exposures via changes in skeletal muscle performance and biological changes. Young animals exhibited an adaptive response to the chronic exposure of repetitive physical loading with a ~30% increase in static and dynamic performance and a 15% increase in muscle mass. Old animals, however, exhibited a mal-adaptive effect via a ~30% loss of static and dynamic muscle performance, loss of muscle mass, increased levels of oxidative stress and apoptotic markers as compared to their younger cohorts during the 4.5 week exposure period. Morphological changes in the old animals were also indicative of a mal-adaptive response.

Significance: The findings from this study suggest that aging impairs the ability to adapt to repetitive physical exposures. We plan to investigate the biological mechanisms that cause aging-related mal-adaptation to repetitive physical exposures. Understanding those mal-adaptive mechanisms is integral to developing preventative strategies to reduce musculoskeletal injuries in an aging workforce.

Poster: 0103

Aging And Intermittent Work Capacity

MA Nussbaum (1) presenting, Y Yassierli (1)

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Population projections indicate an increasing percentage of older workers in the next decade. There is a practical (ergonomic) need to quantify these workers' physical capacity. Extensive evidence exists on age-effects in the context of simple static efforts, yet few have focused on more occupationally relevant repetitive and/or dynamic exertions. The present work was conducted with a central goal of determining work capacity in terms of muscular endurance, development of local fatigue, and strength recovery from intermittent shoulder abductions and torso extensions at low-moderate levels (relative to individual capacity). Sustained static shoulder abduction and torso extension were also investigated for purpose of comparison. A total of 48 participants (24 younger, 24 older, gender balanced within each group) performed each exercise, representing two age extremes within the typical working population (18-24 and 55-65 years old). Indicators of local fatigue included declines in maximum strength and changes in both electromyographic (EMG) measures and ratings of perceived discomfort (RPD). Consistent with earlier work, older participants had a ~17-27% reduction muscular strength across exercises. In contrast to muscle strength, age effects on fatigue were generally associated with longer endurance and more resistant to fatigue for older individuals. This age effect was not consistent between exercises, with more substantial and consistent effects found for the shoulder vs. torso efforts. Age effects were typically moderated by effort level and, for several measures, by gender, with greater differences at higher effort levels and among males. Significant effects of cycle duration were found, with shorter cycle times yielding slower fatigue development. A substantial portion of the exercise-induced strength loss was regained rapidly within a few minutes, followed by a more gradual pattern. Rates of recovery were dependent upon exertion level, but no influences were found for age, gender, or effort duration. Analysis of the multiple dependent measures highlighted the practical value of muscle strength and RPD as indicators of fatigue, and supporting the use of these measures for ergonomic assessments of relatively complex tasks (here intermitting and dynamic). Traditional EMG fatigue indicators (EMG amplitude and spectral parameters) were sensitive to age and changes in exercise conditions, though the results were more consistent for the shoulder efforts. In summary, comparisons between the younger and older individuals revealed clear differences in work capacity, as measured by endurance and fatigue development, though the effects of aging were moderated by muscle group and task factors. This suggests the importance of accounting for both individual and task

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factors simultaneously in job design and evaluation. Based on existing speculations regarding a causal role of fatigue in musculoskeletal injury, designs that minimize fatigue development or accumulation may lower risks of workplace musculoskeletal symptoms and problems.

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Poster: 0104

The Health Behaviors of the Aging U.S. Worker: The National Health Interview Survey (NHIS)

LE Fleming (1) presenting, DJ Lee (1), AJ Caban (1), WG LeBlanc (1), K Chung Bridges (1), SL Christ (2), KL Arheart (1), T Pitman (1)

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Objectives: As the U.S. workforce ages, lifestyle factors will increasingly affect their health, yet little information is available on their prevalence in aging working populations.

Methods: Using the nationally representative 1997-2003 National Health Interview Survey (NHIS), reported current smoking, risky drinking and leisure-time physical activity behaviors of current older workers were compared with younger workers and older non workers. These behaviors were evaluated by gender, race, ethnicity and occupation, as well as prototype "healthy" and "risky" workers.

Results: The study population represented an estimated 123,052,357 younger workers, 3,917,960 older workers, and 28,879,284 older non-workers annually between 1997-2003. Older workers reported less current smoking and risky drinking than younger workers, but not compared to older non workers. Leisure-time physical activity was inadequate in all subpopulations. There were variations by gender, race, ethnicity, and occupation among the different US. worker subpopulations.
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Discussion and Recommendations: The 2010 Healthy People Recommendations are focused on behavior prevention and education particularly related to tobacco and ethanol use, and physical activity in obesity prevention. With a rapidly aging U.S .worker population, all industries need to evaluate the healthy and risky behaviors of their workforce. Certain occupations, as well as gender-race-ethnic subpopulations of both workers and non workers, can be targeted for age-appropriate behavior prevention interventions.

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Poster: 0105

New York City Restaurant Health and Safety Project

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The primary purpose of the New York City Restaurant Health and Safety Project, sponsored by the Restaurant Opportunities Center of New York (ROC-NY) is to empower restaurant workers in New York City to have greater control over their occupational safety and health and to work with employers in the industry to understand the importance of these workers' occupational safety and health to their success and the success of the City's industry. This will be achieved through a collaborative process that will use both quantitative and qualitative research methods to understand and describe the nature, extent, constraints, and context of work-related hazards, injuries, and illnesses among restaurant workers, with a special emphasis on immigrant workers, eventually to promote public dialogues and to stimulate real policy options for change in the industry. Most excitingly, the project involves the use of a new, cooperative worker-owned restaurant opened by ROC-NY that will serve as a model ergonomic laboratory for data collection and ultimately for employer training on best practices to avoid injury and illness in their restaurants.

Immigrant workers disproportionately experience occupational injury and disease. The restaurant industry is especially important to immigrant workers in part because many of the jobs require relatively little skill and in part because the credentials, skills, and prior experience of immigrant workers outside the United States may not be recognized by employers in the U.S. Although the restaurant industry is a positive economic force overall, especially in job creation, segments of the industry are plagued by shortsighted, unlawful, and abusive employment practices that hurt workers and their families, as well as other law-abiding restaurants and consumers. Existing government data, as well as data gathered by the Restaurant Opportunities Center of New York, reveal that these practices, while not universal, are pervasive in the industry. However, relatively little is available in the published medical literature about the occupational health and safety of restaurant workers, with the exceptions of environmental tobacco smoke and issues involving safe food handling to protect public health.

The specific project goals are:

1. To improve the understanding of the nature and prevalence of occupational hazards, injuries and illnesses in the restaurant industry;

2. To develop, effect, and test changes in working conditions and knowledge of restaurant workers or the purposes of reducing the previously identified hazards;
3. To enhance the diagnosis and treatment of job-related injuries and health conditions of restaurant workers;
4. To disseminate project findings to key parties—workers, labor organizations, employers, academics, and government—in order to promote changes in the relevant practices, policies, physical settings, work organization of the restaurant industry and health services for the purpose of reducing job-related hazards and ill health.

The research, currently underway, will involve 500 worker surveys, worker focus groups, and employer interviews. The research findings will be used to achieve goals 2, 3, and 4 above. Specifically, they will be used to design and test a set of improved ergonomic and work organizational conditions in a model cooperatively owned restaurant; develop a culturally and linguistically appropriate educational program—classes, curriculum, and handbook that will be facilitated by worker peer trainers—to enhance the ability of restaurant workers to prevent job-related injuries and illnesses; and finally to conduct a set of complementary activities, including workers educational programs, an employer technical assistance service, a Restaurant Industry Summit, and industry-specific health services, to promote model practices as a result of the project.

Abstracts

Poster: 0106

How Well Does the Strain Index Predict Carpal Tunnel Syndrome?

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Key words: risk assessment methods, MSD, strain index

Introduction: Work-related carpal tunnel syndrome (CTS) involves compression of the median nerve at the wrist. It can result in decreased hand function, long disability and high medical costs. We conducted a three-year prospective study of carpal tunnel syndrome incidence in the manufacturing and health care sectors in Washington State using individual exposure assessment and health assessment methods.

Methods: This prospective study in 12 workplaces consisted of baseline and follow-up data collection every four months over three years. Health assessment included health and job history, physical examination, psychosocial questionnaires and electrodiagnostic testing. Carpal tunnel syndrome was defined as: 1) recurring symptoms of numbness/tingling/pain in median nerve distribution of the hand present during the interview week and not due to acute trauma and 2) positive electrodiagnostic tests for the median motor/sensory nerve at the wrist. Individual job exposure data was collected at baseline and after job change. We collected data to calculate a strain index (Moore and Garg 1995) (SI) for each hand and a cumulative SI (CSI) similar to the NIOSH lifting equation method for multiple lifts. We then multiplied the CSI by the number of years the worker was on that job, and added additional CSI*years for job changes over time (CSIYRS). We also collected Hand Activity Level (HAL) and peak hand force data according to the ACGIH (ACGIH 2003). We used Cox proportional hazard model to assess the relationship between incidence of CTS and individual, psychosocial and physical exposure measures (proc phreg, SAS 9.1).

Results: There were 733 fulltime employees who participated at baseline. We excluded 63 who had CTS at baseline. We followed 670 for up to 3.5 years (range 0.2-3.5, median 1.9). Over three years, participation decreased due primarily to layoffs. We identified 58 dominant hand CTS incident clinical cases. CSI averaged 5.4 with a range of 0.3-121.5. We used the log of the CSIYRS due to extreme skewness. Table 1 shows the final model. Controlling for age and gender, both BMI and CSIYRS were statistically significant predictors. Decision latitude and job satisfaction were independently significant

variables but lost statistical significance when physical exposure variables were included in the model

Table 1. Predictors of Dominant Hand Carpal Tunnel Syndrome Incidence

Variable	Hazard Ratio	95% Hazard Ratio Confidence Limits	
Age (by year)	1.02	0.99	1.05
Gender (1=Female)	0.97	0.53	1.75
BMI	1.07	1.02	1.12
Log CSIYRS	1.33	1.07	1.65

Discussion: These results suggest that the strain index may predict future cases of work-related CTS. Future analyses of individual exposure metrics such as frequency of high hand forces, duration and frequency of specific postures and their interaction are necessary to provide more precision to the models. Loss to follow-up cannot preclude a healthy worker effect. This study was funded in part by NIOSHU01OH07316.

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Poster: 0107

Turning the Computer Mouse and Keyboard into Exposure Assessment Devices

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Purpose: Our goal was to use Exposure Variation Analysis (EVA) based methodologies to compare the continuous force exposures measured with a force-sensing mouse and keyboard to the non-invasively measured exposure information collected by continuously monitoring the digital signals of a worker's computer keyboard and mouse.

Methods: Using a repeated measures design, 13 subjects randomly performed three different computer tasks, a text typing task (keyboard only), a text editing task (mouse and keyboard) and a graphics task (mouse only). While performing the computer tasks, force exposures were continuously measured using a force-sensing mouse and keyboard. Simultaneously, using the subject's own computer, a computer input-device usage monitoring program recorded the duration of every episode of mouse and keyboard activity and inactivity. Using EVA based methods, the distributions of the actual mouse and keyboard force exposures (Gold Standard) were compared to the exposure information measured by the computer input-device usage monitoring program. Based on physiologically relevant force levels and durations, the forces applied to the mouse and keyboard were divided into five groups: 1) dynamic (forces applied for 100ms or less), 2) quasi static (forces > 0.4N applied between 100ms - 12.5 seconds), 3) static (forces > 0.4N applied for longer than 12.5 seconds), 4) microbreaks (periods with forces < 0.4 N lasting between 100ms - 3 seconds) and 5) rest (periods with forces < 0.4 N lasting longer than 3 seconds). The digital signal from the mouse and keyboard computer input-device usage monitoring program was analyzed in a parallel fashion based on the same duration demarcations except dynamic, quasi static, and static activity were based on when the keys were depressed (digital signal = ON) and inactivity when the keys were not depressed (digital signal = OFF). The percent time subjects were exposed to each type of activity (dynamic, quasi-static, static, microbreaks, rest) was calculated and compared for each computer task.

Results: As shown in Table 1, the exposure distributions derived from the actual forces applied to the mouse and keyboard (Gold Standard) were similar to the exposure distributions measured by the computer input-device usage monitoring program using the digital signal from the subject's own keyboard and mouse. Absolute mean errors between the two methods were no greater than 7%.

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Table 1 - Task distributions based on the EVA analysis of the force and computer odometer (Odom) data. [n = 13]

	Typing	
	Text Editing	
	Graphics	
	Force	
	Odom	
	Force	
	Odom	
	Force	
	Odom	
Dynamic		
		54%
		59%
		13%
		6%
		8%
		1%
Quasi Static		
		21%
		5%
		48%
		48%
		71%
		72%
Static		
		0%
		0%
		0%
		0%
		0%
		0%

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Microbreaks	
	24%
	28%
	33%
	34%
	14%
	8%
Rest	
	2%
	8%
	6%
	11%
	6%
	19%
Mean Error	
	± 4.8%
	± 3.2%
	± 6.8%

Conclusions and Applications: The digital signal from the mouse and keyboard as collected by the computer input-device monitoring program can be used to measure the actual force exposures during work (dynamic, quasi-static, static, microbreaks and rest) without having to physically collect the forces using cumbersome, expensive force-sensing input devices. This creates a simple, inexpensive, continuous and non-invasive means to indirectly, but accurately determine a computer worker's force exposure information. This tool could be used to collect a continuous record of exposure data from service industry employees, a NORA Second Decade focus sector, and may be suitable for use in large scale, prospective, epidemiological studies in order to better understand factors leading to computer related musculoskeletal disorders.

Poster: 0108

Reliability Of Observational Posture Assessment Using Multimedia Video Task Analysis

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An important step in developing improved exposure assessment tools for MSDs is the evaluation of intra- and inter-rater reliability. Reliable exposure measurements are necessary to establish causal relationships between occupational risk factors and health outcomes. Unreliable exposure methods due to random error may over or underestimate the risk of health outcomes. The National Institute for Occupational Safety and Health (NIOSH, 1997) and the National Research Council (NRC/IOM, 2001) have both called for improved methods to assess risk factor exposure in occupational health studies. Due to the magnitude of musculoskeletal injuries and their associated costs, the NIOSH included "upper extremity MSDs" as one of the priority areas in its National Occupational Research Agenda (NIOSH, 2004). Improved exposure assessment methods were another priority identified in the National Occupational Research Agenda (NIOSH, 2004).

There are few studies that have assessed the reliability of postural observation of specific body parts and postures across subjects, raters, and occasions. This study evaluated the inter- and intra-rater reliability of assessing worker posture during manufacturing tasks using Multimedia Video Task Analysis (MVTA), a relatively new exposure assessment tool. Posture of the neck, shoulder, and wrist of 20 manufacturing employees was evaluated by two raters from digital video footage of employees. Inter- and intra-rater reliability were estimated for all posture categories evaluated. Generalizability theory was used to estimate the inter- and intra-rater reliability. Inter-rater reliability results demonstrated good to excellent reliability for neck and shoulder postures and fair to excellent reliability for wrist postures. Intra-rater reliability results demonstrated good to excellent reliability for both raters evaluating all postures of the neck, shoulder, and wrist. This reliability study was part of a larger epidemiological prospective cohort study that investigated the relationship between hand-intensive work and upper extremity MSDs at a home appliance manufacturing facility in the Midwest.

This reliability study demonstrated the viability of assessment of posture through video observation. Demonstration of reliability for these types of assessment tools is important for several reasons. Observational tools are the most common form of assessment tool used to evaluate posture. They allow researchers to evaluate large sample populations at a relatively low cost and create a historical record of all

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data analyzed. Tools such as MVTA are currently being used in several prospective cohort studies to analyze posture. Exposure information gathered from MVTA will be modeled to assess risk of incident cases of upper extremity MSDs or MSD symptoms. MVTA can provide individual assessment of exposure to physical job stressors, which can then be related prospectively to any incidence of MSDs. Establishing a causal relationship between risk factor and outcome relies on the consistency and accuracy of the tool used to predict these relationships. Demonstration of reliability allows more confidence in the inferences and conclusions drawn from data collected. Future research should demonstrate the validity and accuracy of MVTA. Other research should evaluate the inter- and intra-rater reliability of additional posture categories for all possible body parts.

Poster: 0109

Linking Health and Productivity in Seated Environments: Results of an Intervention

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Musculoskeletal disorders remain a costly problem for businesses and place a great burden on the social insurance system. More and more Americans are playing and working in front of computers, yet the evidence base for making decisions on what are good or bad support technologies remains sparse. Is one keyboard better than another? How about a mouse or a trackball? What about ergonomics training? What about rest breaks while computing? Any literature review reveals few if any studies to draw conclusions for practice. Furthermore, few studies consider the productivity consequences of the intervention and provide little evidence of a return on investment. Simply put knowledge transfer from research to practice is inhibited by the research. The objective of this study was to evaluate the health and productivity consequences of a highly adjustable chair and an office ergonomics training program.

A non-randomized field trial was designed with one group of workers receiving a highly adjustable chair with an office ergonomics training, a second group of workers only receiving the office ergonomics training and a third group serving as controls – receiving nothing until the study end when they received the training. The study was first conducted in a unionized public sector Department of Revenue Services and a replication was conducted in a private insurance company. The primary outcomes were musculoskeletal symptoms and objective productivity data. For the public sector organization this was actual dollars. We do not report the productivity data from the private sector company due to data problems. At both workplaces workers completed questionnaires at two and one month pre-intervention and two, six and twelve months post-intervention. Multi-level statistical models were used to test hypotheses.

All musculoskeletal symptom results in the public sector organization were replicated in the private sector organization. In both workplaces: (1) workers who received both the chair and office ergonomics training experienced significantly reduced average daily musculoskeletal symptoms and symptom growth over the workday compared to either workers who only received the training or workers in the control group. (2) Workers who only received the office ergonomics training did not improve their musculoskeletal health compared to workers in the control group.

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In the public sector workplace, workers received both the chair and training increased their productivity by 18% over workers in the control group. While workers who only received the office ergonomics training increased their productivity by 6%, the increase was not statistically significant. The estimated return on the investment was about 25:1. Simply put the chair and training pay for themselves in about 90 days.

This is the first replication study of an ergonomics intervention and the first study to examine both average symptom levels and symptom growth. This study adds to the growing literature on the limited usefulness of training when the training is not coupled to structural changes in the workplace. It is the first field evaluation of a chair and presents a strong economic case for ergonomic investments.

Practitioners are always interested in knowing whether there is a return on the investment of the furniture purchase. The research provides the first scientific evidence of how purchasing a highly adjustable ergonomics chair with arm supports can not only improve workers health, but also productivity – it's a win/win. Offering an ROI helps occupational safety and health practitioners communicate with financial managers. As more and more workers shift to seated work environments the type of chair may be an important determinant of their musculoskeletal health.

These findings are important to all industries where workers are in seated environments. It is particularly relevant to the rehabilitation and insurance sectors where risks are being managed.

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Poster: 0110

The Reliability of an Observational Tool to Assess Personal Computer Keyboarding Style

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Computer use has been identified as one probable cause of work-related musculoskeletal disorders of the upper extremity (MSD-UE). Currently more than half the of all workers use a computer at work (1), and the number has been growing steadily since 1993. The incidence of computer related MSD-UE is around 20% (2) suggesting that a significant number of computer-related MSD-UE disorders occur due to computer use. While computer use is a potential risk factor for MSD-UE, there are currently few methods available to evaluate computer keyboard use, and none of these instrument evaluates the user's hands and fingers. There is currently no observational assessment tool available that can be used to document the postures and actions of the neck, arm, hand, and fingers during computer keyboarding.

The purpose of this study was to describe the reliability of an observational computer workstyle tool called the Evaluation of Personal Computer Keyboard Style (PeCKS), a 20 item rating scale that documents the frequency of stereotypical motions and posture combinations hypothesized to be potential risk factors for MSD-UE that are used by computer keyboarders during routine typing tasks. Items on the PeCKS can be divided into 3 general categories, (items of static posture, items of dynamic postures (frequencies), and items of force and tension), and examines postures and actions of the torso, neck, arms, wrist, hands and fingers. When completed this assessment tool will provide researchers and clinicians with a valid and reliable method to describe computer keyboarding postures and kinematics.

Forty-five computer users between the ages of 18 and 65 were videotaped while typing on a computer keyboard. These videotaped performances were rated by trained independent raters with the PeCKS. Intraclass correlation coefficients (ICC) were used to calculate the reliability of each item and the overall PeCKS instrument.

The overall PeCKS inter-rater ICC was .90 ($p = .000$), which indicates that the instrument as a whole has excellent reliability. The inter-rater reliability of individual items was generally above .75 which is indicative of good reliability. Only 4 items demonstrated moderate reliability. Future research will evaluate both the concurrent criterion-related validity and the predictive criterion-related validity of the tool. Once the psychometrics of the PeCKS are established, the tool will be useful for both clinical and research

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purposes. It can be used to: a) document the parameters of personal keyboarding style and how they interact; b) evaluate which parameters of personal keyboarding style place a worker at risk; c) evaluate the effect of environmental constraints and personal anthropometry on personal keyboarding style; and d) design specific interventions to reduce risky personal keyboarding style.

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Poster: 0111

Using a Software as an Exposure Assessment Device to Measure and Detect Computer Users' Muscle Fatigue

CH Chang (1), PW Johnson (2), JT Dennerlein (1) presenting

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Purpose: The aim of this study was to determine whether changes in keystroke duration, which can be continuously and non-invasively measured by one's own computer, could be used as a surrogate to detect the computer user's muscle fatigue. We have developed a customized computer usage monitoring software to precisely record keystroke durations. If keystroke duration is related to muscle fatigue, then this software program, without additional instrumentation, would measure physiological changes of a user during exposure to computer work. As a step to developing such a measurement tool, the relationship between finger muscle fatigue and computer typing performance, specifically the keystroke durations recorded by the software, was tested in a laboratory study. The study tested the hypothesis that the keystroke duration during a typing task changes as the physiological changes of muscle. Our measure of muscle physiology was low frequency muscle fatigue, which has been associated with exposure to sub-maximal repetitive activities.

Methods: Sixteen right-handed touch typists volunteered for a laboratory experiment where their typing performance and muscle fatigue was repeatedly measured throughout three different conditions randomized on three separate days. Two exposure conditions with two different types of fatiguing exercise on the right ring finger were performed along with one control condition without exposure. The two exposure conditions consisted of 15 minutes of static exercise (constant isometric finger flexion at 15% MVC), and 15 minutes of fluctuating exercise (isometric finger flexion with force cyclic between 0% and 15% MVC 2.5 times per second), respectively. Typing performance and muscle fatigue were measured before exercise, immediately after exercise, and 30, 60 and 120 minutes after exercise for recovery. The typing performance was measured in a 5-minute typing test on a word processor where keystroke duration, the time between when a key is pressed and released, was recorded using the computer usage monitoring software loaded on the test computer. Typing speed and typing accuracy, which is the percentage of words correctly typed, were also measured during the typing test. The muscle fatigue was measured by isometric force response to 2Hz (twitch), 100 and 20 Hz electrical stimulation trains for both the right ring finger flexor and extensor muscle. Muscle contraction time was also measured during

muscle electric stimulations. Repeated measurement-ANOVA tested for differences in typing performance (keystroke duration) and muscle fatigue before exercise, immediately after exercise and during recovery.

Result: The keystroke duration decreased as finger flexor muscle fatigued, and recovered during the recovery period. Average keystroke duration of the keys hit by the right ring finger was 5.1ms (4%) and 10.3ms (8%) shorter after the static and fluctuating exercise, and recovered within 120 minutes afterwards. Typing speed (52 words/min) and typing accuracy (94%) remained constant across conditions and over the whole duration of the experiment. The right ring finger flexor exhibited muscle fatigue, and significantly faster muscle contraction after both exercises. Within the 120 minutes of recovery, the flexor muscle recovered from fatigue after the fluctuating exercise, but not the static one.

Conclusion: Changes in keystroke duration were associated with changes in muscle fatigue. Keystroke duration decreased with onset of muscle fatigue. These results indicated that keystroke duration can possibly be a surrogate measure of physiological change of the muscle – i.e. muscle fatigue. The next step is to understand the influences of actual computing tasks on muscle fatigue as well as the role and interaction of central fatigue on these measures of typing performance.

Application: This software-based tool aims to be an objective exposure assessment tool for field applications and scientific studies on large population of computer users or with long measurement periods. It has the potential to provide continuous direct surrogate measurement for muscle fatigue and to continuously record the patterns of exposure (distribution of activity and inactivity). The tool provides an alternative to the high cost of direct physiological instrumentation and their invasiveness on the human subject.

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Poster: 0112

Occupational Vibration Alters Neuromuscular Control in the Low Back

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Low back disorders are a NORA priority research agenda area. A NIOSH review of epidemiologic evidence for work-related musculoskeletal disorders has identified vibration and particularly whole body vibration as a risk factor for low back injury. Vibration has been associated with a higher incidence of low back disorders in occupations such as pilots, tractor drivers and heavy equipment operators. While research on vibration transmissibility in the low back is extensive, there is still little understanding of the mechanism by which the vibration may lead to injury. The purpose of this research has been to investigate how vibration alters neuromotor control of the low back in order to better understand a potential mechanism for vibration-induced low back injury.

In these studies, neuromotor control was assessed by examining sudden load response dynamics (the ability of a subject to respond to a sudden, unexpected perturbation) and position sense (the ability of a subject to reproduce a posture) before, during and after exposure to vibration either applied directly to the muscle or applied as a whole body vibration. A computation model of the low back was used to examine the relationship between these two measures and the potential underlying neuromotor changes that may be occurring.

Subjects were found to respond more slowly to a perturbation both during and after exposure to vibration applied either locally to the paraspinal musculature or applied in a more occupationally-relevant manner as a whole body vibration. This increased delay persisted for up to 30 minutes after removal of the vibration. With this delayed neuromuscular response, the perturbations resulted in increased trunk flexion and a decrease in trunk stabilization. A greater muscle force response was then required to return to an upright posture. Subjects were not found to change their preparatory behaviour.

Position sense was measured by examining the ability of the subject to reproduce a lumbar curvature target in an upright standing posture. Subjects were found to have greater error both during and after the vibration. While these errors demonstrated a directional bias during vibration, they did not have the same bias after vibration. This suggests that during vibration, the vibration results in a perception of muscle

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lengthening. After removal of the vibration, habituation to the vibration leaves the subject less able to sense their low back posture. Computational modelling of the low back stabilization illustrates how such sensory changes could result in increased response delays and loss in trunk stabilization.

By understanding how vibration increases low back injury risk, improved prevention methods may be developed. For example, since vibration induced changes in stability were observed to last approximately 30 minutes, it may be advisable to have truck drivers rest for 30 minutes before unloading their vehicles. In addition, vibration exposure could be reduced through appropriately designed seating. This seating should be designed not only to eliminate seat pan vibration transmission but also vibration that may be carried through the backrest as vibration applied directly and transversely to the low back had similar effects.

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Poster: 0113

The Measurement of Grip and Push Forces Applied to Vibrating Tools Using a Psychophysical Force-Recall Technique

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Operators of powered, vibratory hand tools are at risk of developing health problems associated with repeated forceful actions and exposure to intense hand-transmitted vibration. Carpal tunnel syndrome (CTS), hand/wrist tendonitis, hand-arm vibration syndrome (HAVS), and other hand-arm system disorders have been associated with forceful hand actions in combination with awkward postures and repetitive motions. To better assess health risks, comprehensive risk evaluations of these tasks must include quantitative assessments of hand-tool coupling forces; however, no standardized method for quantifying hand forces exists. Studies have shown that humans have an awareness of the sensations associated with the application of static and dynamic forces to stationary and mobile objects. Humans are also able to reproduce postures, movements, and forces by relying on the memory of those sensations. Hence, psychophysical force-recall techniques may be viable alternatives to handle instrumentation. An understanding of the effects of vibration and other factors upon force-recall accuracy and reliability must first be explored before such methods are applied in risk assessments.

In this study, the effects of vibration and other factors on the accuracy of a psychophysical force-recall technique were explored in two experiments. Twelve male subjects participated in the first experiment. The second experiment employed 20 participants (10 female, 10 male). In each experiment, participants applied specific grip and push forces to an instrumented handle mounted on a shaker system. Participants were exposed to sinusoidal vibration at frequencies that ranged from 0 Hz to 250 Hz. Three levels of applied force (grip=30±15 N; push=50±25 N) and two levels of vibration magnitude were examined. During the vibration exposure period, participants were provided with visual feedback while they attempted to “memorize” the applied grip and push forces. At the conclusion of the vibration exposure/force memorization period and a controlled rest period, the participants tried to duplicate the grip and push forces without the aid of visual feedback. The effects of different vibration frequencies, vibration magnitudes, and grip and push force levels were tested in a random order from trial to trial. To evaluate test-retest reliability, the test was repeated on a later day with each participant.

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Overall, recalled force errors were relatively small over the range of operationally-relevant hand-handle coupling forces and vibration exposure conditions. Participants tended to overestimate grip and push forces. Depending on exposure conditions, error means ranged from 2 N to 10 N. The ANOVA revealed that force-recall errors were statistically-significantat vibration exposures between 31.5 Hz and 63 Hz ($p < 0.05$). Error means were greater when participants were exposed to the higher vibration magnitude (mean=9.14 N, 95% CI=8.19-10.08 N) when compared with the lower vibration magnitude (mean=4.88 N, 95% CI=3.93-5.82 N) ($p < 0.05$). The average error for females (4.90 N, 95% CI=4.01-5.79 N) was significantly less than that for males (8.30 N, 95% CI=7.41-9.19 N) ($p < 0.05$). The effect of force level remains unclear. Pearson product-moment correlation results indicated strong test-retest reliability as correlations for all but one participant were found to be significant ($0.45 < r < 0.95$, $p < 0.01$) for recalled grip and push forces.

This force-recall technique shows promise as an alternative to expensive and fragile force-sensing instrumentation. To account for anticipated force-recall errors due to vibration effects, weighting functions can be developed. Once refined, this psychophysical force-measuring technique can be incorporated into various risk assessments used in the construction, manufacturing, mining, and other industry sectors.

Poster: 0114

Biological and Functional Effects of Repeated Vibration Exposures in Muscle Tissue

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According to the Bureau of Labor Statistics, over 1 million U.S. workers in the manufacturing sector use vibrating hand tools, such as grinders, polishers, and power cutters; and NIOSH estimated that 50% of workers exposed to vibration will develop symptoms such as cold-induced vasospasms, loss of tactile sensory function, or loss of strength in fingers and hand, collectively known as vibration white finger (VWF) or hand-arm vibration syndrome (HAVS). Hand-transmitted vibration is also a major factor associated with carpal tunnel syndrome (CTS). Despite numerous studies of the pathological symptoms associated with prolonged vibration exposure, there is little understanding of the underlying physiological mechanisms that lead to injury.

The purpose of this study was to examine gene expression in muscles exposed to prolonged vibration exposure and determine if changes are associated with vascular constriction and subsequent depletion of oxygen (hypoxia) in peripheral soft tissues. Manual dexterity was also assessed intermittently to determine if repeated disruption in blood flow and oxygen availability was accompanied by deficits in muscle function.

A physiologically representative animal model was developed to experimentally investigate vibration-induced biological and functional changes. In this model, the right forelimb and paw of intact rats were exposed to a platform vibrated at a frequency of 250 Hz and amplitude of 49 ms-1, similar to the vibration caused by hand-held grinders and sanders commonly used in the manufacturing and construction sectors. Three groups of 8 rats each were studied: a vibration-exposed group, an exposure-control group, and a home-cage control group. Exposures were conducted 4 hr/day, 5 days/week for 5 weeks. After the exposure, gene-transcript levels for factors associated with vasoconstriction and hypoxia were determined from dissected flexor muscles of the rat forelimb. Manual dexterity was assessed intermittently during the exposure period with the Montoya stair-case test, which assessed the rat's ability to grasp and retrieve small food pellets.

Compared with control the control groups, results for the vibration-exposed group showed significant 50% and 29% increases in the expression of α2c and α1a/d receptor transcripts, respectively, which are known to increase vascular sensitivity to norepinephrine-induced vasoconstriction. There also was a

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significant 63% increase in the level of hypoxia-induced factor-1 (HIF-1), a transcription factor associated with reductions in oxygen availability. The staircase test showed an average 57% improvement in manual dexterity for the control groups, but only a 9% change for the vibration-exposed group.

Results are consistent with the notions that vibration causes increased vasoconstriction in the microvasculature, and subsequent tissue damage or loss of function may be associated with hypoxia. Follow-up investigations of these mechanisms can lead to the discovery of biomarkers for early detection and advancements in diagnostic methods or treatment options. In addition to advancing our understanding of the underlying physiological mechanisms of HAVS, the experimental findings generated by the use of the present model can support the development of exposure guidelines by determining the biological plausibility of various associations between exposure risk factors and HAVS.

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Poster: 0115

Genes Related to Growth, Inflammation and Degeneration Increase in Muscles in Temporally Different Patterns in a Rat Model of Work-Related Musculoskeletal Disorder

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Purpose: Our purpose was to examine the effect of performing repetitive tasks on the development of muscle pathologies in a rat model of work-related musculoskeletal disorder (WMSD). To reach that goal, we used gene microarray technology to assess gene expression patterns in flexor forelimb muscles from rats performing a repetitive reaching and grasping task.

Background and Significance: WMSD accounted for one third of lost work time injuries and illnesses in U.S. private industry in 2003. These disorders can be caused or exacerbated by the performance of highly repetitive movements. We have studied a rat model of repetitive reaching and grasping in which tissue pathology and motor behavior can be monitored over time. We have found evidence of localized inflammation that is dose-dependent. The inflammatory response, evidenced by macrophage infiltration and cytokine production,peaks within 6-8 weeks in high repetition tasks, followed by resolution thereafter. However, we observed persistent fibrotic tissue changes and persistent declines in motor abilities that exceed the time period for the peak inflammatory phase. We now seek to elucidate underlying pathomechanisms occurring in muscle at the gene transcription level that might contribute to these persistent changes.

Methods: Eleven young adult female Sprague-Dawley rats were used. Eight rats performed a high repetition low force (HRLF) task for 2 hrs/dy, 3 dys/wk for 3, 8 or 10 weeks. Three were age-matched controls. After mRNA extraction, Affymetrix oligonucleotide 230A analysis was performed (Genome Explorations) and analyzed (Gene Sifter) statistically.

Results: mRNA expression levels of 6% of 8000 genes examined underwent significant up- or down-regulation in HRLF rats compared to controls. Clusters of genes associated with specific cellular functions showed distinct alterations in expression levels by week of task performance. (1) mRNAs of 17 genes related to muscle growth and differentiation, e.g. myosins, procollagens, general transcription factor B and growth response protein CL-6, up-regulated in week 3, returned to control levels in week 8, but down-regulated in week 10. (2) mRNAs of 7 genes related to inflammation and immune responses up-regulated

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in week 3, e.g. IL6-receptor 1 (7 fold increase), integrin alpha (1.5 fold increase) and several complement factors. Many of these genes, as well as 5 others related to TGF-beta and JAK-Stat inflammatory pathways continued to upregulate through week 8. For example, integrin alpha increased 4.22 fold. Most genes related to inflammation down-regulated in week 10, with a few exceptions, e.g. IL-6 receptor 1 (10.74 fold increase), neutrophil cytosol factor, and complement factor D. (3) mRNAs of genes related to tissue catabolism and cell injury up-regulated only in week 10. These included mRNAs for heat shock proteins (markers of cell stress), DNA damage proteins, and growth arrest proteins.

Conclusions: Gene expression profiling provides insight into the biology of progressive tissue changes associated with WMSDs. Our results show that performance of a repetitive task contribute initially to muscle growth, then inflammation, which at least partially resolves, followed by tissue degenerative changes. These findings will aid the development of appropriate therapeutic interventions.

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Poster: 0116

An Experimental Model for Studying the Biodynamic and Physiological Effects of Vibration

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Exposure to upper limb vibration through the use of powered hand tools puts workers at risk for developing hand-arm vibration syndrome (HAVS). HAVS is characterized by cold-induced vasospasms in the digits and hands and reductions in tactile sensitivity, grip strength and manual dexterity. Although numerous studies have described the pathological changes in tissues from workers with HAVS, the mechanisms underlying these changes are unclear. Models exposing rat tails or limbs to vibration can be used to determine what mechanisms underlie vibration-induced tissue injury. However, because the physical response of tissue to vibration (i.e., biodynamic response) is dependent upon the morphology of the tissue, it is not clear if vibration has similar effects on rat and human tissues.

Goal: To measure the biodynamic response of rat tail tissue to different vibration frequencies and magnitudes, and the effects of vibration on tactile sensitivity and gene transcription to determine if the physiological responses of tails are similar to the responses of human fingers.

Methods: The effects of different vibration frequencies (31 – 500 Hz) and magnitudes (10 – 100 m/s2 r.m.s.) on the amplitude of the tail vibration were measured using a laser vibrometer. Each adult male rat was exposed to all frequency/magnitude combinations during a single bout of vibration. Changes in sensory nerve function in the tail were measured after exposure to a single 4 h bout of vibration (125 Hz, 45 m/s2 r.m.s.) using the current perception threshold (CPT) method and RT-PCR.

Results: The frequency and magnitude dependent biodynamic responses of rat tails to vibration were similar to those displayed by human fingers. Exposures to frequencies between 63-250 Hz amplified the biodynamic response of the tail (1.3 to 2.5 fold frequency dependent increase over the input amplitude). Increasing the magnitude did not alter the frequency dependent response of the tail, but did amplify the magnitude of the tissue response. Exposure to a single bout of vibration at 125 Hz also resulted in a 19% reduction in the sensitivity of large myelinated fibers to stimulation. The reduction in sensitivity was associated with a 4-fold reduction in nitric oxide synthase-1(NOS-1) and a 2-fold increase in calcitonin-gene related peptide (CGRP) transcript levels in nerves, factors critical in mediating pain and blood flow.

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Based on these findings, we conclude that the rat tail serves as a good model for determining how changes in the biodynamic responses of tissue to vibration lead to tissue injury and alterations in sensory function. These findings also demonstrate that the non-invasive CPT method can be used to identify vibration-induced changes in sensory nerve fiber function.

Significance: Over 1 million workers in the construction, mining, agriculture and manufacturing sectors are regularly exposed to upper limb vibration. Epidemiological studies indicate that approximately 50% of these workers may develop HAVS. Using the rat tail model to uncover mechanisms underlying vibration-induced injury will provide information about what aspects of a vibration exposure are most injurious so that equipment and products can be respectively engineered or altered to reduce injury. In addition, this information can be used to develop new diagnostic and assessment methods to identify vibration-induced injuries before they result in permanent damage to vascular and neural tissues.

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Poster: 0117

Quantifying the Effects of Precision on Muscle Loading of the Upper Extremity During a Highly-Repetitive Hand Transfer Task

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Introduction: Musculoskeletal disorders of the upper limb are common among semi-automated occupational hand transfer tasks. Some of these tasks that are seen in retail trades, manufacturing, and production assembly1, have precision requirements that could potentially increase muscle loading. While a few studies have examined the effect of precision on musculoskeletal loading, no studies have looked at this effect in a cyclical pick and place task.

Objective: Our aim is to examine the effects of the precision requirement of a repetitive hand transfer task on the upper extremity musculature loading in a laboratory setting.

Methodology: Ten healthy adults were recruited (5 males, 5 females) with a mean age of 27.8 years (± 5.9) and a mean body mass index of 24.2 kg/m2 (± 1.6). Surface electromyography (EMG) was collected from eight muscles of the right arm: upper trapezius (UTR), supraspinatus (SUP), infraspinatus (INF), brachioradialis (BRA), extensor carpi radialis (ECR), extensor carpi ulnaris (ECU), extensor digitorum indicis (EDI), and flexor digitorum superficialis (FDS). The task consisted of a repetitive transfer of a 13x13x11cm 1.8-kg part (length, width, height) with precision (14x14x11cm) and non-precision placements (21x21x12cm). Muscle loading was quantified using 10th percentile of the amplitude probability distribution function (static)2 from the EMG.

Results: A repeated measures design was utilized to analyze loading for each muscle. This study found that precision resulted in an increased static loading in forearm muscles (ECR, ECU, EDI, and FDS) ($p<0.001$). Precision task resulted in a 0.6 to 1 %MVC increase in muscle loading compared to the non-precision condition. This finding was not observed for the shoulder muscles (UTR, SUP, INF) and one forearm muscle (BRA). In addition, precision placement was perceived to be more difficult than non-precision ($p<0.05$) based on a self-report questionnaire.

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Conclusion: The findings suggest that precision increased the loading by 43% on average in the forearm musculature under the conditions we tested. We found that the muscles affected were the very muscles that are commonly involved in musculoskeletal disorders affecting the upper extremity among "injured" workers. This study will help us further understand precision as an important measure of exposure in highly repetitive hand transfers such as those seen in the assembly and manufacturing occupations. Further, we can design 'safer and healthier' jobs not only by considering the repetitiveness of the task but also the precision at which the task must be performed.

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Poster: 0118

Two New Methods for Assessing Risk Factors for Occupational Low Back Pain due to Manual Lifting in a Prospective Epidemiological Study

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Occupational low back disorders (OLBDs) represent a significant health problem for workers and a significant financial burden for industry. Most of these disorders are attributed to manual lifting on the job. Among the risks for OLBDs found in the literature, trunk posture and spinal loading are found to be two major predictors (Wells 1997, Norman 1998, Marras 1999). Traditionally, the peak and average of these two risk factors have been used as variables for predicting low back disorders; however, recent literature has indicated that accumulation and interaction of exposures to the two risk factors may also play an important role in developing OLBDs. In order to prevent these disorders, it is important to understand the physical risk factors associated with manual lifting that are responsible their development. One of the objectives of this study was to develop new methods for measuring the risk factors for OLBDs in a longitudinal field study of workers engaged in manual lifting activities. The methods must allow for the capture of spinal load data for every lift performed by a worker over a selected period of time and an analysis of adverse postures used by the worker during the course of the exposure period.

The first method is a spinal load model for estimating cumulative spinal load-time integrals over a specified time period, such as a shift, week, month, or year. This method employs a laboratory-based motion capture technology whereby each lift is simulated by a subject in a laboratory and the posture is then passed to a 3D biomechanical model for computation of the disc compression force, anterior and posterior shear force, spinal moments, and other musculoskeletal loads for each lift. Custom software is then used to extract the posture data for each lift and translate it into readable data for the biomechanical model in order to calculate the total cumulative load which is obtained by summing the loads over time. Previous researchers have suggested that cumulative load may be a strong predictor of risk of OBLDs.

The second method is a common metric approach involving calculating accumulation and interaction of the hand loading and posture to predict low back disorders using Multimedia Video Task Analysis software, developed by researchers at the University of Wisconsin. The software allows quantifying time-based postural and hand loading analysis by reviewing frames of video (10-15 minutes per job) containing manual lifting activities recorded in the study sites. Analysts review each frame of the

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selected video and code hand position and trunk posture of the workers using user-defined events including hand loading (yes, or no) and multiple levels of trunk deviation (flexion and asymmetry). The cumulative temporal interaction of the hand loading and trunk deviation data are calculated and used as the primary variable for predicting the low back disorder incidence rates surveyed by health questionnaires. Percent time and frequency of hand loading and trunk deviation for the job cycle are also included in the common metric approach for testing their significance of predicting low back disorder incidence rates.

Poster: 0119

Can Pain and Inflammation be Prevented in Strain-Injured Skeletal Muscles?

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Repetitive motion disorders can involve lengthening of skeletal muscles to resist rapidly rising forces produced by power hand tools resulting in muscle strains with loss of isometric strength, swelling and pain in humans. The loss of isometric force (weakness) has been shown to be due to mechanical damage to skeletal muscles and the delayed onset of soreness (pain) due to a subsequent inflammatory condition. To investigate the relationship between repeated muscle strains and inflammation, 30 strains of active plantar flexor muscles of rats were produced by rotation of the ankle overcoming the force of the muscles while under deep anaesthesia. Isometric and peak strain forces during the strain protocols and isometric force (strength) before and one-hour after the strain protocols were measured. Histopathology was evaluated in medial gastrocnemius muscle samples using antibodies to cellular proteins (desmin and laminin) and markers for inflammatory cells such as neutrophils (W3/13) and macrophages (ED1). All strain protocols produced the same amount of weakness (50.5 □ 6.0% loss of maximal isometric muscle force, n=18) with little recovery within 1 hour. After 2 days, histopathology was present in all injured samples including desmin negative myofibers (5.6 □ 0.9%). Many of the necrotic myofibers contained infiltrating neutrophils and macrophages indicative of an inflammatory process. Using algometry, pain could be demonstrated in the injured muscles by a decrease (68.6 □ 7.4%, n=3) in the pressure-pain threshold.

Two interventions were successful in preventing the inflammation but did not attenuate the loss of strength from the 30 repeated strains. The first intervention was to block phospholipase A2 – an enzyme responsible for genesis of inflammation. Inhibition of phospholipase A2 with quinacrine resulted in an 88% reduction in the number of desmin negative muscle cells and the almost complete absence of infiltrating inflammatory cells. From these observations, a physiologic rationale for the prevention of muscle inflammation and pain by manipulation of calcium homeostasis was developed. Since self-pacing seemed to have some beneficial effects in the workplace, we wondered if the muscles need more time to recover ionic imbalances induced by successive strains. So, a second intervention of increasing the rest interval between consecutive strains was tested. Increasing the inter-strain rest time from 40 sec to 180 sec almost completely abolished the number of desmin negative myofibers (>98% reduction) and the inflammatory response.

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Since the mechanisms for muscle weakness and histopathologic changes (inflammation) following repeated muscle strains could largely be dissociated from each other, functional testing for isometric strength loss in humans exposed to repeated muscle strains will not identify those individuals who will develop chronic inflammation and pain from repetitive motions. However, understanding of the mechanism for prevention of histopathologic changes should help in the design strategies for avoidance of chronic pain such as altered duty cycles. Further study should also provide insight into whether systemic diseases such as hypertension, known to alter cellular calcium homeostasis, pose additional risk for musculoskeletal disorders in the workplace.

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Poster: 0120

Dynamic Strength and Knowledge of Strength Affect Manual Materials Handling Strategy

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This study investigated (1) whether there is a relation between dynamic (isokinetic) strength and the batch-assorting strategy to initiate a manual materials handling task, and (2) how knowledge of strength influences the relation. Thirty-two participants (16 men and 16 women) were first tested for their isokinetic strengths of trunk extension, knee extension, shoulder extension, and shoulder abduction. The participants were then divided into two groups, each with 8 men and 8 women, such that the between-group strength difference was minimized. One group received knowledge feedback of their strength testing results and the other did not. All participants subsequently performed the same load handling task in which they were asked to carry batches of various weight plates while allowed to assort batches of more than one plate into any combination. Results suggested that people with greater strength tended to adopt a more aggressive handling strategy—heavier load per carry and fewer carries per batch. Receiving knowledge feedback also evoked a tendency of more aggressiveness, which was more salient in the weaker individuals. The research findings lend support to the use of strength testing in identifying higher risk handlers, and have implications for designing repetitive materials handling jobs and proper instructions to promote better strategies of balancing productivity and injury prevention.

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Poster: 0121

Designing Organizations to Promote Successful Return to Work: Pathways to Success

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Employers, labor, health care providers and insurers each want to reduce the lost productive time following an injury or an illness. Often, the worker returns to work and lost productive time continues due to health care quality or the inability to perform all needed job/tasks. It is important to develop and demonstrate the utility of measures of successful work role functioning not simply the fact of return to work. Furthermore, research assumes all organizations are alike and that there is little need to consider the organizational context supporting return to work. Certainly there is a need to develop new measures of organizational context capturing important policies and supervisory practices. Finally, research has focused on one or two predictors rather than a more complex multidimensional model limiting the utility of the information generated in research. The purpose of the study is to identify: (1) the predictors of successful return to work and (2) the pathways whereby a supportive organization influences the return to work process.

A cohort of workers undergoing carpal tunnel surgery (CTS) was given questionnaires at baseline, two, six and twelve months post-surgery. Over 80 employers/organizations and 197 workers participated. The primary outcome was successful return to work (SRTW), that is, the ability of the worker to meet the demands of the job given his or her health. Also, change in self-efficacy and whether a worker received a job accommodation were outcomes. Multivariate statistical models were used to identify significant predictors of SRTW.

Different factors predicted SRTW following CTS. At two months, being depressed at baseline (odds ratio (OR) = 0.32; 95% confidence interval (CI) 0.14-0.74) and having filed a workers' compensation claim for carpal tunnel syndrome (OR 0.3; CI 0.14-0.66) predicted unsuccessful return to work. At six months, having improved self-efficacy in managing pain in the return to work process (OR 7.1; CI 2.5-20.5) and working in a supportive organization (OR 5.2; CI 1.7-16.1) predicted successful return to work. Working in a supportive organization predicts improved self-efficacy at 2 months (β=0.31, t=2.16, p=0.03), at 6 months (β=0.42, t=2.38, p=0.02) and at 12 months (β=0.66, t= 3.51, p=0.00). The most important organizational drivers of self-efficacy improvement were a strong disability management program

and ergonomics policies and practices. It appears that an injured or ill worker is no more likely to be accommodated if he or she works in a supportive organization. The findings advance RTW research in multiple ways. (1) The utility of the successful work role functioning measure as opposed to return to work is demonstrated for the first time. (2) The importance of the organizational context is demonstrated for the first time. (3) One pathway from working in a supportive organization to SRTW is improved self-efficacy – again a new finding. (4) This study replicates research in low back injury cohorts on the time dependence of effects and suggests different interventions at different points in the RTW process.

This study highlights the importance of organizational policies and practices, including, a people-oriented culture, active safety leadership, disability management programs and ergonomics policies and practices in managing return to work and in increasing the likelihood the worker not only returns to work, but returns to his or her job and functions successfully in the job. Second, this research suggests psychosocial interventions to manage depression may be important early in the return to work process and programs targeting improved self-efficacy may be important later. Finally, this research suggest a new health outcome successful work role functioning may be a useful target.

These findings are critical for the service sectors and the manufacturing sectors where carpal tunnel syndrome is prevalent. Changes in organizational policies and practices may save employers millions in lost productive time. Additionally, the insurance sector should consider capturing organizational conditions in assessing risk.

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Abstract: 0122

Gender and the Work-Family Interface in the United States

S Schieman (1) presenting

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Conflicts between core social roles, especially work and family, are central stressors in the stress process framework that often generate undesirable interpersonal, physical health, and mental health outcomes. The present study seeks to contribute to knowledge about two features of the work-home interface: conflict between work-to-home roles and conflict between home-to-work roles. The central objective of this study is to explicate the social distribution of those processes with respect to core ascribed statuses (i.e., gender and age) and the achieved statuses (i.e., education, occupation, work conditions, and home-related conditions). Specific attention is given to the structure and organization of work as potentially influential. Using data from a representative 2005 sample of 1,800 working adults in the United States, we find that different models are needed for women and men in order to understand the social distribution of work-home conflict, home-to-work conflict, and time pressures. Among the numerous findings, we summarize a few new observations: 1) Age. Among men, age patterns in work-to-home conflict are curvilinear such that levels of rise and fall with increasing age over the life span; among women, levels of work-to-home conflict remain fairly stable across the life course. By contrast, age is associate negatively and linearly with levels of home-to-work conflict among both women and men; 2) Education. Among women, levels of work-to-home conflict are highly similar among women across levels of education; however, among men, average levels of work-to-home conflict rise across education categories, with each successive education group reporting more work-to-home conflict than the previous group.

By contrast, education is unrelated to levels of home-to-work conflict among both women and men; 3) Occupation. Professional men and women tend to report higher levels of work-to-home conflict than men in technical, service, precision-craft, and labourer occupations. However, there are no differences in levels of home-to-work conflict across occupations among both men and women; and 4) Work Conditions. Higher status job conditions (i.e., job authority, scheduling flexibility, job complexity, decision-making latitude, income) are associated positively with work-to-home conflict among both women and men. Moreover, among men especially, age- and education-linked patterns in occupation and work conditions explain the observed age and education differences in work-to-home conflict. For example, men in their 30s and 40s and well-educated men are more likely to have

professional occupations with higher status work conditions that elevate the risk for work-to-home conflict. It is also observed that interpersonal conflict in the workplace role-set elevates work-to-home conflict, while interpersonal support in the workplace role-set lowers work-to-home conflict—in both instances the effects are similar for women and men. By contrast, with a few exceptions, work conditions are unrelated to home-to-work conflict among both women and men; and 5) Home- and Nonwork-Related Conditions. Economic hardship and stressful life events elevate the risk of work-to-home conflict among women, while only life events are associated positively with work-to-home conflict among men. Conversely, the number of children at home, time spent on housework, economic hardship, and stressful life events are all associated positively with home-to-work conflict among both women and men. Collectively, these five broad sets of observations advance knowledge in the work-family interface by documenting and describing social status variations in levels of both directions of work-family conflict. Our discoveries about age and education variations, and the reasons for them, have not been previously described in the general population of working adults. Moreover, the results speak to the ongoing debate about gender differences in the structural antecedents and experiences of the work-family interface by showing (with a few exceptions) stark similarities between women and men. In sum, given previous evidence about the social and health implications of inter-role stressors and gender variations in such processes, our findings reveal new patterns that can inform policy about work-family interface in the U.S. We document that the organization of work matters explains the effects of core ascribed and achieved social statuses. We also offer insights about the ways that work-family processes generate the generalized sense of time pressures ("always feeling rushed for time"), the ways these processes vary for women and men, and their potential connections to the quality and organization of workplace relationships.

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Poster: 0123

Work Organization and Employed Women's Post-Partum Health

NL Marshall (1) presenting

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Broad Importance of the Research Problem: The occupational safety and health needs of employed women with young children are not known, yet 54% of mothers of infants were employed in 2003. The relationship between work organization, particularly job demands and limited control, and worker health is well-established, but recent changes in the organization of work coincide with the rising workforce participation of mothers of young children to create potential health risks, the effects of which are unknown.

Purpose or Objectives of the Study: The objectives of the study are to model the relationship between the organization of work (job stress, work schedule, job flexibility) and total workload (hours of employment and family labor), on the one hand, and women's post-partum health trajectories, as mediated by perceived work-family conflict.

Summary of Methods: The study uses existing data from a prospective longitudinal study of 1364 families (NICHD Study of Early Child Care), collected at 1- month post-partum and at 3-month intervals from 3- to 36-months post-partum. The study uses a structural equation modeling approach that utilizes latent variable growth curve modeling (representing continuous developmental change) and direct effects of covariates on specific time points (representing discontinuous change) to test the hypotheses. The study is supported with funding from the National Institute for Occupational Safety and Health.

Summary of Findings: Preliminary results indicate that work organization is significantly related to women's perceptions of work-family balance, particularly in the first 6-months post-partum. In addition, women who worked more hours reported greater difficulty balancing work and family responsibilities; women's work schedule was marginally related to perceptions of work-family balance. By the time of the NORA Symposium 2006, we will complete the models to test the relationship of work organization, work schedule and workload with health outcomes, as mediated by perceived work-family balance. Our health measures include depressive symptoms, self-report of health status, and health problems (illnesses and conditions).

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How the Findings Advance the Field and can be used to Improve Workplace Safety and Health and Related Outcomes: Results from this study will provide important information on employed women's health during the critical three years following childbirth. The study findings will identify aspects of the organization of work that support or place at risk women's health. Knowledge of these factors will facilitate the design and testing of policies and interventions relevant to employers, policy makers and occupational health providers.

How the Findings Relate to a Particular Industry Sector (if applicable): Not applicable. The women in this sample are employed in a variety of industries, with significant concentrations in health care, education and social assistance.

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Poster: 0124

Work Organization and Postpartum Health of Employed Mothers Twelve Weeks After Childbirth

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Broad Importance of the Research Problem: Mothers of infants are one of the fastest growing segments of the American labor force, yet relatively little is known about the association of work organization with women's recovery from childbirth.

Purpose: To identify work-organization factors associated with women's postpartum health at 12 weeks after childbirth.

Summary of Methods: A prospective cohort of employed women, ages 18 and older, were recruited from hospitals in 2001 and interviewed at enrollment, 6 and 12 weeks after childbirth. 661 women completed the 12-week interview (81% of 817 enrollees). Dependent variables included physical and mental health (SF-12) and childbirth-related symptoms. Independent variables included maternal and infant characteristics and work organization factors. Multivariate models were estimated with two-stage least squares.

Summary of Findings: At 12 weeks after delivery 50% of women had returned to work. On average, women experienced four (SD: 3.2) childbirth-related symptoms, most commonly fatigue, headaches, back/neck pain and sexual symptoms. Multivariate analyses revealed that better preconception health, no prenatal mood problems, no breastfeeding, more perceived control over work and home activities, more social support at home and work, fewer job-related psychological demands and less job stress were associated with better postpartum health for one or more dependent variables.

How the Findings Advance the Research: Work-related factors such as job stress, psychological demands and coworker support should be explored as modifiable factors that influence women's postpartum health.

How the Findings Can Be Used to Improve Workplace Health: These mothers continued to experience several childbirth-related symptoms 12 weeks after delivery, indicating a need for rest and recovery beyond the traditional 4 to 6 week postpartum period. Occupational health providers should evaluate women upon return to work to assess fatigue levels and other symptoms, including those related to breastfeeding and adaptation to work. Women may need help to identify ways to decrease job stress, increase control over work and home activities and enlist social support.

Poster: 0125

The Role of Psychosocial Work Exposures on Work-Role Functioning after Carpal Tunnel Release Surgery

D Gimeno (1) presenting, BC Amick III (1), RV Habeck (2), J Ossmann (1), JN Katz (3)

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Background: Carpal tunnel syndrome (CTS) is one of the most prevalent and costly upper extremity musculoskeletal conditions with over 250,000 CTS release surgical procedures performed annually in the U.S.A. Clinical, personal, economic, legal, and work-related factors, including psychosocial work stress factors, have been associated with return to work (RTW). Although high demands and low control have been associated with sickness absence, the evidence of their impact on RTW is rather limited. Moreover, just a few studies have considered worker's functional status upon RTW, that is, the ability of an individual to meet the job requirements given a state of health. The aim of the study was to examine the combined effect of psychosocial job demands and job control on RTW and WRF following CTS surgery.

Methods: A community-based cohort of CTS patients from physician practices was recruited between April 1997 and October 1998 throughout Maine (USA). 128 patients at 2 months and 122 at 6 months completed all relevant questions. Three-level outcome (15 items, α=0.91) indicated if patients had: (1) not RTW for health reasons, (2) RTW and WRF with limitations, or (3) RTW and successfully WRF. According to the job strain model, four work states (the Karasek quadrants) were created by cross classifying the median split variables of psychological job demands (3 items, α=0.72) and job control (5 items, α=0.83). Also, given the likelihood of committing Type II error due to median split dichotomization, two quotients were computed dividing demands by control: the job strain quotient (the greater the score, the greater the demands and the lower the control) and the active learning quotient (the greater the score, the greater the demands and the control). Covariates included clinical, family, economic, legal, job and organizational factors. Ordinal logistic regression was used.

Main results: After adjustments, in the short-term (at 2 months), workers in active jobs (high psychological demands combined with high job control) were less likely to RTW and successfully WRF (OR=0.22; p=0.014) than those in low strain jobs (low demands and high control). Active workers may be

more likely to remain out of work longer as a strategy to avoid or reduce stressful working conditions. In the longer-term (at 6 months), in agreement with the job strain model, having a job with relatively higher psychological job demands than job control (high strain) predicted not RTW or poorly WRF (OR=0.14; p=0.001). A 2 by 2 table cross-classifying exposures by the quotient and the quadrants models was constructed to see whether agreement on exposure classification resulted in different effects. Using the relationship with the outcome as gold-standard we found an overall agreement of less likelihood to RTW and successfully WRF for both active and high strain work exposures.

Conclusions: The findings underscore the role of psychosocial work conditions in explaining RTW and WRF. Clinicians, researchers and employers should consider a multidimensional and integrative model of successful WRF upon RTW. These findings point to the need for collaborative interventions that address both disability and occupational factors to facilitate RTW. From a methodological perspective, further research should focus on methodological and theory-based work on how to estimate psychosocial work exposures and develop consensus on analytic issues.

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Poster: 0126

The Relationship Between Work Organizational Factors, Physical Symptoms & Psychological Distress Two Years after the World Trade Center Terrorist Attacks

OYO Osinubi (1) presenting, P Ohman (1), S Ghandi (2), N Fiedler (2), M Robson (2), H Kipen (2)

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Study Objective: To examine the relationship between organizational factors, workplace disaster-related crisis intervention programs and psychological distress as well as work productivity among employees exposed to a large-scale disaster in the work environment. The specific aims: 1) Identify the resources that were available to workers in the aftermath of the disaster, 2) assess how helpful these resources were to the workers 3) determine the prevalence of physical symptoms and psychological distress and their impact on work productivity two years after "9/11' and, 4) to explore the relationship between work organizational factors such as job-stress, workplace culture, disaster-related corporate programs, workers' physical health and psychological well-being.

Methods: We conducted a survey of federal, state, municipal and union employees in 17 different work sites within a ten-mile radius of the World Trade Center (WTC) on physical symptoms and psychological well-being two years after the WTC disaster ("9/11"). We obtained data on employer-sponsored "9/11" psychological, educational and social assistance/programs, utilization and perceived helpfulness of such programs, job stress and the culture of the organization. Surveys were mailed to 750 subjects and the response rate for those with valid addresses was 52%.

Results: Majority (86%) of the subjects were in good/excellent overall health and mental health. Persons who worked south of canal street (SOC) reported severe headache/migraine more frequently than those who worked north of Canal Street (NOC) (p=0.0202). Relative to other victims and non victims, primary victims reported severe headache/migraine and cough more frequently (p=0.0086 & 0.0043 respectively). Persons who worked in organizations with negative (aggressive defensive or passive defensive) cultures were 34% more likely to report cough compared to those who worked in organizations with a positive (constructive) culture (p =0.02).

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Only 7% of the subjects endorsed symptoms suggestive of nonspecific psychological distress. Logistic regression analysis showed that this was likely related to personal life event stressors and not due to "9/11" events. None of the subjects met the criteria for clinically significant PTSD (impact of event scale –revised IES-R), however, primary victims tended to have higher IES-R scores relative to other victims and non victims ($p = 0.04$). Persons who worked in iso-strain jobs (high demand, low control, low social support) had higher IES scores relative to those with other types of jobs ($p = 0.03$). Workers who were □ 60 years tended to have higher IES scores relative to those that were □ 39 years
old ($p = 0.02$).

Overall, subjects reported a 10% decrease in job performance in the prior 4 weeks of the survey relative to the months prior to "9/11". Persons who had iso-strain jobs (high demand, low control, low social support) were more likely to have higher on-the-job productivity losses (presenteeism) relative to those with other types of jobs ($p =0.04$).

The majority (83.74%) reported that their employers provided at least one of the WTC disaster-related psychological, educational or social assistance/programs to help employees cope with "9/11"events. Those in organizations with positive cultures were 97% more likely to report that their employers provided educational materials compared to those who reported negative work cultures ($p = 008$). Relative to their counterparts who report positive work cultures, those who reported negative work cultures were 74% less likely to utilize the employer-sponsored resources even though they felt that they needed help coping with "9/11" events ($p = 0.049$). Respondents who worked in organizations with negative cultures were 80% more likely to be concerned about their personal safety at work, relative to their counterparts in organizations with positive cultures ($p=0.02$).

Implications: This study provides data on the physical and mental health symptoms in a sample of federal, state, municipal and union workers two years after "9/11". It details the employer-sponsored programs that were offered in the aftermath of "9/11", as well as the organizational factors (culture, job stress) which predict long-term symptoms, health and safety concerns and utilization of employer-sponsored programs. Organizations need to consider interventions that address negative work cultures and mitigate job strain in order to optimize workers' health. This data provides useful information and insight for disaster preparedness program planners and is applicableto other types of employer-sponsored health promotion and wellness programs.

Poster: 0127

Individual Reactions to High Involvement Work Processes

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Management scholars have had an interest spanning many decades in understanding the advantages of participatory work processes, and how such processes impact both employee and organizational effectiveness. Like most participatory initiatives, high involvement work processes (HIWP) involve employees in key aspects of decision-making that have traditionally been reserved for management. What differentiates HIWP from past initiatives, though, is that it provides employees with a system of inclusion (PIRK) into the organization that simultaneously embraces the benefits of increased power (P), access to critical information (I), exposure to rewards (R) linking individual performance to organizational outcomes, and the opportunity to expand organizational- and task-related knowledge (K). The basic operating premise underlying HIWP is that, relative to organizations not implementing HIWP, organizational practices driving PIRK (and hence, HIWP) result in favorable outcomes for both the organization and its employees, as a result of employees working both harder (i.e., more motivated) and smarter (i.e., using more cognitive abilities). HIWP was also strongly associated with employee morale indices such as job satisfaction, commitment to the organization, and turnover intention.

The present research focused on understanding how high involvement work processes are processed at the employee level. There were 3,930 participants in the current study representing employees from 21 selling units of a large national retail chain. Employees completed questionnaires administered in small group sessions conducted by the researchers at the retail centers during normal working hours. The tests of hypotheses were undertaken using a structural equation-modeling framework, and within that framework, the interaction representing the moderation hypotheses was formed at the latent variable level. A model was tested and supported in which HIWP are viewed as antecedents of employee psychological empowerment. Empowerment, in turn, was supported as the primary antecedent to job satisfaction, organizational commitment, employee performance, and job stress. Perceived organizational support (POS), however, was hypothesized to moderate the relationships between empowerment and the outcomes such that the latter associations would be strongest under conditions of high support. With the exception of the empowerment-job satisfaction association, all other effects of empowerment were moderated in the expected directions. The model test also supported viewing turnover intentions as an immediate outcome

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of both job satisfaction and organizational commitment. Finally, anger was hypothesized as an outcome of job stress, and in turn, employee absence and lateness behaviors were viewed as driven by levels of employee anger. Again, the latter expectations were completely supported by the analyses.

The findings from this study provide useful insights into the link between policies and procedures driving high involvement practices, and how the individual perceives and translates them into functional work attitudes and behaviors. Most previous research on high involvement processes has ignored the individual-blackbox, and simply associated the processes directly to organizational level outcomes.

The findings regarding POS are also potentially useful. With the exception of the empowerment-job satisfaction association, POS moderated all other associations of empowerment to the outcomes. This suggests that individuals driving HIWP efforts in their organizations need to be cognizant of the broader organizational context, and identify those aspects of that context that could potentially undermine those efforts, or at minimum, constrain the efforts so that maximum effects are not fully achieved. The moderating effects are also a gentle reminder that simply putting "feel good" policies and procedures in place is not enough to gain benefits from them.

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Poster: 0128

What's Good for Your Eyes? Results From a Field Evaluation of Two Interventions

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Amid all of the well-deserved concern about upper extremity musculoskeletal disorders there is little said about the greater prevalence of visual symptoms among office workers. It is estimated visual symptoms cost at least 15 billion dollars and are simple to prevent. However, preventing them is not limited to corrected eyeglasses and lighting. Some workstation characteristics also play a role in visual health while computing. However, few office ergonomics intervention studies address visual symptoms, incorporate comprehensive interventions to impact them and provide sufficient follow-up needed to determine sustainability of effect. Two non-randomized field trials were implemented at public and private sector worksites for the purpose of evaluating the effects of two office ergonomics interventions (a highly adjustable chair and an office ergonomics training) in reducing visual symptoms.

For each worksite three study groups were created: a chair with training group receiving the highly adjustable chair and office ergonomics training, a training only group receiving only the training and a control group receiving the training at the end of the study. The same office ergonomics training used at both worksites was designed using instructional systems design principles and adult learning theories. An a priori framework was constructed to describe the mechanisms through which the training and chair would impact visual health. One-hundred and eighty-four participants at the public sector worksite and 181 participants at the private sector worksite completed surveys. Survey and symptoms data were collected over one workweek at 2 months and 1 month prior to the intervention. After the intervention was implemented, the same data were collected over one workweek at 2, 6 and 12 months post-intervention. Multilevel linear statistical models were used to test post-intervention reductions in visual symptoms for each study group relative to the control group.

At both worksites the chair with training intervention significantly reduced visual symptoms after twelve months of follow-up ($p<0.001$ for public sector worksite and $p=0.01$ for private sector worksite). In addition, the training only intervention significantly reduced visual symptoms after twelve months of follow-up at the private worksite ($p<0.001$). We conclude a highly adjustable chair with office ergonomics training can reduce visual symptoms.

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These findings advance the field of office ergonomics because they demonstrate visual health among office workers is not just about glasses and lighting. It is about having an appropriately designed office ergonomics training and adjustable furniture. An ergonomics knowledge base will in turn allow the worker to adopt healthier computing behaviors. Furthermore, seeing the main findings of the first study replicated in the second study broadens the generalizability of the results.

Practically speaking, an intervention designed for decreasing upper extremity musculoskeletal s ymptoms can also effectively address visual symptoms. Using well-designed interventions such as a highly adjustable chair and an office ergonomics training in the workplace that has demonstrated effectiveness for both musculoskeletal health and visual health, in addition to productivity, is a cost-effective and efficient way to use evidence-based results. This is the kind of sound science that an ergonomics company can cite when making claims that buying a highly adjustable chair can improve worker health (accompanied by the proper training).

Improvements in computing-related health stand to directly impact knowledge workers who rely on computer use for extended periods of time in addition to the services sector where computers are used to input and store data.

Poster: 0129

Interactive and Participatory Training in Evaluation Methodology for Researchers and Practitioners in Occupational Safety and Health

T Scharf (1) presenting, K Gilmore (2), J Valosen (3), E Kapeller (4), K Bletzer (5), PS Kidd (6)

NIOSH, Cincinnati, OH, United States (1), University of Texas Health Center at Tyler, Tyler, TX, United States (2), CDC, Atlanta, GA, United States (3), Health and Human Services Commission, Austin, TX, United States (4), Border Health Foundation, Tempe, AZ, United States (5), formerly: Arizona. State University, Tempe, AZ, United States (6)

Translating workplace safety and health research into practice is a complicated process that is, for the most part, quite particular to the area of research and to the work environments to be changed. However, there are common tools and research strategies that can be used to assist researchers and practitioners in many different settings and circumstances to evaluate the changes, programs, or interventions they have devised to address particular problems in occupational safety and health.

This poster reports the development of a participatory workshop that combines case studies focused on specific problems in occupational safety and health with generic research methodology. The purpose of the workshop is to help OSH researchers and practitioners develop a practical application of the generic research tools to their specific needs. The core of the workshop is based in the case studies which open the workshop. To date, 26 case studies have been developed in 9 topic areas: agriculture, construction, emergency response, ergonomics/musculoskeletal, migrant health care, mining, nursing, occupational medicine, and public health.

Workshop participants select a case study that is relevant to their interests and experiences. The practical realities of the case study provide a focused application for the generic methodology. Participants are challenged to develop a comprehensive research design to evaluate the effectiveness of an intervention for their case study. Brief instruction assists participants to:

1) develop testable hypotheses, using both qualitative and quantitative approaches,
2) build a research team that represents the entire community,
3) incorporate strong ethical standards that are sensitive to local concerns,
4) develop a research/evaluation design,
5) recruit, select, and assign participants to study conditions,
6) anticipate and plan for potential problems of validity,

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7) select appropriate measures that maximize reliability, and
8) consider the effect sizes of their dependent measures and other features of a power analysis.

This workshop has been developed to highlight another NORA IER team product: Robson, L.S., Shannon, H.S., Goldenhar, L.M., and Hale, A.R. (2001). Guide to evaluating the effectiveness of strategies for preventing work injuries: How to show whether a safety intervention really works. National Institute for Occupational Safety and Health, Cincinnati, Ohio. Institute for Work and Health, Toronto, Canada. DHHS (NIOSH) Publication No. 2001-119.

The original request for this workshop came from the Midwest Farmworker Stream Forum sponsored by the National Center for Farmworker Health, in Austin, Texas. Additional workshops have been conducted for the East Coast and Midwest Migrant Stream Fora, the National Institute for Farm Safety; the American College of Occupational and Environmental Medicine; the College of Nursing, Southeastern Louisiana University; the School of Public Health, University of Illinois, Chicago; the National Mine Health and Safety Academy, and the American Psychological Association. While some of these outlets are fairly typical academic venues, the migrant fora, agriculture safety, and mine training venues were targeted specifically for safety trainers and other safety and health professionals with little or no prior experience in conducting an evaluation.

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Poster: 0130

Selling Driver Safety in a Safety Naïve Organisation

RK Howell (1) presenting

AstraZeneca, Macclesfield, United Kingdom (1)

Driver safety is a growing issue for governments and organisations. However the section of the organisation using drivers for business may be culturally safety naïve even in organisations with an espoused safety culture. This abstract documents the empirical methodology utilised to identify mechanisms of managing safety that engage and motivate this group to improve their safety performance.

The purpose of this study was to develop and instigate a standard approach that would reduce the number of serious accident in the company. The company has many thousands of sales people internationally. Despite training and senior management demands this group of drivers were responsible for more than 30% of all serious accidents.

The method was to examine a number of best practice approaches to identify which appeared to deliver consistent results. These were then stripped of any element that required a pre-existing safety culture. The remaining elements were then allied to current management practices (sales targeting, safes force effectiveness).

Several findings were essential to the success of the project: recognition that this was a change management process, creating a dataset that could be used to set meaningful and actionable targets and promotion of the benefits to the drivers of safe driving. The company is also developing additional tools to increase the diversity of the data set in order to identify other areas for improvement related to driving safety. Three areas affected the success and speed of the driver safety programme; local senior management attitudes and beliefs, internal bureaucracy and the management of senior management expectations of "something happening now" during the initial project phases.

The final standard approach is based on a "Measure, Target, Execute, Assess and Manage" approach. The cornerstone of this is the creation of a driver management database containing all relevant information on the driver, containing information on the driver risk profile, motor vehicle records, training performance and information from psychometric tests. This information is then used to create a "need for change"

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essential for the change management process to begin.

This is presented as a standard management system rather than as “safety issue” with a clear business case showing the financial benefits of the process.

These findings may help other professionals face with a similar issue in organisations that are led primarily by financial targets.

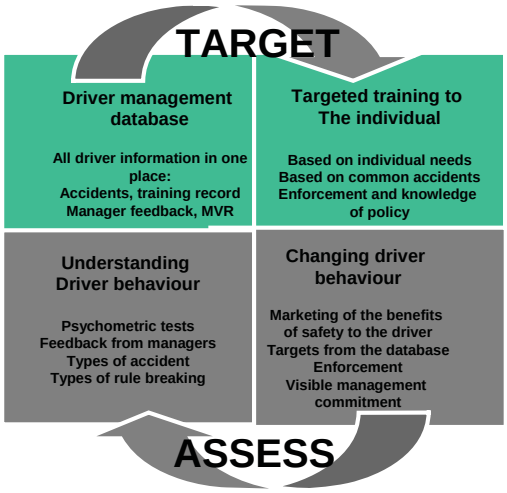

Figure: Integrated Driver Management Model

Poster: 0131

Community and Workplace-Based Training Program for Occupational Medicine

EA Emmett (1) presenting, J Green-McKenzie (1)

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We have developed and evaluated a unique community and workplace based residency-training program to train specialist in Occupational and Environmental Medicine (OEM). The program addresses the serious national shortage of physicians in OEM by focusing on additional skill development in physicians who are already in practice, but lack the special knowledge and skills to be effective in this field. Beyond basic clinical or internship training, specialist training in OEM requires two additional years, one year in obtaining an MPH or equivalent degree, and a second year of "practicum" training in the practice of OEM. Our program addresses the "practicum "year. There is a number of Universities that allow an MPH degree through distance learning. In contrast to traditional residency practicum training which requires moving to an institution offering training, our program allows trainees to stay employed in their community, if suitable supervision, educational resources and experiences are available locally. Our training methods blend traditional medical residency, graduate school, and executive MBA education. Residents complete supervised clinical training at their community location. A variety of educational methods are used, resident's medical records are audited and they maintain a log of educational experiences. Core University of Pennsylvania faculty visit training locations four times a year to ensure the adequacy of training and supervision. Residents also spend 3 days a month in Philadelphia. Each resident undergo must complete a substantive project from their home base for each of: the workplace, hazard identification and control; environmental health, risk assessment and risk communication; organizational and health-care management; population occupational health and epidemiology; and the worker, fitness for work and disability.

Since 1998 a NIOSH Training Grant has supported program development and evaluation and funded residents according to community need criteria of: service to underserved population(s); difficultyin accessing a training program (remote location, location where there is no training, family responsibilities, etc.); specific regional workforce need (lack of occupational medicine specialists in area, other regional needs, etc.) and/or service to special populations at risk, including minority and disadvantaged workers.

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After 9 years 51 physicians have completed the program, 8 are in-training. All graduates remain in the field of Occupational Medicine, most in their training location. Graduates are employed in industry, Universities, health-care institutions, freestanding clinics and government. Almost all have increased responsibilities since graduation. Applications for training slots are steadily increasing.

Advantages over traditional training include: no requirement to leave community where they are in practice, so minimizes physician specialist drain to large metropolitan areas; rational economic arrangement as residents paid for their work, and invest in their training through tuition; tuition can be subsidized on criteria of community need. Program quality is measured through: before and after the year resident self assessments of skills; assessment by residents as to whether the program met their needs; faculty assessments of resident performance, and performance on the American Board of Preventive Medicine Certifying Examination. Residents assess the program as outstanding. Scores on the specialty certification examination are comparable to the nations best.

Poster: 0132

The Use of Recreational Techniques to Raise Awareness and Train Workers in Occupational Risks Prevention

L Margulis (1) presenting, E Erbojo (1)

Provincia ART, Capital Federal, Argentina (1)

OSH specialists in Latin America are concerned about the difficulties of installing an effective workplace prevention culture. Cultural change has proven elusive at all levels and risk identification and prevention is yet to be incorporated in managerial practices. Unless a change is achieved in the culture and practices of all actors involved in the production process, OSH specialists will hardly succeed in promoting a safer, healthier and more productive work environment.

Awareness raising and training activities have become common denominators in OSH specialists' initiatives, advertisement of insurance companies, union claims, and legal framework issued by regulatory bodies. Nevertheless, one might wonder what results have been achieved and what obstacles are yet to be overcome.

As of the passing of Work-Related Risks legislation, employers, insurance companies, unions and the State became responsible for improving workers' awareness and training in order to achieve better working conditions. However, their efforts have had a limited impact so far. Training contents tend to refer only to mandatory issues. There is also a language barrier: specific technical contents and advises are not translated into everyday language, making them hard to understand by specific audiences (manual and agricultural workers, for instance). Also, employers have shown little commitment to engage in awareness raising campaigns. Some institutions have developed remarkable initiatives, but even these success stories have fallen short in educational aspects. The root of this common limitation can be traced back to the superior educational system: OSH specialists lack specific training in communication, education and motivation in order to allow them to effectively convey knowledge and information that can be put into practice.

Taking into account the above described situation, and as abundant research in the field of managerial and educational sciences has proven, recreational techniques present a useful approach to overcome mentioned shortcomings. Playing games has several didactic advantages over traditional training methods: it develops a higher level of emotional commitment with the issue at stake, increases knowledge

retention, and improves knowledge management. It has also proven more effective in terms of inducing the quick adoption of practical measures. Recreational techniques' positive outcomes open a window of opportunity to manage the cultural change necessary to foster a healthier, safer and more productive work environment.

If we believe that experiencing and learning go well together, there is nothing better than to learn and teach in an amusing way, enjoying the whole process and promoting active and committed participation on behalf of the audience. Playing games makes all this possible, since pupils in the audience become leading figures of their own learning process. Unlike traditional training sessions perceived by many as dull and arid, playing games allows to learn more from the knowledge shared by other attendants than from the trainer or reading materials. Recreational techniques generate positive group dynamics that make it easy to share previously acquired knowledge and to manage the construction of new ideas and practical advises. Grownups tend to enjoy learning by playing, since they perceive it as an opportunity to escape from their structured routine and bond with others by getting in touch with their emotions.

These arguments lead us to believe, test and confirm that learning by playing could prove extremely effective to manage cultural change in OSH matters. These techniques are appropriate for manual workers, supervisors, managers and businessmen; since they all need to incorporate occupational risks identification and prevention to their daily activities.

This paper is structured in 3 main sections. Section I explains in detail the logic and the mechanic of the game developed by our institution. Section II narrates the experience of playing the game for the first time during a training session for public servants. In Section III we share the lessons learned from that initial experience and from discussing the game with OSH specialists. The paper ends with some thoughts on further applications of recreational techniques for enhancing a preventive culture among different publics.

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Job Demands and Occupational Health Among Immigrant Poultry Processing Workers

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Workers in the poultry processing industry experience high rates of illness and injury. Estimates indicate that poultry processing ranks 3rd among over 700 industries in cumulative trauma disorders and 4th in terms of overall occupational illnesses. Despite these high rates, very little peer-reviewed research has documented the organizational and environmental factors contributing to variation in injury and illness among poultry processing workers.

Importance of the Research Problem: Determining the organizational and environmental factors contributing to injury and illness among poultry workers is important for two reasons. First, it provides insight into potential strategies for protecting the health of poultry workers, either by redesigning how poultry is processed or policies that protect workers. Second, recognizing that poultry processing is increasingly reliant on the immigrant workforce, such research and subsequent interventions would assist in eliminating ethnic disparities in health.

The Purpose of the Study: The goal of this study was to identify modifiable organizational and environmental factors associated with occupational illness and injury among workers in the poultry processing industry. To accomplish this goal, this study: 1) documented levels of physical and psychological demands reported by poultry workers, and 2) identified physical and psychological demands associated with recent symptoms of musculoskeletal problems, respiratory problems, and self-report injury or illness in the past year.

Summary of Methods: Face-to-face interviews were conducted with a community-based sample of 200 immigrant Latinos working the poultry processing industry in western North Carolina. This region has five processing plants belonging to three different companies. The content of the interview was informed by existing literature and data gained through formative research involving in-depth interviews. The questionnaire included several valid and reliable self-report instruments. The concepts of interest in this paper were job-related physical demands (e.g., physical exertion, repetitive movements and awkward postures), psychological demands of work (e.g., demands, control, variety), and safety climate.

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Summary of Findings: Employees' reports of several physical and psychological job demands differed significantly by poultry processing company. More frequent repetitive movements/awkward posture, greater psychological strain, and absence of variety were associated with recent symptoms of musculoskeletal disorder. A safety climate characterized by little management concern for worker safety was associated with increased risk of respiratory symptoms, and lack of variety and a poor safety climate were associated with greater risk of illness and injury in the past year.

How Findings Advance Research: This is the first study to document associations of physical and psychological job demands, including perceptions of the safety climate, with occupational illnesses and injury in poultry processing: a high risk industry that is increasingly reliant on immigrant workers.

How Findings can be Used to Promote Worker Health: The results of this study suggest that poultry processing can be organized in ways that limit exposure demands that threaten worker health. The results also suggest that reductions in job related demands, though such processes as reductions in line speed, job rotation, and clear demonstration of managements' commitment to safety can assist in reducing occupational illness and injury in this high risk industry.

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Poster: 0134

Recovery Pattern of Neck and Shoulder Pain among Sewing Machine Operators

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Introduction: Few studies to date have addressed recovery from work-related musculoskeletal pain. The aim of this study was to explore factors that may affect or modify recovery from a neck/shoulder disorder among garment workers. Garment workers have elevated rates of neck/shoulder pain and disorders due to sustained shoulder abduction and neck flexion.

Methods: This 4-month prospective cohort study followed 129 sewing machine operators who reported neck/shoulder pain at baseline before adopting ergonomic interventions.Musculoskeletal pain data was gathered in a standardized interview at baseline and during the follow-up period. Recovery pattern was evaluated using a proportional pain score of baseline pain in percentile as a continuous measurement of severity by multiplying pain frequency and pain intensity to generate a pain score, and dividing the score at each survey by the baseline score for each individual. Linear mixed models were used to examine the association between individual characteristics and work-related ergonomic and psychosocial factors on overall reduction of pain from baseline to four months and average reduction rate of pain per month while controlling for the intervention.

Results: The mean proportional pain score reduction was 9.2% per month. One unit baseline pain score increase was associated with increasing of proportional pain score reduction rate of 0.3% per month. Both total rest periods of 35-50 minutes and more than 55 minutes were associated with a faster recovery rate compared to less than 35 minutes of total rest (with proportional pain score reduction rate of 32.8 and 30.2 % more per month respectively). In contrast, subjects aged 50 years and above were associated with slower recovery rate compared to those less than 30 (with 31.4% less per month on proportional pain score reduction rate).

Conclusion: These results suggest that baseline musculoskeletal pain is positively associated with pain recovery rate. Individual and ergonomic factors, but not psychosocial factors, were associated with pain recovery. The total rest period duration in a day should be considered when managing neck/shoulder pain among garment workers. These findings suggest that the medical management of neck/shoulder pain among workers performing work involving static neck and shoulder loads should consider both individual (age) and work-related factors (work-rest pattern).

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Aerosolization of Microbial Contaminants and Fine Particles from Metalworking Fluids

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University of Cincinnati, Department of Environmental Health, Cincinnati, OH, United States (1), University of Wisconsin at Whitewater, WI, United States (2)

Background: Workers exposed to machining fluid aerosols may have an increased risk in developing a variety of respiratory and skin diseases, such as allergies, asthma, hypersensitivity pneumonitis, and dermatitis. Microbial contamination of water-based MWFs is one of the suspected causes for respiratory diseases but the exposure-response relationship is not well understood. One reason for this knowledge cap is that insufficient information has been available so far on the composition and concentration of airborne microorganisms at metalworking sites.

Objective: We have studied the aerosolization of microorganisms and mist with a laboratory-scale set-up, which allows investigating one variable at a time. Using this simulator, we investigated the aerosolization of fine particles, microorganisms, and endotoxin from two types of water-soluble MWFs: semi-synthetic MWF and soluble oil. Field sampling was performed to validate the results obtained in the laboratory.

Methods: Clean fluids were inoculated with P. fluorescens in the laboratory. The simulator was also utilized to test used fluids that were brought in from the field sites. The concentration of fine particles was measured with a condensation nucleus counter (P-Track, model 8525). The measurement of particle size distribution and the collection of particles for endotoxin analysis were conducted by an electrical low-pressure impactor (ELPI; 3935 series). Endotoxin analysis was performed with endpoint quantitative chromogenic Limulus amoebocyte lysate (LAL) assay. Microorganisms were collected using the Button Sampler and the BioSampler and analyzed by microscopic counting and cultivation. The same methods and equipment was used in the field sampling performed in two manufacturing sites.

Results: Laboratory experiments showed that hydrophobic microorganisms are easier to aerosolize than hydrophilic ones, and that increasing microorganism size decreased aerosolization. Bacterial contamination increased the aerosolization of fine particles. This effect was more pronounced for semi-synthetic MWF than for soluble oil. The particle size-selective collection revealed that particles below the intact bacterial cell size contained significant concentration of endotoxin. This finding was confirmed in field sampling performed in two manufacturing sites. Field test also showed that the concentrations obtained in the

laboratory simulated realistic field situations and that fine and ultrafine particles can easily migrate from production areas to other areas in the plant.

Discussion: The results indicate that the estimation of workers' exposures cannot be based solely on the analysis of bulk MWF as there are differences among microorganisms in their aerosolization potential. The data suggest that some of the fine particles may come from the cell wall fragments of bacteria in the MWFs. The microbial fragments cannot be detected by traditional microbiological methods, cultivation and microscopic counting. To fully understand the workers' exposure to microbial contaminants in MWF environments, sampling and analysis methods have to be modified to account for microbial fragments. For fluid maintenance, the total microbial biomass in the fluid, not only the culturable microorganisms, should be kept under control in order to prevent the aerosolization of microbial fragments.

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Mycobacteria in Metalworking Fluids: Development of DNA-based Methods for Exposure Assessment

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Mycobacteria growing in modern metalworking fluids (MWF) have been implicated in occupational health hazards particularly as causal agents of hypersensitivity pneumonitis (HP) and other respiratory illnesses in machine workers exposed to these fluids and their aerosols. The conventional methods for assessment of mycobacteria in the in-use MWF are often cumbersome, especially due to the presence of other microbial co-contaminants. Hence there is a need for the development and use of improved methods for exposure assessment of these biological hazards in machining industry. With NORA/NIOSH funding, we undertook development of a series of DNA-based methods for monitoring of mycobacteria in modern metalworking fluids. Genus-specific real-time PCR assay based on the 65-kDa heat-shock protein (hsp65) gene was developed for the direct culture-independent detection and quantification of Mycobacteria in contaminated MWF with a minimum quantification limit of 1 CFU/ml. In parallel, we optimized method for enhanced cultural recovery of mycobacteria from these fluids to further characterize their species and strains. A single-tube PCR method, based on direct cell lysis instead of a time-consuming DNA extraction pre-step, was developed for rapid (3h) and efficient identification of the mycobacterial isolates. A total of 13 mycobacterial isolates were recovered from 100 in-use MWF samples obtained from geographically diverse industrial plants, and were identified using our newly optimized methods based on restriction fragment length polymorphism (hsp65 gene and Internal Transcribed Spacer region) and DNA sequencing (441-bp-hsp65 gene segment). Contrary to the assumption that these fluids are colonized by a single clone of Mycobacterium immunogenum, our isolates revealed a genotypic diversity of mycobacteria in these fluids, represented by multiple novel genotypes of two distinct species, M. chelonae and M. immunogenum. Six of the isolates were identified as M. immunogenum, and seven as M. chelonae. Genomic DNA macro-restriction fragment pattern analysis (MRFPA) revealed three novel genotypes of M. immunogenum and two of M. chelonae. This research directly contributed to the NORA objectives by developing state-of-the-art rapid exposure assessment methods for monitoring of mycobacteria in metalworking fluids in occupational environments.

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Machine Safety Evaluation in Small Metal Fabrication Facilities

LM Brosseau (1) presenting, D. Parker (2), Y Samant (2)

University of Minnesota, Minneapolis, MN, United States (1), Park Nicollet Foundation, St. Louis Park, MN, United States (2)

Importance of Problem: The metalworking industry has one of the highest rates of non-fatal injury in the United States. However, a systematic evaluation of machine-related hazards is lacking in this industry.

Purpose: The Minnesota Machine Guarding Study will evaluate the effectiveness of a peer-based technical and educational intervention designed to reduce exposure to amputation hazards among workers in small machining/metal working businesses. Here we describe the development and pilot evaluation of machine safety scorecards.

Methods: An advisory board of shop owners, safety engineers, labor representatives and government agency employees assisted with identifying specific businesses, processes and machines in the metal fabrication industry. Safety engineers, OSHA consultants, machinists and business owners helped with scorecard development. Three trained raters used the scorecards in a pilot study of inter-rater reliability.

Results: We developed 23 machine safety scorecards following OSHA regulations, ANSI standards and industry best practices. Each scorecard addresses 1) point of operation guarding, 2) guarding of moving parts, 3) labeling of safe work practices, 4) accessible and protected operational and emergency controls, 5) proper disconnects that can be locked and tagged, and 6) general work environment characteristics. Items are scored as present (1), absent (0), or not assessable (0.5). Each item is weighted (high, medium, low; 6,3,1 respectively) for likelihood and severity of injury and all items are added for a maximum possible score of 100.

Three trained raters used the scorecards to assess 179 machines in four pilot businesses ranging in size from 18 to 97 employees. At least five machines in eight categories were evaluated by all three raters (total of 59 machines). Inter-rater reliability was assessed using the kappa statistic, which ranges from 0 (no agreement) to 1 (complete agreement among raters).

The mean score in the four shops for all machines ranged from 69.4-74.5. The score for individual

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machine types ranged from 34-72. Hydraulic power presses received the highest scores (71-72) while full-revolution mechanical presses (hands in die) had the lowest scores (34-45).

The kappa statistic for all items ranged from 0.4-0.75, demonstrating fair to good inter-rater reliability. Medium priority items were generally scored with the highest reliability (kappa>0.8). Full-revolution presses (hands in die) were the most difficult to assess (kappa ranged from 0.5 to 0.63). One rater, who was trained at a different time and with a different format, consistently scored lower than the other two.

Importance of Findings: Scorecards can be used to reliably and consistently assess safety for a range of metal fabrication machines, which supports their usefulness as input to the design of safety interventions and measures of intervention effectiveness. Machine scores measured at four pilot locations indicate there is considerable room for improvement in machine safety in small metal fabrication businesses. Our pilot study results emphasize that training is important to the reliable application of these scorecards.

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Poster: 0138

Small Business Owners' Opinions about Written Health and Safety Information

LM Brosseau (1) presenting, AL Fredrickson (1), MA Casey (1)

University of Minnesota, Minneapolis MN, United States (1)

Importance of Problem: Owners of small businesses are less likely than those in large businesses to have ready access to affordable health and safety assistance. There is a need for simple, effective tools to bring about changes in small business owners' intentions and attitudes toward improving their employees' health and safety. Health communication can be effective in bringing about changes in attitudes, perceptions, knowledge and social norms. However, transmission of information does not ensure effectiveness.

Purpose: This presentation will describe the results of discussions with owners of small manufacturing businesses about their expectations for effective written health and safety information. These results were used to guide the design of newsletters for a study of their effectiveness in changing owners' attitudes and outcome beliefs toward workplace health and safety.

Methods: Owners (n=40) of small manufacturing businesses (5-50 employees) from twelve industrial sectors participated in focus groups. Participants were recruited by advertisement in an electronic newsletter, flyers at a local safety conference, recommendations from key informants, lists of businesses on trade association websites and contacts from a business database. Signed consent was elicited at the start of each discussion; each participant received $100. Owners were asked to describe what they read for their business and where they go for health and safety information. Participants were also asked to evaluate the content and format of sample newsletters and articles. In a second phase, participants were asked to comment on the design and content of a prototype newsletter.

Results: Owners most frequently read trade and local business publications; few regularly read or receive health and safety materials. They select business-related materials that are specific to their business, give them new ideas or have information that is easy to use. Insurance companies and business associations are the most frequently mentioned sources of health and safety information. The most important aspects of a prototype newsletter are sponsorship, color and graphics, length and relevance. Most are positive about a university logo, because it indicates a trusted source. The front page should have a table of contents with short article descriptions and catchy headlines. A newsletter should take no more than ten minutes to read.

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Owners did not like articles that were written in first person, used quotes, were too personal or gave no solutions. Owners think a newsletter will be successful if it is targeted to their industry, shows costs, focuses on a different topic with each issue, and gives readers an opportunity to provide feedback.

Importance of Findings: In the majority of cases, input is not sought during the development of health communication messages, usually for reasons of resources or time. We could find few studies that evaluated the effectiveness of written health and safety materials in general and none for owners of small businesses. The two-phase approach proved to be useful to developing a preliminary understanding of the audience, gathering new insights and confirming previous findings. Our results indicate that both design and content are important features of a health and safety newsletter. The most important design features are those that assist owners in determining whether to read or keep the information. Owners want content that is relevant to their business and industry, allows comparisons and identifies costs and benefits in actual dollar amounts.

Poster: 0139

Machine Safety in Small Metal Fabrication Businesses

DL Parker (1) presenting, Y Samant (1), L Brosseau (1), W Pan (1), M Xi (1), D Haugan (1)

Park Nicollet Clinic, Minneapolis, MN, United States (1)

Importance of Problem: Metalworking has been identified as an industry with one of the highest rates of non-fatal injury in the United States. Hand injuries and finger amputations are an ongoing cause of disability. However, the systematic evaluation of machine related hazards is lacking.

Purpose: The Minnesota Machine Guarding Study will evaluate the effectiveness of a peer-based technical and educational intervention designed to reduce exposure to amputation hazards among workers in small machining/metal working businesses. The baseline data presented here provide a profile of machine guarding in small (5-100 employees) metal fabrication businesses in Minnesota.

Methods: We developed a set of scorecards to quantify machine-guarding practices. Up to 25 randomly selected machines were evaluated in each facility. In addition, audits were conducted to assess machine-related safety practices and programs (e.g., lock out – tag out).

To compute a machine safety score, each scorecard item (e.g., barrier guard) was assigned a priority of one (high; e.g., emergency stops), two (medium; e.g., strain relief on electrical wires) or three (low; e.g., yellow color on the guards) to reflect both the probability and severity of injury. The number of scorecard items and items in each priority group varied by the type and complexity of the machine.

Results: A total of 824 machines in 40 shops were assessed, the majority of which were milling, drilling and boring machines (33%) or presses (31%). Shops had an average of 37 machines (SD = 27, range 5 -100) and 15 shops had fewer than 25 machines. Overall we found that 55% (SD = 11%) of items addressing machine guarding were present, 39% (SD = 11%) were absent, and 6.4% (SD = 4.1%) could not be assessed.

We assessed a total of 28,817 items. Of these, 47% were considered high priority, 31% medium priority and 22% low priority. Overall, 60% (SD = 16.4%), 54% (SD = 13.8%), and 51% (SD = 18.2%) of high (1), medium (2) and low priority (3) items respectively were present.

The four most commonly assessed high priority items were guards and devices, operational controls,

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electrical wiring, and emergency stops. We found no single machine with all high priority items present. Shops with safety committees tended to have better scores than did those without. Thirty-five percent of all businesses had established machine guarding procedures and 17% provided training in machine guarding (e.g., use of machine guards and devices in daily operations) to their employees.

Importance of Findings: Our data indicate that machine guarding and related safety programs in small metal fabrication businesses are inadequate. The data also suggest that safety committees are an important component in improving machine safety and related programs in small metal fabrication businesses.

The evaluation tools developed for this study provide a straight forward way for workers and owners to monitor machine safety within their shops. Evaluation tools provide a concise summary of important safety standards and prioritize findings. This prioritization is important in resource-limited settings where it may not be possible to remediate all problems at the same time.

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Poster: 0140

Seasonal Influences on Low Back Pain

EW Wood (1) presenting, KT Hegmann (1), A Garg (1), M Thiese (1), S Oostema (1)

University of Utah, Salt Lake City, UT, United States (1)

Background: Low Back Pain (LBP) is extraordinarily common, reportedly affecting 75-80% of the population (Andersson). Back claims represent 16% of total workers compensation claims, but a disproportionate 33% of total claim costs (Snook 1982; Webster and Snook 1994). Studies of LBP and/or LBP-associated disability have suggested risk factors including job physical factors, increasing age, a prior history of LBP, gender, smoking, physical fitness, psychosocial factors, and depression (Andersson 1997; Frymoyer 1989; Garg and Moore 1992, Schneider et al. 2005). To our knowledge, seasonal patterns of occurrence of LBP have not been previously reported.

Methods: Data were analyzed from a large multi-center occupational prospective cohort study (n=742) of 23 manufacturing plants from Utah, Wisconsin and Texas. All participants underwent a detailed questionnaire, structured interview, and 2 standardized physical examinations at baseline enrollment. Monthly follow up evaluations are performed to assess the development of cases of LBP, including using structured interviews on all participants, and standardized physical examinations on new incident cases of LBP. Outcome measures for LBP were assessed including using a 0-10/10 pain scale rating, pain plus use of medications (over-the-counter or prescription), and pain scale plus any other reported treatment.

Results: Monthly period prevalence of LBP with pain scale >3/10 was approximately doubled during the months of August (12%), September (13%), and October (13%) compared with all other months (monthly mean of 6.7%). Incident cases of LBP with pain scale >3/10 were greatest in the months of May (4.7%), October (4.6%), and November (4.3%), and least in the months of June (1.9%), and July (1.7%). Relative Risk for incidence of LBP with pain scale >3/10 was 2.8 from May, the highest month to July, the lowest (reference group) month. In comparing markers of severity, there is an apparent lag in time for reported markers of severity from pain scale >3/10,to pain scale >3/10 plus medications, to pain scale >3/10 plus any other treatment.

Discussion: These data indicate a seasonal pattern of LBP in this population of workers in the manufacturing sector. A greater period prevalence of LBP is observed in the months of August-

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October compared to all other months. The cause(s) of this increased prevalence remain unclear, but does not appear related to changes in production or staffing issues. Additionally, there appears to be a similar, seasonal lag in initiation of treatment (either use of medications or other treatment options) from initial onset of symptoms that is offset from incidence cases by about one month.

Conclusions: There appears to be a seasonal influence on LBP that has not been previously reported. While the cause of this increase remains unclear, awareness of this tendency by employers and policy makers may allow for better identification of risk factors and development of interventions to potentially reduce incidence of LBP.

Poster: 0141

HELD's Hand-Transmitted Vibration Program - From R&D to Practice

R Dong (1) presenting, J Wu (1), D Welcome (1), A Brumfield (1), T McDowell (1), O Wirth (1), K Krajnak (1)

NIOSH, Morgantown, WV, United States (1)

Significance and Objectives: Powered hand tools such as chipping hammers, grinders, chainsaws, rock drills, road breakers, and riveters are widely used in several industries such as foundries, automobile manufacturing, forestry, construction, mining, and bridge construction. Hand-arm vibration syndrome (HAVS) is one of the major diseases among more than one million U.S. workers exposed to hand-transmitted vibration (HTV). The most well-known component of HAVS is termed as vibration-induced white finger (VWF). Although HAVS has been studied for more than 80 years, the mechanisms of the syndrome are not sufficiently understood. It is still inconvenient, expensive, and technically difficult to accurately measure tool vibration and to assess related exposure factors such as applied forces and postures. The diagnosis of the disease still mainly depends on subjective questionnaires. Many aspects of current risk assessment methods have not been validated. Further studies on HTV exposure and health effects are required. In responding to these needs, a research and development program has been gradually established in the Health Effects Laboratory Division (HELD) of NIOSH. This presentation provides a brief outline of the program's status and its major achievements.

Methods: The HTV Program is currently aimed at: (1) conducting comprehensive studies of the biodynamics of the fingers-hand-arm system using advanced vibration testing and measurement methods, and finite element modeling; (2) developing practical and efficient methodologies to measure hand-applied forces and to assess hand-arm postures when using powered hand tools; (3) understanding the cellular, physiological, and pathological effects of vibration exposure using animal models; (4) using human subjects to determine the acute effects of vibration exposure on physiological measures such as the vibrotactile perception threshold shift, the thermal perception threshold shift, and blood circulation changes in the fingers and hand; (5) establishing new frequency weightings and dose-response relationships for risk assessments of the major components of hand-arm vibration syndrome; (6) developing more effective vibration measurement methods, devices, and expert systems so that reliable and accurate measurements can be carried out by non-experts in the field; and (7) investigating the effectiveness of vibration isolation devices such as anti-vibration gloves and sleeves through tests using

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an instrumented vibrating handle that simulates specific tools and vibration characteristics.

Results: Systematic studies have created several new concepts and methodologies for studying HTV exposure and health effects, generated new knowledge of the biodynamics of the system, proposed new frequency weighting for exposure quantification, developed new anti-vibration glove test methods and medical test devices, enhanced understanding of the disorders and diagnostic methods, proposed alternative tool tests, and improved vibration and force measurement methods. This program has led to many conference presentations and the publication of more than 40 peer-reviewed journal papers.

R2P Outcomes: Our instrumented handle developed from this program has been marketed as a commercial product. We have helped develop another commercial product: a novel 3-D HTV test system. Our automation nail press test has been patented. The knowledge generated from this program has directly influenced the revisions and/or developments of several international standards. The knowledge has also been used to provide consulting service and health hazard evaluation (HHE) for workplaces.

Poster: 0142

Using Workplace Medical Surveillance to Evaluate A New Preventive Program in the Beryllium Industry: A Model for The Manufacturing Sector

KJ Cummings (1) presenting, CR Schuler (1), DC Deubner (2)

National Institute for Occupational Safety and Health, Morgantown, WV, United States (1), Brush Wellman Incorporated, Cleveland, OH, United States (2)

As many as 130,000 U.S. workers are exposed to beryllium and potentially at risk for chronic beryllium disease (CBD), an immune-mediated granulomatous lung disease. The blood beryllium lymphocyte proliferation test (BeLPT) detects beryllium sensitization, identifying workers at higher risk for CBD. Prevention of sensitization and CBD has traditionally emphasized engineering controls to maintain airborne beryllium levels below the Permissible Exposure Limit (PEL) of 2 □g/m3. A beryllium ceramics manufacturing facility initially focused preventive efforts on engineering controls such as enclosing machines and augmenting exhaust ventilation. Yet a 1998 survey of the facility's current workers showed 10% (15/151) were sensitized and 3% (5/151) had CBD. A new preventive program, stressing administrative controls and personal protective equipment (PPE) in addition to further engineering controls, was subsequently established from 1998-2000. In 2000, medical surveillance was initiated for early identification of prevention failures, allowing ongoing evaluation of the preventive program. We aimed to determine the effectiveness of the new preventive program and the impact of medical surveillance on its content.

Starting in 2000, newly hired workers had BeLPTs at hire and 3, 6, 12, 24, and 48 months of employment. We compared workers hired from 2000-2004 with workers hired from 1993-1998 and tested in the 1998 survey, using sensitization per person-months of employment. With the facility's industrial hygienist, we reviewed changes made to the preventive program after the establishment of medical surveillance, identifying changes resulting from detection of beryllium sensitization.

From 2000-2004, the facility hired 126 new workers; 97 of these had at least 1 BeLPT after hire. Four workers had abnormal BeLPT results at hire, and 1 developed sensitization during employment, giving a range of sensitization of 0.7 (excluding those workers with abnormal results at hire) to 2.7 (including those workers) per 1000 person-months of employment. From 1993-1998, the facility hired 200 new workers; 70 were still employed during the 1998 survey and participated. Seven had sensitization, or 6.4 per 1000 person-months of employment. A total of 37 changes to the preventive program occurred from 2000-2005; 9 (24%) were motivated by medical surveillance results.

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These findings demonstrate the effectiveness of the new preventive program at reducing beryllium sensitization during the first years of employment. They also highlight the substantial impact that the workplace medical surveillance had on the preventive program's content. The extension of this comprehensive preventive program, in which engineering controls to reduce airborne beryllium levels are augmented by enhanced administrative controls and PPE, to other beryllium facilities has the potential to improve workplace safety and health throughout the beryllium industry. This preventive approach may also be useful in other manufacturing sector industries in which the existing PEL does not prevent adverse health outcomes or in developing industries for which exposure limits have not been established. More generally, workplace medical surveillance can be used to provide feedback on health and safety interventions throughout the manufacturing sector.

The findings and conclusions in this abstract have not been formally disseminated by NIOSH and should not be construed to represent any agency determination or policy.

Poster: 0143

Development of an Effective Beryllium Safety Model

DC Deubner (1) presenting

Brush Wellman Inc., Elmore, OH, United States (1)

Broad Importance of the Research Problem: Beryllium contributes substantial benefits to society. Its unique physical properties allow beryllium to play a critical quality and reliability role in defense, safety, health and a variety of commercial applications. However, people continue to be diagnosed with clinical chronic beryllium disease (CBD). Surveillance has identified in some settingsadditional persons with sub-clinical CBD or who are beryllium sensitized (BeS).

Purpose or Objectives of the Study: The study set out to define the workplace and personal susceptibility factors that contribute to CBD and BeS and to use this knowledge to develop, implement and evaluate an effective beryllium safety model.

Summary of Methods: A series of work place CBD and BeS prevalence surveys in the primary beryllium industry were carried out by collaborating government, academic, and industry based scientists under formal partnership arrangements. These data were linked to industrial hygiene methods research, genetics research, and laboratory and animal model research to create a rich perspective on the possible contribution to disease risk of routes of exposure, quantitative and qualitative attributes of exposure, and genetic susceptibility. Using these findings and drawing on other industrial hygiene knowledge and the beryllium safety models used in the United Kingdom and Japan, an enhanced beryllium safety model was proposed, implemented in a primary beryllium materials manufacturing company, and evaluated through serial testing of new workers.

Summary of Findings: The prevalence surveys suggested that beryllium sensitization can be detected in the first months in employment, and that casual entry into beryllium workplaces, and migration of beryllium from beryllium work areas onto people and into other workplace areas, along with air level exposures above 0.2 µg/m3 8h TWA, may contribute to elevated risk of CBD and BeS. A preventive model that incorporated features to address these issues was developed and implemented. Serial testing of workers hired since implementation show that BeS is being detected at a lower rate in these workers compared to prior experience.

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How the Findings Advance the Particular Research Field: The development of an effective beryllium safety model is an important accomplishment in itself. A number of linked research findings, such a genetic susceptibility factors, how small particles may penetrate skin, and how beryllium particles migrate and contribute to multiple routes of exposure, are important specific knowledge advances that have potential application to other occupational diseases..

How the Findings can be used to Improve Workplace Safety and Health and Related Outcomes: Work is underway in a government-industry partnership to develop tools and processes for communicating the enhanced beryllium safety model to downstream processors and users of beryllium materials. A primary beryllium manufacturer is also establishing partnerships with segments of downstream beryllium processors to characterize how best to apply the model to specific work processes.

How the Findings Relate to a Particular Industry Sector: The model of government--industry partnership that is proving successful with beryllium safety has other potential applications in the manufacturing sector. As the model for promoting beryllium safety with down stream users of beryllium materials is further developed and implemented this also will have other potential applications within the manufacturing sector.

Poster: 0144

Practical Impact of Programmatic Research Results in the Beryllium Industry

A Weston (1) presenting, M Stanton (1), K Kreiss (1), C Schuler (1)

National Institute for Occupational Safety and Health, Morgantown, WV, United States (1)

Exposure to beryllium and its compounds can lead to immunological sensitization of beryllium industry employees, which is identified by the blood beryllium lymphocyte proliferation test.

Cross-sectional screening of current workers in the primary beryllium industry documents sensitization rates of up to 10%, and longitudinal follow-up of worker cohorts, including former workers, documents up to 20% cumulative prevalence over 10-12 years. Sensitized workers are at high risk for chronic beryllium disease (CBD), and cross-sectionally, 10-100% of sensitized workers have beryllium disease at the time sensitization is identified, while others remain at high risk for future diagnosis of disease. We have estimated that there are more than 130,000 current U.S. workers and perhaps more than 1 million people who have ever been exposed beryllium may be at risk of CBD. Since 1998, NIOSH and the largest US producer of beryllium and beryllium-containing products have had a Memorandum of Understanding to conduct beryllium-related research. These research program efforts have included cross-sectional and longitudinal epidemiologic investigations of beryllium sensitization and chronic beryllium disease among the company's workers, and comprehensive industrial hygiene research. The Beryllium Research Program at NIOSH also includes a genetic component where participation is offered separately, but the employees that participate have access to their own results if they request them and to NIOSH's overall conclusions. The company has been using research results on process-relatedrisk, exposure-response relations, physicochemical characterization of beryllium particles, and potential multiple exposure pathways to effect changes in the workplace, which preliminary observations suggest may be resulting in reduced rates of sensitization. The research partnership also includes several communications components, among them an annual worker-focused meeting, bi-monthly research meetings, presentations to employees at the worksites, and newsletters. The annual meeting is attended by company employees from the three main facilities, company management and research staff, NIOSH researchers, and other interested parties who have included DOE, OSHA, union members, and other manufacturing concerns. The primary purpose of this meeting is to facilitate an open exchange of information between researchers and company employees. Researchers convey the latest study results to the employees, who subsequently communicate these findings to their fellow employees, both formally

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and informally. Employees present what they learned from the previous year's meeting, as they have presented it to their co-workers, along with the changes that they have made in their work practices, organization, and housekeeping. They also use this time as an opportunity to make researchers aware of the questions and concerns of their fellow employees. This company's employees have been empowered by management to address challenges in their work areas, including industrial hygiene sampling, using the company health and safety staff as consultants. Thus, NIOSH sees the needs for and results of our research in its practical translation in improved worker health and safety. This approach to conveying research results to those most directly affected and obtaining input and feedback directly from the plant floor has been effective in this manufacturing sector industry. This model could be successfully used in a wide variety of work environments.

Poster: 0145

International Evaluation of Injury Rates in Coal Mining: A Comparison of Risk and Compliance Based Regulatory Approaches

GS Poplin (1) presenting, HD Miller (2), J Ranger-Moore (1), CM Bofinger (3), M Kurzius-Spencer (1), RB Harris (1), JL Burgess (1)

University of Arizona, Tucson, AZ, United States (1), Colorado School of Mines, Golden, CO, United States (2), University of Queensland, Brisbane, Queensland, Australia (3)

Objectives: In the United States (U.S.), the mining industry is largely governed by a complex framework of health and safety regulations administered through a compliance-based regulatory structure. In contrast to this conventional approach, the Australian mining industry began evaluating the merits of a regulatory system predicated upon risk management and analysis in 1992, followed by its formal adoption in Queensland (QLD) in 1999 and in New South Wales (NSW) in 2002. The primary objective of this study was to determine whether implementation of the risk management approach was temporally associated with a more rapid decline in lost time injuries (LTIs) than seen in the U.S. In 2003, injuries represented over 80% of all reported mining accident, injury and illness claims.

Methods: Accident and illness surveillance databases in the U.S., QLD and NSW were accessed to collect relevant occupational injury data for the years 1996-2003. Variable definitions and data coding were harmonized between countries. Generalized estimating equations (GEE) were constructed to analyze the rates of decline among incident rate ratios (IRR) of LTIs among coal mines after adjusting for potential confounders.

Results: In 1996, LTI rates per 100,000 miners were 6,710, 6,072, and 9,694 in the U.S., QLD and NSW, respectively. From 1996-2003, LTIs per 100,000 miners declined 20% in the U.S. as compared with 78% and 52% in QLD and NSW, with respective rates of 5,388, 1,320, and 4,625 LTIs per 100,000 miners in 2003. GEE analyses indicated that for all mine sizes, underground mines posed a statistically significant increased risk of injury when compared to surface mines. Additional variables of significance included the size of the mining workforce and tonnage of coal produced annually. During the same period, the IRR for each region, adjusted for the type of mine, size of workforce and production, decreased by 11%, 72% and 44% in the U.S, QLD, and NSW, respectively. Declines in QLD and NSW were statistically significant when compared to the U.S.

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Conclusions: During the study period, the rate of LTIs decreased markedly in Australia relative to the U.S. The implementation of a risk-based regulatory approach in Australia may provide one potential explanation for this differential effect. Historically, the most significant declines in occupational injuries have been associated with regulatory change and the implementation of new technologies. Despite these efforts, mining remains one of the more dangerous occupations, and the rates of decline among injuries appear to be tapering off. Conceptually, the risk-based approach should produce a greater awareness of personal risk, whether related to personal behavior traits or awareness of the surrounding environment, resulting in a decline of injury rates.

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Poster: 0146

Injury and Fatalities in the Mining Workplace: Comparing the United States with Other Mining Countries

TM Brady (1) presenting, C Bise (2), CJ Fowler (3)

SRL/NIOSH, Spokane, WA, 99207, United States (1), Pennsylvania State University, State College, PA, United States (2), Johns Hopkins University, Baltimore, MD, United States (3)

This paper compares published mining statistics on injuries and fatalities for the United States and several mining countries where mining plays a significant role in the economic well being of the country. The authors examine similarities and differences between the United States experience and those of countries such as Canada, South Africa, Russia, and Sweden. The focus of discussion is the identification of sometimes hidden clues that help pinpoint the actual injury and fatality rates of the non-US mining countries. It is well known that mining is one of the most dangerous occupations in the Unites States; this paper will document how dangerous mining is in other major mining countries worldwide. The document will identify the technical needs for valid injury statistics and for injury prevention of countries outside of the United States and will give an indication of injury trends in countries where no statistics are available to improve occupational health and safety outcomes.

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Poster: 0147

The Oil and Gas Extraction Industry: Recent Fatal Injury Data and Areas for Action

NA Mode (1) presenting, Frederick, JR (1), S Richardson (2)

CDC/NIOSH, Anchorage, AK, United States (1), Bureau of Labor Statistics, Washington, DC, United States (2)

The mining industry has long been one of the more hazardous industries in the country. In 2004 the Census of Fatal Occupational Injuries (CFOI) program reported that the rate of fatal injury in mining was 28.3 fatal work injuries per 100,000 workers or nearly seven times the rate for the average U.S. worker and the second highest among major industry sectors. While the dangers of coal mining and many other mining industries have been well documented, the oil and gas extraction industry has received less attention, even though over half (55 percent) of the fatalities in mining from 1993 through 2004 were related to the oil and gas extraction industry. The purpose of this session is to summarize current surveillance data on fatal injuries in the oil and gas extraction industry, with a look at some of the initiatives being formulated to address the issues revealed by the data. CFOI data for 2003-2004 were analyzed for the oil and gas extraction (NAICS 211) and support activities for oil and gas (NAICS 21311, 213112) industries. For the two-year period from 2003 through 2004, there was a total of 183 fatal work injuries in oil and gas extraction (including support activities related to oil and gas extraction). The number of fatal work injuries in the oil and gas extraction industry increased by 15 percent over this period (from 85 in 2003 to 98 in 2004). Over a third of all oil and gas extraction fatalities occurred in one state (TX) and five states combined accounted for 70 percent of the fatalities (TX, LA, OK, WY, and CO). Highway incidents accounted for largest share of the fatal injuries, 31 percent, over the study period. However, another 21 percent of the fatal cases involved workers who were fatally injured after being struck by an object or by machinery, such as building materials or material handling machinery. Fires and/or explosions accounted for another 16 percent of the cases. While 4 out of 5 of the fatal injuries involved non-Hispanic, White workers (147), another 16 percent (29) of the fatally injured workers in oil and gas extraction were Hispanic. Of the 29 fatalities involving Hispanic workers for the two-year period, 20 occurred in Texas. CFOI data provide information for developing prevention activities and a framework for evaluation. To address this pressing problem, several federal agencies are working with industry to design innovative solutions to hazards. Findings and possible intervention strategies will be presented.

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Poster 0148

Personal Emergency Stop PE-StopTM For Mining

This research is aimed at significantly reducing the number and severity of traumatic injuries in our mining industry. To accomplish this, the grantee proposed continued development of their patent pending Personal Emergency Stop (PE-StopTM) technology. PE-StopTM is a system wherein all relevant powered equipment is equipped with a RF receiver/actuator that can shutdown the associated equipment. Each individual in the area is equipped with a small, wearable RF transmitter conveniently positioned for quick activation. In an emergency situation, any of the personnel can quickly (less than two seconds) shutdown all powered equipment in their immediate area. In order to accomplish this, we must first show that it will be beneficial to our society and technologically feasible. Therefore, Phase I research included estimation of the reduction in traumatic injuries and development of mechanisms that could be used to shutdown two types of powered equipment. Preliminary estimates show that a significant number of injuries and fatalities could be prevented. Two prototype receiver/actuator assemblies were developed and tested. These included a mechanical switch module (MSM) and an electronic switch module (ESM). In addition, a personal wearable transmitter was developed and tested. In the mining industry, very large equipment is used in confined spaces. The equipment operator's field of vision is generally very limited. In most situations, effective verbal communication is nearly impossible due to hearing protection and equipment noise. And, this practically deaf and blind operator is the only person in the area with the ability to stop/shutdown the equipment quickly. PE-StopTM can give all personnel the ability to quickly shutdown powered equipment in an emergency situation.

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Poster: 0149

Using Simulation and Modeling to Study Traumatic Injuries: Case Study Mine Roof Bolting

EF Fries (1) presenting

NIOSH, Pittsburgh, PA, United States (1)

This paper examines the boom arm vertical speed of a roof bolting machine to study the effects of its moving appendage at five different speeds, at three different seam heights and during four different work postures. The goal of this study was to determine the impact of the appendage speed on the likelihood of the operator's hand, arm, head, or leg coming in contact the moving appendage. The overall research goal is to reduce workers' risks to injury from exposure to underground mining machinery.

Accident investigation reports from the Mine Safety and Health Administration do not usually contain enough information to aid in studying this problem, and lab experiments with human subjects are not feasible because of safety concerns. As an alternative, researchers used a computer simulation model that uses a virtual human, vision tracking, and generates random human motions and risky work behaviors. Researchers accurately identified potential hazards of tasks by using a simulated environment that reflected the real world scenario.

Researchers partnered with J. H. Fletcher and Company who provided information on a roof bolting machine. Fletcher is the market leader supplying about 80% of the underground coal mine roof bolting equipment.

Results of a frequency distribution analytic approach showed that, regardless of other variables, contact incidents were always greater when the boom was moving up, always greater on the hand, and always greater for the boom arm part of the machine. The reason why the subject experiences more contacts when the boom arm is moving up rather than down is that more risky behaviors occur during drilling and bolting when the boom is ascending.

Results of a cross-tabulation analytic approach show that the 25th- percentile operators experienced more contacts than other operator sizes and had most of their contacts during a boom speed of 13in/sec. The hand-on-boom behavior during drilling and bolting tasks experienced more contacts than other work behaviors, and both tasks had most of their contacts during speed of 13in/sec. The 60-in seam experienced more contacts than other seam heights and had most of the contacts during speed of 16in/sec.

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For univariate logistic regression models, seam height is the most important predictor of the probability of a contact. However, a multivariate logistic regression model predicted contacts are more likely with the both-knee work posture in the 60-in seam, a 25th-percentile operator compared to a 55th-percentile operator, and speeds 16 and 22in/sec compared to 7in/sec.

Results of a survival analytic approach suggest that controlling the boom speed is the most important factor in determining the danger of an operator making contact. Based on the data collected, boom speeds greater than 13in/sec result in a substantial increase in danger to the roof bolter operator making contact Virtual operator's response time had little effect on the number of contacts experienced.

The mining industry can use the information in this study to reduce the likelihood that roof bolter operators experiencing injury due to contact with a moving roof bolting machine's boom arm.

Abstracts

Poster: 0150

Reducing Rock Fall Injuries to Coal Miners Using Roof Screen

GM Molinda (1) presenting, C Mark (1), S Gallagher (1)

NIOSH, Pittsburgh, PA, United States (1)

Over 500 coal miners are injured every year from the fall of rocks averaging 30 in x 18 in x 4 in. These rocks are falling between roof supports or before roof bolts can be installed. 61% of these injuries occur in the working face shortly after the coal has been mined. Severe crushing injuries and lacerations are occurring to roof bolters and continuous mining machine operators because of their high exposure to newly undercut roof rock. Research has shown dramatic reductions in injury with the use of welded steel screen to cover the roof. NIOSH is actively promoting the use of steel screen as the "gold standard" in providing protection from rock fall. NIOSH has addressed a number of barriers which exist to the widespread acceptance of steel screen by the coal mining industry. These include a lack of conviction of the safety value of steel screen, the cost of steel screen, the lost production time of increased support installation, and the potential for new injury which is perceived to be attached to screen handling and installation. Through extensive underground investigation NIOSH has documented the common surface control methods and shortcomings, and demonstrated the value of installing steel screen on-cycle. Walk-thru bolters and screen handling systems are currently available to operators and are beginning to find acceptance. NIOSH has developed and demonstrated a smaller screen called the Personal Bolter Screen (PBS) which allows the roof bolter to advance his own canopy of protection. The PBS is easier to install in confined mine openings, weighs 11 lbs, and can be handled by one miner. NIOSH researchers have identified potential handling hazards in the screen installation process, and developed hardware to attach the screen to the roof bolter for safer installation. A simulated mine opening has been built and biometric testing is underway to identify safe screen handling and installation procedures for low coal. NIOSH recently completed an economic study which shows that the true cost of an injury from workman's comp, loss of production, legal proceedings, extra support, cleanup, and out-of- seam dilution can exceed the additional cost of screen installation. Screen installation demonstrations and time studies have been conducted at 12 mines as a means to directly promote the use of high coverage surface control. Through an array of technology transfer forums, including direct presentation of research findings to the Mine Safety and Health Administration (MSHA), presentation at open industry briefings, publication in trade journals, and the distribution of a training video, NIOSH is attempting to change the culture of acceptance of rock fall injuries. We look forward to the day when rock fall injuries no longer plague the American underground coal miner.

Abstracts

Poster: 0151

Reducing Injuries in Underground Mining Through the Application of Waterjet Scaling

ME Kuchta (1) presenting, HB Miller (1)

Colorado School of Mines, Golden, CO, United States (1)

A review of accident and fatality statistics for underground metal/nonmetal mines show that nearly one-quarter of all fatalities at these operations were related to rock falls, where nearly one-third of these fatalities involved scaling activities. In response to this detrimental trend, research is being conducted to evaluate the effectiveness of using high-pressure waterjet technology as part of a mechanized scaling system to safely remove loose and unstable rock from underground mine openings. Sponsored by CDC NIOSH, this project builds upon previous research in waterjet scaling performed by the authors, where waterjet scaling has been shown to be a viable alternative to conventional scaling methods. With the current research program, the relative effectiveness of various nozzles designs, including continuous, oscillating, and two types of pulsed jets, are being examined. It is believed hat the utilization of a properly designed waterjet system will provide significant improvements in employee safety over that of conventional manual or mechanized scaling methods by removing miners from high-risk areas and reducing their potential exposure to rock falls. Additional benefits stem from the ability to utilize high velocity fluid to scarify and clean rock surfaces, thereby substantially improving the performance and adhesion characteristics of shotcrete as a ground support membrane. Focal to this proposed research are efforts to empirically quantify the critical operating variables associated with hydraulic scaling and to assess the performance and efficiency of these systems relative to conventional scaling methods in terms of employee health and safety. The project will conclude by performing an extensive field trial at an operating underground mine, where exposure assessments and risk analysis will be conducted.

Abstracts

Poster: 0152

Methods to Characterize Diesel Particulate Matter in Occupational Settings

SE Mischler (1) presenting

NIOSH/PRL, Pittsburgh, PA, United States (1)

Exposure of workers to diesel particulate matter (DPM) is gaining attention due to the growing amount of evidence that DPM can cause both short and long-term adverse health effects. NIOSH Researchers have developed an engine exhaust emission measurement laboratory to allow the characterization of diesel particulate matter in an occupational setting. This laboratory will enable researchers to characterize fine and nano-sized particles emitted from both modern and older diesel engines operating with and without diesel emission control technologies. This work is part of a large NORA effort in the area of ultra-fines research. Work to this point has shown that the use of certain control technologies can increase the concentration of nano-particles in the workplace air. The knowledge gained through this research will assist the medical community in gaining an increased understanding of the health risks associated with exposure to diesel exhaust in the mining environment as well as in other occupational settings. Additionally, it will aid industry, labor, and government in the development of effective diesel control strategies thereby reducing the exposure of workers to DPM. This work is all part of a larger diesel emission control and measurement effort that is being done in conjunction with both a Coal Diesel Partnership and a Metal/Nonmetal Diesel Partnership, both of which involve industry and labor representation. Findings from this research will be disseminated through partnership meetings, workshops, peer-reviewed publications, and presentations.

Abstracts

Poster: 0153

A Person-Wearable Monitor to Continuously Measure Occupational Dust Concentrations

SE Mischler (1) presenting

NIOSH/PRL, Pittsburgh, PA, United States (1)

Measurement of workplace dust is an essential first step in eliminating lung disease caused by overexposure to dust. Currently, personal coal mine dust exposure measurements rely on a filter-based method, which takes days or weeks before the results are returned to the miner. NIOSH in partnership with the National Mining Association, Bituminous Coal Operators Association, and the United Mine Workers of America has embarked on research to improve sampling instrumentation for use in the mining industry at the recommendation of The Secretary of Labor and the Federal Advisory Committee on the Elimination of Pneumoconiosis among Coal Mine Workers. As a result of this research, a new person-wearable monitor, to continuously assess occupational exposure to respirable particulate, has been developed through the miniaturization of a highly successful environmental monitor. Extensive field testing in coal mines has shown that this monitor accurately measures occupational coal dust concentrations and is comparable to the technique used for regulatory measurement. Applications to other areas of industrial hygiene monitoring are anticipated. Results of this research effort will be disseminated through Partnership meetings, publications, and workshops. Additionally, further research will be conducted to evaluate how miners make use of this technology in their day to day work environment. This will further the r2p process.

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Poster: 0154

Clothes-Cleaning Booth Enables More Effective Removal of Dust from Workers' Clothing

DE Pollock (1) presenting, AB Cecala (1)

NIOSH/PRL, Pittsburgh, PA, United States (1)

A quick, safe, and effective process has been developed that allows workers to clean their dust laden work clothing periodically throughout the day. Contaminated work clothing has been a known major contributor to increased employee respirable dust exposure for many years. This newly designed process is relatively inexpensive and can be easily installed at any operation to allow workers to clean their clothing without exposing the worker, the work environment, or co-workers to elevated respirable dust levels. The clothes cleaning process uses an air-spray manifold to blow dust from a worker's clothing in an enclosed booth. Since the booth is under negative pressure, no dust escapes to contaminate the work environment and or other workers. The worker performing the cleaning process is required to wear a half-mask fit-tested respirator, hearing protection, and full seal goggles. Dust samples taken inside the respirator of test personnel performing the clothes cleaning process showed minimal to no respirable dust exposure. During field testing, the clothes cleaning process was 10 times faster (taking less than 20 seconds) and was approximately 50 percent more effective than either the federally approved method of vacuuming or the most commonly used method of using a single air hose. The National Institute for Occupational Safety and Health developed this new process under a cooperative research effort with Unimin Corporation. This clothes cleaning process has tremendous applicability to any industry where workers' clothing become contaminated with any type of dust or product. Current research is looking to the development of a more mobile stand alone unit that does not require a baghouse. Results of this research effort will be disseminated through workshops with industry organizations such as the National Stone, Sand and Gravel Association and Industrial Minerals Association-North America, publications in industry trade journals, and conference presentations.

Abstracts

Poster: 0155

Remotely Installed Mine Seals: A Technology Upgrade

MA Trevits (1) presenting, AC Smith (1), JF Brune (1)

NIOSH, Pittsburgh, PA, United States (1)

Over the last 6 years, 20 mine fires or thermal events have occurred in underground coal mines in the United States. On average about three events have occurred each year and a maximum of five events have occurred in any given year over this time period. Although not all mine fires cause fatalities, each event has the potential for disastrous consequences due to the presence of methane gas and the limited means of egress from the mine. Direct attempts are normally made underground to control the fire through the application of fire extinguishing material. However, an indirect approach is applied when access to the fire zone is impossible. This approach involves the construction of mine seals to close off mine openings to limit the inflow of oxygen and enclose the fire zone. Mine seals can be constructed from within the mine or remotely from vertical boreholes. The process is usually followed by flooding the affected area or the entire mine with water, inert gases, silt or other material to extinguish the fire. When underground access is impossible or too dangerous, mine seals are often constructed remotely from the surface through vertical boreholes. Underground observations suggest that the current available commercial technology often cannot fully close the mine opening. The resultant mine seals cannot adequately control inflow of oxygen which can lead to uncontrolled growth of a mine fire. Also, seals that do not close the mine opening cannot be used as bulkheads for impounding water or inert gases for fire extinguishment. Research is underway under a NIOSH-funded small NORA effort that was initiated in 2005. This work is designed to identify and remedy existing technology shortcomings, to develop novel technologies, and to transfer the new or improved technologies to the mining industry as soon as possible. Work under this effort consists of improving downhole material mixing and delivery technology followed by full-scale in-mine testing (air leakage and mine explosions). This work is being conducted with active industry participation and with the input of Mine Safety and Health Administration technical specialists who serve as research partners. This presentation will provide an overview of the work, research accomplishments and technology transfer activities.

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Poster: 0156

Participative Ergonomics for Manual Tasks Injury Prevention in Australian Coal Mines

RJ Burgess-Limerick (1) presenting, L Straker (2), C Pollock (2), G Dennis (1), S Leveritt (1), S Johnson (1)

University of Queensland, Brisbane, Queensland, Australia (1), Curtin University of Technology, Perth, Western Australia, Australia (2)

A participative ergonomics approach to manual task injury prevention asserts that, given sufficient training and motivation, work teams are in the best position to undertake hazard identification, risk assessment and risk control activities. This paper describes a multiple case study in which a participative ergonomics for manual tasks program incorporating training in manual tasks risk assessment and control was implemented in 11 surface and underground coal mines.

Results include examples of risk assessments and control suggestions provided by the miners. These demonstrated that after a relatively short training period, and given appropriate tools, coal miners are able to undertake manual task risk assessment and generate potential control options.

The mines involved have highly developed safety management systems and this, combined with the low staff turnover, creates opportunity for skills in manual task risk assessment and control to be utilised and for design changes to be implemented. Conversely, the size and the complexity of the workplaces, creates challenges for ensuring that the control suggestions resulting from the participative ergonomics process are evaluated, trialled, and implemented. The processes employed across the sites to achieve this varied, and had highly variable success. A person onsite who drives the process, the site "champion", is very important - this person needs to have easy access to and support from management to proceed with projects. Sites where such a person did not emerge, or did not stay at the site, struggled to realise implementation of the suggested controls.

It was seen to be important, particularly given the delays that typically occur, that communication with the teams involved in a project was maintained. Even if there was no progress to report, it was important that workers understood that the process was still underway. Seeking feedback on changes of, or modifications to, plant and equipment was also important, and was not often done very well. Communication between different crews (i.e. day, afternoon and 'dog-watch' shifts) was also a common problem.

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The speed with which potential control ideas were generated was impressive, however the information obtained typically requires considerable refinement following the "brainstorming" stage, and it is this stage that the process has the greatest potential to break down. The expertise drawn upon to identify the nature of the risk and to suggest control ideas may not be the same expertise that is needed to design and implement the controls. Input from other areas may be required for a variety of reasons, including: (a) ensuring that materials introduced into the underground environment are intrinsically safe; (b) ensuring that the use of new controls will not create a flow-on effect on any other part of the operation; (c) ensuring that costs are realistic; and (d) ensuring that controls comply with regulatory requirement, site and company guidelines.

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Poster: 0157

Field Evaluation of a Continuous Passive Lumbar Motion System Among Operators of Earthmoving Equipment

MJ Jorgensen (1) presenting, M Viswanathan (1), NK Kittusamy (2)

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Operating heavy mobile construction equipment is often associated with elevated rates of low back discomfort. However, few formal studies have evaluated interventions that may reduce low back discomfort among these workers. The objective of this study was to determine the effectiveness of a continuous passive lumbar motion system (CPLMS), which is an additional lumbar seat support that can cyclically inflate and deflate, in reducing low back discomfort among operators of heavy earth-moving equipment. This was a quasi-experimental intervention study with multiple observations in which body part discomfort surveys were collected from an intervention and a control group during normal working days. The intervention group also completed a CPLMS preference survey after completing use of the CPLMS for 646 hours.

Results from the body part discomfort survey showed no significant difference in low back discomfort between mornings and evenings for the first seven days, but a significant difference on the eighth and final day for the intervention group. In the control group, there was a significant difference between mornings and evenings on three out of five days for the low back discomfort score, where, the evening score was always higher than the morning score for all days.

In addition, comparisons between the control and intervention groups indicated that the difference between morning and evening low back discomfort rating was less for the intervention group than the control group ($p = 0.06$). The CPLMS preference survey showed that 54% of the operators felt very comfortable using the CPLMS, 36% wanted one for their equipment, and 54% showed interest in experimenting with the CPLMS for a longer time period. Results from this study suggest that the use of this intervention may effectively reduce the development rate of low back discomfort experienced by operators of heavy earth-moving equipment throughout the work day.

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Poster: 0158

Disseminating Research Products Based on Stakeholder Characteristics and Needs

DCR Reinke (1) presenting, DsY Yantek (1), PJ Jurovcik (1)

NIOSH-Pittsburgh, Pittsburgh, PA, United States (1)

Noise induced hearing loss (NIHL) continues to be a problem in the mining industry. Hearing loss data suggests that by the age of 50, nearly 90% of coal miners have a hearing impairment, as compared to 10% for a general population of non-exposed males. The use of engineering controls as a way to lower noise exposure is the most desired among the hierarchy of controls to prevent NIHL. While integrating stakeholder involvement into the research and development is imperative to successful technology transfer efforts, often communicating this information is overlooked. This presentation will highlight stakeholder importance in the design and development of marketing and dissemination products. In partnership with stakeholders in the mining and surface drilling industries, NIOSH conducted research to develop engineering control technologies that reduces workplace noise exposure. Previous studies indicated that operators of non-cab surface drill rigs are overexposed to noise. These rigs are in use for the work of various surface drilling industries including mining and construction. Many surface rigs do not have full cabs as a result of the original equipment manufacturer design or the prohibitive cost of aftermarket products. NIOSH researchers determined that a noise engineering control to protect the operator at the rig's control panel would be effective based on the organization of work practices and typical worker behaviors.

Developed as a partial cab, the NIOSH engineering control design addressed stakeholders needs associated with cost, transport and worker usage. Field tests found the partial cab effective in reducing overexposure at the rig's control panel, a typical location for a drill rig operator. Sound levels at the control panel were reduced from 104dB(A) to 96dB(A). Coupled with continued use of personal protective equipment, such as hearing protection devices, the partial cab can help reduce sound levels below the NIOSH REL (85 dB(A)) during a typical work day.

Taking into account industry characteristics, researchers developed industry-specific marketing and technology transfer materials to disseminate the research findings. A communication suite was assembled with components that would help surface drilling operators to understand the benefit of this noise control technology as well as construct the product. Packaged on a CD to be viewed on a standard computer; this suite includes video, graphic and instructive components. For example, a viewer of the CD can watch a

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video that highlights the benefits of the partial cab in real work scenarios, view CAD drawings of the partial cab design and then print out information on construction materials and design details. Additionally, the CD provides background information on noise induced hearing loss and hearing protection devices for knowledge acquisition. This information can also be coupled with an accompanying training checklist to help promote the partial cab's importance to workers utilizing the technology. By identifying specific industry characteristics and needs, the partial cab communication suite serves as an example of translating

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Poster: 0159

Closing the Loop from Science to Prevention - A NORA Research Initiative

T Pizatella (1) presenting

NIOSH, Morgantown, WV, United States (1)

Occupational traumatic injuries affect all 130 million U.S. workers, regardless of their industry or occupation. Each day, an average of 15 U.S. workers are fatally injured. The leading causes of fatal occupational injury are motor vehicles, falls, and homicides, which account for nearly 3,000 worker deaths annually. Additionally, there are more than 4 million nonfatal occupational injuries each year.

Despite gradual reductions of work-related injuries over the past several decades, occupational trauma remains a public health problem of significant proportion. Workplace injuries often affect workers in their prime, productive years, increasing their adverse effect on the involved families and communities, both socially and economically. The economic burden of occupational traumatic injuries rivals that of cancer and heart disease.

As a result of the continuing toll of workplace trauma, NIOSH funded Occupational Traumatic Injuries: Closing the Loop from Science to Prevention as a NORA Research Initiative in fiscal year 2001. The overall objectives for the initiative are to: build on past NIOSH surveillance and research efforts in traumatic occupational injury to increase prevention impact; emphasize completing the Public Health Model to bring practical and effective prevention products to the workplace; and widely disseminate research results for application to worker protection programs. Through this NORA Initiative, NIOSH funded six projects which address various research priorities for occupational traumatic injury: three technology transfer projects and three intervention evaluation projects. The NIOSH Division of Safety Research, along with the Pittsburgh and Spokane Research Laboratories, each has projects funded through the Initiative. The projects were designed to be interdisciplinary and involve collaboration across NIOSH and with relevant stakeholders and industry partners.

As work on the projects advance, significant efforts were directed to focus on research to practice issues to maximize the impact of the new information and protective devices being developed. To date, two of the six projects have been completed, with three more scheduled for completion in 2006, and the final one targeted for completion in 2008. The projects are leading to new knowledge for improving worker safety as well as updating consensus standards. Additionally, NIOSH research staff has been working with

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several manufacturers to further refine protective devices developed through the Initiative for application in the workplace. The overarching theme of Closing the Loop to Prevention, i.e., following the r2p continuum of bringing practical and effective prevention products to the workplace, is being demonstrated. The key accomplishments and impact of the Initiative projects will be summarized to exemplify successful strategies for transferring new knowledge and technology from science to prevention.

Poster: 0160

An Action Agenda for Commercial Motor Vehicle Driver Safety

DM Freund (1) presenting

USDOT/FMCSA, Washington, DC, United States (1)

In 2003, trucks and buses were involved in some 436,000 highway crashes, resulting in 4,986 fatalities and 122,000 injuries. The fatalities represent nearly 12 percent of all highway fatalities and 4.2 percent of all highway injuries. The fatality rate per 100 million vehicle miles travelled is 2.3 for commercial motor vehicles, but 1.5 for all highway vehicles. The comprehensive cost of commercial vehicle crashes is over $14 billion per year. As in other transport modes, improper or insufficient driver actions or inactions – on the part of drivers of all vehicles -- contribute to the majority of these crashes.

Approximately 10.4 million truck and bus drivers are subject to Federal and State commercial vehicle safety regulations. These regulations include physical qualifications, prohibition on alcohol abuse and controlled substance use, licensing standards set according to the types of vehicles operated, hours of service (specified periods for driving, on-duty, and off-duty time), and prohibitions against operating vehicles if the driver has been convicted of various categories of serious traffic violations. Many of these regulations date from the 1950s – 1970s and require updating to enable them to contribute to improved highway and motor carrier safety.

Driving as a profession can be divided into 3 elements: physical and psychological qualifications; safe vehicle operation; and occupational qualification. The intersection between physical and psychological qualifications and occupational qualification has been explored in a series of studies of driver fatigue and loss of alertness. However, the intersection between occupational qualification and safe vehicle operation – driving knowledge, driving skill, and vehicle preparation – has not been addressed since the early 1990s. The intersection between physical and psychological qualification and safe vehicle operation – ergonomics and effects of environmental stressors – has received even less attention.

An important model of highway safety is the Haddon matrix, which describes the crash environment in terms of time (pre-, during, and post event) and operational factors (driver, vehicle, environment). This model can be adapted to address the safety needs of drivers in temporal terms (pre training/ selection; training and selection; and post-selection oversight) and in terms of the degree and type of oversight appropriate for different situations (such as initial, in-service, advanced, and remedial training).

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The Federal Motor Carrier Safety Administration (FMCSA), an agency of the U.S. Department of Transportation, is embarking on a major set of initiatives to improve highway safety by focusing on the world and work of the truck and bus driver. In 2005, the agency began a program to review and revise the driver medical qualifications, including establishment of a Medical Review Board and merging the physical qualifications and Commercial Drivers License (CDL) standards. In 2006, the agency will expand the initiative to explore driver skills acquisition and enhancement, particularly for the entry-level driver. It will also continue its review of State licensing oversight and implementation of CDL sanctions. The agency will also expand a 2004 pilot Driver Violation Notification Service Feasibility Study program where State licensing agencies automatically notify employers when their CDL drivers are convicted of driving violations or experience CDL status changes.

Finally, changes in demographics, attractiveness of other occupations, and many other factors are contributing to a current and projected shortage of truck and drivers. Given that the U.S. economy depends on trucking – in 2002, trucks hauled about 64 percent of the value, 58 percent of the tonnage, and 32 percent of the ton-miles of total shipments – and that highway passenger transportation serves many communities and users with limited access to other transportation – it is in the Nation's interest to continue to develop and nurture the drivers of the future. FMCSA will explore this important concern in concert with its industry and safety partners and stakeholders.

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Poster: 0161

Evaluation of Emergency Service Vehicle Occupant Safety

PH Moore (1) presenting

National Institute for Occupational Safety and Health, Morgantown, WV, United States (1)

Broad Importance of the Research Problem: Working in the patient compartment of an ambulance in transit exposes emergency medical service (EMS) personnel to a high-risk of crash-related injury or death on every call. All occupants of ambulance patient compartments are at a 5-fold higher risk of suffering fatal crash-related injuries than the front seat ambulance occupants. Ambulance drivers and front seat passengers are protected from vehicle crash-related injuries by occupant protection systems required by Federal Motor Vehicle Safety Standards (FMVSS). However, similar protection for the patient compartment occupants is not addressed by FMVSS and research related to crash protection for these occupants is sparse. A key contributor to the increased risk among EMS staff in the patient compartment is lack of use of available lap belts or other occupant restraint systems. Seat belts currently provided in ambulances do not allow the mobility that EMS workers need to care for patients. As a result, EMS workers routinely work unrestrained in the patient compartment.

P**urpose or Objectives of the Study:** This project seeks to prevent work-related EMS vehicle crash injuries to emergency service workers in ground ambulance patient compartments. This objective will be accomplished through the development of mobile occupant restraint systems that allow EMS personnel the mobility to provide appropriate patient care while simultaneously providing a level of crash protection similar to that available for front seat occupants.

Summary of Methods: Crash-related injury mechanisms for EMS staff in patient compartments were identified through NIOSH Fatality Assessment and Control Evaluation investigations and National Highway Traffic Safety Administration reconstructions of ambulance crashes. Engineering interventions were identified through an announcement in FedBiz ops for potential solutions to the problem. From this announcement, four occupant restraint systems that provide user mobility and restraint were chosen for evaluation. NIOSH, in cooperation with public and private sector partners, evaluated these mobile restraints using accepted automotive industry methods that included mathematical models; a 29-run, laboratory-based sled-testing program; and a four-vehicle crash test program. Each sled and crash test included four instrumented anthropomorphic test devices (ATD), or crash test dummies, in the patient compartment. The test data was compared with Injury Assessment Reference Values (IARV) used by the automotive industry to relate force and moment data from ATDs to the potential for human injury.

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Summary of Findings: The crash investigations and reconstructions show that regardless of occupant location within the ambulance patient compartment, secondary collisions between unrestrained occupants and compartment bulkheads and cabinets is the primary injury risk. During the sled and crash tests, the mobile restraints which proved structurally sound at acceleration levels between 25 and 30 Gs, prevented the ATDs from secondary collisions in the patient compartment. Comparison to the IARVs for head, neck, and chest injury indicated that the restraint systems were capable of providing protection similar to that afforded front seat occupants by FMVSS requirements. Use of mobile restraints has the potential to significantly reduce crash-related injuries to EMS workers in ambulance patient compartment.

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Poster: 0162

Risks for Workplace Violence in Long Haul Truckers

DG Anderson (1) presenting, DB Reed (1)

University of Kentucky, Lexington, KY, United States (1)

Significance of problem: Seventeen workers are murdered and an estimated 33,000 workers experience a non-fatal assault in the U.S. each year (NIOSH, 2004). The transient nature of trucking increases the risk for experiencing workplace violence (Renner, 1998).

Purpose: To investigate the incidence and distribution of workplace violence among long-haul truck drivers. Specific aims: (1) identify the types of violence experienced by long-haul truck drivers; (2) identify risk factors that contribute to the violence; (3) differentiate the risks of work-related stress among distinct socio-demographic groups of truckers; (4) determine the prevalence of domestic violence experienced by long-haul truck drivers; and (5) identify work environment factors that place truck drivers' at risk.

Method: A quantitative survey has been conducted with a non-probability sample (N=987) recruited at truck shows and truck stops across the U.S. Data were collected on violence-related variables (e.g. harassment, weapons, assault, rape, worksite security, psychological strain, and substance abuse). Qualitative data on violence at the worksite is continuing to be collected via phone interviews with a purposive sample of 30 female and 30 male participants.

Data Analysis: Descriptive statistics will be compiled as appropriate for the level of measurements of the variables. Dependent on the specific aim, bivariate relationships, logistic regression, discriminant analysis, Cronbach's alpha, and ANCOVA will be used. Constant-comparative methods and content analysis matrices will be used to describe, analyze, and interpret the qualitative data.

Preliminary Findings:

- N = 987 truckers surveyed
- 90.45% Caucasian (C); 6.26% African-American (A-A); and 3.28% other races
- Majority of both groups male (C = 80.7%; A-A = 96.72%).
- African-American truckers were more likely to be unmarried (A-A = 24.6%; C = 14.1%)
- 44.4 years median age of the Caucasian truckers; 39.5 years median age of the African-American truckers
- 12% Caucasian truckers and 13% African-American truckers surveyed do not maintain a residence outside of their trucks

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Variable	% of Caucasian subjects	% of African-American subjects
Robbery	6.92	13.11
Physical Assault	7.27	3.28
Sexual Assault	2.50	0.00
Had an incident (robbery, physical assault, sexual assault)	10.56	19.67
Carried a weapon	44.67	45.45

Conclusion: Preliminary results indicate that long-haul truckers are a group at risk for workplace violence. Safety measures at truck stops, rest areas, and delivery sites are needed to decrease workplace violence experienced by this occupational group. There are disparities in the type and amount of workplace violence dependent on gender, race, and occupation. Because of the disparities, research is necessary to determine the best practices for a diverse workforce.

Keywords: Workplace violence, long-haul truckers, occupational health

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Poster: 0163

Intimate Partner Violence & the Workplace: Moving Toward a Better Measure of Partner Violence Job Interference

JE Swanberg (1) presenting, TK Logan (1)

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Background: An estimated 1.5 million women experience partner violence annually in the United States. While partner violence has serious physical and psychological consequences for its victims regardless of where the violence occurs, data indicates that there are serious workplace implications. According to the National Crime Victimization Survey, each year between 1992 and 1996, an average of 18,000 people were assaulted by an intimate partner at work. The Bureau of Justice Statistics reports that among the 1 to 2 million employees victimized at work, intimates are identified as the perpetrator in approximately 1% to 3% of all workplace violence incidents. Furthermore, despite recent attention on employee-motivated aggression in the workplace, analysis of the National Crime Victimization Survey data shows that employees are nearly as likely to be assaulted by a partner at work as by a coworker. The Bureau of National Affairs estimates that employers spend $3 to $5 billion yearly on consequences related to partner violence, including lost productivity, employee turnover, and health care costs.

The Occupational Safety and Health Administration includes “violence by personal relations” as a form of workplace violence and provides measures for addressing WPV. Yet, there has been limited research on partner violence as a workplace issue. As a result, measurement of this workplace issue is at an early stage of development. One step to developing strategies that may prevent partner violence from interfering with women’s employment, disrupting workplace operations, and reducing negative consequences when it does, is to create a measure that assesses the ways partner violence interferes with women’s employment andthe places where they work.

Study Objective: This study seeks to identify the constructs that comprise: (1) partner violence job interference and (2) consequences associated with partner violence job interference.

Study Methods: Using a sample of 518 employed women with protective orders and interviewed between February 2001 and November 2003 in Kentucky communities, this study conducts factor analyses to identify the factors that comprise partner violence job interference and its associated consequences. Effects of partner violence on work were measured using a modified version of the

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Work/School Abuse Scale Riger, Ahrens & Blickenstaff (2000) and using 6 new items developed by authors based on a previous pilot study.

Preliminary Findings: Preliminary analyses suggest two findings. First, partner violence job interference is comprised of two factors: work disruption and job-related stalking. Second, job-related consequences of partner violence are comprised of job performance consequences and job retention factors.

Implications for Further Research and Workplace Safety: Further work is needed to understand this complex social problem. The current measure may need to include the effects of partner violence on other people in the workplace. Further, the measure could be improved by including other exacerbating factors such as substance use or mental health problems and including positive consequences of employment for victimized women. Results suggest that workplaces may want to be more explicit in their procedures for managing partner violence as a form of workplace violence.

Industry Application: Partner violence cuts across all economic groups; partner violence job interference is an issue all workplaces regardless of industry should address.

Poster: 0164

Violence in the Home Visiting Workplace

KM McPhaul (1) presenting, K Soeken (1), JV Johnson (1), JA Lipscomb (1)

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Importance: Workplace violence is recognized as a significant hazard in the healthcare sector but has not been studied extensively in visiting health care workers. These workers are potentially exposed to violence from clients, household members, and communities without the safety services of a "fixed" workplace. The limited data suggest that they experience risk factors including client characteristics, location, working alone, and work schedule. The prevalence of verbal violence may be as high as 37% and physical violence 19.9%. (Schulte, 1995; Barling, 2001). Homicides have also been reported.

Purpose: Develop new measures for the study of workplace violence in the home visiting healthcare workplace using the NIOSH Organization of Work framework.

Methods: The study was a mixed method cross-sectional design using focus groups, expert content reviewers, cognitive interviews, and a self-administered survey of home visiting health workers at four home health programs (n=130). Three new scales were evaluated for evidence of reliability and validity using Cronbach's alpha, item analysis, CFA, and hypothesis testing.

Results: Over 60% (61.5%) of the sample reported being verbally abused in the last year. Just over 10% reported being assaulted in their home health career. The Home Visiting Risk Scale (HVRS) and the Employer Violence Prevention Scale (EVPS) demonstrated evidence for acceptable reliability and preliminary validity. Six hypotheses were supported. The HVRS was significantly and positively associated with violence and psychological job demands and different for those who made a safety decision in the past 12 months; the EVPS was significantly and positively associated with social support and staff perception of the OSHA Violence Prevention elements, and negatively correlated to violence. Furthermore the data demonstrate a dose-response relationship between home visit risk and verbal, physical, and total violence. Logistic regression controlling for job type, caseload and for-profit status further supported the validity of the risk measure and the employer role measure.

Conclusions and Implications: The Home Visit Risk Scale and Employer Violence Prevention Scale demonstrated preliminary evidence for reliability and validity. These scales should be utilized in a larger, representative sample of home visiting health providers in order to verify their usefulness. The findings

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also support conceptualizing home visit risk for violence and violence prevention using the OSHA Workplace Violence Prevention Guidelines for Healthcare and Social Services. Measuring the Hazard (Home Visit Risk) and the Control (Employer Strategies) provides a means to assess employer adherence to a comprehensive workplace violence prevention program. These findings relate to the home visiting healthcare and social services workforce including nurses, homecare aides, case workers, child protective services, and mental health case managers.

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Poster: 0165

Occupational Violence: Incidence, Consequences and Identification of Risk Factors as a Basis for Prevention

SG Gerberich (1) presenting, TR Church (1), PM McGovern (1), HE Hansen (2), NM Nachreiner (1), MS Geisser (1), AD Ryan (1), SJ Mongin (1), GD Watt (1), A Jurek (1)

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Work-related violence has recently been recognized as a major problem. Homicide is the third leading cause of occupational fatality, overall, and the second leading cause of occupational fatality for women. However, there has been a serious deficiency in the knowledge of non-fatal work-related violence and the associated risk or protective factors. Few analytic studies have been conducted, whereby comparisons of exposures have been made between victims and non-victims of violence -- studies that enable identification of risk or protective factors and, in turn, serve as a basis for prevention.

The purpose of this study was to identify the magnitude and consequences of and risk factors for the problem of work-related violence within a major occupational population. In particular, this enabled determination of the relation between work-related violence in a cohort of registered and licensed practical nurses and: 1) personal exposures; 2) environmental situations/exposures in the work environment; and 3) characteristics of others in the environment (other workers, patients, visitors). In this study, work-related violence was defined as the intentional use of physical force or emotional abuse, against an employee, that resulted in physical or emotional injury and consequences. This included physical and non-physical violence (threat, sexual harassment, and verbal abuse). Work-related events included any activities associated with the job or events that occurred in the work environment; work-related travel was included.

Initially, a comprehensive survey instrument was sent to a random selection of 6,300 nurses,licensed in one state in the United States, to identify work status and work-related violence experience in the past year. Subsequently, using a case-control design, a survey was then sent to the cases and randomly selected controls to obtain data on work-related exposures. This enabled analyses of exposures between cases (n=475) and controls (n=1,425) to identify specific risk and protective factors to be used as a basis for

developing prevention and control efforts. Both univariate and multiple regression analyses were performed to identify the incidence and consequence of and risk factors for violent outcomes. Logistic regression was used to model the dependence of physical assault on each exposure of interest and associated confounders; adjustments were included for unknown eligibility and non-response.

Response to the initial survey was 74%. Adjusted respective rates of physical assault and non-physical violence per 100 persons per year (with 95% confidence intervals [CIs]) were 13.2 (12.2, 14.3) and 38.8 (37.4, 40.4). Perpetrators varied by type of violence, and consequences appeared greater for non-physical than physical violence. From the case-control survey (response, 75%), increased risks (Odds Ratios with 95% CIs) were identified, respectively, for working in: long-term care facilities (2.6; 1.9-3.6); emergency (4.2; 1.3-12.8) and psychiatric/behavioral (2.0; 1.1-3.7) departments; and environments with illumination less than "bright as daylight" (2.2; 1.6-2.8). Decreased risks were identified for working with young populations (0.4; 0.2-0.99); carrying cell phones/personal portable alarms (0.3; 0.2-0.7); and working in home/public heath agencies (0.2; 0.1-0.4), outpatient facilities (0.4; 0.2-0.8), and clinics/health provider offices (0.2; 0.1-0.5).

From these findings, it is evident that work-related violence is a problem within this population, and that specific prevention and control strategies can be developed more realistically. For example, attention to environmental factors within facilities or departments, such as lighting or use of protective devices like cell phones, need to be addressed by employers and relevant safety committees. Work-related violence affects not only the victim but also, the employer,others in the work environment, families and significant others outside the work setting, and society, in general. It is a problem that warrants continued and rigorous attention.

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Poster: 0166

Prevention of Patient Violence in Health Care Settings

M Lanza (1) presenting, J Rierdan (2)

Edith Nourse Rogers Memorial Veterans Hospital, Bedford, MA, United States (1), University of Massachusetts/ Boston, Boston, MA, United States (2)

Importance of Research Problem: Violence in the health care sector has become a major safety issue. Psychiatric units have among the highest rates of violence; nursing staff are the most vulnerable workers. A recent epidemiological study reported that over 20% of psychiatric nurses were physically assaulted during the equivalent of a single workweek. Such high assault rates impact the professional and personal lives of nursing staff workers, discourage workers from entering or staying in nursing, and disrupt patient care.

Purpose of the Study: Research is needed to validate intervention programs to reduce violence by psychiatric patients. To that end, a Violence Prevention Community Meeting (VPCM) treatment program was introduced on an inpatient psychiatric unit and rates of assault were compared for Pre-Treatment, Treatment, and Post-Treatment periods.

Methods: A protocol for conducting a Violence Prevention Community Meeting (VPCM) was designed by a panel of experts in patient violence, using a Delphi Approach to achieve consensus. The protocol had content validity and a structure that provided both focus and flexibility.

The efficacy of the VPCM protocol was tested on an acute inpatient psychiatric unit in a Veterans Hospital over a 4-phase, 20-week period: Pre-Treatment (3 weeks), Transition (4 weeks), Treatment (9 weeks) where the VPCM was held twice weekly, Post-Treatment (4-weeks). The average patient census was 30 and average length of stay was 5 days. Patient Violence included verbal assault and actual or threatened physical violence. Every staff member on all three shifts carried a mechanical counter and recorded patient violence in "real time."

Findings: Since data involved counts of incidents, analyses using the Poisson Model were undertaken. Wald Chi Square tests found significant ($p<.01$) reductions in violence incidents from Pre-Treatment to Treatment (30% reduction) and from Pre-Treatment to Post-Treatment (50% reduction).

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Advancing the Research Field: Most research on violence reduction focuses on lowering assaults through identifying particular high risk patients and/or through modifying the behavior of individual patients. The VPCM focuses on the unit as a whole, using a method that can be manualized and implemented on psychiatric units with varying levels of risk and emergent violence. Use of "real time" data collection with inexpensive, easy-to-use counters provides more accurate data regarding patient assault of healthcare workers than do other self-report methods.

Improving Workplace Safety and Health: The results provide initial empirical support for the efficacy of a low-cost intervention to reduce patient violence and thus increase worker safety. With enhanced worker safety, patient care can likewise be enhanced. Further validation studies are recommended for diverse groups of patients in public and private psychiatric treatment facilities.

Application to Health Care Sector: Particularly in these times of short stays and rapid turnover of patients on psychiatric units, the VPCM can serve as an important transitional treatment by which to promote a culture and practice of safety for nursing staff and patients alike. Unlike personalized behavior modification programs that require longer treatment times, the VPCM offers promise for violence reduction in the short-term psychiatric units that are common across the U.S.

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Poster: 0167

Abuse and Violence During Home Care Work as Predictor of Worker Depression

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Importance: Abuse and violence towards workers are present in many healthcare work environments. When the workplace is a private home, the normal protections that workers have in hospital settings (e.g. co-workers, security guards, alarm systems) are not present. Because home care workers perform their duties in isolation, they must rely on their own resources to deal with abuse and violence. Once abusive or violent events occur in the home, the home care worker must return to deliver care, and fears reoccurrences of these events. This fear can be debilitating, and is linked to negative mental health outcomes.

Purpose: Therefore, the purpose of this longitudinal study is to describe the prevalence of abuse and violence experienced by home care workers as well as to examine its relation to the incidence of depression.

Methods: A two-wave computer assisted telephone survey (N=1643) (English/Spanish) was conducted to assess the prevalence of abuse situations and incidence of worker depression.

Findings: Significantly elevated odds for depression were associated with each abuse variable, and there was a dose effect seen when comparing low and high levels of abuse with no abuse. Violence during home care was uncommon (< 4% of sample) but highly associated with depression.

Advances: Our research was the first to use the revised CES-D to measure depression in this population, which provides an estimate of both clinical and subthreshold depression using a current nosology of symptoms. In addition, we captured a large sample of Hispanic workers, who have been understudied.

Use of Findings to Improve Workplace Safety and Health: This study suggests that both preventative and early intervention measures need to be taken to reduce adverse mental health consequences of abuse and violence among this population.

Health Care Sector Implications: There are currently 1.3 million unlicensed health care workers providing direct care to consumers in the U.S., however this number will need to increase dramatically in the next 20 years with the need to care for an increasing elderly population who will "age in place." Thus, the number of home care workers exposed to abuse and violence and the workplace risk to these workers is substantial. As depression has implications for worker's overall health and well-being, prevention is critical.

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Poster: 0168

Violence Prevention in the Mental Health Setting: The New York State Experience

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In the mid 1990's, the New York State Office of Mental Health (OMH) collaborated with staff labor unions in pilot initiatives to reduce workplace violence. One product of these efforts was the 1998 issuance of an agency policy requiring all NY State operated psychiatric facilities to develop and implement a proactive violence prevention program modeled after the OSHA Guidelines for Violence Prevention for Health Care and Social Service Workers. This presented a unique opportunity to evaluate the impact of the Guidelines on worker health and safety. This presentation will provide a summary of a NIOSH supported intervention effectiveness study of violence prevention in the mental health in-patient setting. We will describe a process for implementing the Guidelines in three intervention facilities and findings from the evaluation of the impact of the intervention on risk factors for violence and physical assault in both intervention and comparison facilities following program implementation.

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Poster: 0169

Personal Protective Eyewear and Postural Control

L Wade (1) presenting

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In occupational or industrial settings it is necessary to regulate the "weight" of the information received from the visual, vestibular, and/or somatosensory systems depending on the environmental framework and requirements for postural control. It is difficult to overemphasize the function vision plays in information processing, specifically in maintaining postural control. Vision appears to be an immediate, effortless event; suggesting we need only to open our eyes to employ the visual information provided by the environment. It is believed that there is no single combination of sensory information the three sensory systems supply regarding precise center of mass (COM) control under every plausible circumstance to which an individual may be exposed. During sensory conflicting situations, such as moving about on an altered support surface in low illumination, the central nervous system (CNS) must select the sensory input(s), which provide accurate orientation information and disregard or lessen emphasis on misleading sensory inputs. The question then arises: Is there a decrement in accurate sensory information from the visual system as a result of the implementation of Personal Protective Eyewear (PPEe) (29 CFR 1910.133)?

Purpose: This study is focused on investigating the effect of OSHA regulated personal protective eyewear (29 CFR 1910.133) on physiological and cognitive factors associated with information processing capabilities associated with postural control.

Methods: Twenty-one college students between the ages of 19 and 25 were randomly tested in each of three eyewear conditions (control, new, and artificially aged) on an inclined and horizontal support surface for auditory and visual stimulus reaction time. Data collection trials consisted of 50 randomly selected (25 auditory, 25 visual) stimuli over a 10-minute surface-eyewear condition trial.

Results: Auditory stimulus reaction time was significantly affected by the surface by eyewear interaction ($F_{2,40} = 7.4$; $p < .05$), similarly, analysis revealed a significant surface by eyewear interaction in reaction time following the visual stimulus ($F_{2,40} = 21.7$; $p < .05$). Post hoc comparisons of the surface by eyewear interactions showed that: (a) exposure to the inclined surface condition resulted in a significantly slower reaction time to both stimuli than that of exposure to a horizontal surface; (b) artificially aged eyewear, no matter the surface condition, produced a significantly slower reaction time to both stimuli that that of the new and no eyewear conditions; (c) new eyewear, no matter the surface condition, produced a significantly

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slower reaction time to both stimuli than that of the no eyewear condition.

Conclusions: The current findings do not trivialize the importance of personal protective eyewear usage in an occupational setting; rather, they suggest the value of future research focused on the effect that personal protective eyewear has on the physiological, cognitive, and biomechanical contributions to postural control. These findings suggest that while personal protective eyewear may serve to protect an individual from eye injury, an individual's use of such personal protective eyewear may have deleterious effects on sensory input from the visual system and compensatory strategies to maintaining or regaining postural stability. Individuals who employ protective eyewear on a daily basis need to be aware of the effect of altered visual input resulting from eyewear on their postural stability, especially during sensory-challenging tasks, such as navigating ladders, scaffolding and elevated surfaces, typically found in construction environments.

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Poster: 0170

Predicting Relative Workload During Physically Demanding Work

T Abdelhamid (1) presenting

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Measurement of physical demands of work, and assessment of physical fatigue and the limitations it may have on worker productivity has attracted and occupied work physiologists and industrial engineers for many years. The decrease in performance due to fatigue is widely accepted, but no agreement has been reached in trying to quantify this decrease, or in setting acceptable limits for it.

Oxygen uptake measurements during the performance of actual work activities are considered a good measure of the absolute physiologic workload experienced by a person. Expressing measured oxygen uptake as a percentage of maximum oxygen uptake (VO2max), commonly known as relative workload, is recommended by many work physiologists since it provides a subject-specific workload. In addition to accounting for individual differences in physiological capacities among workers, relative workload also enables more accurate assessment of potentials of physical fatigue. The specific aim of this research was to develop a practical and direct method to predict relative workload (expressed as a percentage of maximum oxygen uptake) from in-situ collected sub-maximal oxygen uptake data without the need to determine maximum oxygen uptake.

The method was developed by modeling the human cellular utilization system as a stochastic system and on the hypothesis that oxygen uptake data are serially dependent, and that by exploiting this dependence using time series analysis techniques, a regression model between relative workload and a statistical characteristic of collected oxygen uptake data can be developed.

In this project, a previously developed concept for a method to predict relative workload from in-situ collected sub-maximal oxygen uptake data was validated for 100 experimental subjects. A relative workload prediction equation (RWP model) was developed with a standard error of prediction of □7.6% and □0.65 liter•min-1 for %VO2max and VO2max, respectively.

In an effort to improve the predictive accuracy of the RWP model, a number of factors were considered in constructing a multiple linear regression (MLR) model. The prediction capability was best when the Energy of Green's function, relative heart rate, and body surface area were usedas predictors. Using

the regression model that combined these predictors, the standard error of prediction for %VO2max and VO2max were □4.9% and □0.53 liter•min-1, respectively.
All regression models have been validated using non-steady state oxygen uptake and heart rate data measured for 100 validation subjects. In particular, the MLR model provided a robust, efficient and reliable statistical methodology capable of predicting relative workloads from submaximal exercises data collected in-situ. It is expected that the proposed multi-regression model will improve the accuracy of relative workload predictions from sub-maximal oxygen uptake data collected in-situ. This prediction method will be safer for unfit subjects and easier to use in general, compared to maximal testing protocols and restrictive lab requirements.

The prediction technique developed in this research will help in better understanding the physical demands for today's workforce doing today's work and will have widespread application in identifying excessively demanding tasks so can be better matched to the abilities of subjects. Specifically, the technique presented will be instrumental for research focusing on: (1) Reliable evaluation of the workload a worker is subjected to, such that engineering or administrative interventions may be better contemplated by management to reduce the workload if needed; (2) Expanding job opportunities for women, older workers, and workers who are partially disabled, by placing in jobs according to their capabilities; (3) Evaluation of the effectiveness of rehabilitation programs for workers who previously suffered overexertion injuries. In general, this research is expected to have widespread application in identifying excessively demanding tasks so they can be better matched to the abilities of subjects.

Poster: 0171

Noise Exposure and Hearing Conservation Programs in Eight Noisy Industries

WE Daniell (1) presenting, SS Swan (1), J Camp (1), MM McDaniel (2), M Cohen (1), J Stebbins (3)

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Occupational noise-induced hearing loss is generally a preventable condition. The Occupational Safety and Health Administration (OSHA) requires most employers with noisy workplaces to maintain effective hearing conservation programs and, when noise levels are relatively high, to use feasible noise controls. However, occupational hearing loss (OHL) remains a common disease. It is conceivable that current workers' risk for OHL may have been minimized by hearing conservation programs and noise controls implemented during twenty years of OSHA regulation, but noise exposures and regulatory compliance have not recently been broadly assessed.

Therefore, we conducted a cross-sectional study of 76 companies in eight industries in one state, to characterize current noise exposures and hearing loss prevention practices. Industry selection was based on high rates of workers' compensation claims for OHL. Each company evaluation included personal noise dosimetry (n=983) and interviews (n=1,557) of selected workers, interviews of hearing conservation program coordinators (n=76), and reports and observations of hearing protector use.

Nearly all companies had noise exposures requiring a hearing conservation program, and 62% had exposures requiring consideration of noise controls. Overall, full-shift average noise exposures were >85 dBA for 50% of workers, and >90 dBA for 14%. Using National Institute for Occupational Safety and Health (NIOSH) instead of OSHA parameters, these percentages were 1.5 and 3 times higher, respectively. Most companies had measured noise levels, but most did not keep records or plan new noise controls. Hearing conservation programs were often incomplete. Scores calculated for program coordinator interviews (higher score = more complete program) were significantly higher when more workers had full-shift exposure >85 dBA and when a union was present. Overall, 38% of employees reported never or only sometimes using hearing protection when exposed. Protector use was significantly higher at companies where more workers were required to use protection, programs were more complete, and workers spent more time in noise >95 dBA.

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The frequent findings in this study of excessive noise exposure, shortcomings in hearing conservation programs, inattention to noise controls, and underuse of hearing protection—after twenty years of OSHA regulation—indicate a need to consider different prevention, regulation, and enforcement strategies to reduce the risk of OHL. The study findings can help guide this process. Hearing loss prevention efforts were most complete and hearing protector use was most routine at the noisiest companies. The greatest potential for interventions to reduce OHL risk may be at companies with relatively moderate or intermittent noise exposures and also companies without a union. Hearing protector use was also most routine at companies with relatively complete programs, illustrating the potential for a complete program to promote the desired safety behavior. Conversely, safety behavior was worse at companies with deficient commitment and effort, relative to behavior at other companies with similar exposures, demonstrating the importance of organizational influences on individual behavior. Interventions, such as training, should probably target the company as well as individual workers. The implications of these findings extend beyond noise exposure and hearing loss.

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Poster: 0172

Hospital Noise: Characterization and Interventions that Work Long Term

IJ Busch-Vishniac (1) presenting, JE West (1)

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The importance of noise in health care has been recognized for years but little work has been done to characterize and reduce it. There are a small number of hospital noise surveys in the scientific literature. This body of literature suggests that a significant problem exists, and that it is generally getting worse rather than better, even in new construction.

Noise in hospitals is important for a number of reasons in addition to the obvious issue of annoyance. There is evidence that the high sound levels in the hospital contribute to stress and burn-out in hospital staff, and to hearing loss in some medical professionals. There is also evidence that noise negatively affects the speed of wound healing. Additionally, there is concern that hospital noise could negatively affect speech communication and cause increased numbers of medical errors.

The purpose of the present study has been to characterize the noise environment in Johns Hopkins Hospital, to place our results in context geographically and historically, and to implement noise reduction strategies that will work long term. We have measured sound pressure levels in various units of Johns Hopkins Hospital using a precision sound level meter. This has produced sound levels as a function of location, time of day, and frequency. We have compared the results obtained to all similar results reported in the literature recently. We have also introduced two noise reduction strategies: the elimination of overhead paging through use of personal broadcast units, and the addition of hygienic sound absorption material. In both cases, we obtained objective measures of noise level reduction as well as survey data on perceived impact by staff and patients.

Our results indicate that the level of noise in hospitals throughout the world has been rising about 0.4 decibels per year since 1960. The sound levels are now sufficiently high to be a concern in terms of sleep and speech interference. Further, the noise problem in hospitals seems universal – it does not vary much with geographic location or type of hospital.

The noise in virtually every unit of Johns Hopkins Hospital we monitored has a spectrum which indicates a great deal of noise in the frequency range at which speech is concentrated. Additionally, the air handling systems produce significant noise at low frequencies.

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Both noise interventions have been very successfully implemented at units at Johns Hopkins Hospital. The personal broadcast devices have reduced overhead paging in the PICU from roughly once every 5 minutes to once every hour and have been rated by staff as significantly improving communications and increasing efficiency. The addition of sound absorption material on an oncology unit has reduced the reverberation time in the unit by nearly a factor of 3, and has been judged by staff and patients to have converted the unit from very noisy to fairly quiet.

The results of this study suggest that it is possible to develop standard approaches to reducing noise in the hospital in ways that will work long term. Further, they emphasize the need to address the noise problem now, as we are already to the point where critical speech communication is compromised and patient safety risked. Although the work performed focused on Johns Hopkins Hospital, it is clear from the literature that the noise problem is universal in all hospitals in the world.

Next steps in our work to quiet hospitals and other health care facilities will focus on alarms, telecollaboration, and equipment noise. Each of these areas pose unique problems. For instance, alarms are a great irritant to patients, and the literature suggests that well over 95% of alarms result in no action being taken. The question, then, is how to preserve the information content of alarms while making them less of an irritant to patients.

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Poster: 0173

Noise Level Measures in a Large Metropolitan Subway System

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Purpose/Problem: Noise induced hearing loss (NIHL), the single most common occupational health problem in industrial societies, is prevalent in heavy machinery, transportation, textiles, utilities, chemicals, fabricated metals, lumber, rubber, and coal industries. In particular, given the rate of increasing world wide urbanization, noise associated with mass transit is of concern, not only because of the vast ridership potentially at risk of noise exposure, but because excessive noise levels have been documented for various forms of mass transit. Subways, in particular, may be associated with excessive levels, especially since high levels of noise have been associated with railroads. Importantly, almost no information is available on noise exposure in subway system environments. In the U.S., there are 14 Mass Transit Systems, with over 350,000 subway workers that provide service to over 33 million riders weekly. As part of a large subway noise assessment study, we recently conducted a pilot study on noise levels in a large metropolitan subway system.

Methods: Using a digital sound level meter (Quest 1200, A-level type I), levels were measured as follows: at platform level with (1) subway trains approaching the station, (2) subway trains leaving the station and, (3) express trains passing the platform. Measurements were also taken inside subway cars while trains were approaching the station, when express trains were passing the station, and at bus stops at street level.

Results: Noise levels on the platform ranging from 60 to 140 dB (mean 86 dB) were noted, with the highest levels associated with impulse noises which occurred when trains braked as they entered stations. Noise levels inside the car ranged from 84 to 112 dB (mean 96 dB) and noise levels at bus stops ranged from 76 to 89 dB (mean 84 dB). The length of time per noise exposure ranged from 23-49 seconds with a mean of 33.81 seconds.

Conclusion: These data indicate that excessive levels of noise may occur on platforms in the subway, as well as inside the train, and at bus stops. The impact of subway noise exposure on NIHL, prevalence of NIHL in both workers and passengers, and the effect of noise exposure on other health outcomes remains to be determined.

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Poster: 0174

Testing the Predictors for use of Hearing Protection Model for use with Hispanic and Non-Hispanic White Factory Workers

DM Raymond (1) presenting, O Hong (2), SL Lusk (2), DL Ronis (3)

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Introduction: Noise-induced hearing loss (NIHL) is one of the NORA Priority Areas, and has been noted as the occupational illness facing the greatest number of workers (NIOSH, 1996). NIOSH (1999) has also recognized the value of and need for theoretical models to guide research and interventions to promote protective behaviours in workers. The Predictors for Use of Hearing Protection Model (PUHPM) is a framework for intervention research to increase worker's use of hearing protective devices (HPDs). The 2000 United States census reported significant growth in Hispanic populations, with the largest percentages of workers employed in labor-intensive industries associated with excessive noise exposure. The PUHPM was developed through research with samples of primarily middle-aged White males. The purpose of this study is to evaluate the PUHPM fit with Hispanic workers.

Methods: Participants included 208 Hispanic and 1832 non-Hispanic White factory workers at an automotive manufacturer, located in the United States Midwest area, who had a minimum noise exposure of 85 decibels for an 8-hour time-weighted average. Self-reported data were collect by a computer-based system. PUHPM measures included; HPD Use, gender, age, years at plant, noise level, HPD availability, perceived hearing, social norms, social models, interpersonal support, supervisor climate, union climate, benefits, barriers, and self-efficacy. Using regression analysis, the explained variance in use of HPDs by the model predictors was identified for Hispanic workers and compared with the non-Hispanic White workers. Mean populations differences on measures were also examined.

Results: Hispanic workers reported significantly higher HPD use, interpersonal support, benefits, and perceived hearing ability than non-Hispanic White workers. The Models explained variance was lower for Hispanics (R2 = .20, Adjusted R2 = .14) than for non-Hispanic Whites (R2=.37, Adjusted R2 = .37). The measures of age, noise level, and benefits were significant for both groups. The measures of social norms, social modeling, interpersonal support, supervisor climate, and barriers were significant for the non-Hispanic White sample only.

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Conclusions: These results suggest that further exploratory research with Hispanic workers is needed to improve the PUHPM fit for Hispanic workers. The findings affirm the need cross-cultural testing of models.

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Poster: 0175

Predicting Potentiation of Noise-Induced Hearing Loss by Chemicals: Oxidative Stress as a Mechanism of Hearing Loss

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Loma Linda VA Medical Center, Loma Linda, CA, United States (1)

Laboratory animal studies as well as occupational epidemiological studies demonstrate that a broad range of chemical agents can increase the vulnerability of subjects to noise exposure. Consequently, under conditions of workplace exposure to specific chemicals, permanent hearing loss may occur even at permissible noise exposure levels. Predicting which chemicals can promote noise-induced hearing loss is essential both in establishing safe work conditions and developing potential treatment modalities for accidentally exposed workers. The objectives of this research are to determine the biological basis for the interaction between chemicals and noise in order to facilitate prediction of chemical agents that can promote noise-induced hearing loss. Specific chemical agents were selected based both upon their common use in occupational settings and their potential to produce oxidative stress. The specific hypothesis tested was that chemicals, which interfere with normal antioxidant pathways, would render the inner ear particularly vulnerable to noise. A two process model is envisaged: (a) initiation of reactive oxygen species by moderate noise exposure and (b) promotion of oxidative stress through disrupting intrinsic antioxidant defenses. This hypothesis has been tested using carbon monoxide, hydrogen cyanide, and acrylonitrile (ACN); widely used industrial chemicals with clear pro-oxidant potential. Carbon monoxide is the most common air pollutant and is a key contaminant in work settings that involve combustion including transportation, firefighting, and smelting operations. Cyanide is used in metallurgic occupations and as a chemical intermediary. Acrylonitrile is one of the 50 most commonly used chemicals in the United States. ACN is used to make nylon and acrylic fibers, plastics, nitrile rubber, and as a chemical intermediary. In our studies, laboratory rats were exposed to noise alone, selected chemical agents alone (carbon monoxide, hydrogen cyanide, and acrylonitrile), mixed exposure to chemicals and noise, and no experimental treatment (control). In some instances drugs with known antioxidant potential were included to evaluate their protective effects. Hearing was assessed repeatedly using a non-invasive, objective method (distortion product otoacoustic emissions) that is frequently used in testing the function of the human inner ear. Subsequent to measuring auditory thresholds for permanent hearing loss 4-5 weeks following exposure, cochleae were harvested to allow histological evaluation of hair cell loss. The data gleaned from multiple experiments demonstrate that chemical agents capable of interfering with intrinsic antioxidant pathways do, in fact, increase noise-induced hearing loss and produce extensive outer hair cell

death. Such interactions can be seen even when noise exposure by itself produces no hearing loss and when the noise exposure used is at a level permitted under OSHA regulations. Moreover, drugs that can reduce free radicals are protective against the promotion of noise-induced hearing loss by chemicals. These findings advance the fields of hearing research and noise control by establishing the importance of oxidative stress as a mechanism of hearing loss and in identifying a class of chemicals with potential to enhance vulnerability to noise. They identify potential occupational exposures with potential to promote the effects of noise and focus future epidemiological investigations. (Supported in part by grant # OH-03481).

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Poster: 0176

A New Approach to Field Evaluation of Hearing Protectors

L Hager (1) presenting, J Voix (1)

Sonomax Hearing Healthcare, Inc., Portland, MI, United States (1)

While hearing protection devices (HPD) have been the last line of defense against noise-induced hearing loss (NIHL) in the workplace, significant questions linger regarding their performance. HPD in use today do not provide the level of protection that would be expected from their laboratory evaluations under ANSI S3.19-1974 or S12.6-1997(R2001), with OSHA devaluing the laboratory rating by half in some applications, and NIOSH recommending deratings as high as seventy percent for some devices. One resolution of this issue is individual fit testing of HPD, where the performance of the HPD is tested on the individual user(s) of the devices. Several protocols have been developed to attempt this outcome; this presentation will address a modified microphone-in-real-ear (MIRE) approach called SonoPass™ that is software driven, field tested, and relatively quick to administer. The protocol measures noise reduction (simultaneous sound pressure levels inside and outside the HPD), and applies compensation factors derived from rigorous laboratory testing to provide personal attenuation equivalents, yielding an effective personal predicted attenuation rating, or P-PAR, for individual users. Comparison of SonoPass™ P-PAR findings and laboratory real ear attenuation at threshold (REAT) will be provided, demonstrating the reliability and utility of the SonoPass™ approach for determining HPD protection provided to the individual end user for a range of types and styles of HPD.

Poster: 0177

Hearing Loss in the Military: The Results of Deployment to a Combat Environment

T Ross (1) presenting, W Daniell (2), A Wiesen (1)

Madigan Army Medical Center, Fort Lewis, WA, United States (1), University of Washington, School of Public Health, Seattle, WA, United States (2)

Background: Hearing loss is one of the most disabling chronic health problems. In addition to the direct costs of disability and loss in the workforce people with hearing loss are less satisfied with their lives, lose independence, and have relationship problems. The National Institute on Deafness estimates that 10 million Americans are affected by noise induced hearing loss (NIHL) and 12 million suffer from tinnitus. Over 30 million civilian workers are exposed to hazardous noise in the workplace and of those 7.5 million will end up with permanent hearing damage. The military has similar statistics. In 2004 there were over 88,000 new cases of hearing loss claims handled by the Veteran's Administration with a total compensation of over $633,000,000. Since 1977 the VA has paid over $6.6 billion in compensation for hearing loss. In the last year the Army reported a 16.5% Significant Threshold Shift in its military population and a 19.6% STS in its civilian workforce.

Individual worker hearing protection standards have been in place since 1983. These regulations set out exposure limits and actions levels that require monitoring of work environments, and require hearing exams for exposed individuals. These standards fail our military population in two ways. The unanticipated noise hazards of combat cannot be covered by exposure standards and the multiple ototoxic exposures that are inherent in the deployed environment are not addressed. Studies of NIHL in the are sparse and do not address the hazards or environment of combat deployments.

Hypotheses: The incidence of NIHL in combat soldiers will be significantly higher than support soldiers in the same cohort. NIHL will be inversely related to the self reported use of hearing protection, and there will be a positive correlation between tobacco use and NIHL.

Study Methods and Results: This is a prospective cohort study of a Stryker Brigade with approximately 4000 soldiers, stationed at Ft Lewis, WA. Demographic and audiometry data come from the DOEHRS data repository, a centrally maintained Department of Defense database that collects all Hearing Conservation testing results for the Army. A locally developed survey will be administered to subjects as a part of their post deployment medical screening. The survey will collect information on

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self reported use of hearing protection, noise hazard exposure, symptoms of hearing loss, and smoking history. The audiometric data collection is 80% complete and shows a Significant Threshold Shift of 15.4% within the cohort. The survey will be administered in January 2006. The data analysis will be completed by the end of February 2006.

Conclusions: Noise Induced Hearing Loss has a significant impact in both the civilian and military workplace. Unique aspects of hazards in the combat environment are not addressed by hearing conservation programs. This cohort study of a deployed Infantry Brigade characterize the hazards that contribute to hearing loss and provide incidence rates specific to this "workplace." From this starting point more effective interventions can be developed to protect the soldier from noise hazards and preserve his hearing.

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Poster: 0178

From Noise Research to Preventive Practice on Work-Related Hearing Loss

D. Henderson, presenting (1)

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ISO 1999 and current U.S. noise standards were established using the results of a number of demographic studies done at least 30 years ago. The original noise standards reflected a reasonable synthesis of prevailing scientific understanding and had merit when they were first advanced. However, science has since produced important new insights into the relation between a subject's noise exposure and the resultant hearing loss. The ISO and Department of Labor standards were based on demographic studies of noise-induced hearing loss that are fundamentally limited by large intersubject variability. It is conceivable that the variability seen in hearing loss databases may be, in part, the result of organizing the diverse exposure conditions to which the subject population was exposed around the single descriptive metric; energy. In this presentation, the limitations of this approach and the alternative of using energy metric in combination with the statistical metrics of frequency- and time-domain kurtosis and the joint peak-interval histogram to evaluate any noise environment's potential for causing hearing loss are discussed. Moreover, the potential risk to hearing loss posed by chemical agents in the work place is addressed as well as the involvement of reactive oxygen species (ROS) as a common factor in these causes of sensory-neural hearing loss.

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Poster: 0179

Performance of Portable Microbial Samplers for Estimating Human Exposure to Airborne Biological Agents

M Yao (1), G Mainelis (1) presenting

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Portable microbial samplers are becoming popular for estimating human exposure to airborne biological agents, which are known to present a significant health impact. However, not much informationis available about the performance of these samplers. This research investigated the collection efficiencies and inhalation conformities of seven portable microbial samplers: MAS-100, Microflow, SMA MicroPortable, Millipore Air Tester, SAS Super 180, BioCulture, and RCS High Flow. Their physical efficiencies and adherence to the inhalation standards were investigated using aerosolized Polystyrene Latex (PSL) particles and six species of bacteria and fungi. Biological efficiencies of the samplers were also studied and compared with two reference samplers (Andersen-type impactor and Button Aerosol Sampler) by collecting anthrax simulant Bacillus subtilis and other biological agents under controlled humidity level of 40-45%.

Experimental results have shown that all evaluated samplers collect approximately 5% or less of 0.5µm particles. The effective cut-off size, or d50, of the investigated samplers ranged from 1.2µm for the RCS High Flow, 1.7 µm for the MAS-100, 2.1 µm for the SAS Super 180, to 2.3 µm for the Millipore Air Tester; for other three samplers the cut-off sizes were above 5.2 µm. The cut-off size of a bioaerosol sampler indicates the size at which 50% of the particles are collected. In addition, the RCS and the SAS Super 180 samplers were found to match the inhalation curve fairly well when sampling fungal spores, but not bacterial species. The RCS sampler was also found to be able to reflect the pattern of particle deposition in the lung when sampling both bacterial and fungi species. The MAS-100 and the SAS Super 180 samplers were found to match fairly well the total lung deposition curve when collecting bacterial and fungi species, respectively. Biological efficiency tests with B. subtilis have shown that the reference sampler Button Aerosol Sampler with gelatin filter performs best among the samplers tested. The RCS High Flow and the reference Andersen-type impactor recovered about 40% less culturable B. subtilis compared with the Button Aerosol Sampler; recovery of B. subtilis by other samplers was substantially lower.

This study indicated that most of the currently available portable microbial samplers have limited ability to collect smaller bacterial species because of their large cut-off sizes. Therefore, their results

pertaining to human exposure to bacteria have to be treated with caution, and research leading to modern tools capable of efficiently measuring exposure to bacteria is urgently needed. For heavily contaminated sites, the Button Aerosol Sampler with gelatin filter may perform best in terms of biological efficiency. The RCS High Flow and the BioStage samplers, however, might be more suitable for sampling less contaminated air based on their high sampling flow rates and relatively higher recovery of culturable bioaerosols.

The results from this study will help researchers in making decisions when selecting samplers for bioaerosol sampling and detection studies, thus providing better assessment of human exposure to the biological agents.

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Poster: 0180

Modern Offices Desiccate The Eyes – Why and What Can Be Done?

P Wolkoff (1) presenting, JK Nøjgaard (1), C Franck (2), P Skov (3)

National Institute of Occupational Health, Copenhagen Ø, Denmark (1), Slagelse County Hospital, Slagelse, Denmark (2), Roskilde County Hospital, Roskilde, Denmark (3)

Eye irritation symptomatology (e.g. burning, irritating, staining, and tired) is common in the office environment. It is important to understand the physiological factors that are responsible for eye complaints such as "dry eyes" with specific attention to the occupational risk factors, e.g. those associated with visual display unit (VDU) work, in which the visual and cognitive demand is high. Merging indoor air science, occupational health and ophthalmology is necessary to promote understanding office-related eye irritation symptomatology, the cause of which is still partly unknown.

For almost three decades it has been considered that the relative humidity is less important for the development of sensory irritation symptoms in eyes and airways. Instead, the explanation has been that indoor pollutants are responsible for the perception of "dry air". However, common organic air pollutants are unlikely to explain such an effect. Thus, one question is how low relative humidity (RH) influences the precorneal tear film (PTF). In particular during VDU work and in the presence of indoor pollutants that are sensory irritants.

High periocular RH, however, appears to protect the precorneal tear film against desiccation and sensory irritants, and reduces the development of eye irritation symptoms. This is particularly relevant for intensive VDU work, where the PTF is altered resulting in dry spot formation and eye dryness, which enhances the susceptibility towards sensory irritants. The workplace, work schedule (including breaks) should be planned in such a way to maintain a normal eye blink frequency to minimize alterations of the PTF. The consequence is that the impact of the RH should not be underestimated for eye irritation symptoms. The beneficial effect of multiple short breaks on the PTF should be considered acceptable, in addition to longer breaks and downward gaze, in particular during visual demanding work, where the PTF is altered. Such breaks appear also to be beneficial for the work performance.

Eye blink frequency and break-up time of the PTF are informative signs that should be pursued more rigorously in future studies about the influence of the thermal climate, reactive chemistry, lighting, noise, work duration and task demand in the office environment. The important research question is whether eye irritation such as dry eyes is associated with the perception of dry air.

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Wolkoff,P., Nøjgaard,J.K., Franck,C. and Skov,P. (2006) "The modern office environment dessicates the eyes?", Indoor Air, 16, in press.

Wolkoff,P., Nøjgaard,J.K., Troiano,P. and Piccoli,B. (2005) "Eye complaints in the office environment: Precorneal tear film integrity influenced by eye blinking efficiency", Occupational and Environmental Medicine, 62, 4-12.

Wolkoff,P., Skov,P., Franck,C. and Pedersen,L.N. (2003) "Eye irritation and environmental factors in the office environment. Hypotheses, causes, and a physiological model", Scand J Work Environ Health, 29, 411-430.

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Poster: 0181

Sensory Irritation, Odor, and "Reactive Chemistry" in the Office Environment: A Review

P Wolkoff (1) presenting, CK Wilkins (1), PA Clausen (1), GD Nielsen (1)

National Institute of Occupational Health, Copenhagen Ø, Denmark (1)

Sensory irritation and odor effects of volatile organic compounds in indoor environments are common complaints in the office environment, as components of the so-called "sick-building syndrome." It now appears salient to distinguish roughly between four groups of organic compounds in indoor air (OCIAs) according to their expected health effects, including odor annoyance. These groups are: 1) Chemically non-reactive, 2) Chemically "reactive," 3) Biologically reactive (i.e. form chemical bonds to receptor sites in mucous membranes), and 4) Toxic compounds. Specific OCIAs may belong to two or more of the above groups.

Chemically non-reactive OCIAs are considered non-irritants at typical indoor air concentrations. However, compounds with low odor thresholds contribute to the overall perception of the indoor air quality that is built up during a whole working day. It appears that odor thresholds for many OCIAs probably are considerably lower than previously reported. This explains why many building materials persistently are perceived as odorous, although the concentrations of the detected OCIAs are close to or below their reported odor thresholds. Certain odors in addition to odor annoyance may result in psychological effects, possibly causing sensory irritation in eyes and airways and distraction from work.

Ozone reacts with terpenes and terpenoids (used in many consumer products) to form agas and aerosol phase of oxidation products, some of which are sensory irritants that result in eye irritation in humans. However, all of the sensory irritating species have not yet been identified. Both a bioassay and a human eye exposure study indicate that low relative humidity exacerbates the sensory irritation impact. Whether the secondary aerosols contribute to sensory irritation requires investigation.

The pursuit of the "reactive chemistry" hypothesis should be continued in search of plausible explanations for sensory irritation in office environments; however, this should be carried out in combination with both climate and work-related factors. In addition, an understanding of the psychological impact of odors in indoor environments should be promoted.

Wolkoff,P., Wilkins,C.K., Clausen,P.A. and Nielsen,G.D. (2006) "Organic compounds in office environments - Sensory irritation, odor, measurements, and the role of reactive chemistry," Indoor Air, 16, in press.

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Poster: 0182

Ultrafine (Nano) Particles are Retained in the Respiratory System in Higher Proportion than Comparable Fine Particles

WS Beckett (1) presenting, DC Chalupa (1), MW Frampton (1), MJ Utell (1), G Oberdorster (1), LS Huang (1), D Speers (1)

University of Rochester School of Medicine and Dentistry, Rochester, NY, United States (1)

Particle size is a major determinant of how deeply particles penetrate into the respiratory tract. Particles less than 10 microns aerodynamic diameter penetrate to the sensitive alveolar region deep in the lungs. The deposition fraction of inhaled particles is the ratio of particles retained in the respiratory system, divided by the total particles inhaled. Thus, the concentration of a particles in air multiplied by the minute ventilation multiplied by the time of exposure multiplied by the deposition fraction determines the actual dose to the respiratory system.

Most occupational health standards for inhaled particles are based on the mass concentration of particles in workplace air (e.g. 5 mg/m3 air) and the previously observed mass concentration - response relationships under workplace and experimental conditions.

While many workplace particle exposures are to particles of a large range of sizes, some processes (fuel combustion, manual welding) produce particles with a larger proportion in the ultrafine fraction, defined as particles less than 100 nanometers (< 0.1 μm in diameter, also known as nano-particles).

We compared inhalation exposure to ultrafine and fine particles at a mass concentration of 0.5 mg (500 microgram) per cubic meter, using zinc oxide (ZnO) particles freshly generated by an electric discharge system similar to arc welding. Twelve normal adult subjects breathed ultrafine zinc oxide particles (count median diameter 40.4 nanometer), fine zinc oxide particles (count median diameter 291.2 nanometer) and clean air for two hours by mouthpiece at rest, each exposure separated by at least 2 weeks.

Comparison of the size distribution of inhaled ultrafine and fine particles is shown above. The particle number deposition fraction was approximately 0.78 for the ultrafine zinc oxide particles, and 0.35 for the fine zinc oxide particles, indicating a retention in the respiratory system of twice the proportion of total ultrafine particles inhaled compared to the fine particles, and thus a doubling of the dose to the respiratory system. The observed deposition fraction was considerably higher than the 0.39 predicted by the Multiple Path Prediction Model. These results are consistent with previous studies in our laboratory of mouthpiece

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inhalation exposure to freshly generated ultrafine carbon particles at 25 micrograms per cubic meter, in which we also observed a high deposition fraction of ultrafine particles at rest, and a further increase in deposition fraction with exercise.

We conclude that the dose to the lungs of an aerosol of ultrafine particles may be higher than the dose of fine particles at the same mass concentration.

Poster: 0183

NIOSH Nanotechnology Safety and Health Research Program

NIOSH Nanotechnology Research Center (1) presenting

NIOSH, Cincinnati, OH, Morgantown, WV, Pittsburgh, PA, Spokane, WA, and Washington, DC, United States (1)

The National Institute for Occupational Safety and Health (NIOSH) is the federal agency that conducts research and makes recommendations for preventing work-related injuries, illnesses, and deaths. As a member of the Nanotechnology Science, Engineering, and Technology Subcommittee (NSET) of the National Science and Technology Council Committee on Technology, NIOSH works closely with other federal agencies and private sector organizations to plan, conduct, and facilitate research that will support the responsible development and use of nanotechnology. With the Food and Drug Administration, NIOSH co-chairs the NSET interagency working group on Nanotechnology, Environmental and Health Implications (NEHI). Within NIOSH, the NIOSH Nanotechnology Research Center (NTRC) and the NTRC Steering Committee have been established to address immediate and long-term issues associated with nanotechnology and occupational health in partnership with other federal agencies, research centers, and industry. The NIOSH Vision for Nanotechnology is: Safe nanotechnology by delivering on the nation's promise – safety and health at work for all people through research and prevention. The NIOSH Mission for Nanotechnology is: To provide national and world leadership in research into the application of nanoparticles and nanomaterials in occupational safety and health and the implications of nanoparticles and nanomaterials in work-related injury and illness. The NIOSH Top 10 List of Critical Occupational Safety and Health Issues arising from Nanotechnology is: Exposure and Dose, Toxicity, Epidemiology and Surveillance, Risk Assessment, Measurement Methods, Controls, Safety, Communication and Education, Recommendations, and Applications. The nanotechnology health and safety research programs of the NIOSH NTRC include projects on Nanotechnology Safety and Health Research Coordination, Nanoparticles in the Workplace, Implementation of the Web-based Nanoparticle Information Library, Generation and Characterization of Occupationally Relevant Airborne Nanoparticles, Pulmonary Toxicity of Carbon Nanotube Particles, the Role of Carbon Nanotubes in Cardio-Pulmonary Inflammation and COPD-Related Diseases, Particle Surface Area as a Dose Metric, Ultrafine Aerosols from Diesel-Powered Equipment, An Ultrafine Particle Intervention Study in Automotive Production Plants, Evaluation of Respiratory Effects of Particulate Exposures in Wildland Firefighters, and Nanoparticle Dosimetry and Risk Assessment. Additional information

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about the NIOSH Nanotechnology Safety and Health Research Program can be found at http://www.cdc.gov/niosh/topics/nanotech/.

(The findings and conclusions of this abstract have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.)

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Poster: 0184

Building a Nanoparticle Information Library

AL Miller (1), MD Hoover (2) presenting

NIOSH, Spokane, WA, United States (1), NIOSH, Morgantown, WV, United States (2)

A web-based Nanoparticle Information Library (NIL) has been developed to organize and share information on nanomaterials and their associated properties. The NIL initiative is intended to meet the global needs of researchers, industrial users, and occupational health professionals and includes data such as material properties, origin/synthesis methods and information for contacting people who are developing nanomaterials. Users have the option to submit data for inclusion in the database, and it is expected to become part of a global hub for sharing information. As the world inventory of nanomaterials increases, it is also providing a mechanism for cataloging new materials and facilitating the integration of that information with other data sources such as surveillance and toxicology studies of nanomaterials. The NIL also provides a snapshot of global activities to optimally keep pace with the rapid developments in this expanding field. It is expected to positively impact the course of future research, especially in regards to the health and safety of workers. A prototype version of the NIL is currently running and a range of national and international partners who are collaborating on the format and content of the NIL. Additional information about the NIOSH Nanomaterial Information Library can be found at http://www.cdc.gov/niosh/topics/nanotech/NIL.html/.

(The findings and conclusions of this abstract have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.)

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Poster: 0185

Potential Application of "Control Banding" for Safe Handling of Engineered Nanoparticles in the Workplace

NIOSH Control Banding Working Group (1) presenting

NIOSH, Cincinnati, OH, Morgantown, WV, Pittsburgh, PA, Spokane, WA, and Washington, DC, United States (1)

Because of their small size and large surface area, engineered nanoparticles may have biological properties distinct from fine particles of similar chemical composition. Such properties may include a high pulmonary deposition, the ability to translocate from the lung to systemic sites, the ability to penetrate dermal barriers, and a high inflammatory potency per mass. As research proceeds in a proactive manner to identify and resolve potential safety and health issues posed by nanotechnology, practical approaches are needed to control engineered nanoparticles in the workplace and to minimize both the likelihood of human exposure and the possible development of adverse health effects. Control banding is a complimentary, risk-based approach to protecting worker health that focuses resources on exposure controls and describes how strictly a risk needs to be managed. NIOSH considers control banding a potentially useful tool for small businesses. Control banding has been validated in various settings, particularly in Great Britain. NIOSH is currently evaluating its utility for the United States. Activities of the NIOSH Control Banding Working Group include communicating through the NIOSH website, publications, and the Workplace Solutions database; fostering national and international collaboration; critically investigating the merits of control banding; partnering with industry, labor, academia and government to develop a national strategy to make the best use of this tool; and emphasizing the need for hypothesis driven validation studies and verification of strategies for small and medium sized businesses to install and maintain controls. Challenges to applying control banding in the U.S. include considerations of a compliance strategy versus the traditional regulatory scheme; the need for risk phrases (R-phrases) as part of the Global Harmonization System; the need for validation and verification of effectiveness; a shift in thinking from "exposure assessment" to "exposure control;" attention to gaps such as how to handle mixtures; and issues related to the role of sampling and analysis. Applying control banding as part of a Nanotechnology Safety Toolbox would provide an integrated approach to assessment of potential risk and effective use of control practices. Applying the hierarchy of exposure controls routinely as part of a toolbox, without expert advice, will require that the controls have been demonstrated to be effective under a wide variety of circumstances.

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Demonstration will require researchers, developers, manufacturers, and users to share and disseminate information. Additional information about control banding and its potential applications can be found at http://www.cdc.gov/niosh/topics/ctrlbanding/.

(The findings and conclusions of this abstract have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.)

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Poster: 0186

Safe Approaches to Nanotechnology: An Information Exchange with NIOSH

CL Geraci (1) presenting, RD Zumwalde (1)

NIOSH, Cincinnati, OH, United States (1)

Nanotechnology has been described as one of the fastest growing technological areas in history and has the potential to revolutionize global industry by changing and improving products in many sectors. As with any new technology, there are a number of unknowns which generate awareness and concern in the occupational safety and health community. The National Institute for Safety and Health (NIOSH) has played a leading role in conducting research on the potential implications and applications of nanotechnology on workplace safety and health, and is committed to ensuring worker protection as this technology evolves. NIOSH has developed and posted on its web site the document Approaches to Safe Nanotechnology: An Information Exchange with NIOSH to raise awareness of potential safety and health concerns from exposure to nanomaterials. A key feature of this document is the ability for readers to provide feedback to NIOSH in the form of comments, recommendations, and case studies in response to the initial guidance being offered. The broad scope, diversity, and rapid developments in nanotechnology make it impossible to offer definitive guidelines or practices that will apply to all situations. However, the NIOSH document will provide a vehicle for more rapid sharing of results from NIOSH studies; a means to share lessons from the OS&H community; and a more effective process for translating findings from field and research studies into practices that can be applied. The document presents information that is the Institutes current knowledge and opinion. As the knowledge base on nanotechnology grows, NIOSH intends to provide updates on the guidance for the safe handling of nanoparticles and other safe approaches to nanotechnology. Safe Approaches to Nanotechnology: An Information Exchange with NIOSH can be found at http://www.cdc.gov/niosh/topics/nanotech/nano_exchange.html.

Poster: 0187

NTP Center for the Evaluation of Risks to Human Reproduction

MD Shelby (2) presenting, GD Jahnke (1), AR Iannucci (1), AR Scialli (1)

Sciences International, Inc., Alexandria, VA, United States (1), NIEHS, Research Triangle Park, NC, United States (2)

The NTP Center for the Evaluation of Risks to Human Reproduction (CERHR) was established by the National Toxicology Program (NTP) and the National Institute of Environmental Health Sciences (NIEHS) in 1998 to address the impact of chemical exposures on human reproductive and developmental health. CERHR evaluations involve the critical review of reproductive, developmental, and other relevant toxicity data and exposure information by independent panels of scientists. Chemicals are selected for evaluation based upon several factors including: the potential for human exposure from use and occurrence in the environment, extent of public concern, production volume, and extent of data from reproductive and developmental toxicity studies. The main products are expert panel reports and NTP monographs. These reports are publicly available from the CERHR web site or by contacting CERHR. CERHR reports impact regulatory decisions by international, federal and state agencies. The public has opportunities to nominate chemicals for evaluation to CERHR, to recommend scientists to serve on expert panels, and to provide oral comments at the panel meeting and written comments on draft and final expert panel reports. The NTP evaluates these comments, the conclusions of the expert panel, and any new data not available at the time of the panel meeting. The NTP then prepares a brief describing in plain language NTP's conclusions on the reproductive and developmental hazard from exposures to the chemical. The expert panel report, public comments, and NTP brief comprise the NTP monograph on the chemical. CERHR has conducted expert panel meetings and published expert panel reports on seven phthalates (DEHP, DINP, DIDP, DnOP, DnHP, DBP, BBP), methanol, 1-bromopropane, 2-bromopropane, ethylene glycol, propylene glycol, fluoxetine (Prozac®; Sarafem™), acrylamide, amphetamines and methylphenidate, and styrene. Of particular importance to concerns about occupational exposures are the evaluations of bromopropanes, ethylene glycol, acrylamide, and styrene. In addition, evaluations of genistein and soy formula are near completion. The NTP monographs, expert panel reports, other CERHR publications, and information on reproductive health topics can be accessed through the CERHR web site (http://cerhr.niehs.nih.gov) or by contacting the CERHR office at NIEHS.

(Work supported in part by the National Institute of Environmental Health Sciences Contract N01-ES-35503).

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Poster: 0188

Sperm Biochemical Markers Detect Diminished Support to Pregnancy Maintainance and Success

G Huszar (1) presenting

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Significance of Research: In men exposed to environmental or occupational reproductive toxicants, sperm fertilizing potential, and ability of sperm contribute to embryo development may decline much before diminished sperm concentration or motility give a warning signal. The proportion of sperm which support fertilization and a favourable pregnancy outcome may be assessed by biochemical markers. In this ongoing study, we have devised methods that (i) facilitates the quick detection of adversely affected sperm; (2) provide accessibility to our biochemical assays in central laboratories, by preservation of sperm for overnight transport.

Objectives: The biochemical markers reflect changes in male reproductive health by addressing the concurrent nuclear and cytoplasmic processes of sperm development, such as meiosis, DNA chain repair, histone-protamine replacement, and cytoplasmic extrusion. Further, we have initiated the testing of the same sperm with multiple biochemical markers. Such approach is important because reproductive toxicity may selectively affect phases of the sperm development, and single probes could miss particular defects. Testing with multiple markers demonstrated that the five-minute assay of aniline blue staining, that detects persistent histones, is related to several cytoplasmic and nuclear sperm markers.

Design: Aniline blue stain sperm light (L, normal), intermediate (IN) and dark (D, sperm with high levels of persistent histones). We have studied the potential relationship between aniline blue staining and DNA nick translation, as well as aniline blue staining and the caspase 3 apoptotic marker within the same sperm.

Methods: In these multiple-probe experiments, sperm were stained with aniline blue, and the microscopic fields of aniline blue stained sperm were digitized and captured. Subsequently, the aniline blue stain was bleached, and the sperm fields were subjected to a second probe which was either DNA nick translation which generates color in proportion with DNA breaks, or caspase 3 staining which detects the enzyme causing the programmed DNA destruction in sperm, The color intensities, similar to the aniline blue, were graded as light (L), intermediate (IN) and dark (D). The DNA nick translation

and caspase stained images were than compared with the saved aniline blue images of the same sperm. **Results:** Comparison of the patterns with aniline blue and nick translation in the same sperm indicated that 84.4% of sperm showed identical L-L, IN-IN and D-D staining patterns with the two methods (N=2446 sperm evaluated in 5 men, mean: 489 sperm/man; range: 276-602). The correlation between the aniline blue and nick translation staining patterns was very close ($r=0.82$, $p<0.001$). Thus, aniline blue staining reflects well the integrity of DNA strands in spermatozoa. Regarding the aniline blue and caspase-3 apoptotic protein double probing, in the 2101 sperm examined, 85.2% of sperm exhibited identical L-L, IN-IN or D-D (12.7±5.4%) patterns. Thus, aniline blue also reflects the presence of apoptosis.

Conclusions: Using probes for persistent histones and fragmented DNA or for apoptotic markers in the same sperm, indicate that defects in histone-protamine replacement also related to DNA fragmentation and presence of the apoptotic process in spermatozoa. Both of these DNA-related defects are known to adversely affect the paternal contributions of sperm to the zygote. Thus, aniline blue staining facilitates the quick and inexpensive prospective evaluation of DNA integrity in men investigated for exposure to environmental and occupational toxicants. Moreover, if there is an increase in aniline blue stained dark sperm over the normal values, using our shipping protocol that preserves sperm attributes, the semen sample investigated maybe sent to a central laboratory for further biochemical marker studies.

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Poster: 0189

Mixed Exposures in the Work Environment: A Bilingual Web Tool for Their Management

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Workers are commonly exposed to multiple substances, either as mixtures of substances or as separate simultaneous exposures. However, little is known about how individual agents in mixed exposures may interact to increase or otherwise modify the likelihood of adverse health effects. Research has shown that interactions from some mixed exposures may lead to an increase in the severity of the harmful effect. The problem is multifaceted, given the large number of different types of mixed exposures that occur every day in a variety of workplaces. The Quebec regulation, as well as many other regulatory agencies, is similar to the ACGIH® approach. It states that when two or more substances are present and when they have similar effects on the same organs of the human body, their effects should be considered additive, unless established otherwise. This project was undertaken to build a toxicological database and a user-friendly tool for the identification of possible interactive effects of mixtures. Standard general literature references were used to compile critical data for each of the 695 substances in the regulation: target organs, effects in target organs, mechanism of action and toxicokinetic characteristics. Only the heath effects occurring at a concentration below 5 times the OEL for each substance were compiled. They were grouped into 32 classes of "similar health effects". When two or more substances (up to 12 substances) are queried, the tool analyzes the health effects for each substance and its related class(es), and, using Boolean calculation, then combines the data in order to report any possible additivity or interaction. When the exposure concentrations are entered, the tool also calculates, if applicable, the sum of the fractions of the OEL. Several preoccupations emerged from the toxicological team: 393 substances were in the "upper respiratory tract irritation" class and there is a debate whether all types of irritants should be considered as having additive effects. Also, when a substance is classified as a carcinogen based on animal studies, it cannot always be considered as a specific target organ carcinogen. Furthermore, since an "ALARA" principle is usually applied to carcinogens, it does not seem appropriate to calculate a mixture exposure level, as the concentration of each of the carcinogens should be reduced to the lowest feasible level. This decision-making tool will help occupational health and safety stakeholders to assess the toxicological risk of mixtures but will not replace professional judgment on a particular situation. In the future, this tool could be adapted to other bodies of reference values such as the TLVs® of the ACGIH®, the PELs of OSHA or the RELs of OSHA.

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This tool is now available on the Web either in French or in English at the following address: http://www.irsst.qc.ca/en/_outil_100037.html.

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Poster: 0190

Towards a Biomarker Database and Decision Support System

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For over two decades, scientists have been touting the importance of the application of biomarkers in reducing disease and protecting individuals from the harmful effects of exposure to occupational and/or environmental chemicals. However, few scientists apply stringent criteria to biological end points before proclaiming them biomarkers. While established guidelines for biomarker validation exist, methods for their implementation and case studies testing the methods are rare. This pilot study seeks to develop and demonstrate the use of a system for integrating complex and multifaceted data, validating biomarkers, and incorporating the biomarkers into an occupational risk assessment. A survey of 59 occupational health safety professionals was conducted and benzene was identified as an occupationally relevant, relatively data rich chemical. The structure for the biomarker database and decision rules were developed to organize the diverse types of data. A Bayesian network and regression analysis techniques were developed to test and validate (or discount) biomarkers along the entire exposure-disease continuum. The Bayesian network is used to analyzing the strength of the dependencies between exposure, the potential biomarkers, and disease. The framework lays out an approach to consider a variety of biomarkers from the exposure-disease continuum for the enhancement of occupational risk assessment. Recommendations for utilizing biomarkers in general in risk assessment were developed and discussed. Future research will focus on refinement of the quantitative validation techniques and derivation of a revised, biomarker-based OEL for benzene.

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Poster: 0191

Methodological Issues Regarding Confounding and Exposure Misclassification in Epidemiological Studies of Occupational Exposures

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Confounding and exposure misclassification are issues that concern epidemiologists because of their potential to bias results of studies and complicate interpretations. In occupational epidemiology both are routinely raised to argue that an observed result is either a false positive or a false negative finding. Although it is important to consider the potential for limitations of epidemiologic investigations, judgment regarding their importance should be based on their actual likelihood of occurrence. Clear examples of substantial confounding are rare in occupational epidemiology. In fact, even for studies of occupational exposures and lung cancer, tobacco-adjusted relative risks rarely differ appreciably from the unadjusted estimates. This is surprising because it seems the perfect situation for confounding to occur. Yet, despite the lack of evidence that confounding is a common problem, nearly every epidemiologic paper includes a lengthy discussion on uncontrolled or residual confounding. On the other hand, exposure misclassification probably occurs in all studies. The only question is, how much? The direction and magnitude of nondifferential exposure misclassification (the type most likely to occur in cohort studies) on estimates of relative risks can be largely predicted given knowledge on the degree of misclassification, i.e., relatively small amounts of misclassification can bias relative risks substantially towards the null. The literature, however, is full of discussions implying that misclassification of exposure is an explanation for a positive finding. These comments are not to suggest that all potential limitations for epidemiologic studies should not be considered and evaluated. We do believe, however, that the likelihood of occurrence and the direction and magnitude of the effect should be more carefully and realistically considered when making judgments about study design or data interpretation.

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Poster: 0192

Development of Dermal Uptake Pharmacokinetic Models for Solvents in Rats

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Dermal exposures and subsequent percutaneous absorption of solvents and other chemicals can be a critical exposure route in occupational settings. However, in silico predictive methods do not generally provide an accurate estimate of absorption when compared to dermal studies which have demonstrated that dermal exposures can be a significant contributor to total absorbed dose. Physiologically based pharmacokinetic (PBPK) models allow both the estimation of internal dose from a dermal exposure and the calculation of equivalent dose levels across dosing routes, since many chemicals have more significant oral or iv data sets. Dermal exposures to both lipophilic and hydrophilic chemicals were conducted in F344 rats with uptake measured via exhaled breath to allow detection of rapid concentration changes. Exposures were conducted by placing a set amount of test compound, either neat or in an aqueous formulation, into a sealed chamber secured to the back of the rat and monitoring exhaled breath concentrations from the animal in a gas uptake chamber for approximately three hours. Exposures were conducted for acetone, ethyl benzene, styrene, methyl ethyl ketone (MEK) and methyl n-butyl ketone (MnBK). Exposures were run with neat test material, in aqueous vehicle, or both neat and aqueous depending on solubility. All exposures were repeated at least three times and experiments with leaking test chambers were discarded.

The concentration of acetone peaked at approximately 10-20 minutes while styrene and ethylbenzene were still increasing at the end of the three hour exposures. Total dermal absorption was found to increase with styrene>ethyl benzene>MEK>MnBK>acetone. Dermal exposure routes were added to existing pharmacokinetic models for acetone, ethyl benzene, styrene and MEK. Additional exposures (oral, intraperitoneal and gas uptake) were conducted as the basis for constructing a model for MnBK. In addition, a single standardized model structure was constructed to allow for simple direct comparison of the test chemicals. The percutaneous absorption data and the PBPK model constructs allow a quantitative assessment of the risk from dermal exposures and an improvement in the occupational safety assessments of solvents.

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Poster: 0193

Improved Prediction of Dermal Absorption of Small Doses of Potentially Volatile Chemicals

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Dermal exposures span the range of NORA sectors, second in impact only to inhalation as a source of chemical hazard to workers. Dermal risk assessment concerns itself with identifying and quantifying the hazard associated with dermal exposure, starting with absorption of chemicals though the skin. Despite the considerable body of research in this area, accurate estimation of skin absorption subsequent to transient exposures to solvents, pesticides and other organic chemicals remains elusive. In this research project we have developed an improved tool for making such estimations.

The disposition of an arbitrary dose of a (potentially) volatile compound applied to skin neat or dissolved in a volatile vehicle is described in terms of a diffusion model with novel components. Permeant properties that must be specified are molecular weight (MW), density (□), water solubility (Sw), octanol/water partition coefficient (Koct) and vapor pressure (Pvp). Optionally, a steady-state skin permeability coefficient (kp) from aqueous solution may be provided. The environmental variables are skin temperature (T), hydration state (partial or full) and wind velocity (u). Given this information and the dose, the associated computer program, which is written as a Visual Basic add-in for an Excel® spreadsheet, calculates the time course for absorption and evaporation of the permeant from the skin as well as the final mass balance. The novel components to the calculation include: (1) the concepts of a deposition depth and saturation concentration in the stratum corneum; (2) an evaporation mass transfer coefficient based on chemical spill correlations; and (3) hydration-dependent stratum corneum/water partition and permeability coefficients derived from a microscopic model. Application of the model to the problem of N,N-diethyl-m-toluamide (DEET) and benzyl alcohol applied to skin as ethanolic solutions is described.

The method addresses known problems of estimating the permeability of partially hydrated skin and correctly decomposing skin permeability into its diffusive and partitioning components. It can be applied broadly to non corrosive organic chemicals having moderate-to-high lipophilicities, including those with mild skin permeation enhancing effects. Consequently, it has potential use in risk assessment associated with organic solvents, cutting fluids, pesticides, herbicides, preservatives, fragrances and sunscreens. Additional experimental confirmation of the model predictions is an ongoing activity in our laboratory.

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Poster: 0194

IRSST Institut de Recherche Robert-Sauvé en Santé et en Sécurité du Travail MISSION VISION IMPACT

DG Gaudet (1) presenting

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Established 25 years ago with such goals as to contribute to the prevention of industrial accidents and occupational diseases as well as to the rehabilitation of affected workers, to offer laboratory services and expertise necessary for the activities of the public occupational health and safety prevention network, to disseminate knowledge and to act as scientific benchmark and expert, the IRSST can now be considered a mature organization. With a budget of US $17 M, a workforce of 150 specialists, and staff supported by a network of 200 external researchers from Québec universities and research centres, the Institute has become a reference centre that is vital to the operations and strategies of the Québec Workers' Compensation Board and its OHS network.

Research projects funded by the Institute are carried out in a context of labour/management collaboration. Both sides are represented on the Institute's Scientific Advisory Board (6 scientists, 4 management representatives and 4 labour representatives), advising the administration regarding the pertinence and priority of each proposed research project before it is evaluated by scientific peers. Their comments along with the researchers' answers are then submitted to the Board for grant approval.

This labour/management collaboration is extended to the workplace. Field projects funded by the Institute are always carried out in collaboration with both parties. Before the researchers receive approval to go into a workplace, the objectives and goals have to be explained to both parties. Following field research, the preliminary results are presented to both management and labour representatives. The researchers are always available to explain the multiple facets of the report and to answer questions.

Before a research project is approved, in order to increase the transfer of knowledge, a committee consisting of representatives of labour, management and a selected group from the OHS network is formed, when possible. Their mandate is to look closely at the development of the research project and also to initiate transfer activities for the final results.

All research projects supported by our Institute are integrated into a matrix system including research priorities (accidents, musculoskeletal disorders, etc.), research topics (isocyanates, young workers, psychosocial health, etc.) and industrial sectors.

In relation to the NORA priorities, the mixed approach used to reach our goals will be presented and discussed.

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Poster: 0195

Fiber Deposition in the Human Respiratory Tract

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Asbestos is a notorious occupational hazard. Exposure to airborne asbestos fibers in the workplace increases the incidence of lung cancer, fibrosis, and mesothelioma for asbestos miners and workers. Although the use of asbestos fibers was banned by the U.S. Environmental Protection Agency in 1989, new fiber materials such as man-made vitreous fibers (MMVFs) are being manufactured to replace asbestos for new applications. However, some research studies conducted in laboratory animals have shown that certain MMVFs may have a biological effect similar to that of asbestos. Therefore, it is believed that a potential risk of fiber-related diseases for workers in the MMVF textile industry still exists.

The health effects of exposure to fiber strongly depend upon the regional and local sites in the human respiratory tract where the fiber deposits. By knowing these sites of preferred deposition and the corresponding fiber dimension distribution at these sites, the understanding of the etiological process and the determination of hazard for fiber-related lung diseases would improve significantly. However, ethicalconstraints severely limit the use of fibers in human volunteer studies. Hence, the experimental data are extremely limited on this topic. This lack of data makes the nature of fiber deposition in the human respiratory tract to remain unknown and also hampers the verification of available lung deposition models.

The goal of this research is to obtain sufficient experimental data for fiber deposition in the human respiratory tract for investigating the deposition patterns and mechanisms. In this study, realistic human respiratory tract replicas with well-defined airway geometry were made that included the nasal airway, oral airway, and tracheobronchial airways. MMVFs were used as the test fiber material including glass fibers and carbon fibers. The fiber deposition experiments were conducted by delivering fiber aerosol into the replicas with three inspiratory flow rates (15, 43.5, and 60 l/min), which cover an adult breathing rate from rest to performing moderate exercise. The post-experimental procedure was then carried out to obtain the fiber deposition information from each region of the replica.

The experimental results acquired showed a series of fiber deposition patterns, trends, and efficiencies in the human respiratory tract. Impaction was found to be the dominant deposition mechanism in the upper

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airway. Most of the fibers with high inertia deposited in the nasal airway or pharynx and larynx regions in the oral airway. In contrast, fibers with low inertia were found to pass through the upper airway easily and entered the lower respiratory tract (deep lung). Since fiber deposition in the human respiratory tract is believed to be a function of its physical characteristics, for the occupational health point of view, the information obtained from this research is useful in assessing the exposure dosimetry of fibers and also will improve predicting the fiber deposition pattern for other types of fibers, including asbestos and new MMVFs being developed.

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Poster: 0196

Smoking Prevalence and Healthcare Provider Smoking Cessation Advice Among US Worker Groups: The National Health Interview Survey (NHIS)

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Objectives: Smoking prevention and cessation are important to prevent a range of chronic diseases. Among workers in dusty occupations, tobacco use is particularly important due to the potential s ynergistic effects of occupational exposures (e.g. asbestos) in causing disease (e.g. lung cancer). Research has demonstrated that one of the most effective forms of smoking prevention is for the healthcare provider to recommend smoking cessation to their patient. Even among US workers with access to medical care, most providers do not evaluate occupational exposures and their potential impact on the health of US workers. This study explored the prevalence of smoking and the reported smoking cessation discussion among US workers with access to medical care, particularly among occupations with high dust exposures and high reported smoking.

Methods: Using the nationally representative 1997-2003 National Health Interview Survey (NHIS), the prevalence of reported current smoking was examined among US workers in 41 occupational categories. The 2000 NHIS Cancer Control Module was used to determine the reported prevalence of the following among current US workers who had visited a healthcare provider in the past 12 months: a) Did the provider ask if the worker smoked; and b) If they smoked, was the worker advised to stop smoking by the provider. Data analysis was performed with adjustments for sample weights. Prevalence estimates were not calculated for any occupational subgroup with less than 25 observations.

Results: The study population represented an estimated average 126,970,317 US workers annually between 1997-2003. Among all US workers, the average annual prevalence of current smoking was 25%. Among the US workers participating in the 2000 NHIS Cancer Control Module, the annual reported prevalence of visiting a healthcare provider during the past 12 months was 63%. On average 48% reported being asked by their physician if they smoked (range 21%-56% among 38 occupations). Among those workers who were current smokers at the time of the 2000 NHIS interview, 67% were told by their provider to stop smoking (range 53%-79% among 28occupations). Among the 28 occupational

categories with adequate sample size for assessment, the group of workers with an expected increased occupational exposure to dusty work environments (including asbestos, coal dust, silica, particulates, etc) and high smoking prevalence had relatively low reported discussions with physicians about smoking cessation, including: Farm workers (39% overall smoking prevalence; 54% told to quit), Construction and extractive trades (41%; 57%), Machine operators/tenderers (44%; 59%), Precision production occupations (51%; 64%), and Freight, stock and material handlers (47%; 66%).

Discussion and Recommendations: Regular discussion of tobacco use and smoking cessation recommendations by healthcare providers is one of the few low cost and effective methods of decreasing the prevalence of smoking in the US population. The relatively low reported prevalence of smoking cessation discussion with their healthcare provider reported by US workers, particularly among workers with potentially synergistic occupational exposures and high current smoking prevalence reflects a lack of knowledge of occupational exposures and risks on the part of healthcare providers. Furthermore, given the decreasing access to medical insurance among US workers, it is essential for health care providers to effectively utilize each patient contact to ascertain smoking status, provide a clear message to smokers to quit, and to provide assistance to those seeking to quit. Finally, additional strategies are needed to reach smokers who do not come in contact with the health care system.

Poster: 0197

Occupational Animal Exposure as a Predictor of Allergy and Asthma Prescription Drug Claims

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Research has shown that employees who work with animals are at risk of developing animal-induced occupational allergies and asthma. This study explores the possibility that occupational exposure to animals could have a measurable effect on health care use, specifically the prevalence of health insurance claims for allergy and asthma prescription drugs.

The study population was comprised of employees at a large academic medical center, some of whom worked with research animals and all of whom were eligible for an employer-provided prescription drug benefit in 2003 (n=9,925). Data about prescription drug claims, employee demographics, job information, and occupational exposure to animals were extracted from a de-identified database that had been constructed for research purposes. Of all employees in the study population, 22% had at least one claim for allergy drugs, 10% had at least one claim for asthma drugs, 7% had occasional animal contact and 0.5% had daily animal contact.

The effect of occasional and daily animal exposure on the number of allergy and asthma drug claims was estimated using two ordered probit regressions, which can be used when the dependent variable contains a small number of ordered categories. Three levels were used for asthma drugs (0, 1, and 2 or more), and four levels were used for the more pervasive allergy drugs (0, 1, 2, and 3 or more). Control variables included age, race, gender, and broad job categories (service/maintenance and clerical).

Results indicate that employees with daily animal contact had higher levels of allergy and asthma prescription drug claims than those with no animal contact, though differences were not statistically significant. The model results predict that if all employees were exposed to animals on a daily basis, over 17% would have 3 or more allergy drug claims per year (compared to 10% if none were exposed) and nearly 9% would have 2 or more asthma claims per year (compared to 5% if none were exposed).

Among those with occasional animal contact, levels of allergy drug claims were lower and levels of asthma drug claims were similar to employees with no animal contact. Specifically, if all employees

were exposed to animals occasionally, 7% would be expected to have 3 or more allergy claims (compared to 10% if none were exposed) ($p<0.001$). Occasional animal exposure had little effect on expected prevalence of asthma drug claims – as with the unexposed employees, approximately 5% of these employees had 2 or more asthma drug claims per year.

The results suggest opportunities for future research. For example, it is possible that interventions aimed at reducing animal allergen exposures among those who work most closely with laboratory animals could have an impact on their utilization of allergy and asthma prescription drugs (and possibly their health as well).

This study joins a small but growing literature exploring differential health services utilization as a function of occupational exposure, and is perhaps the first to look specifically at prescription drug use among animal-exposed employees. As employers grapple with increasing healthcare costs for employees, research about the impact of workplace exposure on healthcare utilization could provide employers with additional incentives to implement targeted injury and illness prevention efforts.

NOTES