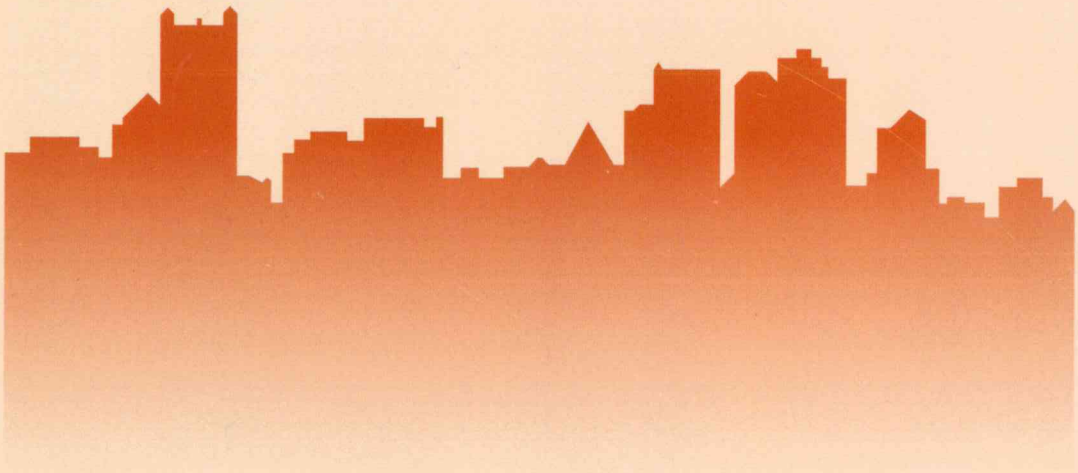
CDC
Workplace Safety and Health

NOIRS 2008

National Occupational Injury Research Symposium 2008



October 21-23, 2008

Pittsburgh, PA

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

NIOSH

October 2008

NOIRS 2008 Participants,

I would like to welcome you to the 4th National Occupational Injury Research Symposium (NOIRS). The response to this year's symposium reinforces the critical value of convening a national forum for sharing current research and knowledge on the prevention of occupational injuries. Few areas have such a tremendous impact on public health as occupational injuries, yet such a modest research community to generate the scientific basis for effective prevention. Progress is being made, however it will take our sustained, collective efforts to further reduce the devastating impact that traumatic injuries have on workers, their employers and their families. The multidisciplinary nature of occupational injury research makes it essential that NIOSH and its partners bring together epidemiologists, engineers, economists, health practitioners, communication specialists, and other scientists and professionals committed to the research and prevention of occupational injuries.

Partnerships are critical to effective workplace prevention. I would like to acknowledge our co-sponsors, the **National Safety Council (NSC)** and the **Liberty Mutual Research Institute for Safety** and thank each of them for their support of NOIRS as well as their continued support of and collaboration with NIOSH and its programs.

As with the previous National Occupational Injury Research Symposia, this year's program represents the breadth and diversity of occupational injury research topics. NIOSH continues to place a strong emphasis on moving the results of research into preventive actions through our Research to Practice Initiative, and NOIRS 2008 will highlight some of the successful partnerships we have had in transferring research to the workplace for prevention. Through the NOIRS, NIOSH will continue to provide a forum for the presentation of diverse, state-of-the-art occupational injury research, and provide an opportunity to foster partnerships and collaborations among the various disciplines and industry sectors with a common interest in research leading to the prevention of occupational injuries. It is my hope that NOIRS 2008 will reinvigorate us, stimulate new partnerships, and help focus our energies to ensure all workers come home safely each day.

I hope you share my enthusiasm for a productive interchange of science and prevention strategies as we work toward our common goal to prevent traumatic injuries and fatalities in the workplace.

Christine M. Branche

Christine M. Branche, Ph.D.
Acting Director
National Institute for Occupational Safety and Health

GENERAL INFORMATION

Symposium Goal

The goal of the NOIRS is to provide a forum for researchers and other professionals to share their findings and experiences aimed at preventing traumatic occupational injury through research and prevention. In addition to presenting current research findings, NOIRS also seeks to foster collaboration among researchers from a broad range of disciplines and perspectives; showcase innovative and state-of-the-art approaches to research and prevention; demonstrate the effectiveness of transferring research results to the workplace for prevention; and promote further research that will advance the goals of the National Occupational Research Agenda.

Color Key for Name Badges

Keynote Speakers:	WHITE
Speakers:	GREEN
Moderators:	YELLOW
Symposium Staff:	RED

Symposium staff are available to assist you with registration, accommodations, messages, logistics, and any other special needs or questions.

Messages and Telephones

Telephone messages will be delivered to the symposium registration area. All hotel rooms have voice mail. The phone number for the Sheraton is (412) 261-2000. Public telephones are available on the first floor near the Grand Station Ballroom and in the lobby area across from the gift shop/newsstand. Public telephones are also available on the second floor near the elevators. If fax services are required, the hotel offers a self-serve business center that is open 24 hours/day.

Parking

The hotel parking lot charges $16.00 per day. The parking garage, directly across the street from the hotel, charges $16.00 per day. The West Lot (Gateway Clipper Lot) is adjacent to the hotel to the West at a $5.00 "pay upon entry rate" per day. Parking charges for the West Lot and parking garage cannot be posted to your guest room. You can pay the parking attendant directly with cash or credit card.

Speaker Room

A speaker preparation area is available for presenters to preview audio-visual materials. This area is located in the Woodlawn I Room on the second floor.

Open Seating Policy

Seating for all symposium sessions will be on a first-come, first-seated basis. Since it is not possible to determine the number of participants interested in specific concurrent sessions, we urge you to review the agenda and select an alternate session in the event your first choice is filled.

Cell Phones

Please have your cell phones on vibrate/mute during sessions.

Poster Social

The Poster Social will be held in the Sheraton Station Square Hotel's Admiral Room on **Tuesday, October 21, 2008, from 5:30 p.m. – 7:30 p.m.,** and poster authors will be available for discussion and questions.
Hors d'oeuvres will be served.

Smoking

Smoking is **not** permitted in the hotel.

Abbreviations

CDC - Centers for Disease Control and Prevention
NIOSH - National Institute for Occupational Safety and Health
DSR - Division of Safety Research
NOIRS - National Occupational Injury Research Symposium

NOIRS 2008 AT A GLANCE

DAY ONE
TUESDAY, OCTOBER 21, 2008

Time	Tuesday				
7:30-8:30	Registration				
8:30-10:00	Opening Plenary *Grand Station Ballroom I and II*				
10:00-10:30	Break				
10:30-12:00	**Concurrent Sessions A**				
	A1 *Grand Station III* Describing and Preventing Falls From Heights in Construction	A2 *Grand Station IV* Cutting Edge Research: The NORA Intervention Evaluation Contest	A3 *Grand Station V* Identifying and Characterizing Fatal Injury	A4 *Brighton II* Worker Safety Associated With Disaster Response	A5 *Brighton IV* Assessing the Safety Experience in Mining
12:00-1:30	Lunch				
1:30-3:00	**Concurrent Sessions B**				
	B1 *Grand Station III* Assessing Risks and Interventions in Fall Prevention	B2 *Grand Station IV* Intervention Evaluation in Agriculture, Forestry and Fishing	B3 *Grand Station V* Improving the Collection and Interpretation of Injury Surveillance	B4 *Brighton II* Emergency Responders Safety	B5 *Brighton IV* The Relationship of Organizational Culture, Climate, and Safety
3:00-3:30	Break				
3:30-5:00	**Concurrent Sessions C**				
	C1 *Grand Station III* Ladder Safety	C2 *Grand Station IV* Intervention Evaluation in Healthcare Settings	C3 *Grand Station V* Characterizing and Preventing Injuries to Hispanic Workers	C4 *Brighton II* Needlestick Injuries Among Healthcare Workers	C5 *Brighton IV* Assessing the Safety Experience in Coal Mining
5:30-7:30	Poster Social *Sheraton Station Square Hotel* *Admiral Room*				

NOIRS 2008 AT A GLANCE
DAY TWO
WEDNESDAY, OCTOBER 22, 2008

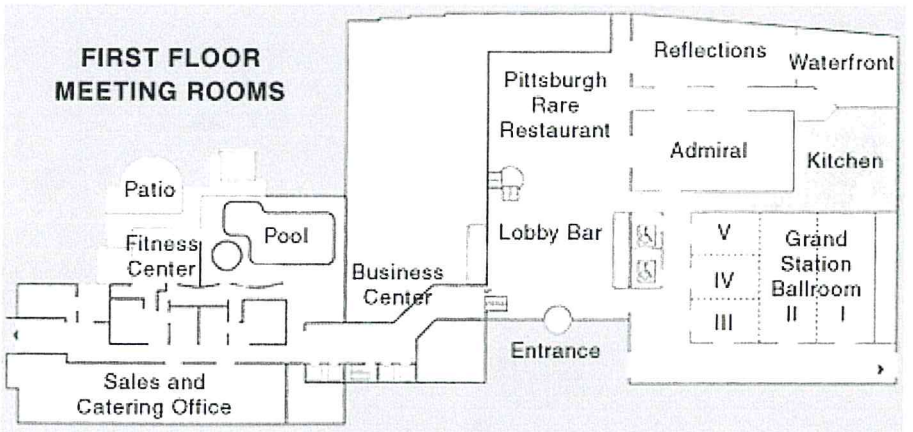
Time	Wednesday				
7:30-8:30	Registration				
8:30-10:00	**Concurrent Sessions D**				
	D1	D2	D3	D4	D5
	Grand Station III	*Grand Station IV*	*Grand Station V*	*Brighton II*	*Brighton IV*
	Injury Prevention in Construction - I	Examining the Risk Factors Associated with Slips and Falls	Nonfatal Injury Prevention Activities in Other Countries	Identifying and Characterizing Injuries in Agriculture	Motor Vehicle Safety
10:00-10:30	Break				
10:30-12:00	**Concurrent Sessions E**				
	E1	E2	E3	E4	E5
	Grand Station III	*Grand Station IV*	*Grand Station V*	*Brighton II*	*Brighton IV*
	Training in Construction	Physical and Ergonomic Risk Factors Associated With Slips	Injury Assessment and Methods	Youth in Agriculture	Assessing Injury Risk Factors
12:00-1:30	Lunch				
1:30-3:00	**Concurrent Sessions F**				
	F1	F2	F3	F4	F5
	Grand Station III	*Grand Station IV*	*Grand Station V*	*Brighton II*	*Brighton IV*
	Injury Prevention in Construction - II	Workplace Violence in Healthcare Settings	Review of Comprehensive Injury Efforts	Preventing Injuries Among Fire Fighters	Safety Practice I
3:00-3:30	Break				
3:30-5:00	**Concurrent Sessions G**				
	G1	G2	G3	G4	G5
	Grand Station III	*Grant Station IV*	*Grand Station V*	*Brighton II*	*Brighton IV*
	Injuries Among Electric Utility Workers	Workplace Violence Risk Factors	Evaluating Mining Safety Initiatives	Effects of Work Organization on Safety	Systematic Review of Occupational Injury Literature

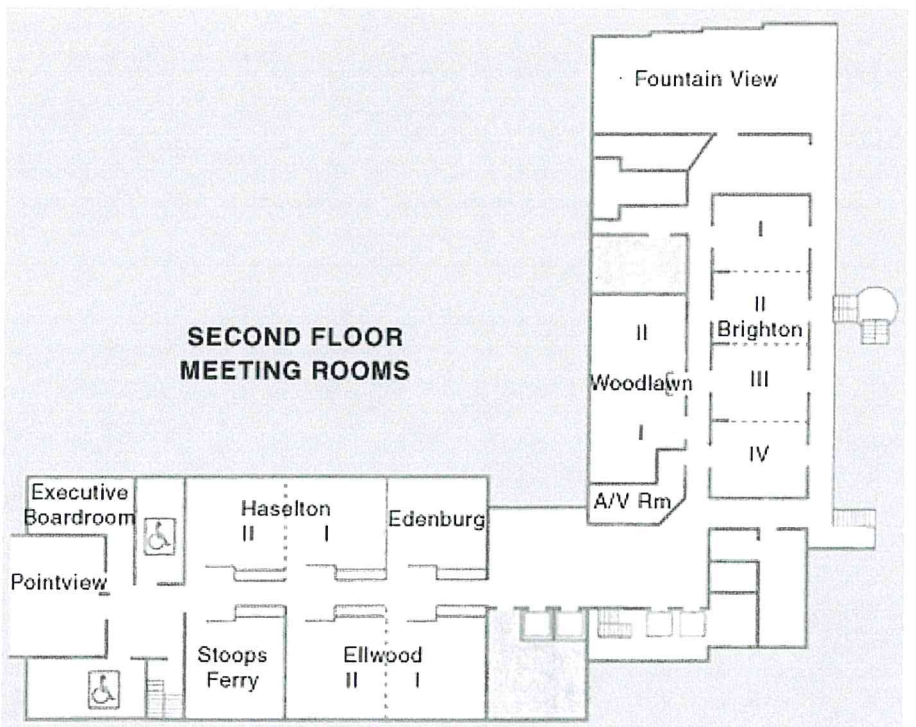
NOIRS 2008 AT A GLANCE

DAY THREE
THURSDAY, OCTOBER 23, 2008

Time	Thursday				
8:30-10:00	**Concurrent Sessions H**				
	H1	H2	H3	H4	H5
	Grand Station III	*Grand Station IV*	*Grand Station V*	*Brighton II*	*Brighton IV*
	Using Surveillance Systems to Identify Injury Characteristics in Construction	Injury Experience of Public Safety Workers	Safety Practices II	Evaluations of Safety and Health Management Practices	No Session
10:00-10:30	Break				
10:30-12:00	Closing Plenary *Grand Station Ballroom I*				

Meeting Facilities





ACKNOWLEDGEMENTS

NOIRS 2008 is being convened by the Division of Safety Research, NIOSH
Nancy A. Stout, Ed.D., Director, DSR
Timothy J. Pizatella, Deputy Director, DSR

We gratefully acknowledge our co-sponsors for their contribution and support:
National Safety Council
Liberty Mutual Research Institute for Safety

Special acknowledgements are made to the following for their support and dedication to planning NOIRS 2008

Conference Management Committee
Debra Handlin [Chair], Tonya Jacquez,
Barbara Phillips, Tonya Rowan, Richard Whisler

Scientific Review Committee
James Collins [Chair], Alfred Amendola, Jennifer Beaupre,
Jennifer Bell, Elyce Biddle, Guang Chen,
Sharon Chiou, Brad Husberg, Suzanne Marsh,
Marilyn Ridenour, Mahmood Ronaghi, Hope Tiesman

Support Services

Registration
National Safety Council
Tammy Washington

Contractor
Professional and Scientific Associates
Michael Freeman, Nina Norris

NOIRS Website Design
NIOSH, Division of Safety Research
Joyce Spiker

NOIRS 2008 Coordinator
Debra Handlin

Tuesday, October 21, 2008

7:30 a.m. - 8:30 a.m. **REGISTRATION**

8:30 a.m. - 10:00 a.m. **OPENING PLENARY SESSION** *Grand Station Ballroom I and II*

"The Impact of Occupational Injury Research:
Science-Based Prevention at Work"

Welcome: **Christine Branche, Ph.D.**, Acting Director, NIOSH

Nancy A. Stout, Ed.D.
Division of Safety Research, NIOSH

Letitia Davis, Sc.D., Ed.M.
Massachusetts Department of Public Health

Corinne Peek-Asa, MPH, Ph.D.
University of Iowa

Audrey Nelson, Ph.D., RN, FAAN
James A. Haley Veterans Administration Medical Center

Stacy W. Smallwood, MPH
University of South Carolina

10:00 a.m. - 10:30 a.m. **BREAK**

Tuesday, October 21, 2008

10:30 a.m. - 12:00 p.m. **CONCURRENT SESSION A**

A1.0 ***Describing and Preventing Falls From Heights in Construction*** **Grand Station III**
Moderator: Paul Becker

10:30 a.m.	*Observation of Fall Risks in Residential Construction Sites*	Vicki Kaskutas A1.1
10:50 a.m.	*Interventions for Overhead Drilling in Construction*	David Rempel A1.2
11:10 a.m.	*Development of a Unique Fall-Prevention Guardrail System for the Construction Industry*	Thomas Bobick A1.3
11:30 a.m.	*Plantar Vibration Effects on Postural Balance at Elevation*	Peter Simeonov A1.4
11:50 a.m.	Questions and Discussion	

A2.0 ***Cutting Edge Research: The NORA Intervention Evaluation Contest*** **Grand Station IV**
Moderator: James Collins

10:30 a.m.	*Applying Research to Practice: Anti-Vibration Interventions in Sheet Metal Assemblers*	Amanda Burwell A2.1
10:50 a.m.	*Prevention of Traumatic Nail Gun Injuries in Apprentice Carpenters: Use of Population-Based Measures to Monitor Intervention Effectiveness*	John Dement A2.2
11:10 a.m.	*A Randomized-Controlled Intervention of Machine Guarding and Related-Safety Programs in Small Metal Fabrication Businesses*	David Parker A2.3
11:30 a.m.	*Evaluation of a Community Based Effort to Reduce Injuries and Illnesses to Wild Blueberry Harvesters*	Lynae Hawkes A2.4
11:50 a.m.	Questions and Discussion	

Tuesday, October 21, 2008

10:30 a.m. - 12:00 p.m. **CONCURRENT SESSION A (cont'd)**

A3.0 ***Identifying and Characterizing Fatal Injury*** **Grand Station V**
Moderator: Gordon Smith

10:30 a.m.	*Characterizing OSHA-Investigated Deaths Using CFOI Fatality Data*	Miriam Schoenbaum A3.1
10:50 a.m.	*Injury Circumstances of Occupational Fatalities in the U.S.— A Comparison of Two Classification Schemes*	Suzanne Marsh A3.2
11:10 a.m.	*Metrics for Predicting Fatal Accidents and LWDII Rates*	Hangsheng Liu A3.3
11:30 a.m.	*Fatality Rates: Disentangling the Relation of Establishment Size and Firm Size*	John Mendeloff A3.4
11:50 a.m.	Questions and Discussion	

A4.0 ***Worker Safety Associated With Disaster Response*** **Brighton II**
Moderator: James Spahr

10:30 a.m.	*Safety as a Factor that Influences Recruitment and Retention of a Volunteer Disaster Response Workforce*	Kristine Qureshi A4.1
10:50 a.m.	*Participatory Action Research Methodology in Disaster Research: Results From the World Trade Center Evacuation Study*	Robyn Gershon A4.2
11:10 a.m.	*Point and Long-Term Injury Patterns Among World Trade Center Evacuees*	Kristine Qureshi A4.3
11:30 a.m.	*Event Study Analysis to Establish Capitalization Effects for Publicly Traded Corporations Reporting Fatal Injury Events Related to Chemicals*	Paul Keane A4.4
11:50 a.m.	Questions and Discussion	

Tuesday, October 21, 2008

10:30 a.m. - 12:00 p.m. **CONCURRENT SESSION A (cont'd)**

A5.0 ***Assessing the Safety Experience in Mining*** **Brighton IV**
Moderator: Linda McWilliams

10:30 a.m.	*The Burden of Fatal Occupational Injuries in the U.S. Mining Industry, 1992-2002*	Elyce Biddle A5.1
10:50 a.m.	*Underground Coal Mining Injury Trends: A Look at How Age and Experience Relates to Severity of Injury*	Katherine Klein A5.2
11:10 a.m.	*A Comparison of Equipment Related Injury Causes in U.S. and Australian Underground Coal Mines*	Robin Burgess-Limerick A5.3
11:30 a.m.	*Real Time in Ear Dosimetry*	Brandon Takacs A5.4
11:50 a.m.	Questions and Discussion	

12:00 p.m. - 1:30 p.m. **LUNCH** (On Your Own)

1:30 a.m. - 3:00 p.m. **CONCURRENT SESSION B**

B1.0 ***Assessing Risks and Interventions in Fall Prevention*** **Grand Station III**
Moderator: Alfred Amendola

1:30 p.m.	*Michigan Focus on Fatal Falls: Factors, Fixes and Follow-up*	Debra Chester B1.1
1:50 p.m.	*Fall-Safe Intervention Research, Final Results*	Paul Becker B1.2
2:10 p.m.	*Effect of Side Forces on the Stability of Scissor Lifts*	Christopher Pan B1.3
2:30 p.m.	*Development of Improved Harness Sizing System*	Hongwei Hsiao B1.4
2:50 p.m.	Questions and Discussion	

Tuesday, October 21, 2008

1:30 p.m. - 3:00 p.m. **CONCURRENT SESSION B (cont'd)**

B2.0 ***Intervention Evaluation in Agriculture, Forestry and Fishing*** **Grand Station IV**
Moderator: Jennifer Bell

1:30 p.m.	*Hazard Assessment of Aquaculture Operations*	Melvin Myers B2.1
1:50 p.m.	*Cost-Effectiveness of the Commercial Fishing Industry Vessel Safety Act of 1988*	Regina Pana-Cryan B2.2
2:10 p.m.	*The Effectiveness of the New Zealand FarmSafe™ Programmes: Development and Investigation of a Method for Outcome Evaluation*	Colin Cryer B2.3
2:30 p.m.	*Injury Surveillance in the U.S. Commercial Fishing Industry*	Devin Lucas B2.4
2:50 p.m.	Questions and Discussion	

B3.0 ***Improving the Collection and Interpretation of Injury Surveillance*** **Grand Station V**
Moderator: John Mendeloff

1:30 p.m.	*The Sorry State of Surveillance for Occupational Injury Hospitalizations*	Gordon Smith B3.1
1:50 p.m.	*The Use of Data Linkage for Surveillance of Serious Occupational Injury: Methods and Findings*	Joseph Kufera B3.2
2:10 p.m.	*How Many Workplace Injuries Remain Unreported? A Capture-Recapture Study in Six States*	Leslie Boden B3.3
2:30 p.m.	*Using the SOII to Tell Which States are Safest—And Why You Shouldn't Believe the Results*	Rachel Burns B3.4
2:50 p.m.	Questions and Discussion	

Tuesday, October 21, 2008

1:30 p.m. - 3:00 p.m. **CONCURRENT SESSION B (cont'd)**

B4.0 ***Emergency Responders Safety*** **Brighton II**
Moderator: Timothy Pizatella

1:30 p.m.	*Fireground Command Decision Making: Understanding the Barriers Impacting Situation Awareness*	Richard Gasaway B4.1
1:50 p.m.	*Correlation Relationship of Fire Fighter Anthropometry, Hand Grip and Lateral Thumb Pinch Peak Strength Measurement*	James Spahr B4.2
2:10 p.m.	*Identifying and Preventing Traumatic Injuries in Hazardous Material Events, the Experience of 14 Hazardous Substances Emergency Events Surveillance System States*	Maureen Orr B4.3
2:30 p.m.	*NIOSH's Fire Fighters Fatality Investigation Program Raises Awareness of Quiet Alarms*	Robert Stein B4.4
2:50 p.m.	Questions and Discussion	

B5.0 ***The Relationship of Organizational Culture, Climate, and Safety*** **Brighton IV**
Moderator: Robyn Gershon

1:30 p.m.	*Narratives in Safety and Health Communications*	Mitch Ricketts B5.1
1:50 p.m.	*The Role of Organizational Policies and Practices in Injury Prevention and the Management and Prevention of Work Disability*	Benjamin Amick, III B5.2
2:10 p.m.	*Safety Culture in Extended Care: The Innovation Project*	Waqar Mughal B5.3
2:30 p.m.	*Inter-Rater Reliability Assessment of an OH&S Management System Audit Tool*	Anna Matheson B5.4
2:50 p.m.	Questions and Discussion	

3:00 p.m. - 3:30 p.m. **BREAK**

Tuesday, October 21, 2008

3:30 p.m. - 5:00 p.m. **CONCURRENT SESSION C**

C1.0 ***Ladder Safety*** **Grand Station III**
Moderator: Hongwei Hsiao

3:30 p.m.	*Prevalence of Hazards Associated With Falls from Stepladders and Targets for Intervention*	Chris Ronk C1.1
3:50 p.m.	*Portable Ladder Tool Development and Validation—Quantifying Best Practice in the Field*	Jack Dennerlein C1.2
4:10 p.m.	*Can a CSA Standard Certified Type-2 Ladder Design Hold a 0.41m Free Fall?*	Brian Varrasso C1.3
4:30 p.m.	*Effect of Ladder Types on Energy Expenditure, Forearm Force Exertion and Climbing Behavior*	Peter Vi C1.4
4:50 p.m.	Questions and Discussion	

C2.0 ***Intervention Evaluation in Healthcare Settings*** **Grand Station IV**
Moderator: James Collins

3:30 p.m.	*Musculoskeletal Injuries Resulting From Patient-Handling Activities Among Hospital Workers*	Lisa Pompeii C2.1
3:50 p.m.	*The Importance of Observational Methods in Intervention Evaluation: Patient-Handling Injuries at Two Hospitals Before and After Implementation of Patient Lifting Equipment*	Ashley Schoenfisch C2.2
4:10 p.m.	*Evaluation of a Comprehensive Slip, Trip, and Fall Prevention Program for Hospital Employees*	Jennifer Bell C2.3
4:30 p.m.	*Evaluation of the Impact of Workers' Compensation Sponsored Interventions on Musculoskeletal Injuries in Nursing Homes*	Robert Park C2.4
4:50 p.m.	Questions and Discussion	

Tuesday, October 21, 2008

3:30 p.m. - 5:00 p.m. **CONCURRENT SESSION C (cont'd)**

C3.0 ***Characterizing and Preventing Injuries to Hispanic Workers*** **Grand Station V**
Moderator: Cammie Chaumont Menéndez

3:30 p.m.	*Hand Injury Outcomes in Hispanic Workers: Translation and Validation of the DASH Questionnaire*	Linda Forst C3.1
3:50 p.m.	*Exploring the Excess Burden of Traumatic Workplace Injury to Hispanic Workers in Heavy Manufacturing*	Keisha Pollack C3.2
4:10 p.m.	*Preventing Hispanic Fatalities*	Virgil Casini C3.3
4:30 p.m.	*Fatal Occupational Falls Among Hispanic Construction Workers, 1992-2006*	Sue Dong C3.4
4:50 p.m.	Questions and Discussion	

C4.0 ***Needlestick Injuries Among Healthcare Workers*** **Brighton II**
Moderator: Letitia Davis

3:30 p.m.	*Blood and Body Fluid Exposure Risks in Operating Room*	Douglas Myers C4.1
3:50 p.m.	*Cost of Needlestick Injuries and Subsequent Hepatitis and HIV*	Paul Leigh C4.2
4:10 p.m.	*Development of an Evidence-based Evaluation Framework for a Safety Engineered Needle Program*	Prescillia Chua C4.3
4:30 p.m.	*Blood Exposure in the Home Care Workplace: Comparing Risks Among Registered Nurses and Personal Care Assistants*	Jane Lipscomb C4.4
4:50 p.m.	Questions and Discussion	

Tuesday, October 21, 2008

3:30 p.m. - 5:00 p.m. **CONCURRENT SESSION C (cont'd)**

C5.0 ***Assessing the Safety Experience in Coal Mining*** **Brighton IV**
Moderator: Gail McConnell

3:30 p.m.	*From Scotia to Brookwood, Fatal U.S. Underground Coal Mine Explosions Ignited in Intake Air Courses*	Thomas Dubaniewicz, Jr. C5.1
3:50 p.m.	*Effect of Mine Size on the Rate and Type of Fatal Accidents in Underground Coal*	Linda McWilliams C5.2
4:10 p.m.	*Expectations Training for Self-Contained Self Rescuers in Escape from Underground Coal Mines*	Kathleen Kowalski-Trakofler C5.3
4:30 p.m.	*Workers' Compensation Insurance Costs Associated With Rockfall Injuries in Underground Coal Mines*	Suresh Bhatt C5.4
4:50 p.m.	Questions and Discussion	

Tuesday, October 21, 2008

5:30 p.m. - 7:30 p.m. **POSTER SOCIAL**
Sheraton Station Square
Admiral Room

LIST OF FEATURED POSTERS

Construction Safety

P01 *Self-Reported Postures and Task Parameters within the Construction Industry that Lead to Instability Upon Standing*
Angela DiDomenico

P02 *Incidence Patterns of Lost Time Injuries within a Large Population of Construction Companies*
Doug McVittie

P03 *Improvements in Injury Rates in Construction — 1998-2006*
Brian Varrasso

P04 *Claim Persistence and Cost Measures for a Large Population of Construction Disability Cases*
Daniel Fiorini

P05 *Preventing Worker Deaths and Injuries from Contacting Overhead Power Lines with Metal Ladders*
Nancy Romano

P06 *Review of Research on Disability in Construction*
Paul Becker

P07 *Crane-Related Fatalities in Construction, 1992-2006*
Michael McCann

P08 *Nail-Gun Injuries Treated in Emergency Departments—United States, 2001-2005*
Larry Jackson

P09 *Direct-Fired Construction Heater Emissions Study*
Ray Hopkins

Work Organization and Safety Climate

P10 *Hurt at Work in America: An Examination of Workplace Injury Through the 2002 General Social Survey and NIOSH Quality of Worklife Module*
Todd Smith

P11 *The Effect of Plant-And Department-Level Job Satisfaction and Job Stress on Occupational Injury Rates: Use of HR Survey Data*
Kerry Souza

Tuesday, October 21, 2008

LIST OF FEATURED POSTERS (con't)

Home Health Care Worker Injuries

P12 *Health and Safety Hazards in the Home Healthcare Setting*
Allison Canton

P13 *Violence in the Home Healthcare Setting*
Stephanie Samar

P14 *Home Health Care Registered Nurses and the Risk of Percutaneous Injuries*
Robyn Gershon

P15 *Prevalence of Back Injuries in Home Healthcare Workers*
Julie Pearson

P16 *Injury in the Nursing Workforce: Associations with Organizational Safety Culture and Turnover*
Jennifer Taylor

Workplace Violence

P17 *Staff and Management Perceptions of Hospital Workplace Violence Prevention Programs*
Maryalice Nocera

P18 *Physical and Psychological Trauma to Emergency Department Workers due to Violence from Pediatric Patients and Visitors*
Gordon Gillespie

P19 *NIOSH Workplace Violence Initiative Intramural Research*
Daniel Hartley

Agriculture

P20 *A Decade of Progress: Childhood Agricultural Safety and Health Research*
David Hard

P21 *Agricultural Injury Among Rural California High-School Students*
Stephen McCurdy

Heat and Physiological Stress

P22 *Effects of Heat Stress on Risk Perceptions and Risk Taking*
Chu-Hsiang Chang

P23 *Evaluation of the Physiological Stress Imposed by a Prototype Fire Fighter Ensemble with Additional Chem/Bio Hazard Protection*
Jon Williams

Tuesday, October 21, 2008

LIST OF FEATURED POSTERS (con't)

Surveillance

P24 *A Survey of National Occupational Injuries: The Need to Strengthen National Standards*
Jinky Leilanie Lu

P25 *The California Fatality Assessment and Control Evaluation (FACE) Program 1992-2005: Fatal Work Injuries Among Hispanics in Los Angeles County*
Laura Styles

P26 *Pilot Surveillance Methods for Injuries Among Day Laborers*
Sarah Lowry

P27 *Deriving a Valid Description of the Epidemiology of Serious Non-Fatal Work-Related Injury—A Demonstration Project*
Colin Cryer

P28 *Survey of Safety Indices and Control Chart Drawing in Tehran Oil Refinery Company*
Akbar Ahmadi Asour

Motor Vehicle Safety

P29 *Characterization of Available Data on Injuries and Fatalities Associated with All-Terrain Vehicle Use in Occupational and Recreational Settings*
Kara Franke

P30 *Washington FACE Program Truck Driver Injury Fatalities*
Randall Clark

Older Workers

P31 *Prevalence of Visual and Hearing Impairment Among Older U.S. Workers: The National Health Interview Survey, 1997-2004*
Evelyn Davila

General Injury

P32 *Oral-Maxillofacial Injuries Among Active Duty U.S. Military Personnel, 1996-2005*
Michelle Canham-Chervak

P33 *Concentrations of PM 2.5 in a Faculty Hospital in Turkey*
Mehmet Sarper Erdogan

Tuesday, October 21, 2008

LIST OF FEATURED POSTERS (con't)

Emergency Response

P34 *Effect of Boot Weight and Material on Gait Characteristics of Men and Women Fire Fighters*
Sharon Chiou

Intervention Evaluation

P35 *The Sacred Vocation Program: A Meaning-Centered Intervention to Reduce Injuries in Health Care*
Jessica Tullar

P36 *A Communication-Based Train-the-Trainer Program as an Injury Prevention Tool*
April Smith

Economics of Injury Prevention

P37 *The Economic Evaluation of a Worksite Intervention to Improve the Ergonomics of Seated Environments*
Benjamin Amick, III

Wednesday, October 22, 2008

7:30 a.m. - 8:30 a.m. **REGISTRATION**

8:30 a.m. - 10:00 a.m. **CONCURRENT SESSION D**

D1.0 ***Injury Prevention in Construction - I*** **Grand Station III**
Moderator: Matthew Gillen

8:30 a.m.	*Diffusion of Modular Home Installation Safety Work Practices as a Result of Field Research*	Mark Fullen D1.1
8:50 a.m.	*Viability of Tying Off to Residential Roof Trusses for Fall Protection During Truss Erection*	Daniel Fiorini D1.2
9:10 a.m.	*Train-the-Trainer Training—A Case Study*	April Smith D1.3
9:30 a.m.	*Demonstration of Proximity Warning Systems (PWS) to Reduce Worker Exposure to Asphalt Trucks at Highway Paving Operations*	Jennifer Beaupre D1.4
9:50 a.m.	Questions and Discussion	

D2.0 ***Examining the Risk Factors Associated with Slips and Falls*** **Grand Station IV**
Moderator: Wen Chang

8:30 a.m.	*Bilateral Lower Extremity Response to Unexpected Slips*	Rakie Cham D2.1
8:50 a.m.	*Worker Slips and Falls in Limited Service Restaurants*	Theodore Courtney D2.2
9:10 a.m.	*Design and Evaluation of Multi-Modal Methods to Follow-up Multilingual Fast-Food Workers in a Prospective Cohort Injury Study*	Santosh Verma D2.3
9:30 a.m.	*Beware! Slippery Floor: An Interactive Game to Improve Floor Cleaning and Prevent Slips and Falls in the Food Industry*	Francois Quirion D2.4
9:50 a.m.	Questions and Discussion	

Wednesday, October 22, 2008

8:30 a.m. - 10:00 a.m. **CONCURRENT SESSION D (cont'd)**

D3.0 ***Nonfatal Injury Prevention Activities in Other Countries*** **Grand Station V**
Moderator: Larry Jackson

8:30 a.m.	*A Method to Calculate the Period Prevalence of Workers Receiving Compensation Benefits*	Richard Phaneuf D3.1
8:50 a.m.	*Patterns of Severe Work-Related Traumatic Hand Injury in the People's Republic of China*	Kezhi Jin D3.2
9:10 a.m.	*Prevalence and Predictors of Work-Related Injuries Among Children Laboring in the Streets of Latin America*	Angela Pinzon-Rondon D3.3
9:30 a.m.	*Development and Evaluation of an Intervention Study to Prevent Injuries at Work Among Stevedores in Havana*	Caristina Robaina Aguirre D3.4
9:50 a.m.	Questions and Discussion	

D4.0 ***Identifying and Characterizing Injuries in Agriculture*** **Brighton II**
Moderator: James Harris

8:30 a.m.	*Statewide Surveillance of New York Farm Injuries: An EMS-based Method*	Melissa Brower D4.1
8:50 a.m.	*Occupational Injury Rates and Treatment Patterns Among Migrant and Seasonal Farm Workers in the Northeast*	Giulia Earle-Richardson D4.2
9:10 a.m.	*Impact on the Agricultural Industry: Animal-Related Injuries*	Susan Gerberich D4.3
9:30 a.m.	*Injury Severity Related to Overturn Characteristics of Tractors*	Melvin Myers D4.4
9:50 a.m.	Questions and Discussion	

Wednesday, October 22, 2008

8:30 a.m. - 10:00 a.m. **CONCURRENT SESSION D (cont'd)**

D5.0 ***Motor Vehicle Safety*** **Brighton IV**
Moderator: Audrey Reichard

8:30 a.m.	*Sleep Apnea and Motor Vehicle Crashes—A Systematic Review and Meta-Analysis*	Michael Greenberg D5.1
8:50 a.m.	*Using Technology to Improve Driver Behavior*	Hod Fleishman D5.2
9:10 a.m.	*The Effect of Passengers on Large Truck Collisions Involving Older Male Drivers*	Terry Bunn D5.3
9:30 a.m.	*Global Collaboration to Improve Worker Safety on Roads*	Jane Hingston D5.4
9:50 a.m.	Questions and Discussion	

10:00 a.m. - 10:30 a.m. **BREAK**

10:30 a.m. - 12:00 p.m. **CONCURRENT SESSION E**

E1.0 ***Training in Construction*** **Grand Station III**
Moderator: Thomas Bobick

10:30 a.m.	*Informal Training in Small Construction Work Systems*	Tonya Smith-Jackson E1.1
10:50 a.m.	*Construction Safety Training Issues for New Construction Employees*	Bryan Hubbard E1.2
11:10 a.m.	*Diffusion of Fall Hazard Safety Training for Hard-to-Reach Residential Construction Workers Through the Internet and Utilizing New Media*	Mark Fullen E1.3
11:30 a.m.	*Design and Preliminary Evaluation of a Fall Protection Curriculum for Apprentice Carpenters in Residential Construction*	Rebecca Abraham E1.4
11:50 a.m.	Questions and Discussion	

Wednesday, October 22, 2008

10:30 a.m. - 12:00 p.m. **CONCURRENT SESSION E (cont'd)**

E2.0 ***Physical and Ergonomic Risk Factors Associated With Slips*** **Grand Station IV**
Moderator: Sharon Chiou

10:30 a.m.	*Physics-Based Computational Modeling for Shoe-Floor-Contaminant Friction*	Kurt Beschorner E2.1
10:50 a.m.	*The Stochastic Distribution of Available Friction Coefficient for Human Locomotion*	Wen-Ruey Chang E2.2
11:10 a.m.	*Assessing Floor Slipperiness: The Effects of Friction and Perception on Gait*	Chien-Chi Chang E2.3
11:30 a.m.	*Influence of Localized Muscle Fatigue of the Knee Joint on Kinematics and Kinetics Related to Slip-induced Falls*	Thurmon Lockhart E2.4
11:50 a.m.	Questions and Discussion	

E3.0 ***Injury Assessment and Methods*** **Grand Station V**
Moderator: Suzanne Marsh

10:30 a.m.	*Modeling Occupational Low Back Injury Risk Due to Repeated Joint Loading*	Waqar Mughal E3.1
10:50 a.m.	*Comparison of Injury Types and Severity Among Workers Admitted to Hospitals vs. Treated in Emergency Departments*	Patricia Dischinger E3.2
11:10 a.m.	*Work-Related Physical and Psychosocial Exposures are Risk Factors for Incident Symptoms and Functional Impairment of the Hands and Wrists*	Bradley Evanoff E3.3
11:30 a.m.	*Etiology of Work-Related Electrical Injuries: A Novel Taxonomy and In-Depth Narrative Analysis of Workers' Compensation Claims*	David Lombardi E3.4
11:50 a.m.	Questions and Discussion	

Wednesday, October 22, 2008

10:30 a.m. - 12:00 p.m. **CONCURRENT SESSION E (cont'd)**

E4.0 ***Youth in Agriculture*** **Brighton II**
Moderator: Susan Gerberich

10:30 a.m.	*Identifying Determinants of Being a Child Bystander on Midwestern Agricultural Operations*	Quintin Williams, Jr. E4.1
10:50 a.m.	*Farm Chores Worked by Youth and Adherence to the North American Guidelines for Children's Agricultural Tasks*	Jay Wilkins E4.2
11:10 a.m.	*Enhancing Adherence to the North American Guidelines for Children's Agricultural Tasks*	Catherine Heaney E4.3
11:30 a.m.	*Using Longitudinal Data Analysis Methods to Assess the Effectiveness of the North American Guidelines for Children's Agricultural Tasks in Reducing Childhood Agricultural Injury Risk*	Jay Wilkins E4.4
11:50 a.m.	Questions and Discussion	

E5.0 ***Assessing Injury Risk Factors*** **Brighton IV**
Moderator: Theodore Courtney

10:30 a.m.	*Gender Differences in Injury Patterns Among Workers in Heavy Manufacturing*	Linda Cantley E5.1
10:50 a.m.	*Acute Injury and Heat Stress Level in an Aluminum Smelter*	Thomas Bernard E5.2
11:10 a.m.	**A Case-Crossover Study of Occupational Laceration Injuries in Pork Processing: Methods and Preliminary Findings*	Lina Lander E5.3
11:30 a.m.	**A Descriptive Study of Workers' Compensation Claims in Washington State Orchards*	Jon Hofmann E5.4
11:50 a.m.	Questions and Discussion	

* Winning submissions for the Liberty Mutual Student Paper Contest

12:00 p.m. - 1:30 p.m. **LUNCH** (On Your Own)

Wednesday, October 22, 2008

1:30 p.m. - 3:00 p.m. CONCURRENT SESSION F

F1.0 ***Injury Prevention in Construction - II*** **Grand Station III**
Moderator: David Fosbroke

1:30 p.m.	*Applying NIOSH Prevention Through Design to Electrical Hazards in Construction Work Environments*	Landis Floyd F1.1
1:50 p.m.	*Construction Safety Training Issues for Hispanic Construction Employees*	James McGlothlin F1.2
2:10 p.m.	*A Community-based Participatory Approach to Prevent Falls Among Latino Construction Workers*	Maria Brunette F1.3
2:30 p.m.	*Reducing Exposure to Pedestrian In Blind Zones*	Spencer Barclay F1.4
2:50 p.m.	Questions and Discussion	

F2.0 ***Workplace Violence in Healthcare Settings*** **Grand Station IV**
Moderator: Marilyn Ridenour

1:30 p.m.	*Emergency Department Security Programs, Community Crime, and Employee Assaults*	James Blando F2.1
1:50 p.m.	*Hospital Employee Assault Rates Before and After Enactment of the California Hospital Safety and Security Act*	Carri Casteel F2.2
2:10 p.m.	*Evaluation of Workplace Violence at a Tertiary Hospital*	Elena Delgado Folgado F2.3
2:30 p.m.	*Workplace Violence Prevention in Public Sector Addiction Treatment Centers*	Kate McPhaul F2.4
2:50 p.m.	Questions and Discussion	

Wednesday, October 22, 2008

1:30 p.m. - 3:00 p.m. **CONCURRENT SESSION F (cont'd)**

F3.0 ***Review of Comprehensive Injury Efforts*** **Grand Station V**
Moderator: Harlan Amandus

1:30 p.m.	*A Systematic Review of Occupational Health and Safety Interventions With Economic Analyses*	Emile Tompa F3.1
1:50 p.m.	*Foreign Workers' Safety and Health in the United States*	Magdy Akladios F3.2
2:10 p.m.	*Safety and Health in the Wholesale and Retail Trade Sectors: Information Gaps and Research Needs*	Vern Anderson F3.3
2:30 p.m.	*A Systematic Review of the Effectiveness of Interventions to Prevent Agricultural Injury and Disease*	Colin Cryer F3.4
2:50 p.m.	Questions and Discussion	

F4.0 ***Preventing Injuries Among Fire Fighters*** **Brighton II**
Moderator: Stephen Miles

1:30 p.m.	*Preventing Deaths and Injuries of Fire Fighters Working Above Fire-Damaged Engineered Wood Floor Joists*	Timothy Merinar F4.1
1:50 p.m.	*Preventing Fire Fighter Deaths and Injuries Caused by Failure to Wear Vehicle Safety Restraints*	Virginia Lutz F4.2
2:10 p.m.	*Physiological Effects of Boot Weight in Men and Women Fire Fighters*	Nina Turner F4.3
2:30 p.m.	*Survey Evaluation of the Fire Fighter Fatality Investigation and Prevention Program*	James Wassell F4.4
2:50 p.m.	Questions and Discussion	

Wednesday, October 22, 2008

1:30 p.m. - 3:00 p.m. **CONCURRENT SESSION F (cont'd)**

F5.0 ***Safety Practice I*** **Brighton IV**
Moderator: Mahmood Ronaghi

1:30 p.m.	*Operator Presence System: From Design to Implementation*	Douglas Ammons F5.1
1:50 p.m.	*Comparison of Anti-vibration Interventions for Use With Fastening Tools in Metal*	Ann Marie Dale F5.2
2:10 p.m.	*Forklift-Related Injuries*	Janice Windau F5.3
2:30 p.m.	*Toward Safer Stairways: Evaluation of the Nose-to-Nose Method for Measuring Uniformity of Steps in a Flight of Stairs*	Roger Jensen F5.4
2:50 p.m.	Questions and Discussion	

3:00 p.m. - 3:30 p.m. **BREAK**

3:30 p.m. - 5:00 p.m. **CONCURRENT SESSION G**

G1.0 ***Injuries Among Electric Utility Workers*** **Grand Station III**
Moderator: Richard Current

3:30 p.m.	*Work-Related Motor Vehicle Crashes Among Electric Utility Workers*	Tiffani Fordyce G1.1
3:50 p.m.	*Factors That Distinguish Serious Versus Less Severe Strain and Sprain Injuries: An Analysis of Electric Utility Workers*	Libby Morimoto G1.2
4:10 p.m.	*Work-Related Injury Trends Among Electric Utility Workers*	Tiffani Fordyce G1.3
4:30 p.m.	*Development of an Electric Field Sensor for Electrical-Proximity and Contact Detection*	Shengke Zeng G1.4
4:50 p.m.	Questions and Discussion	

Wednesday, October 22, 2008

3:30 p.m. - 5:00 p.m. **CONCURRENT SESSION G (cont'd)**

G2.0 ***Workplace Violence Risk Factors*** **Grand Station IV**
Moderator: Hope Tiesman

3:30 p.m.	*Place Characteristics of Industries at High Risk for Worker Homicide*	Myduc Ta G2.1
3:50 p.m.	*Burnout: The Risk of Physical Assault*	Evette Pinder G2.2
4:10 p.m.	*Environmental Violence and Physical Assault Against Teachers*	Susan Gerberich G2.3
4:30 p.m.	*EMS Providers' Exposure to Violence*	Rebecca Heick G2.4
4:50 p.m.	Questions and Discussion	

G3.0 ***Evaluating Mining Safety Initiatives*** **Grand Station V**
Moderator: Robin Burgess-Limerick

3:30 p.m.	*Reduction of Fire Hazards on Large Mining Equipment*	Maria De Rosa G3.1
3:50 p.m.	*Making it Safer With Roof Screen: Evaluating the Intervention Effectiveness of an Occupational Safety Communication Product in the Mining Industry*	Gail McConnell G3.2
4:10 p.m.	*Evaluation of Peripheral Visual Performance When Using Incandescent and LED Miner Cap Lamps*	Miquel Angel Reyes G3.3
4:30 p.m.	*Evaluation of Discomfort and Disability Glare From Incandescent and LED Miner Cap Lamps*	Tim Lutz G3.4
4:50 p.m.	Questions and Discussion	

Wednesday, October 22, 2008

3:30 p.m. - 5:00 p.m. **CONCURRENT SESSION G (cont'd)**

G4.0 ***Effects of Work Organization on Safety*** **Brighton II**
Moderator: Max Lum

3:30 p.m.	*Risk Evaluation Index of Psychophysical Hazard Exposures in Electronics and Garments*	Jinky Leilanie Lu G4.1
3:50 p.m.	*Is Current Workload Too Much for Nurses to Handle? Psychophysiologic Evidence from Hospital Settings*	Jie Chen G4.2
4:10 p.m.	*Safety Issues in the Workplace Confronting Those in Extended Shift Work*	Jinky Leilanie Lu G4.3
4:30 p.m.	*Health Outcomes Associated With Perceived Work Stress in Police Officers*	Robyn Gershon G4.4
4:50 p.m.	Questions and Discussion	

G5.0 ***Systematic Review of Occupational Injury Literature*** **Brighton IV**
Moderator: Bradley Evanoff

3:30 p.m.	*Workplace Injury/Illness Prevention and Loss Control Programs: A Series of Systematic Reviews*	Shelley Brewer G5.1
3:50 p.m.	*Sharing Best Evidence: Results From Four Systematic Reviews of the Occupational Health and Safety Literature*	Emma Irvin G5.2
4:10 p.m.	*A Review of the Literature on Process and Implementation of Participatory Ergonomics*	Dwayne Van Eerd G5.3
4:30 p.m.	*Interventions in Healthcare Settings to Protect Musculoskeletal Health: A Systematic Review*	Jessica Tullar G5.4
4:50 p.m.	Questions and Discussion	

Thursday, October 23, 2008

8:30 a.m. - 10:00 a.m. **CONCURRENT SESSION H**

H1.0 ***Using Surveillance Systems to Identify Injury Characteristics in Construction*** **Grand Station III**
Moderator: David Fosbroke

8:30 a.m.	*Fatal and Nonfatal Injuries in Construction Industry, 1992-2006*	Sue Dong H1.1
8:50 a.m.	*Are Back Injuries in Carpenters Decreasing or Not?*	Hester Lipscomb H1.2
9:10 a.m.	*Fractures in Construction—Activities, Events, Sources, and Disability Duration*	Theodore Courtney H1.3
9:30 a.m.	*Relationships Between Medical Care and Paid Lost Time From Work After Work-Related Back Injury Among Washington State Union Carpenters*	Kristen Kucera H1.4
9:50 a.m.	Questions and Discussion	

H2.0 ***Injury Experience of Public Safety Workers*** **Grand Station IV**
Moderator: Anita Schill

8:30 a.m.	*Evaluating the Ambulance Patient Compartment as a Work Environment Using Digital Human Modeling Tools*	Douglas Ammons H2.1
8:50 a.m.	*Occupational Injury Experiences of EMS Providers*	Rebecca Heick H2.2
9:10 a.m.	*Occupational Safety and Health for Public Safety Employees: Assessing the Evidence and Implications for Public Policy*	Seth Seabury H2.3
9:30 a.m.	*Contrasting the Transportation Safety Data for Emergency Medical Services With Other Commercial Vehicles*	Nadine Levick H2.4
9:50 a.m.	Questions and Discussion	

Thursday, October 23, 2008

8:30 a.m. - 10:00 a.m. **CONCURRENT SESSION H (cont'd)**

H3.0 ***Safety Practices II*** **Grand Station V**
Moderator: Guang Chen

8:30 a.m.	*Quantifying Workers' Hazard Identification Ability Using Fuzzy Signal Detection Theory*	Tariq Abdelhamid H3.1
8:50 a.m.	*The Reducing and Avoiding Injury Initiative: The Alberta Experience*	Waqar Mughal H3.2
9:10 a.m.	*Building a Culture of Safety and Health Through Integrated Safety and Health Management System*	Bernadette Evangelista-Alvarez H3.3
9:30 a.m.	*Development of an Integrated Dataset for the Health Workplace Initiative*	Waqar Mughal H3.4
9:50 a.m.	Questions and Discussion	

H4.0 ***Evaluations of Safety and Health Management Practices*** **Brighton IV**
Moderator: Elyce Biddle

8:30 a.m.	*Does a Safety and Health Management System Contribute to a Safer Work Environment*	Elyce Biddle H4.1
8:50 a.m.	*Development of a Comprehensive Working Alone Program for Community Care*	Anna Matheson H4.2
9:10 a.m.	*Proactive Management: A Multilevel Communication Intervention in the Construction Industry*	J. Taylor Moore H4.3
9:30 a.m.	Questions and Discussion	

10:00 a.m. - 10:30 a.m. **BREAK**

Thursday, October 23, 2008

10:30 a.m. - 12:00 p.m. **CLOSING PLENARY SESSION** *Grand Station Ballroom I*

"Using Evidence-Based Results to
Change Industry Practice"

Moderator: **Nancy A. Stout, Ed.D.**
Division of Safety Research, NIOSH

James Collins, Ph.D.
Division of Safety Research, NIOSH

Joseph Feldstein, B.S.
Mining Safety Appliances Corporation

Dave Eherts, Ph.D, CIH
Sikorski Aircraft Corporation

Brad Boehler, P.Eng.
Skyjack Manlift Corporation

Steve Spata, BSME
National Truck Equipment Association

NOIRS 2008 List of Pre-Registered Participants

Our apologies for any errors in your name, affiliation, address, phone, etc.

Pre-registered Participants

Tariq Abdelhamid, PhD
Associate Professor
School of Planning, Design and Construction
Michigan State University
116 Human Ecology
East Lansing, MI 48824
Telephone: (517) 432-6188
Email: tariq@msu.edu

Rebecca Abraham, BS
Student
School of Public Health
Saint Louis University
3545 Lafayette Avenue
St. Louis, MO 63104
Telephone: (314) 363-5337
E-Mail: rlabraham21@gmail.com

Caristina Robaina Aguirre, MD
Associate Professor
Occupational Epidemiology
National Institute for Worker's Health,
Instituto Nacional de Salud de los Trabajadores (INSAT)
Oeste #9108 J y K
Miraflores Viejo
Habana, Cuba 11800
Telephone: (537) 644-1703
Email:
caristina.robaina@infomed.sld.cu

Magdy Akladios, PhD, PE, CSP, CPE
Assistant Professor
School of Science and Computer Engineering
University of Houston-Clear Lake
B-3531-4
2700 Bay Area Boulevard
Houston, TX 77058
Telephone: (281) 283-3744
Fax: (281) 283-3709
Email: akladios@uhcl.edu

Harlan Amandus, PhD
Chief
Analysis and Field Evaluations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-5913
Fax: (304) 285-6235
Email: HAmandus@cdc.gov

Alfred Amendola, PhD
Chief
Safety Controls Team
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-6386
Fax: (304) 285-6047
Email: AAmendola@cdc.gov

Benjamin Amick, III, PhD
Scientific Director
Institute for Work and Health
481 University Avenue, Suite 800
Telephone: (416) 927-2027
Toronto, Ontario M5G 2E9
Email: bamick@rogers.com

Douglas Ammons, BS
Computer Engineer
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-6223
Fax: (304) 285-6047
Email: DAmmons@cdc.gov

Vernon Anderson, PhD
Chief
Information Resources Branch
Education & Information Division
NIOSH
4676 Columbia Parkway, MS/C-18
Cincinnati, OH 45226
Telephone: (513) 533-8319
Fax: (513) 533-8465
Email: VAnderson@cdc.gov

Akbar Ahmadi Asour
Postgraduated/Occupational Health
Islamic Azad University
Sabzevar, Razavi Khorasan
Iran 981888
Islamic Republic of Iran
Telephone: +98 571 2239744
Fax: +985712647513
Email: asour50@yahoo.com

Spencer Barclay
Sales Manager
BT Products, LLC
1619 Griffin Avenue
Enumclaw, WA 98022
Telephone: (253) 886-9628
Fax: (206) 260-2416
Email: spencer@safetyspotter.com

Jennifer Beaupre, BSF, MSSM
Health Scientist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-6185
Fax: (304) 285-6047
Email: JBeaupre@cdc.gov

Paul Becker, ScD
Professor
Safety and Health Extension
West Virginia University
130 Tower Lane
Morgantown, WV 26501
Telephone: (304) 293-5905
Email: paul.becker@mail.wvu.edu

Jennifer Bell, PhD
Epidemiologist (Research)
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-5802
Fax: (304) 285-6235
Email: JBell@cdc.gov

Pre-registered Participants

CDR Stephen Berardinelli, Jr., MS, CIH
Safety and Occupational Health Specialist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-5801
Fax: (304) 285-6047
Email: SBerardinelliJr@cdc.gov

Thomas Bernard, PhD
Professor
Department of Environmental and Occupational Health
College of Public Health
University of South Florida
12301 Bruce B. Downs Boulevard
Tampa, FL 33612-3805
Telephone: (813) 974-6629
Fax: (813) 974-4718
Email: tbernard@health.usf.edu

Kurt Beschorner, BSME
Bioengineering Graduate Student
749 Benedum Hall
University of Pittsburgh
Pittsburgh, PA 15217
Telephone: (412) 904-2554
Email: keb52@pitt.edu

Elyce Biddle, PhD
Research Economist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-6015
Fax: (304) 285-6235
Email: EBiddle@cdc.gov

Suresh Bhatt, MSME
Mining Engineer
Pittsburgh Research Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 156
Pittsburgh, PA 15236
Telephone: (412) 386-5027
Fax: (412) 386-6891
Email: SBhatt@cdc.gov

James Blando, PhD
Occupational Health Surveillance Program
NJ Dept of Health & Sr. Services
H & A Building 7th Floor
PO Box 360
Trenton, NJ 08625-0360
Telephone: (609) 777-3039
Fax: (609) 292-5677
Email: james.blando@doh.state.nj.us

Fred Blosser, BA
Public Affairs Officer
Office of the Director
NIOSH
Patriots Plaza Bldg, Suite 9200
395 E Street, SW
Washington, DC 20201
Telephone: (202) 245-0645
Fax: (202) 245-0664
Email: FBlosser@cdc.gov

Donald Bloswick, PhD
Professor
University of Utah
Room 2110
50 S Central Campus Drive
Salt Lake City, UT 84112
Telephone: (801) 581-4163
Email: keough@mech.utah.edu

Thomas Bobick, PhD
Safety Engineer (Research)
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-5986
Fax: (304) 285-6047
Email: TBobick@cdc.gov

Leslie Boden, PhD
Professor of Public Health
Dept of Environmental Health
School of Public Health
Boston University
715 Albany Street T-444W
Boston, MA 02118
Telephone: (617) 638-4635
Fax: (617) 638-4857
Email: lboden@bu.edu

Brad Boehler, PEng
Director, Product Safety
Skyjack Inc.
87 Campbell Road
Guelph, Ontario, N1H 1B9
Telephone: (519) 341-5908
Toll Free: (800) 265-2738
Fax: (519) 837-4895
Email: brad.boehler@skyjack.com

Matt Bowyer, BSE
General Engineer
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-5991
Fax: (304) 285-6047
Email: MBowyer@cdc.gov

Christine Branche, PhD
Acting Director
NIOSH
Patriots Plaza Bldg, Suite 9200
395 E Street, SW
Washington, DC 20201
Telephone: (202) 245-0625
Fax: (202) 245-0664
Email: CBranche@cdc.gov

Shelley Brewer, DrPH, CSP
Chemical Loss Control Specialist
Chemplan, Inc.
2527 Micliff Boulevard
Houston, TX 77068
Telephone: 941-961-8015
Email: sbrewer@chemplan.net

Tom Broderick
Executive Director
Construction Safety Council
4100 Madison St.
Hillside, IL 60162
Telephone: 708-544-2082
Fax: 708-544-2371
Email: tbroderick@buildsafe.org

Pre-registered Participants

Melissa Brower, MPH, BS
Research Project Coordinator
Northeast Center for Agricultural Medicine and Health
One Atwell Road
Cooperstown, NY 13326
Telephone: (607) 547-6023
Fax: (607) 547-6087
Email: mbrower@nycamh.com

Maria Brunette, PhD
Assistant Professor
Department of Work Environment Health
University of Massachusetts-Lowell
Kitson 200
One University Avenue
Lowell, Massachusetts 01854
Telephone: (978) 934-3248
Email: maria_brunette@uml.edu

Terry Bunn, PhD, AAS
Project Manager
Fatality Assessment and Control Evaluation Program
Injury Prevention & Research Center
College of Public Health
University of Kentucky
333 Waller Avenue, Suite 206
Lexington, Kentucky 40504
Telephone: (859) 257-4955
Email: tlbunn2@uky.edu

Robin Burgess-Limerick, PhD
Associate Professor
Human Movement Studies
University of Queensland
Brisbane, Australia 4072
Telephone: +61 7 3365 4718
Fax: +61 7 3365 6877
Email: robin@hms.uq.edu.au

Rachel Burns, MPH
Research Assistant
RAND Corporation
4570 Fifth Avenue, Suite 600
Pittsburgh, PA 15213
Telephone: (412) 683-2300
Fax: (412) 683-2800
Email: jmendel@rand.org

Amanda Burwell, BS
Division of General Medical Sciences
School of Medicine
Washington University- St Louis
Campus Box 8005
660 S Euclid
St. Louis, MO 63110
Telephone: (314) 454-8568
Fax: (314) 454-5113
Email: adale@dom.wustl.edu

Michelle Canham-Chervak, PhD, MPH
Epidemiologist
Injury Prevention Program
ATTN: MCHB-TS-DI
U.S. Army Center for Health Promotion and Preventive Medicine
Aberdeen Proving Ground, MD 21010-5403
Telephone: (410) 436-1377
Email: michelle.chervak@us.army.mil

Linda Cantley, PT, MS
Research Associate
Yale University
135 College Street, Suite 366
New Haven, Connecticut 06510
Telephone: (203) 785-7202
Email: linda.cantley@yale.edu

Allison Canton, BA
Research Director
Department of Sociomedical Sciences
Mailman School of Public Health
Columbia University
722 W 168th Street, Suite 1003
New York, New York 10032
Telephone: (212) 305-1186
Email: rg405@columbia.edu

Virgil Casini, BS
Senior Investigator
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-6020
Fax: (304) 285-5774
Email: VCasini@cdc.gov

Carri Casteel, PhD
Research Assistant Professor
Department of Epidemiology
University of NC-Chapel Hill
CB# 7505
137 E Franklin Street, Suite 500
Apex, NC 27599-7505
Telephone: (919) 843-3529
Email: ccasteel@email.unc.edu

Dawn Castillo, MPH
Chief
Surveillance and Field Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-5916
Fax: (304) 285-5774
Email: DCastillo@cdc.gov

Rakie Cham, PhD
Department of Bioengineering
University of Pittsburgh
740 Benedum Hall
3700 O'Hara Street
Pittsburgh, PA 15237
Telephone: (412) 624-7227
Email: chamr@upmc.edu

Chu-Hsiang "Daisy" Chang, PhD
Assistant Professor
Department of Environmental and Occupational Health
University of South Florida
MDC 56
13201 Bruce B Downs Boulevard
Tampa, FL 33612
Telephone: (813) 396-9597
Email: cchang@health.usf.edu

Chien-Chi "Max" Chang, PhD
Research Scientist
Liberty Mutual Research Institute for Safety
71 Frankland Road
Hopkinton, MA 01748
Telephone: (508) 497-0260
Email: chien-chi.chang@libertymutual.com

Pre-registered Participants

Wen-Ruey Chang, PhD
Investigator
Center of Physical Ergonomics
Liberty Mutual Research
Institute for Safety
71 Frankland Road
Hopkinton, MA 01748
Telephone: (508) 497-0219
Email:
wen.chang@libertymutual.com

Guang Chen, MD
Epidemiologist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-5995
Fax: (304) 285-6235
Email: GChen@cdc.gov

Jie Chen, MSN
Doctoral Candidate
College of Nursing
University of Cincinnati
Apt 2B
681 Old Buffalo Grove Road
Wheeling, IL 60090
Telephone: (859) 462-3611
Email: chje@email.uc.edu

Debra Chester, MS
Project Coordinator
Michigan Fatality Assessment
and Control Evaluation
Occupational and Environmental
Medicine
Michigan State University
117 W Fee Road
East Lansing, MI 48824-1315
Telephone: (517) 432-1008
Email: debra.chester@ht.msu.edu

Sharon Chiou, PhD
Senior Service Fellow
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-6029
Fax: (304) 285-6047
Email: schiou@cdc.gov

Prescillia Chua, MS, BS
Exposure Prevention Specialist
Fraser Health Authority
#100 - 13450 102nd Avenue
Surrey, British Columbia CV3T 5X3
Telephone: (604) 412-6140
Email: prescillia.chua@fraserhealth.ca

Randall Clark, BA
Research Analyst
Safety and Health Assessment
and Research for Prevention
(SHARP) Program
Washington State Department of
Labor and Industries
PO Box 44330
Olympia, WA 98504-4330
Telephone: (360) 902-5661
Email: claa235@lni.wa.gov

Valerie Clark, MBA
Chief
Program and Administrative Activity
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1901
Morgantown, WV 26505-2888
Telephone: (304) 285-5904
Fax: (304) 285-6039
VAClark@cdc.gov

CAPT James Collins, PhD
Associate Director for Science
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1900
Morgantown, WV 26505-2888
Telephone: (304) 285-5988
Fax: (304) 285-6046
Email: JCollins1@cdc.gov

Helen Corns
Liberty Mutual Research Institute
for Safety
71 Frankland Road
Hopkinton, MA 01748-1298
Telephone: (508) 497-0204
Email:
Helen.Corns@LibertyMutual.com

Theodore Courtney, MS, CSP
Director, Research Operations
Center for Injury Epidemiology
Liberty Mutual Research Institute
for Safety
71 Frankland Road
Hopkinton, MA 01748-1298
Telephone: (508) 497-0207
Email:
theodore.courtney@libertymutual.com

Professor Colin Cryer
Associate Professor
Injury Prevention Research Unit
Dunedin School of Medicine
University of Otago New Zealand
PO Box 913
Dunedin, New Zealand
Telephone: +64 3 479 5675 (NZ);
+44 1323 892 987
Fax: +64 3 479 8337 (NZ)
Email: colin.cryer@ipru.otago.ac.nz

Richard Current, BSAE, PE
General Engineer (Research)
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-6084
Fax: (304) 285-6047
Email: RCurrent@cdc.gov

Ann Marie Dale
Occupational Therapist
Department of Internal Medicine
- Gen Medical Sciences
Washington University-St Louis
Campus Box 8005
660 S Euclid Street
St. Louis, MO
Telephone: (314) 454-8470
Fax: (314) 454-5113
Email: adale@dom.wustl.edu

Pre-registered Participants

Evelyn Davila, MPH
Doctorial Candidate
Research Associate
Department of Epidemiology
and Public Health
Miller School of Medicine
University of Miami
1120 NW 14th Street, Room 1049
Miami, FL 33136
Telephone: (305) 243-7565
Email: edavila1@med.miami.edu

Letitia Davis, ScD, EdM
Director, Occupational Health
Surveillance Program
MA Dept of Public Health
250 Washington Street, 6th Floor
Boston, MA 02108-4619
Telephone: (617) 624-5626
Fax: (617) 624-5696
Email: **Letitia.Davis**@state.ma.us

Lindsey Debor, BA
STEP Student
Pittsburgh Research Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 152
Pittsburgh, PA 15236
Telephone: (412) 386-5041
Email: LDebor@cdc.gov

Elena Folgado Delgado, MD
Occupational Medicine
Hospital Ramón y Cajal
Lilas 12
28036 Madrid, Spain
Telephone: +34 913 368 639
Email:
mfernandeze.hrc@salud.madrid.org

John Dement, PhD, CIH
Professor
Duke University
DUMC 3384
2200 W Main Street, Suite 400
Durham, NC 27710
Telephone: 919-684-8065
Fax: 919-286-1620
Email: john.dement@duke.edu

Jack Dennerlein, PhD
Associate Professor
Ergonomics and Safety
Department of Environmental
Health
School of Public Health
Harvard University
665 Huntington Avenue
Boston, MA 02115
Telephone: (617) 384-8812
Email: jax@hsph.harvard.edu

Susan Derk, MA
Epidemiologist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-6245
Fax: (304) 285-5774
Email: SDerk@cdc.gov

Maria DeRosa, MS
Industrial Hygienist
Pittsburgh Research Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 143
Pittsburgh, PA 15236
Telephone: (412) 386-4965
Fax: (412) 386-6595
Email: mgd8@CDC.gov

Angela DiDomenico, PhD, CPE
Research Scientist
Center for Physical Ergonomics
Liberty Mutual Research Institute
for Safety
71 Frankland Road
Hopkinton, MA 01748-1298
Telephone: (508) 497-0274
Email:
angela.didomenico@libertymutual.com

Patricia Dischinger, PhD
Professor of Epidemiology
National Study Center for Trauma
and EMS
School of Medicine
University of Maryland
701 W Pratt Street
Baltimore, MD 21201
Telephone: (410) 328-4246
Fax: (410) 328-3699
Email: pdischin@som.umaryland.edu

Sue Dong, DrPH
Director, Data Center
CPWR-The Center for Construction
Research and Training
8484 Georgia Avenue, Suite 1000
Silver Spring, MD 20910
Telephone: (301) 578-8500
Fax: (301) 578-8572
Email: sdong@cpwr.com

Thomas Dubaniewicz, Jr, MS, PE
Research Electrical Engineer
Pittsburgh Research Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 152
Pittsburgh, Pennsylvania 15236
Telephone: (412) 386-6596
Email: TDubaniewicz@cdc.gov

Giulia Earle-Richardson, PhD
Deputy Director
Northeast Center for Ag Health
One Atwell Road
Cooperstown, NY 13326
Telephone: (607) 547-6023
Fax: (607) 547-6087
Email: gearlerichardson@nycamh.com

David Eherts PhD, CIH
Vice President
Aviation Safety, EHS and Medical
Sikorsky Aircraft Corporation
6900 Main Street
Stratford, CT 06497-9129
Telephone: (203) 386-8666
Cell: (203) 895-0410
Email: deherts@sikorsky.com

Pre-registered Participants

Iresoa Ehilebo
Doctor/Student
University of Wolverhampton
4 Jersey Hall Waterloo Road
Wolverhampton WV1 1QU
United Kingdom
Telephone: +447506309112
Email: ishanchic@yahoo.com

Mehmet Sarper Erdogan, PhD
Associate Professor
Department of Public Health
Cerrahpasa Medical Faculty
Istanbul University
Cerrahpasa Tip Fakultesi
Halk Sagligi AD
34098 Istanbul, Turkey
Telephone: +90 537 2440026
Email: sarper@istanbul.edu.tr

Bernadette Evangelista-Alvarez, MS
Safety Manager
Amkor Technology Philippines Inc.
NSC Compound
Km 22 East Service Road S
Superhighway
1702 Muntinlupa City
The Philippines
Telephone: +63 02 884 3339
Fax: +63 02 850 7287
Email: Bevan@amkor.com

Bradley Evanoff, MD, MPH
Associate Professor of Medicine
School of Medicine
Washington University
Campus Box 8005
660 S Euclid Avenue
St Louis, MO 63110
Telephone: (314) 454-8638
bevanoff@wustl.edu

Joseph Feldstein, BS
Manager, Technical Services
Mining Safety Appliances Corp.
2250 S Tejon Street
Englewood, CO 80110
Telephone: (303) 975-2304
Email:
Joseph.Feldstein@MSAnet.com

Marina Fernandez, MD
Occupational Medicine
Hospital Ramón y Cajal
Lilas 12
Madrid, Spain 28036
Telephone: +34913368639
Email:
mfernandeze.hrc@salud.madrid. org

Daniel Fiorini, CET
Project Coordinator
Construction Safety Assoc of Ontario
Technical Services
21 Voyager Court South
Etobicoke, Ontario M9W 5M7
Telephone: (416) 679-4043
Email: enzoga@csao.org

Ken Flechler
Vice President
Safety and Compliance
Comcast
5th Floor
One Comcast Center
Philadelphia, PA 19103
Telephone: (215) 286-7581
Fax: (215) 286-1022
Email:
sharon_lanciano@cable.comcast.com

Hod Fleishman
Founder and Senior Vice President
Business Development
GreenRoad Technologies, Inc
Suite 240B
240 Twin Dolphin Drive
Redwood Shores, CA 94065
Telephones: (650) 551-1530
(415) 358-2481
Fax: (650) 551-1539
Email: mdelong@breakawaycom.com

Landis Floyd, BSEE
Principal Consultant
Electrical Safety & Technology
DuPont
PO Box 80723
CRP 723-1106
Wilmington, DE 19880-0723
Telephone: (302) 999-6390
Fax: (302) 999-6273
Email: H-Landis.Floyd@usa.dupont.
com

Tiffani Fordyce, MPH
Managing Scientist
Center for Epidemiology, Biostatistics, and Computational Biology
Exponent Failure Analysis Assoc
149 Commonwealth Drive
Menlo Park, CA 94025
Telephone: (650) 688-7038
Email: tfordyce@exponent.com

Linda Forst, MD, MPH
Professor
School of Public Health
University of Illinois-Chicago
2121 W Taylor, MC 922
Chicago, IL 60645
Telephone: (312) 355-3826
Fax: (312) 413-9898
Email: forst-l@uic.edu

David Fosbroke, MSF
Health Statistician
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-6010
Fax: (304) 285-5774
Email: DFosbroke@cdc.gov

Kara Franke, MPH
Associate Health Scientist
ChemRisk Boulder
Suite 300
4940 Pearl E Circle
Boulder, CO 80304
Telephone: (303) 417-1066
Email: kfranke@chemrisk.com

Mark Fullen, MS, CSP
Doctorial Candidate
Assistant Professor
Safety and Health Extension
West Virginia University
130 Tower Lane
Morgantown, WV 26501
Telephone: (304) 293-3200
Fax: (304) 293-5905
Email: m.fullen@mail.wvu.edu

Pre-registered Participants

Enzo Garritano, PEng
Manager Technical Services
Construction Safety Association of Ontario
21 Voyager Court South
Etobicoke, Ontario M9W 5M7
Telephone: (416) 679-4043
Email: enzoga@csao.org

Richard Gasaway, PhD, MBA, BS
Chief
Roseville Fire Department
2660 Civic Center Drive
Roseville, MN 55113
Telephone: (651) 792-7303
Fax: (651) 793-7300
Email:
rich.gasaway@ci.roseville.mn.us

Susan Gerberich, PhD, MSPH
Mayo Professor and Director
MCOHS, RIPRC/CVPC, Division of EHS
University of Minnesota
MMC - 807, Room 1260
420 Delaware Street, SE
Minneapolis, MN 55455
Telephone: (612) 625-5934
Email: gerbe001@umn.edu

Robyn Gershon, DrPH
Professor/Researcher
Department of Sociomedical Sciences
Mailman School of Public Health
Columbia University
722 W 168th Street, Suite 1003
New York, NY 10032
Telephone: (212) 305-1186
Email: rg405@columbia.edu

Matthew Gillen, PhD
Senior Scientist & Construction Coordinator
Office of the Director
NIOSH
Patriots Plaza Bldg, Suite 9200
395 E Street, SW
Washington, DC 20201
Telephone: (202) 245-0651
Fax: (202) 245-0664
Email: MGillen@cdc.gov

Gordon Gillespie, PhD, RN, APRN, BC
Assistant Professor
University of Cincinnati
3110 Vine Street
Cincinnati, OH 45221
Telephone: (513) 558-5500
Email: gillesgl@yahoo.com

James Green, BSME, MBA
Safety Engineer (Research)
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-5857
Fax: (304) 285-6047
Email: JGreen@cdc.gov

Michael Greenberg, MD, MPH
Professor, Emergency Medicine
Professor, Public Health
College of Medicine
Drexel University
Suite 230
110 W Lancaster Avenue
Wayne, PA 19087
Telephone: (610) 688-6700
Fax: (610) 964-9003
Email: mgreenbe@drexelmed.edu

Erica Hall, MS, BA
General Engineer
Pittsburgh Research Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 3
Pittsburgh, PA 15236
Telephone: (412) 386-4075
Email: eoh7@cdc.gov

Debra Handlin
Management and Program Analyst
Office of the Director
NIOSH
1095 Willowdale Road, MS/1901
Morgantown, WV 26505-2888
Telephone: (304) 285-5950
Fax: (304) 285-6039
Email: DHandlin@cdc.gov

David Hard, PhD
Research Agricultural Safety and Health Scientist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-6068
Fax: (304) 285-6235
Email: DHard@cdc.gov

Daniel Hartley, EdD
Epidemiologist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-5812
Fax: (304) 285-6235
Email: DHartley@cdc.gov

James Harris, PhD
Safety Engineer (Research)
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-6120
Fax: (304) 285-6047
Email: JHarris@cdc.gov

Lynae Hawkes, MA
Northeast Center/Agricultural and Occupational Health
NY Center for Agricultural Medicine and Health
One Atwell Road
Cooperstown, NY 13326
Telephone: (607) 547-6023
Email: lhawkes@nycamh.com

Catherine Heaney, PhD, MPH
Associate Professor
Prevention Research Center
Stanford University
211 Quarry Road
Stanford, CA 94305
Telephone: (650) 736-8512
Email: cheaney@stanford.edu

Pre-registered Participants

Frank Hearl, BS, MS
Chief of Staff
Office of the Director
NIOSH
Patriots Plaza Bldg, Suite 9200
395 E Street, SW
Washington, DC 20201
Telephone: (202) 245-0652
Fax: (202) 245-0628
Email: FHearl@cdc.gov

Rebecca Heick, PhD, EMT-P, MS
Adjunct Faculty Member
Trinity College of Nursing and Health Sciences-Rock Island, IL
3426 Central Ave
Bettendorf, IA 52722-5145
Telephone: (563) 355-1010
Email:
epidemiologist2006@msn.com

Jane Hingston, MS
Health Communication Specialist
Office of the Director
NIOSH
Patriots Plaza Bldg, Suite 9200
395 E Street, SW
Washington, DC 20201
Telephone: (202) 245-0673
Fax: (202) 245-0648
Email: JHingston@cdc.gov

Jonathan Hofmann, MPH
Doctorial Candidate
Department of Epidemiology
Box 357236
University of Washington
Seattle, WA 98195-7236
Phone: 206-616-8904
Fax: 206-616-2687
Email: hofmann@u.washington.edu

Ray Hopkins, BAS
Project Coordinator
Construction Safety Association of Ontario
21 Voyager Court South
Etobicoke, Ontario M9W 5M7
Telephone: (416) 674-2726
Email: rayho@csao.org

Hongwei Hsiao, PhD
Chief
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-5910
Fax: (304) 285-6047
Email: HHsiao@cdc.gov

Bryan Hubbard, PhD
Assistant Professor
Knoy Hall
401 N Grant Street
Purdue University
West Lafayette, IN 47907-2051
Telephone: (765) 494-2241
Email: bhubbard@purdue.edu

CDR Bradley Husberg, BSN, MSPH, CEN
Senior Program Management Officer
Alaska Pacific Regional Office
NIOSH
4230 University Drive, Suite 310
Anchorage, AK 99508
Telephone: (907) 271-5259
Fax: (907) 271-2390
Email: BHusberg@cdc.gov

Emma Irvin
Researcher
Institute for Work and Health
481 University Avenue, Suite 800
Toronto, Ontario M4E 1V2
Telephone: (416) 927-2027 Ext: 2109
Fax: (416) 927-4167
Email: eirvin@iwh.on.ca

Larry Jackson, PhD
Chief
Injury Surveillance Team
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1808
Morgantown, WV 26505-2888
Telephone: (304) 285-5980
Fax: (304) 285-5774
Email: LLJackson@cdc.gov

Tonya Jacquez
Administrative Officer
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1901
Morgantown, WV 26505-2888
Telephone: (304) 285-5904
Fax: (304) 285-6039
Email: TJacquez@cdc.gov

Lea Jensen
Loss Prevention Consultant
Liberty Northwest Insurance
PO Box 4555
650 NE Holladay
Portland, OR 97208-4555
Telephone: (503) 736-7019
Fax: (800) 849-5078
Email:
Lea.Jensen@LibertyNorthwest.com

Roger Jensen, JD, PhD
Professor
Occupational Safety and Health
University of Montana-Montana Tech
SHIH S&E 319
1300 W Park Street
Butte, MT 59701
Telephone: (406) 496-4111
Fax: (406) 496-4650
Email: rjensen@mtech.edu

Kezhi Jin, PhD
Post-Doctoral Fellow
School of Public Health
Harvard University
10 Shepherd Avenue
Boston, MA 02155
Telephone: (617) 852-8532
Email: lafumaking@hotmail.com

Pre-registered Participants

Vicki Kaskuta, OTD
Instructor, Occupational Therapy
School of Medicine
Washington University
Campus Box 8505
4444 Forest Park Avenue
St Louis, MO 63108
Telephone: (314) 286-1672
Email: kaskutasv@wustl.edu

Paul Keane, MBA
Technical Writer-Editor
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-5901
Fax: (304) 285-6235
Email: PKeane@cdc.gov

Chrystine Kelley, BS
Environmental Protection Specialist
Colorado Department Public Health and Environment
HMWMD
4300 Cherry Creek Drive, S
Denver, CO 80246
Telephone: (303) 692-3442
Fax: (303) 759-5355
Email: chrys.kelley@state.co.us

Katherine Klein, Ph.D.
Research Scientist
Pittsburgh Research Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 152
Pittsburgh, PA 15236
Telephone: (412) 386-4627
Email: KKlein@cdc.gov

Kathleen Kowalski-Trakofler, PhD
Research Psychologist
Pittsburgh Research Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 153
Pittsburgh, PA 15236
Telephone: (412) 386-4591
Fax: (412) 386-6780
Email: KTrakofler@cdc.gov

Kristen Kucera, PhD
Assistant Professor
Division of Occupational and Environmental Medicine
Duke University
2200 W Main Street, Suite 400
Durham, NC 27705
Telephone: (919) 684-8374
Email: kristen.kucera@duke.edu

Joseph Kufera, MA
Research Statistician
University of Maryland
701 W Pratt Street
Baltimore, MD 21201
Telephone: (410) 328-4161
Fax: (410) 328-3699
Email: jkufera@som.umaryland.edu

Lina Lander, MSc
Doctoral Candidate
School of Public Health
Harvard University
Bldg 1, Room 1418
665 Huntington Avenue
Boston MA 02115
Telephone: (619) 820-2190
Email: ilander@hsph.harvard.edu

Paul Leigh, PhD
Professor
Department of Public Health
University of California-Davis
TB 168
One Shields Avenue
Davis, CA 95616-8638
Telephone: (530) 754-8605
Email: pleigh@ucdavis.edu

Patricia Lenart, BS
IT Specialist
Pittsburgh Research Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 1
Pittsburgh, PA 15236
Telephone: (412) 386-5093
Email: PLenart@cdc.gov

Nadine Levick, MD, MPH
Chairs, National Academies Transportation Research Board's Subcommittee-EMS Transport Safety
EMS Safety Foundation
137 Central Park N, Suite 7B
New York, NY 10026
Telephone: (917) 493-2001
Email: nlevick@attglobal.net

Hester Lipscomb, PhD
Associate Professor
Occupational and Environmental Medicine
Duke University
Box 3834 DUMC
Durham, NC 27710
Telephone: (919) 684-8175
Fax: (919) 286-1620
Email: hester.lipscomb@duke.edu

Jane Lipscomb, PhD, RN, FAAN
Professor
School of Nursing
University of Maryland
655 W Lombard Street
Baltimore, MD 21201
Telephone: (410) 706-7647
Fax: (410) 706-0253
Email: lipscomb@son.umaryland.edu

Hangsheng Liu, PhD
Associate Economist
RAND Corporation
4570 Fifth Avenue, Suite 600
Pittsburgh, PA 15213
Telephone: (412) 683-2300
Fax: (412) 683-2800
Email: hliu@rand.org

Thurmon Lockhart, PhD
Associate Professor/Director
VA Polytechnic Institute and State University
250 Durham Hall
Blacksburg, VA 24061
Telephone: (540) 231-9088
Fax: (540) 231-3322
Email: lockhart@vt.edu

Pre-registered Participants

David Lombardi, PhD
Acting Director and
SR Research Scientist
Center for Injury Epidemiology
Liberty Mutual Research Institute
for Safety
71 Frankland Road
Hopkinton, MA 01748
Telephone: (508) 497-0210
Fax: (508) 435-3456
Email:
david.lombardi@libertymutual.com

Sarah Lowry, MPH
Doctorial Candidate
Department of Environmental and
Occupational Health Sciences
School of Public Health
University of Washington
311 NE 58th Street
Seattle, WA 98105
Telephone: (917) 656-5873
Email: slowry7@u.washington.edu

Jinky Leilanie Lu, PhD, MOH
Research Associate Professor
National Institutes of Health
University of the Philippines-Manila
Unit 1514 Presidnet Tower 81
Timog Avenue
Quezon City
The Philippines
Telephone: +63 2 526 4266
Fax: +63 2 259 9356
Email: jinky_lu@yahoo.com

Devin Lucas, MS
Statistician (Health)
Alaska Pacific Regional Office
NIOSH
4230 University Drive, Suite 310
Anchorage, Alaska 99508
Telephone: (907) 271-2388
Fax: (907) 271-2390
Email: dlucas@cdc.gov

Max Lum, EdD, MPA
Associate Director for
Communication
& Global Collaboration
Office of the Director
NIOSH
Patriots Plaza Bldg, Suite 9200
395 E Street, SW
Washington, DC 20201
Telephone: (202) 245-0644
Fax: (202) 245-0664
Email: MLum@cdc.gov

Timothy Lutz, BSME
Mechanical Engineer
Pittsburgh Research Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Rd, Blg 156
Pittsburgh, PA 15236
Telephone: (412) 386-4904
Fax: (412) 386-6710
Email: tcl9@cdc.gov

Virginia Lutz, WSO, CSE
Safety and Occupational
Health Specialist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1808
Morgantown, WV 26505-2888
Telephone: (304) 285-6342
Fax: (304) 285-5774
Email: VLutz@cdc.gov

Suzanne Marsh, MPA
Statistician
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1808
Morgantown, WV 26505-2888
Telephone: (304) 285-6009
Fax: (304) 285-5774
Email: SMMarsh@cdc.gov

Anna Matheson, BS, CRSP
Safety Consultant
Fraser Health Authority
#100 - 13450 102nd Avenue
Surrey, British Columbia CV3T 5X3
Telephone: (604) 514-6000
Ext: 6487
Email:
anna.matheson@fraserhealth.ca

Michael McCann, PhD, CIH
Director, Safety Research
CPWR-The Center for Construction
Research and Training
8484 Georgia Avenue, Suite 1000
Silver Spring, MD 20910
Telephone: (301) 578-8500
Email: michael.mccann@att.net

Gail McConnell, VMD, MPH
Public Health Advisor
Pittsburgh Research Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Rd, Bldg 1
Pittsburgh, PA 15236
Telephone: (412) 386-4950
Fax: (412) 386-6780
Email: GMcConnel@cdc.gov

Stephen McCurdy, MD, MPH
Professor
Department of Public Health Sciences
University of California-Davis
One Shields Avenue
Davis, CA 95616
Telephone: (530) 752-8051
Fax: (530) 752-3239
Email: samccurdy@ucdavis.edu

James McGlothlin, PhD, MPH, CIH
Associate Professor
School of Health Sciences
Purdue University
Room CIVL 1263F
Civil Engineering Bldg
550 Stadium Mall Drive
West Lafayette, IN 47907-2051
Telephone: (765) 496-6359
Fax: (765) 496-1377
Email: jdm3@purdue.edu

Kathleen McPhaul, PhD, RN, MPH
Assistant Professor
School of Nursing
University of Maryland
655 W Lombard Street, Suite 655C
Baltimore, MD 21201
Telephone: (410) 706-4907
Fax: (410) 706-0253
Email: mcphaul@son.umaryland.edu

Pre-registered Participants

Doug McVittie, DOHS
Assistant General Manager and Director of Operations
Construction Safety Association of Ontario
21 Voyager Court South
Etobicoke, Ontario M9W 5M7
Telephone: (416) 679-4002
Fax: (416) 674-8866
Email: dougmv@csao.org

Linda McWilliams, MS, BS
Manager
Surveillance and Statistics Team
Pittsburgh Research Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 1
Pittsburgh, PA 15236-0070
Telephone: (412) 386- 6116
Fax: (412) 386-6780
Email: LMcWilliams@cdc.gov

John Mendeloff, PhD
Director, Center for Health and Safety in the Workplace
RAND Corporation
4570 Fifth Avenue, Suite 600
Pittsburgh, PA 15213
Telephone: (412) 683-2300
Email: jmendel@rand.org

Cammie Chaumont Menéndez, PhD, MPH
EIS Officer
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-6233
Fax: (304) 285-6235
Email: CMenendez@cdc.gov

Timothy Merinar, MS
Safety Engineer
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1808
Morgantown, WV 26505-2888
Telephone: (304) 285-5965
Fax: (304) 285-5774
Email: TMerinar@cdc.gov

Andrew Merryweather
Research Assistant Professor
University of Utah
Room 2110
50 S Central Campus Drive
Salt Lake City, UT 84112
Telephone: (801) 581-4163
Email: a.merryweather@utah.edu

Stephen Miles, AA
Safety and Occupational Health Specialist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1808
Morgantown, WV 26505-2888
Telephone: (304) 285-6276
Fax: (304) 285-5774
Email: SMiles@cdc.gov

Jeffery Taylor Moore, BA
2nd Year Graduate Student in Psychology
1876 Campus Delivery
Colorado State University
Fort Collins, CO 80523
Telephone: (765) 412-2459
Email:
jeffery.taylor.moore@gmail.com

Paul Moore, BSME
Chief
Fatality Investigations Team
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1808
Morgantown, WV 26505-2888
Telephone: (304) 285-6016
Fax: (304) 285-5774
Email: PMoore@cdc.gov

Libby Morimoto, Ph.D.
Senior Scientist
Exponent Failure Analysis Association
149 Commonwealth Drive
Menlo Park, California 94025
Telephone: (650) 688-7305
Email: lmorimoto@exponent.com

Magdalena Muedra, MD
Ramon Y Cajal Hospital
Ctra De Colmenar
Madrid, Spain 28037
Telephone: +34-695642724
mmuedra.hrc@salud.madrid.org

Waqar Mughal, MSc, BSc
Manager
Occupational and Health Services
Employee Wellness
Calgary Health Region
10101 Southport Road, SW
Calgary, Alberta T2W 3N2
Telephone: (403) 943-1256
Fax: (403) 943-1411
Email:
waqar.mughal@calgaryhealthregion.ca

Douglas Myers, ScD
Assistant Professor
Department of Community and Family Medicine
Duke University
2200 W Main Street, Suite 400
Durham, NC 27705
Telephone: (919) 684-8404
Email: douglas.myers@duke.edu

Melvin Myers, MPA
Associate Professor
College of Public Health
University of Kentucky
1141 Red Mile Road, Suite 102
Lexington, KY 40504-9842
Telephone: (404) 288-7085
(859) 323-6836
Fax: (404) 288-7166
Email: melmyers@bellsouth.net

Audrey Nelson, PhD, RN, FAAN
Director, Patient Safety Center of Inquiry
James A Haley Veterans Administration Medical Center
11605 N Nebraska Avenue
Tampa, FL 33612-5738
Telephone: (813) 558-3902
Fax: (813) 558-3990
Email: Audrey.Nelson@va.gov

Pre-registered Participants

Maryalice Nocera, RN MS
Senior Research Study Coordinator
University of North Carolina
Suite 500 CB 7505
137 E Franklin St
Chapel Hill NC 27599-7505
Telephone: (919) 966-9769
Email: mnocera@email.unc.edu

Maureen Orr, MS
Epidemiologist
Division of Health Studies
ATSDR, CDC
4770 Buford Highway, MS/F-57
Atlanta, GA 30341
Telephone: (770) 488-3806
Fax: (770) 488-1537
Email: morr@cdc.gov

Christopher Pan, PhD
Research Safety Engineer
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-5978
FAX: (304) 285-6047
Email: CPan@cdc.gov

Regina Pana-Cryan, PhD
Senior Scientist
Office of the Director
NIOSH
Patriots Plaza Bldg, Suite 9200
395 E Street, SW
Washington, DC 20201
Telephone: (202) 245-0669
Fax: (202) 245-0664
Email: RPana-Cryan@cdc.gov

Robert Park, MS
Research Health Scientist
Education and Information Division
NIOSH
4676 Columbia Parkway, MS/C-15
Cincinnati, OH 45226
Telephone: (513) 533-8572
Fax: (513) 533-8224
Email: RPark@cdc.gov

David Parker, MD, MPH
Physician and Epidemiologist
Park Nicollet Clinic
2001 Blaisdell Ave S
Minneapolis, MN 55404
Telephone: (952) 993-8753
Fax: (952) 993-8074
Email:
David.Parker@ParkNicollet.com

Julie Pearson
Research Assistant
Occupational Health
Department of Sociomedical
Sciences
Mailman School of Public Health
Columbia University
722 W 168th Street, Suite 1003
New York, NY 10032
Telephone: (212) 305-1186
Email: pj2177@columbia.edu

Corinne Peek-Asa, PhD, MPH
Professor, Injury Prevention
Research Center
University of Iowa
#114 IREH
100 Oakdale Boulevard
Iowa City, IA 52242
Telephone: (319) 335-4895
Fax: (319) 335-4225
Email: corinne-peek-asa@uiowa.edu

Kara Perritt, MS
Chief
Special Studies Team
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1808
Morgantown, WV 26505-2888
Telephone: (304) 285-5916
Fax: (304) 285-5774
Email: KPerritt@cdc.gov

Richard Phaneuf, MSc
Lanaudière Regeional Health Agency
Public Health Department
245, rue du Curé-Majeau
Joliette, Québec J6E 8S8
Telephone: (450) 759-1157
Ext: 4444
Fax: (450) 755-3961
Email:

Barbara Phillips
Program Operations Assistant
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1901
Morgantown, WV 26505-2888
Telephone: (304) 285-6235
Fax: (304) 285-6039
Email: BPhillips@cdc.gov

Timothy Pizatella, MS
Deputy Director
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1900
Morgantown, WV 26505-2888
Telephone: (304) 285-5894
Fax: (304) 285-6046
Email: TPizatella@cdc.gov

Evette Pinder, MPH
Doctoral Candidate
Environmental Health Sciences
School of Public Health
University of Minnesota
17 Bryants Nursery Road
Silver Spring, MD 20905
Telephone: (301) 384-7229
(240) 751-8226
Email: epinder@jhsph.edu

Angela Pinzon-Rondon, MD, MPH
Doctorial Candidate
Family Studies
University of Maryland
8 Carderock Court
Bethesda, Maryland 20817
Telephone: (202) 215-7102
Email: ampinzon@umd.edu

Keshia Pollack, PhD, MPH
Assistant Professor
Department of Health Policy
and Management
Bloomberg School of Public Health
University of Johns Hopkins
624 N Broadway, Room 557
Baltimore, MD 21205-1996
Telephone: (410) 502-6272
Email: kpollack@jhsph.edu

Pre-registered Participants

Lisa Pompeii, PhD
Assistant Professor
Environmental and Occupational Health Science
University of Texas
W1020
200 Herman Pressler Drive
Houston, TX 77030
Telephone: (713) 500-9474
Email: lisa.pompeii@uth.tmc.edu

Gerald Poplin, MS
Doctoral Candidate
University of Arizona
1435 N Fremont Avenue
Tucson, AZ 85719
Telephone: (520) 444-7894
Fax: (520) 882-5014
Email: poplin@email.arizona.edu

John Powers, Jr., BSEE
Chief
Technology Development Team
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-6219
Fax: (304) 285-6047
Email: JPowersJr@cdc.gov

François Quirion, PhD
Qinc Recherche et Développement Technologique Inc
10301 Avenue Pelletier
Telephone: (514) 272-6040
Montréal, Québec H1H 3R2
Email: francois.quirion@qinc.ca

Kristine Qureshi, DNSc
Associate Professor
Department of Nursing
University of Hawaii-Manoa
2528 McCarthy Mall Webster 444
Honolulu, HI 96712
Telephone: (808) 956 2638
Email: kqureshi@hawaii.edu

richard_phaneuf@ssss.gouv.qc.ca

Audrey Reichard, MPH, OTR
Epidemiologist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1808
Morgantown, WV 26505-2888
Telephone: (304) 285-6019
Fax: (304) 285-5774
Email: AReichard@cdc.gov

David Rempel, MD, MPH
Professor of Bioengineering
University of California-Berkeley
Professor of Medicine
University of California-San Francisco
1301 S 46th Street, Bldg 163
Richmond, California 94804
Telephone: (510) 665-3403
Email: david.rempel@ucsf.edu

Miguel Angel Reyes, BSEE
Electrical Engineer
Pittsburgh Research Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 152
Pittsburgh, PA 15236
Telephone: (412) 386-5072
Fax: (412) 386-6710
Email: MAReyes@cdc.gov

Mitch Ricketts, PhD
Safety Coordinator
Kansas State University
105D Waters Hall
Manhattan, KS 66506
Telephone: (785) 532-7068
Email: mrickett@ksu.edu

LCDR Marilyn Ridenour, MPH
Epidemiologist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-5879
Fax: (304) 285-6235
Email: MRidenour@cdc.gov

Medearis Robertson
University of Kentucky
333 Waller Avenue, Suite 206
Lexington, KY 40504
Telephone: (859) 323-2981
Email: medear@uky.edu

Nancy Romano, MS
Safety and Occupational Health Specialist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1808
Morgantown, WV 26505-2888
Telephone: (304) 285-5889
Fax: (304) 285-5774
Email: ndr4@cdc.gov

Mahmood Ronaghi, MSAE, MSME, MBA
Safety Engineer (Research)
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-5889
Telephone: (304) 285-6054
Fax: (304) 285-6047
Email: MRonaghi@cdc.gov

Christopher Ronk, SM
Student
School of Public Health
Harvard University
Apartment 309
1306 Massachusetts Avenue
Cambridge, MA 02138
Telephone: (617) 998-1018
Fax: (617) 384-8994
Email: cronk@hsph.harvard.edu

Roger Rosa, PhD
Senior Scientist
Office of the Director
NIOSH
Patriots Plaza Bldg, Suite 9200
395 E Street, SW
Washington, DC 20201
Telephone: (202) 245-0655
Fax: (202) 245-0664
Email: RRosa@cdc.gov

Pre-registered Participants

Tonya Rowan, MS
Program Operations Assistant
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1901
Morgantown, WV 26505-2888
Telephone: (304) 285-5904
Fax: (304) 285-6039
Email: TRowan@cdc.gov

Stephanie Samar
Research Assistant
Department of Sociomedical Sciences
Mailman School of Public Health
Columbia University
722 W 168th Street, Suite 1003
New York, New York 10032
Telephone: (212) 305-1186
Email: ss3387@columbia.edu

Anita Schill, PhD
Associate Director for Science
Office of the Director
NIOSH
Patriots Plaza Bldg, Suite 9200
395 E Street, SW
Washington, DC 20201
Telephone: (202) 245-0667
Fax: (202) 245-0664
Email: ASchill@cdc.gov

Miriam Schoenbaum, PhD
Statistician
Directorate of Evaluation and Analysis
Occupational Safety and Health Administration
US Department of Labor
N3507 Frances Perkins Office Bldg
200 Constitution Avenue, NW
Washington, DC 20210
Telephone: (202) 693-1841
Email:
schoenbaum.miriam@dol.gov

Ashley Schoenfisch, MSPH
Research Analyst/Occupational Epidemiologist
Department of Environmental and Occupational Health Science
Duke University Medical Center
2200 W Main Street, Suite 400
Telephone: (919) 684-8319
Durham, NC 27705
Email: ashley.schoenfisch@duke.edu

Paul Schulte, PhD
Director
Education and Information Division
NIOSH
Robert A Taft Laboratories
4676 Columbia Parkway, MS/C14
Cincinnati, OH 45226
Telephone: (513) 533-8302
Fax: (513) 533-8588
Email: PSchulte@cdc.gov

Seth Seabury, PhD
Economist
RAND Corporation
1776 Main Street
Santa Monica, CA 90407
Telephone: (310) 393-0411
Fax: (412) 683-2800
Email: seabury@rand.org

Richard Sesek
Research Assistant Professor
University of Utah
Room 2110
50 S Central Campus Drive
Salt Lake City, UT 84112
Telephone: (801) 581-4163
Email: r.sesek@utah.edu

Peter Simeonov, PhD
Safety Engineer (Research)
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-6268
Fax: (304) 285-6047
Email: Peter.Simeonov@cdc.gov

David Sleet, PhD
Associate Director for Science
National Center for Injury Prevention and Control
Chamblee Facility
4770 Buford Highway, MS/F62
Atlanta, GA 30341-3717
Telephone: (770) 488-4699
Fax: (770) 488-1317
Email: DSleet@cdc.gov

Stacy Smallwood, MPH
Director of Fellows Services/
Co-Coordinator/Scholar Advisor
CDC/ASPH
University of South Carolina
701 Sumter Street, EWS 617
Columbia, SC 29208
Telephone: (803) 734-2519
Email: smallwoods@sc.edu

April Smith, MS, BA
Research Associate
Psychology 1876
Colorado State University
Fort Collins, CO 80525-1876
Telephone: (970) 491-6278
Fax: (970) 491-1032
Email: apriles@colostate.edu

Gordon Smith, MD, MPH
Professor of Epidemiology
National Study Center for Trauma and EMS
School of Medicine
University of Maryland
701 W Pratt Street #524
Baltimore, MD 21201-1023
Telephone: (410) 328-3847
Fax: (410) 328-2841
Email: gssmith@som.umaryland.edu

Todd Smith, MS, CSP, ARM
Doctorial Candidate
College of Public Health
University of Georgia
216 Ramsey Center
300 River Road
Athens, Georgia 30602
Telephone: (919) 345-3268
Email: tdsmith@uga.edu

Pre-registered Participants

Tonya Smith-Jackson, PhD
Associate Director
Center for Innovation in Construction Safety and Health
Associate Professor
Industrial and Systems Engineering
Virginia Tech
250 Durham Hall, MC 0118
Blacksburg, VA 24061
Telephone: (540) 231-4119
Fax: (540) 231-3322
Email: smithjack@vt.edu

Kerry Souza, MPH
Doctorial Candidate
Department of Epidemiology
School of Public Health
Harvard University
Kresge Building, Room 911
677 Huntington Avenue
Boston, MA 02115
Telephone: (617) 519-7849
Email: ksouza@hsph.harvard.edu

CAPT James Spahr, MPH
Deputy Associate Director
Emergency Preparedness and Response
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-6242
Fax: (304) 285-6047
Email: JSpahr@cdc.gov

Steve Spata, BSME
Manager, Technical Services
Ambulance Manufacturers Division
National Truck Equipment Association
37400 Hills Tech Drive
Farmington Hills, MI 48331
Telephone: (800) 441-6832 Ext: 127
Fax: (248) 489-7090
Email: SteveS@NTEA.com

Robert Stein, MS, BSME
General Engineer
National Personal Protective Technology Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 20
Pittsburgh, PA 15236
Telephone: (412) 386-6889
Fax: (412) 386-4051
Email: RStein@cdc.gov

Lisa Steiner, MS
Team Leader
Pittsburgh Research Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 152
Pittsburgh, PA 15236
Telephone: (412) 386-6446
Email: LSteiner@cdc.gov

Nancy Stout, EdD
Director
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1900
Morgantown, WV 26505-2888
Telephone: (304) 285-5894
Fax: (304) 285-6046
Email: NStout@cdc.gov

John Stuart, MD
Concentra
115 Laurel Court
Pittsburgh, PA 15202
Telephone: (412) 761-0865
Email: jastuart@bellatlantic.net

Laura Styles, MPH
Research Scientist
Occupational Health Branch
California Department of Public Health
Bldg P, 3rd Floor
850 Marina Bay Parkway
Richmond, CA 94804
Telephone: (510) 620-5772
Email: lstyles@cdph.ca.gov

Myduc Ta, PhD, MPH
EIS Officer
Office of Epidemiology Non-Infectious Conditions
Washington State Department of Health
PO Box 47812
Olympia, WA 98504-7812
Telephone: (360) 236-4247
Email: Myduc.Ta@DOH.WA.GOV

Brandon Takacs, MS
Professor
Safety and Health Extension
West Virginia University
PO Box 6615
Morgantown, WV 26508-6615
Telephone: (800) 626-4748
Fax: (304) 293-5905
Email: brandon.takacs@mail.wvu.edu

Jay Tarley, BSSE
Safety and Occupational Health Specialist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1808
Morgantown, WV 26505-2888
Telephone: (304) 285-5858
Fax: (304) 285-5774
Email: JTarley@cdc.gov

Jennifer Taylor, PhD, MPH
Department of Environmental & Occupational Health
School of Public Health
Drexel University
Bellet Bldg, 13th Floor
1505 Race Street, M/S 1034
Philadelphia, PA 19102
Telephone: (215) 762-2590
Fax: (215) 762-8846
Email: jat65@drexel.edu

Pre-registered Participants

Hope Tiesman, PhD, MSPH
Epidemiologist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-6067
Fax: (304) 285-6235
Email: HTiesman@cdc.gov

Emile Tompa, PhD
Scientist
Institute for Work & Health
Adjunct Assistant Professor
Department of Economics
McMaster University
481 University Avenue, Suite 800
Toronto, Ontario M5G 2E9
Telephone: (416) 927-2027
Ext: 2113
Fax: (416) 927-4167
Email: etompa@iwh.on.ca

Jessica Tullar, MPH
Doctorial Candidate
School of Public Health
University of Texas
8806 Bevlyn
Houston, TX 77025
Telephone: (713) 385-5811
Email:
Jessica.M.Tullar@uth.tmc.edu

Nina Turner, PhD
Research Physical Scientist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-5976
Fax: (304) 285-6047
Email: NTurner@cdc.gov

David Utterback, PhD
Health Science Administrator
Division of Surveillance, Hazard Evaluations, and Field Studies
NIOSH
Alice Hamilton Laboratory
5555 Ridge Avenue, MS/R-12
Cincinnati, OH 45213
Telephone: (513) 841-4492
Fax: (404) 929-2667
Email: DUtterback@cdc.gov

Dwayne Van Eerd, MSc
Student
Institute for Work and Health
481 University Avenue, Suite 800
Toronto, Ontario M5G 2E9
Telephone: (416) 927-2027
Ext 2138
Fax: (416) 927-4167
Email: dvaneerd@iwh.on.ca

Brian Varrasso, BSc
Civil Sector Project Coordinator
Technical Services Department
Construction Safety Association of Ontario
21 Voyager Court South
Etobicoke, Ontario M9W 5M7
Telephone: (416) 679-4047
brianvarrasso@csao.org

Santosh Verma, MPH, MBBS
Injury Epidemiologist
Center for Injury Epidemiology
Liberty Mutual Research Institute for Safety
71 Frankland Road
Hopkinton, MA 01748
Telephone: (508) 497-0213
Fax: (508) 435-3456
Email:
Santosh.Verma@libertymutual. com

Peter Vi, MEng, HonBSc
Ergonomist
Technical Services Department
Construction Safety Association of Ontario
21 Voyager Court South
Etobicoke, Ontario M9W 5M7
Telephone: (416) 679-4050
Email: petervi@csao.org

James Wassell, PhD
Research Mathematical Statistician
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/1811
Morgantown, WV 26505-2888
Telephone: (304) 285-5946
Fax: (304) 285-6235
Email: jtw2@cdc.gov

Darlene Weaver, MS
Project Specialist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-6354
Fax: (304) 285-6047
Email: DWeaver@cdc.gov

Jeffrey Welsh, BA
Deputy Director
Pittsburgh Research Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 1
Pittsburgh, PA 15236
Telephone: (412) 386-4040
Fax: (412) 386-6614
Email: JWelsh@cdc.gov

Leah Westra
Project Coordinator
Department of Sociomedical Sciences
Mailman School of Public Health
Columbia University
722 W 168th Street, Suite 1003
New York, New York 10032
Telephone: (212) 305-1186
Email: lw2294@columbia.edu

Richard Whisler, AA, CTM, CAMM
IT Specialist
Division of Safety Research
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-6043
Fax: (304) 285-6047
Email: RWhisler@cdc.gov

Pre-registered Participants

Professor Jay Wilkins
Division of Epidemiology
College of Public Health
Ohio State University-Columbus
B-150 Starling-Loving Hall
320 W Tenth Avenue
Columbus, OH 43210
Telephone: (614) 293-3878
Fax: (614) 293-2937
Email: wilkins.2@osu.edu

Joanna Willetts, MS
Research Associate
Liberty Mutual Research Institute for Safety
71 Frankland Road
Hopkinton, MA 01748
Telephone: (508) 497-0200
Fax: (508) 435-0482
Email: Joanna.Willetts@LibertyMutual.com

Jon Williams, PhD
Research Physiologist
National Personal Protective Technology Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 29
Pittsburgh, PA 15236
Telephone: (412) 386-4002
Fax: (412) 386-6864
Email: WJWilliams@cdc.gov

Quintin Williams, Jr.
Doctoral Candidate
Environmental Health Sciences
University of Minnesota-Twin Cities
2033 Knapp Street, Apt W1
St Paul, MN 55108-1142
Telephone: (815) 295-1748
Email: will2040@umn.edu

Janice Windau, MS
Epidemiologist
Office of Safety, Health and Working Conditions
Bureau of Labor Statistics
United States Department of Labor
Room 3180
2 Massachusetts Avenue, NE
Washington, DC 20212
Telephone: (202) 691-6160
Fax: (202) 691-7862
Email: Windau.Janice@bls.gov

Lei Yu
Statistician
Kentucky Injury Prevention and Research Center
333 Waller Avenue, Suite 206
Lexington, KY 40504
Telephone: (859) 257-6777
Email: lyu2@email.uky.edu

Shengke Zeng, PhD
Research Biomedical Engineer
NIOSH
1095 Willowdale Road, MS/G800
Morgantown, WV 26505-2888
Telephone: (304) 285-6103
Fax: (304) 285-6047
Email: SZeng@cdc.gov

NOIRS 2008 ABSTRACTS

CONTENTS

DAY ONE—TUESDAY, OCTOBER 21, 2008

CONCURRENT SESSION: A
10:30 a.m. – 12:00 p.m.

CONCURRENT SESSION: B
1:30 p.m. – 3:00 p.m.

CONCURRENT SESSION: C
3:30 p.m. – 5:00 p.m.

POSTER SOCIAL
5:30 p.m. – 7:30 p.m.

DAY TWO—WEDNESDAY, OCTOBER 22, 2008

CONCURRENT SESSION: D
8:30 a.m. – 10:00 a.m.

CONCURRENT SESSION: E
10:30 a.m. – 12:00 p.m.

*Winning submissions for the Liberty Mutual Student Paper Contest

CONCURRENT SESSION: F
1:30 p.m. – 3:00 p.m.

CONCURRENT SESSION: G
3:30 p.m. – 5:00 p.m.

DAY THREE—THURSDAY, OCTOBER 23, 2008

CONCURRENT SESSION: H
8:30 a.m. – 10:00 a.m.

NOIRS 2008 Abstracts

Although the abstracts in this publication were proofread to eliminate obvious errors in spelling, punctuation, and grammar, they were neither edited nor officially cleared by the National Institute for Occupational Safety and Health (NIOSH). Therefore, NIOSH is not responsible for the content, internal consistency, or editorial quality of the abstracts. That responsibility lies solely with the individual authors. Any use of company names and products throughout this publication does not imply endorsement by NIOSH, the Centers for Disease Control and Prevention, the Public Health Service, or the Department of Health and Human Services.

DAY ONE: TUESDAY, OCTOBER 21, 2008

Session: **A1.0**
Title: Describing and Preventing Falls From Heights in Construction
Moderator: Paul Becker

A1.1
Title: Observation of Fall Risks in Residential Construction Sites
Authors: **Kaskutas V**, Dale AM, Lipscomb H, Gaal J, Fuchs M, Nolan J, Patterson D, Evanoff B

Introduction: Workers are exposed to many fall risks at residential construction sites. Methods to quantify these risks are needed.

Methods: Two experienced journeymen carpenters used a 52-item validated observational audit to evaluate the fall prevention behaviors of unionized carpenters at residential construction sites in the St. Louis area. Collaboration with the local carpenters' apprenticeship program, a joint union/contractor partnership, facilitated access to worksites. We computed the frequency of observations meeting the audit safety criteria.

Results: Multiple stages of construction were assessed at 197 worksites representing small, medium, and large contractors. Ladders were observed at 72% of the sites; however, extension ladders were not secured 88% of the time and stepladders were used inappropriately 49% of the time. Carpenters stood and balanced on 3½-inch boards, one story in the air while installing floor joists and roof trusses 81% and 93% of the time, respectively. Unprotected walking surfaces were identified with a warning line 18% of the time, and controlled access zones met OSHA guidelines only 2% of the time. Other operations met the criteria for safe work practices consistently. All of the pump jacks observed met safety criteria and roof slide guards were installed correctly 81% of the time. Fall protection equipment was set up correctly but was in use at only 5% of the sites.

Conclusions: Fall prevention work practices are performed inconsistently at unionized residential construction sites in the St. Louis area. Nonunionized workers may be exposed to even greater fall risks as they rarely participate in formal training programs and may lack other workplace protections. Many of the observed risks could be controlled if safe work practices were followed. Improper ladder use is of concern as ladders are commonly used and ladder use accounts for a large proportion of falls in national injury statistics.

A1.2
Title: Interventions for Overhead Drilling in Construction
Authors: **Rempel D**, Star D, Barr A, Gibbons B

Introduction: Overhead drilling into concrete or metal ceilings is a common task in commercial construction. It is associated with a risk of falls from ladders and acute arm injuries due to high torques applied to the arm when the drill bit seizes. This project developed, field tested, and refined interventions for overhead drilling that would decrease ladder use and reduce risk of acute injuries to the upper extremities.

Methods: The project was conducted in three phases. Each phase involved (1) the development of two or more prototype interventions with input from construction workers; (2) formal field evaluation of the usability, productivity, and safety features of the interventions by construction workers performing overhead drilling in the field; and (3) incorporating recommendations from workers in the next generation of device designs.

Results: In Phase I, an inverted drill press and a foot lever design, each able to reach ceiling heights of 11 feet, were compared the usual method for overhead drilling (N = 20). In Phase II, the inverted drill press design was evaluated with three different mobile bases against the usual method (N = 14). In Phase III, the inverted drill press design with a double column, to reach ceiling heights of 15 feet, was evaluated against the usual method (N = 16). The Phase I devices were rejected by construction workers based on usability and productivity ratings. The Phase III device design was preferred over the usual method across all measures.

Conclusions: Field testing by experienced construction workers and their feedback on design was vital to the successful development of the intervention devices. It is difficult to anticipate how interventions will perform without testing in varied field settings. Designers of health and safety interventions should include an adequate number of rounds of testing and design modifications before settling on a final design.

A1.3

Title: Development of a Unique Fall-Prevention Guardrail System for the Construction Industry

Authors: **Bobick T**, McKenzie T, Cantis D

Introduction: During 1998–2005, an average of 154 workers were killed and 3,374 were seriously injured each year in all U.S. industries after falling from unprotected roof edges or through unguarded holes and skylights. These occurred primarily in construction. Various products are available to guard unprotected roofs, decks, or other interior surfaces. Some are used only on flat surfaces, while others are used on sloped roofs but are adjustable for just a few roof pitches.

Methods: Previous NIOSH research investigated the strength of job-built guardrails and two commercial products as perimeter guarding. A laboratory test was developed that used a weighted manikin mounted on a hinged steel frame to evaluate guardrails according to current OSHA regulations that require the top rail to support a 200-lb force.

Results: Output from the initial study is a unique patent-pending design of an adjustable roof bracket and guardrail system. Extensive laboratory tests indicated the bracket-rail assembly supported a dynamic load of 435 lbs, more than twice the OSHA requirement of 200 lbs at top rail. The NIOSH system is unique since it can be used to guard roof edges and holes, easily moved upslope where extra protection is needed, and used in the interior to guard stairwell openings or as a temporary stair handrail. The new design is adjustable for seven roof pitches, from 6/12 (27°) to 24/12 (63°, or Aframe), three of which are steeper than 45°. Discussions have been initiated with potential manufacturers to establish a partnership to produce this safety device commercially.

Conclusions: When commercially available, residential and industrial-commercial construction workers will have an all-purpose fall-prevention system. If used routinely, it has the potential of preventing dozens of deaths and hundreds of serious injuries caused by falling from heights.

A1.4

Title: Plantar Vibration Effects on Postural Balance at Elevation

Authors: **Simeonov P**, Hsiao H, Powers J, Ammons D, Amendola A, Kau T-Y

Introduction: The risk of falls from height on a construction site increases in conditions degrading workers' postural control. At elevation, workers depend heavily on sensory information from their feet to maintain balance. Recent research suggests that low levels of mechanical vibration to the feet may be beneficial for balance control. This study investigates two hypotheses: (1) sensory-enhancement–undetectable (subthreshold) mechanical vibration at the feet improves worker's balance at elevation, (2) sensory-suppression–detectable (suprathreshold) mechanical vibration degrades worker's balance.

Methods: Twelve construction workers were tested while standing in different postures on instrumented insoles, which applied subsensory and suprasensory levels of random mechanical vibration to the feet. The tests were conducted in a virtual reality system simulating balance-challenging construction environment—i.e., a narrow plank on a residential structure. Upper body kinematics was assessed with a motion-measurement system. Postural stability effects were evaluated by conventional, "random walk," and angular-displacement sway measures.

Results: The analysis did not confirm the "sensory-enhancement" hypothesis, but provided evidence for the "sensory-suppression" hypothesis. The results indicated that plantar-vibration effects were significantly modified by posture. Subsensory vibration slightly reduced some sway measures in the standard posture but significantly increased them in the semitandem posture. Suprasensory vibration increased some sway measures across all conditions; however, the increase was considerably larger in the semitandem posture and affected most of the sway variables.

Conclusions: Sensory suppression associated with detectable levels of mechanical noise to the feet may increase the risk of losing balance. Workers on an elevated construction site might be at increased risk of falls if they can detect vibrations under their feet. To reduce the risk of losing balance, mechanical vibrations in the supporting structures should be minimized when performing tasks at elevation.

Session: **A2.0**
Title: Cutting Edge Research: The NORA Intervention Evaluation Contest
Moderator: James Collins

A2.1
Title: Applying Research to Practice: Anti-Vibration Interventions in Sheet Metal Assemblers
Authors: Dale AM, Rohn AE, Shannon W, Standeven J, Patton A, Dods B, Kilwin J, Hoeckelman L, Braunschweig L, Kick T, **Burwell A**, Evanoff B

Occupational vibration exposure is associated with neurological and musculoskeletal injuries to the upper extremity. This study presents evaluation results for several anti-vibration gloves and an anti-vibration wrap used with vibrating sheetmetal fastening tools and discusses implementation of policy changes related to study results in a large manufacturing setting. Three experienced sheetmetal workers performed a series of fastener installations with a bare hand and six separate vibration-damping hand protection interventions. Two tri-axial accelerometers recorded vibration energy at the tool handle and on the back of the hand. Subjects completed a usability questionnaire following each intervention. Mean vibration from the hand showed reduced vibration ($p<0.001$) for all six interventions (range= 0.31-0.57Gs) when compared to the bare hand condition (1.32 Gs). Worker surveys showed positive feedback, with a preference for gloves with full fingers and gloves with wrist support. Our study showed that the tested vibration damping gloves and wraps consistently reduced vibration values during the specific work conditions measured at the hand. Following study completion, the company instituted a policy mandating the use of an anti-vibration glove or wrap during metal fastening or drilling operations for selected job categories. Early observations demonstrate growing acceptance among plant staff for the new policy. Evaluating interventions under real work conditions and providing workers a choice of interventions may enhance acceptance and support policy changes regarding personal protective equipment use.

A2.2
Title: Prevention of Traumatic Nail Gun Injuries in Apprentice Carpenters: Use of Population-Based Measures to Monitor Intervention Effectiveness
Authors: Lipscomb H, Nolan J, Patterson D, **Dement J**

Introduction: Nail guns are responsible for a significant proportion of injuries in residential construction. The injury burden is particularly high among apprentice carpenters; this is due in part to their more common use of the tools.

Methods: Nail gun injuries were monitored over 3 years among carpenters enrolled in two apprenticeship programs in the Midwest following initiation of training and an ANSI standard change calling for safer sequential triggers on framing nailers. Injury rates, based on reported hours of tool use, were calculated yearly. Information on exposure to training through their apprenticeship program and elsewhere, including mentoring, toolbox talks, etc., was also monitored. Rates and adjusted rate ratios were calculated with Poisson regression methods. Attributable risk percent and population attributable risk measures were calculated yearly for modifiable independent risk factors for injury including lack of training in tool use and type of trigger mechanism on tools.

Results: As more apprentices received training and safer trigger mechanisms became more wide-spread, injury rates per 10,000 hours of tool use decreased significantly (31%). The largest decline was seen in the first follow-up year. While school training and mentoring were both important, injury rates were lowest among apprentices who received both types of training. Although injury rates changed over the observation period, the relative risk comparing trigger mechanisms (contact vs. sequential) did not; contact trip triggers consistently carried a two-fold risk.

Discussion: Although training and safer trigger use both increased over time, because of the relative prevalence of training and trigger exposures in this population, the engineering solution consistently had the potential to make more difference in population risk than training. Our findings demonstrate the utility of observational methods including measures of population-based risk in evaluating the effectiveness of interventions and making recommendations for continued improvement.

A2.3
Title: A Randomized-Controlled Intervention of Machine Guarding and Related-Safety Programs In Small Metal-Fabrication Businesses
Authors: **Parker DL**, Brosseau L, Samant Y, Xi M, Pan W, Haugan D

Objectives: Metal fabrication employs an estimated 3.1 million workers in the United States. The absence of machine guarding and related programs such as lock out and tag out may result in serious injury or death. The purpose of this study was to improve

machine-related safety in small metal-fabrication businesses.

Methods: This study is a randomized trial with two groups (management only and management-worker). Businesses were evaluated for the adequacy of machine guarding (machine scorecard) and related safety programs (safety audit). All businesses were provided a report outlining deficiencies and prioritizing their remediation. In addition, the management-worker group received four, one-hour interactive training sessions from a peer educator.

Results: We evaluated 40 metal fabrication businesses at baseline and 37 (93%) one-year later. Of the three non-participants, two had gone out of business. Over 40% of devices required for adequate guarding were missing or inadequate and 35% of required safety programs and practices were absent at baseline. Both measures improved significantly over the course of the intervention. There were no significant differences in changes between the two intervention groups. Machine guarding practices and programs improved by up to 13% and safety audit scores by up to 23%. Businesses that added safety committees or those that started with the lowest baseline measures showed the greatest improvements.

Conclusions: Simple and easy to use assessment tools allowed business to significantly improve their safety practices. This process is facilitated by the presence of a safety committee.

A2.4

Title: Evaluation of a Community Based Effort to Reduce Injuries and Illnesses to Wild Blueberry Harvesters

Authors: **Hawkes L**, May J, Ginley B, Burdick P

Background: Approximately 8,000 migrant and seasonal farm workers participate in the harvesting of blueberries in Maine. Over a 3–4 week period, blueberries are "raked" from the scrubby "wild" bushes standing no higher than 16 inches off the ground. While the bulk of the 75 million pounds grown annually in Maine is harvested mechanically, a significant amount of land continues to be raked manually by a work force composed of Hispanic (45%), Native American (45%), and local Anglo (10%) workers. Manual raking of wild blueberries can lead to musculoskeletal pain and injury. This study assessed the effects of using a community-based approach to develop, evaluate, and disseminate an intervention aimed at reducing musculoskeletal pain and injury.

Methods: A community-based work team selected rake design for intervention and pilot tested potential design modifications to the blueberry harvesting rake. An "extended" handle design was selected for comparison with the traditional short-handle rake. Tested rakes were of two widths (70 and 80 tines) and four handle lengths (short handle; extended 10, 14 or 16 inches). Workers rated each of the five configurations after four hours of use.

Results: Data from 29 subjects were analyzed using two-factor analysis of variance. Results showed increased productivity ($p = 0.041$), greater acceptability ($p < 0.0001$), less force used ($p < 0.001$), and less pain associated ($p < 0.0001$) with the extended handle designs. The 80-tine width was favored over the 70. Evaluation components indicated successful achievement of all stated goals of the study and identified process-related problems to be addressed.

Conclusions: The "extended" handle rake may prove effective in reducing musculoskeletal injury associated with blueberry harvesting. A community-based approach to developing, evaluating, and disseminating an intervention can be successful, particularly if employers participate.

Session: **A3.0**

Title: Identifying and Characterizing Fatal Injury

Moderator: Gordon Smith

A3.1

Title: Characterizing OSHA-Investigated Deaths Using CFOI Fatality Data

Authors: **Schoenbaum M,** Goddard K

Introduction: The Occupational Safety and Health Administration (OSHA) uses fatality data to develop, refine, and implement programs to protect workers and to set targets and baselines for performance measurement, as required by the Government Performance and Results Act (GPRA). For analytical purposes, the best available fatality data are from the Census of Fatal Occupational Injuries (CFOI) at the Bureau of Labor Statistics (BLS). However, many deaths included in CFOI are outside OSHA's scope or jurisdiction. Because CFOI does not identify OSHA-investigated deaths in their microdata files due to confidentiality agreements, it is necessary to use a model to identify probable OSHA-investigated deaths in CFOI.

Methods: CFOI microdata files for 2004–2006 were obtained and put into a model that eliminated deaths that OSHA is unlikely to inspect or that fall outside coverage under the Occupational Safety and Health (OSH) Act. The former include homicides and most traffic deaths; the latter include deaths among the self-employed and mine workers. Results were tested against fatality data from OSHA's Integrated Management Information System (IMIS).

Results: OSHA-investigated deaths represent roughly one third of deaths in CFOI. Monthly and annual totals from IMIS for deaths in OSHA overall, federal OSHA and OSHA 18(b) states, and construction and nonconstruction industries correlate well with the results from the model.

Conclusions: The model works. The resulting transformed dataset can be used to validate OSHA data for performance measures required by GPRA and to help OSHA protect workers from fatal injury by identifying high-hazard occupations, industries, and demographic groups, analyzing changes over time, and correlating sets of circumstances associated with workplace deaths.

A3.2

Title: Injury Circumstances of Occupational Fatalities in the U.S.—A Comparison of Two Classification Schemes

Author: **Marsh S**

Background: With nearly 6,000 workers dying annually due to injury, occupational deaths continue to be a major public health problem. Effective prevention efforts are dependent upon the ability to categorize circumstances and injury causes at a level detailed enough to identify specific problem areas. This study examines utility and agreement between the Occupational Injury and Illness Classification System (OIICS) and the International Classification of Diseases (ICD), both widely used to categorize occupational fatalities in the U.S.

Methods: To add ICD codes to existing CFOI OIICS, National Center for Health Statistics (NCHS) 2003 and 2004 Vital Statistics Mortality (VSM) data were linked to Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI). A probabilistic program matched up to nine variables to link cases.

Results: Of 11,138 CFOI cases, 10,583 (95%) were linked to corresponding VSM cases. Based on OIICS, workplace fatalities primarily involved highway incidents (25%), falls (13%), and homicides (10%); based on ICD, most deaths involved traffic incidents (24%), falls (12%), and homicide (10%). Although leading events (OIICS) and causes (ICD) were similar, distributions of subcategories sometimes differed as other/unknown codes within ICD were generally identified more frequently. For example, highway and traffic collisions w/stationary objects accounted for 25% (OIICS) verses 11% (ICD), respectively, while falls to lower levels accounted for 89% (OIICS) verses 68% (ICD). However, percentages for homicide-related shootings were similar. In many instances, OIICS provides more detail than ICD. For example, 20% of highway incidents involved vehicles moving in opposite directions.

Conclusions: Injury characteristics by OIICS and ICD are comparable at broad levels. Although ICD allows comparisons of work and nonwork injury deaths, an advantage of OIICS is that it can provide additional detail critical in successfully prioritizing and focusing prevention efforts in U.S. workplaces.

A3.3

Title: Metrics for Predicting Fatal Accidents and LWDII Rates

Authors: **Liu H**, Mendeloff J, Burns R, Schonlau M, Ruder T

Introduction: Host firms that contract with other firms to do work for them often screen them with respect to their projected safety record, as well as on other considerations. Measures that are frequently used are (a) noncompliance with OSHA standards, (b) the occurrence of a recent fatality, and (c) the LWDII. Separately, for construction and manufacturing, we assessed how well these measures predicted performance in terms of (a) the occurrence of fatal or catastrophic accidents and (b) the LWDII rate.

Methods: We relied on different data sources and samples for the 11 different analyses that we carried out. The sources included OSHA inspection data and LWDII data from both the OSHA ODI and from OSHA log data. The samples were either national or used Pennsylvania data. Most analyses used Poisson or logistic regression or ordinary least squares. We controlled for industry variables, employment, and time trends.

Results: For fatal accidents in construction, we found that prior fatalities appear to reduce the probability of a fatality within the next 2 years, prior noncompliance with serious violations probably predicts more fatalities, and the prior LWDII rate has no effect. For manufacturing fatal accidents, the only variable with

probable predictive value was a prior fatality, which again tended to reduce the future risk. For predicting LWDII rates, prior LWD rates had, not surprisingly, a good predictive value, at least for firms with more than 50 employees and for periods of 3 years or less.

Conclusions: A fatal accident within the last two years appears to decrease, not increase, the risk of another fatal accident. Perhaps such major events trigger renewed attention to safety. Thus recent fatal accidents should probably not count against a firm. Evidence about the value of noncompliance as a predictor is less certain, but can support its use.

A3.4
Title: Fatality Rates: Disentangling the Relation of Establishment Size and Firm Size
Authors: **Mendeloff J**, Ko K, Haviland A, Nelson C

Introduction: Research has shown that smaller establishments have higher fatality rates than larger ones. However, it has not been clear whether that relation is confounded by the fact that bigger establishments are often part of bigger firms. Most financial incentives (e.g., workers' compensation (WC) experience rating) operate at the firm, not the establishment, level. Our objective was to disentangle the role of these two.

Methods: For fatality data we relied upon the deaths investigated by OSHA. We estimate that in manufacturing and construction OSHA investigates about 80% of the deaths that CFOI indicates meet the OSHA investigation criteria. We obtained a special Census Bureau table for 1997 that apportioned establishment employment by SIC into firm size employment categories.

Results: Bigger firms do have lower fatality rates than smaller firms; however, once we hold establishment size constant, there was no protective effect of larger firm size for firms with under 1,000 workers. In contrast, the protective effect of larger establishment size is even stronger once we control for firm size. We also found that among establishments with fewer than 50 employees, workers appear to have lower fatality rates if they are in small, presumably single establishment firms than if they are in larger, multi-establishment firms.

Conclusions: The finding that establishment size has a much stronger relation to fatality risk may indicate that the financial incentives that operate primarily at the firm level are less important than many have assumed. Organizational factors, like the greater expertise available at larger establishments, may be more important. Also, the protective effect of being a small, single-establishment firm may reflect the impact of owners on site, although this is speculative. Finally, the fact that small establishments do worse as the severity of the injury increases suggests that their lower rates for LWDII rates reflects underreporting.

Session: **A4.0**
Title: Worker Safety Associated With Disaster Response
Moderator: James Spahr

A4.1
Title: Safety as a Factor that Influences Recruitment and Retention of a Volunteer Disaster Response Workforce
Authors: **Qureshi K**, Gershon RM, Conde F

Introduction: In the United States, the Medical Reserve Corps (MRC) is an important strategy to assure that there will be an adequate supply of public health responders during catastrophic events. Understanding factors that influence health professionals' decisions regarding joining such a volunteer group is essential for effective recruitment and retention of disaster response volunteers.

Methods: A random survey of eleven (11) types of healthcare providers (N = 1,057) was conducted in the state of Hawaii. The aim was to identify factors that influence interest, ability, and willingness to join the MRC.

Results: The response rate was 44.3% (N = 468). Barriers that would need to be addressed before health professionals would volunteer included concerns regarding the safety of their own family members during a disaster, professional liability protection, and competing personal obligations including workplace responsibilities. The most important motivating factor for joining was altruism and the ability to help one's own community. Other significant factors that would influence recruitment and retention included: time commitment, organization and management of the MRC itself, provision of training or education sessions and issuance of continuing education credits.

Discussion: The same factors that influence a paid employee's decision regarding reporting to work during a disaster surface for volunteers as well. The safety and security of disaster response volunteers and their families must be assured to the extent that one would protect paid employees and their families.

Identification and a thorough understanding of all of these issues is the first step in assuring a reliable disaster response workforce, both paid and volunteer.

A4.2

Title: Participatory Action Research Methodology in Disaster Research: Results From the World Trade Center Evacuation Study

Authors: **Gershon RM**, Rubin MS, Qureshi KA, Canton AN, Hurley M, Matzner FJ

Introduction: Participatory action research (PAR) methodology is an effective tool in identifying and implementing risk-reduction interventions. It has been utilized extensively in occupational health research, though infrequently, if ever, in disaster research. A PAR framework was incorporated into the World Trade Center (WTC) Evacuation Study, which was designed to identify the individual, organizational, and structural (environmental) factors that affected evacuation from the WTC Towers 1 and 2 on September 11, 2001. PAR teams, comprised of WTC evacuees, study investigators, and expert consultants, worked collaboratively to develop a set of recommendations to facilitate evacuation from high-rise office buildings and reduce risk of injury among evacuees.

Methods: Over several months, the two PAR teams, consisting of five and six members, worked together to identify data-driven strategies to improve emergency preparedness processes and procedures for high-rise building evacuation.

Results: The PAR teams identified 83 recommendations that addressed risk factors associated with the three major outcomes (length of time to initiate evacuation, length of time to complete full evacuation, and incidence of injury) at the organizational, individual, and structural levels.

Discussion: PAR teams were effective in identifying numerous innovative, feasible, and cost-effective strategies for improvement of high-rise emergency preparedness and evacuation. This approach may have utility in other workplace disaster prevention planning and response programs.

A4.3

Title: Point and Long-Term Injury Patterns Among World Trade Center Evacuees

Authors: **Qureshi K**, Gershon RM

Introduction: The number of high-rise buildings is increasing world wide; each year taller buildings are being planned and constructed. While considered to be modern marvels, occupant safety and security is of paramount concern for these structures. We learned from the World Trade Center (WTC) collapse that plans for rapid, safe evacuation of tall buildings is essential. While 20,000 persons successfully evacuated the towers on that day, many were injured in the process.

Methods: A convenience sample survey of 1,444 WTC evacuees from Towers 1 and 2 was conducted approximately two years after the event.

Results: More than a third (37%) reported a preexisting health condition. Most were chronic in nature and included: respiratory problems (27%), mental health problems (16%), cardiac conditions (12%), vision/hearing problems (8%), and a wide variety of other types of health problems (7%). Many participants (531; 37%) reported sustaining at least one point injury. Of these, the most commonly reported point injury was psychological (24.7%), followed by surface trauma (11.9%), inhalation injury (11.4%), orthopedic injury (7.2%), and eye injury (2.5%). Evacuees who had a preexisting health condition were more than twice as likely to report sustaining a point injury (OR = 2.16, 95% CI 1.70–2.74). Seventeen percent (17%) reported long-term health problems two years after the event; the most common being related to mental health and respiratory problems.

Discussion: As the population ages, it can be expected that a larger portion of the workforce will have chronic health problems. This demographic must be considered when planning for tall building evacuation. Furthermore, psychological trauma continues to be the most common injury sustained in large-scale catastrophic disasters. Occupational setting disaster planning should emphasize employee safety and protection during evacuation endeavors.

A4.4
Title: Event Study Analysis to Establish Capitalization Effects for Publicly Traded Corporations Reporting Fatal Injury Events Related to Chemicals
Authors: **Keane P**, Biddle E

Introduction: Companies using chemicals in the course of business operations are required to submit a hazard control plan to the U.S. Environmental Protection Agency. This plan reports information on injury experience, including fatal injury experience. The surveillance system RMP*Info was queried to determine all publicly traded corporations for which daily changes in stock price were also reported. The purpose of this study was to determine the effect of fatalities on capitalization effects (change in stock prices).

Methods: All publicly traded corporations that reported fatal injuries to the RMP*Info database and that were also included in a standard database of stock price formed the study population (n = 27). Event study analysis, a standard method for determining capitalization effects, using Eventus was conducted on this population to determine abnormal returns on the days immediately following the event. Cross-sectional and time-series measures of dependency were adjusted to determine returns in excess of expected price.

Results: Negative abnormal returns (stock prices decreased) to a group of corporations reporting fatal injury events were found for the first 2 days following the event; were marginal on days 3 and 4; and greater (stock prices increased) than expected on day 5. However, the results were not significant, with p values consistently > .10. Given the heterogeneity of the variables (degree of capitalization, analyst coverage, corporation size, property damage, number of employees involved in each incident), this was expected and largely a function of the characteristics of the reporting system and the study population.

Conclusions: Abnormal returns to the study group were associated with a low probability of causal relationship with the public disclosure of events. Future studies should be designed to control or match variables by event characteristics. This effort represents the first study to analyze the effects of fatal occupational injury events from chemical hazards on stock prices.

Session: **A5.0**
Title: Assessing the Safety Experience in Mining
Moderator: Linda McWilliams

A5.1
Title: The Burden of Fatal Occupational Injuries in the U.S. Mining Industry, 1992–2002
Authors: **Biddle E**, Keane P

Introduction: Historically, mining has been one of the most hazardous industries, with more than 150 miners dying annually from occupational injuries. Understanding the economic burden of these fatalities is important to setting broad occupational safety and health research priorities. Cost estimates provide additional information about how fatal injuries affect society and hence can improve injury prevention and control program planning, policy analysis, evaluation, and advocacy. This study estimates the total, mean, and median societal costs by worker and case characteristic for the mining industry from 1992–2002.

Methods: Mining fatal occupational injuries data are from the Bureau of Labor Statistics Census of Fatal Occupational Injury (CFOI). This system compiles data from all 50 States (excluding New York City) and the District of Columbia using multiple sources for decedents of any age for the mining industry. The cost to society of workplace fatalities in the mining industry 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.

Results: Over the 11-year study period, 1,721 occupational fatalities occurred in mining and accounted for a total cost of $1.8 billion and a mean cost of just over $1million per incident. Mining reported fewer fatalities and lower total costs compared to other industry divisions during this study period. However, the industry demonstrated a relatively high mean cost of an occupational fatal injury—second only to fatalities occurring in Public Administration. By major industry group, oil and gas extraction had the highest total and mean costs; coal mining was second.

Conclusions: Consistent with findings on the number and rate of fatalities in mining, cost estimates from this study suggest that research to prevent fatal occupational injuries in mining should be a high priority.

A5.2

Title: Underground Coal Mining Injury Trends: A Look at How Age and Experience Relates to Severity of Injury

Author: **Klein KA**

Introduction: One possible explanation for the recent severe injuries at underground coal mines is a younger, inexperienced work force. The trend of aging coal miners retiring and being replaced with younger, inexperienced workers will continue. Thus, it is important to understand how age and experience relates to injury. It is often assumed that when an older worker suffers an injury, recovery takes longer. The first hypothesis, therefore, predicts that age will also be positively related to days lost from work. The second hypothesis predicts that experience at the current mine, total years experience as a coal miner, and experience in the current job will be positively related to days lost from work.

Methods: Underground bituminous coal mining data from MSHA's Accident/Injury/Illness Database for the year 2005 was analyzed to assess these hypotheses.

Results: Hypothesis one was tested using a one-way, between-subjects ANOVA which revealed a significant relationship between age and days lost from work, $F = 9.195$ (4, 3227), $p < .001$. The Tukey post-hoc test revealed that days lost by miners aged 18 to 25 were significantly less than those 35 to 44 ($p < .001$), 45 to 54 ($p < .001$), and those 55 and above ($p < .001$). A univariate, between-subjects ANOVA also revealed that only experience at this job had a significant relationship with number of days lost, F (7, 2949) = 1.849, $p = .074$. The Tukey post-hoc test revealed that miners with 0 to 5 years of experience had significantly fewer days lost than miners with 6 to 10 years of experience at this job, $p = .016$. Thus hypothesis one was supported and hypothesis two was partially supported by the data.

Conclusions: This study shows that indeed there is a significant relationship between age and degree of injury. There is not, however, a substantial relationship between experience and days lost from work.

A5.3

Title: A Comparison of Equipment-Related Injury Causes in U.S. and Australian Underground Coal Mines

Authors: **Burgess-Limerick R**, Steiner L

Introduction: Working with or near underground coal mining equipment is inherently hazardous due to the multiple sources of injurious energies and adverse environmental conditions. This paper compares separate analyses of narratives describing injuries associated with underground coal mining equipment in the USA and Australia (Burgess-Limerick & Steiner 2006, 2007).

Methods: The narrative text field describing all injuries reported to MSHA as occurring at U.S. underground coal mines in 2004 were obtained (N = 3405). The narrative fields were obtained for all injuries occurring underground coal mines in one Australian state (New South Wales) during the three years to June 2005 (N = 4169). Injuries involving equipment were identified, and these narratives (N = 1306 and 959, respectively) were coded for the equipment type, the activity being undertaken at the time of the injury, and the injury mechanism.

Results: The proportion of injuries associated with equipment was higher in the U.S. coal mines (37%) than NSW (23%). The hazards highlighted by the U.S. data were: rock falling from supported roof, inadvertent or incorrect operation of bolting controls, handling continuous miner cable, collisions while driving underground vehicles, and driving over rough roads. The hazards highlighted by the NSW narratives were: handling continuous miner cable, strain while bolting, slipping off continuous miner platform, inadvertent of incorrect operation of bolting controls, driving over rough roads, and collisions while driving underground vehicles.

Discussion: The differences between U.S. and Australian equipment related injury causes are likely in part a consequence of differences in environmental conditions and mining methods. For example, higher seam heights in Australia allow greater use of roof screening which is effective in preventing injuries due to minor rock fall. Similarly, the use of integrated miner-bolters in Australia creates different risks. In both cases the results highlight opportunities for reducing injury risks through equipment redesign.

A5.4
Title: Real Time in Ear Dosimetry
Authors: **Takacs B**, Guffey S

Introduction: West Virginia University is all too aware of the significance of noise-induced hearing loss in the mining industry. The state of West Virginia has the distinction of having the highest number of reported noise-induced hearing loss cases for the mining industry (Valoski 1996). At present exposure limits, one in four workers will develop a permanent hearing loss as a result of mining coal (Prince 1997). Mine Safety and Health Administration (MSHA) inspectors found in the period of 1986–1992 that approximately 25% of coal miners' daily noise doses exceeded MSHA's PEL. Virtually all mines have hearing conservation programs and virtually all miners are issued and told to wear either ear muffs or ear plugs. Nevertheless, miners still have a high rate of NIHL.

Methods: This study utilizes the "Microphone in Real Ear" (MIRE) approach for the development of a laboratory and field fit-testing method of HPDs (hearing protector devices). The MIRE is an inherently precise, accurate, and relevant measure of HPD effectiveness. Minute-by-minute data logging of in-the-ear and on-the-shoulder dosimetry is used for full shift samples.

Results: Currently, WVU is analyzing the data to determine the contribution to doses due to removing or compromising the hearing protectors and to the inherent inadequacy of the hearing protectors. Combining this information with employee feedback, WVU will determine the primary parameters for proper selection and fit of HPDs and whether HPDs are being properly utilized in the mines.

Discussion: Convincing evidence from the study is that when a worker receives individual qualitative and quantitative feedback, the worker is capable of properly fitting and wearing HPDs. All of these measures could reshape the way the practicing hearing conservationists train, motivate, supervise, and enforce HPD usage.

Session: **B1.0**
Title: Assessing Risks and Interventions in Fall Prevention
Moderator: Alfred Amendola

B1.1
Title: Michigan Focus on Fatal Falls: Factors, Fixes and Follow-up
Author: **Chester D**

Introduction: The Michigan State University Division of Occupational and Environmental Medicine, Michigan Fatality Assessment and Control Evaluation (MIFACE) Program, has been tracking traumatic work-related deaths in Michigan since 2001.

Methods: MIFACE has compiled the number of Michigan work-related fatal injuries, determined the means of death, and gathered additional information for each fatality. We will present the descriptive epidemiological data of work-related falls, highlighting fatal falls in the construction sector where 60% of the deaths from falls occurred. We will also present illustrative case studies, educational interventions, and implications for policy.

Results: In Michigan, there were 875 work-related deaths for the six years of 2001–2006. One hundred twenty-five (14.3%) of the deaths were a result of a fall. The other major industrial sectors for fatal falls, besides construction, were manufacturing with 9% and agriculture with 7% of the deaths. Roofers and roofer helpers were the occupational group in construction most likely to experience a fatal fall (20 of 75), followed by carpenters (9 falls), and painters and construction laborers (7 falls each). Nine of the 125 falls occurred to individuals identified as Hispanic. Six of these individuals were performing construction activities. Only 4% of the fatal-fall events involved women. Falls of less than 10 feet accounted for 33% of all fatal falls. Most fatal falls occurred from a scaffold or ladder (26 of 116 falls with known fall surface). Eighteen (25%) of 72 with a known fall surface in construction occurred from a scaffold or ladder. Of the 84 cases where the surface was known, the surface conditions may have been a factor in 20 falls.

Discussion: Fatal falls continue to be an area of concern. Effective intervention activities and collaborations are needed to reduce the incidence of fall events.

B1.2
Title: Fall-Safe Intervention Research, Final Results
Authors: **Becker P**, Fullen M, Takacs B

Introduction: Falls are the leading cause of morbidity and mortality in the construction industry. Technology is available but not commonly used to prevent substantial numbers of these falls. This intervention research project hypothesizes that a third party (university, insurance company, nonprofit) can market a program that decreases fall hazards and the incidence of fall on construction sites.

Methods: The Fall-Safe fall hazard management system was provided through West Virginia University, St. Paul Insurance, and Construction Safety Council to 63 contractors. The program consists of training, written and site programs, employee feedback, and weekly site inspections. The program employs third-party audit using a hand-held device to establish compliance with OSHA standards for falls. Scores (arithmetic percent of control measures correctly implemented) on quarterly inspections by the third party provide feedback to contractors on how they are managing fall hazards. A control group of contractors did not receive training but was monitored by the third parties for changes in hazard control scores. A variety of metrics measures difference in hazard control score from a preprogram baseline to post-training implementation and compares the changes between intervention and control contractors.

Results: Program contractors improved their hazard control scores significantly more than control contractors.

Discussion: A quasi experimental experiment indicates that third parties can market and implement organizational interventions with construction contractors that result in improvements in hazard control by the intervention contractors.

B1.3
Title: Effect of Side Forces on the Stability of Scissor Lifts
Authors: **Pan C**, Chiou S, Powers J, Cantis D, Ronaghi M, Boehler B

Construction work is one of the leading fatal occupations. Seventy-four percent of scissor lift fatalities occurred in the construction industry. Previous research evidence indicates that falls were major causes of fatalities related to scissor lifts. In addition, constructing and repairing activities contributed to almost half of scissor lift falls. Operator activities within the platform, such as pushing a drill and pulling wires, create excessive side forces leading to the instability of scissor lifts. The objective of this study was to examine the effect of side forces generated by operator activities on the overall stability of scissor lifts. Twenty construction workers (mean age: 42.3 ± 7.7 years) participated in this study. Maximum side forces were measured while subjects performed simulated construction tasks on the main or extension platform in three standing directions. The experiments were conducted at three levels of lift heights (39, 56, or 72 inches). Three accelerometers were attached underneath the scissor lift to simultaneously determine the lift stability. The greatest side force observed among 1,080 trials was 140.85 lbs. Results from repeated-measure ANOVAs revealed that the height of the scissor lift did not affect the maximum side forces exerted by the subjects, implying high side forces may occur at any level of height. Pushing tasks produced significantly greater side forces than pulling tasks ($p < 0.0001$). Tasks performed in a standing direction parallel with the length of the lift created the greatest side forces ($p < 0.0001$). Significantly greater lift acceleration was also found while subjects performed tasks in the direction parallel with the lift at either 56 or 72 inches of height. This study provides important information on the magnitudes of side forces generated by operators as well as how standing directions affect side forces and the stability of scissor lifts.

B1.4
Title: Development of Improved Harness Sizing System
Author: **Hsiao H**

Introduction: Updated fall-arrest-harness designs are needed to accommodate diverse populations in the current workforce, and the successful design of efficient harnesses relies on quantitative data of human body shape variation. This study determined (1) body shape factors that associated with harness-fit problems, (2) the most favorable number of harness sizes, and (3) the adjustable range for each harness component for harness design.

Methods: An Elliptic Fourier Analysis (EFA) procedure with 123 coefficients was developed to quantify torso-shape effect on harness fit, using 3-dimensional torso scan data of 108 women and 108 men.

Results: The EFA coefficients were then applied to 600 representative body scans from a national database of 2,382 participants to establish an improved sizing system.

Conclusions: The study identified that increased inclination of torso suspension angle (hence fit failure) was associated with a reduction in torso length and a more developed chest; harnesses for women can be designed with a more upward back D-ring than that of the current unisex design to mitigate this problem. Study outcomes also suggested a system of 3 sizes for women and 3 sizes for men, of which the adjustment ranges of the torso straps were approximately within 17 cm and the thigh and hip straps within 23 cm. This research could help reduce the risk of worker injury that results from poor fit, improper size selection, or the failure to don the harness properly.

Session: **B2.0**
Title: Intervention Evaluation in Agriculture, Forestry, and Fishing
Moderator: Jennifer Bell

B2.1
Title: Hazard Assessment of Aquaculture Operations
Authors: **Myers M**, Cole H, Westneat S, Cox D

Introduction: Aquaculture is a fast growing sector of U.S. agriculture but has unaddressed health and safety issues for agricultural workers. Fish farming has many of the same hazards as other types of farming, but it has the added hazards associated with water impoundments and night-time work.

Methods: Risk factors were identified by collecting Occupational Safety and Health Administration (OSHA) investigation and other reports related to aquaculture, which were analyzed by using the Haddon matrix. A total of 29 investigation reports were reviewed regarding injuries and injury-related hazards. The Haddon matrix provides for evaluating the machine, environment, and human factors in the pre-event, event, and post event of an injury. This evaluation leads to risk factor and countermeasure identification.

Results: Causes of death included drowning, electrocution, crushing-related injury, hydrogen sulfide poisoning, and fatal head injury. Other hazards included fires, unguarded equipment, and confined spaces. Several countermeasures were identified including providing rollover protection structures on tractors and maintaining slip resistance and erosion control on levees. In addition, one feed delivery worker fatally fell when climbing to open and close the hatch at the top of the feed bin. The countermeasure was to attach a pull cable from the ground to open and close the hatch. A worker was electrocuted when a crane boom contacted a power line, and a feed delivery worker was electrocuted when his auger touched a power line. The countermeasure was to bury the power line. Workers have entangled their hair in aeration paddles in hatchery tanks. The countermeasure was to install plastic paddles that can easily slip on the driveline.

Discussion: The results from this analysis have identified simple (low-cost or no-cost) solutions to protecting workers from fish farm hazards. Moreover, the results of this analysis have been used to design a field survey of fish farms in the Southeast.

B2.2
Title: Cost-Effectiveness of the Commercial Fishing Industry Vessel Safety Act of 1988
Authors: **Pana-Cryan R**, Myers M, Lincoln J

Introduction: Data from the 1980s showed that the highest rate of occupational fatalities in the United States occurred in the Alaskan fishing industry. More than 80% of these fatalities were due to vessel capsizing or sinking, or falls overboard, resulting in drownings, presumed drownings, or drownings associated with hypothermia. To combat this problem, the U.S. Congress enacted the Commercial Fishing Industry Vessel Safety Act of 1988 (CFIVSA). While commercial fishing continues to have a high fatality rate, previous NIOSH work concluded that CFIVSA has effectively reduced commercial fishing fatalities in Alaska. The purpose of this study was to evaluate the cost-effectiveness of CFIVSA to prevent occupational deaths associated with commercial fishing in Alaska from the societal perspective.

Methods: A decision analysis model was used to compare the relative cost and effectiveness of the strategy of enacting and enforcing CFIVSA with the strategy of not doing so. Results from previous NIOSH work on CFIVSA's effectiveness were utilized, as well as additional NIOSH data such as annual numbers of full-time equivalent fishers. Detailed compliance cost estimates were obtained from the U.S. Coast Guard. Cost per death averted was estimated by the cost-of-illness approach. The discount rate used was 4% but sensitivity analyses on this and other variables are conducted. Outcomes are presented as lives saved and dollars spent per life saved over a 20-year period.

Results: Results indicate that 264 lives will be saved in Alaskan waters by 2010. In addition, enacting and

enforcing CFIVSA results in a savings of $186,000 per life saved. Sensitivity analyses demonstrate which of the model variables most affect the results.

Discussion: CFIVSA is cost-effective in saving lives in Alaska. When averted nonfatal injuries are added to the model, additional savings will be incurred.

B2.3
Title: The Effectiveness of the New Zealand FarmSafe™ Programmes: Development and Investigation of a Method for Outcome Evaluation
Authors: **Cryer C**, Samaranayaka A, Russell D, Barson D, Morgaine K, Langley J, Davie G

Introduction: Farm work-related injury is a serious public health problem. In New Zealand, a national injury prevention effort has been mounted aimed at addressing this problem. FarmSafe™ (FS), which comprises three component programmes, was introduced mid-2002 as part of this effort. FS had not been evaluated previously for its effects on injury rates.

The work funded was for a 12-month pilot study aimed at identifying a method for the valid outcome evaluation of the FS programmes, based on administrative data sources.

Material and Methods: We developed a feasible method of outcome evaluation based on (a) routinely collected earnings-related injury compensation data and (b) registrations for the FS programmes. A cohort-study approach was used that employed five-to-one matching, nonexposed to exposed. Matching was based on prior claims history.

Results: Only one of the FS programmes ("Awareness") had been running long enough to permit evaluation at this time. Attendance at Awareness was associated with an increased rate of earnings-related compensation claims during the 12- and 24-month follow-up post-attendance that was unlikely to be due to chance alone.

Discussion and Conclusions: Our investigations were unable to attribute this result to selection bias and/or bias caused by FS influencing claims-making behavior. Nevertheless, our view is that the observed magnitude of increase was unlikely to be due to attendance at the programme. We explored reasons for these unexpected results, thorough further empirical investigations.

B2.4
Title: Injury Surveillance in the U.S. Commercial Fishing Industry
Authors: **Lucas D**, Lincoln J

Introduction: NIOSH has developed the Commercial Fishing Incident Database (CFID) to collect and analyze data on fatalities in the entire U.S. commercial fishing industry. The purpose of this surveillance system is to identify high-risk fisheries in the U.S. and to identify the risk factors that contribute to fatal incidents. In addition to prospective surveillance, CFID contains retrospective data back to 2000.

Methods: Data for CFID are collected from multiple sources, including the U.S. Coast Guard, law enforcement agencies, and state-based occupational fatality surveillance programs. CFID includes information specific to each incident including vessel characteristics, environmental factors, and victim characteristics. Using data from this new surveillance system, a descriptive analysis of fatalities on the West Coast during 2000–2006 was completed.

Results: There were 58 fatalities along the West Coast during 2000–2006, with a fatality rate of 238 deaths per 100,000 FTE workers per year, which is 2 times higher than the rate in the Alaska fishing industry during the same time period. These fatalities resulted from vessel loss (74%) and falls overboard (19%). Forty percent occurred in the shellfish fishery (primarily crab), 26% in pelagic fisheries (primarily salmon), and 17% in the groundfish fishery. The Northwest Dungeness Crab Fishery had the highest fatality rate of any fishery on the West Coast or in Alaska, including the infamous Bering Sea Crab Fishery.

Conclusions: Interventions should be tailored to these fisheries and may include safety and stability training, targeted preseason safety inspections, and increased personal flotation device usage. Further research using CFID data will analyze commercial fishing fatalities for the East Coast and Gulf Coast of the U.S. In addition, comparative analyses of victims and survivors of vessel loss incidents will be conducted to identify protective factors contributing to survival.

Session: **B3.0**
Title: Improving the Collection and Interpretation of Injury Surveillance
Moderator: John Mendeloff

B3.1
Title: The Sorry State of Surveillance for Occupational Injury Hospitalizations
Authors: **Smith Gordon**, Dischinger P, Ho S, Auman K, Kufera J, Murdock K

Introduction: While fatal work-related injury (WRI) surveillance has improved, estimation of hospitalizations for WRI is only rudimentary.

Methods: Data linkage utilizing probabilistic techniques linked multiple data bases in Maryland to identify hospitalized WRI. We included any indicator of WR in records from hospitals, EMS, police, trauma registries, ED, and death certificates to create incident-specific records for 2001–2004. Validation studies examined agreement between sources and reviewed samples of hospital charts for indications of WR.

Results: Data linkage increased WRI counts by 19.4%, injury rates increased from 73/100,000 workers to 86/100,000, and increases were greater among women than men (27% vs. 18%). The largest numerical increase was among ages16–64 years, although the largest percent increase was among age extremes. Workers' Compensation (WC) as expected pay or source on hospital discharge records identified only 77.1%; E849 place code industrial 6.0%, farm 0.6%, and mine 0.1%. Linking other databases in sequential order identified 16.2% more cases (EMS 8.1%, police 1.4%, trauma registry 6.0%, ED 0.5%, death certificate 0.1%). Hospital charts classified 65% of commercial drivers as WR, although 84% of sampled charts documented WR. Chart abstraction of sentinel injuries revealed that 4.3% of cases not classified as WR from linked data had evidence of obvious work injuries, thus increasing counts for these injuries 16%.

Discussion: Commonly used proxies for WR (WC pay or source), greatly underestimates WRI hospitalizations. Identification of traffic WRI remains problematic. The only source to specifically ask a work injury yes/no question is the trauma registry; and despite only capturing 39.0% of hospitalized injuries they identified 6% more WR cases in the state, over and above those identified by hospital discharge data, illustrating the value of determining all injuries for WR.

B3.2
Title: The Use of Data Linkage for Surveillance of Serious Occupational Injury: Methods and Findings
Authors: **Kufera J**, Ho S, Auman K, Dischinger P, Smith G

Introduction: Many medical and injury databases poorly identify work-related (WR) injuries. This research was designed to develop a comprehensive statewide surveillance of severe occupational injuries by using probabilistic techniques to link injury records from disparate data sources.

Methods: Available sources in Maryland were linked to create an incident-specific database for 2001–2004. Data included emergency department (ED), inpatient and trauma registry records, ambulance run sheets (EMS), police crash reports, death certificates and medical examiners' reports. Severe injuries were defined as deaths, hospitalizations, or ED visits. Potential variables to identify WR injuries were determined for each database; injuries were considered occupational if defined as WR by at least one source. Agreement rates were examined between sources and multiple imputation explored as a means of improving WR estimates.

Results: Linkage estimated 163,739 occupational injury ED visits, 9,847 hospitalizations, and 5,768 trauma admissions over four years. Approximately 7.6% of linked ED injury visits were WR versus 7.5% before linkage, 5.3% vs. 4.5% for hospital admissions, and 8.0% vs. 5.1% for trauma admissions. Agreement of WR status between ED and other sources occurred approximately 75% of the time; lower rates (~50%) were found with death certificates, police reports, and especially EMS data, where the mechanism "fall over 15 feet" was an inadequate WR proxy. Agreement increased dramatically (97%+) with respect to identification of nonWR cases. Multiple imputation resulted in only 58 additional trauma cases.

Discussion: Data linkage is a useful tool for improving WR injury estimates. Most indicators were specific but not sensitive at identifying WR injuries. Addition of an "injury at work" variable to inpatient and ED databases would greatly improve reporting of WR injuries. To our knowledge, this is the first state to estimate occupational injuries by linking available statewide databases.

B3.3
Title: How Many Workplace Injuries Remain Unreported? A Capture-Recapture Study in Six States
Authors: **Boden L**, Ozonoff A

Introduction: This study examines the reporting of nonfatal workplace injuries and illnesses by state workers' compensation systems and the Bureau of Labor Statistics' (BLS) Annual Survey of Occupational Injuries and Illnesses (SOII).

Methods: We link individual case records from establishments reporting to the BLS with individual cases reported to workers' compensation systems in six states for 1998–2002. Using capture-recapture analysis, we estimate the proportion of injuries reported.

Results: For injuries and illnesses eligible for workers' compensation income benefits, we estimate that workers' compensation systems in the six states missed over 180,000 lost-time injuries in the sampled industries, that the BLS survey missed almost 340,000, and that about 69,000 injuries were unreported to either system. Using less conservative assumptions leads to estimates of over 450,000 unreported injuries in workers' compensation and over 610,000 for the BLS survey.

Discussion: Underreporting of nonfatal occupational injury and illness is substantial in both systems, but particularly in the SOII. Using both sources improves coverage but still falls far short of an accurate count for four of the six states. Steps should be taken to improve reporting so a more accurate picture emerges of the extent of workplace injuries in the U.S.

B3.4
Title: Using the SOII to Tell Which States are Safest—And Why You Shouldn't Believe the Results
Authors: Mendeloff J, **Burns R**

Introduction: Researchers are often asked to report how various states perform in terms of injury prevention. For nonfatal injuries and illnesses, the annual SOII can provide rates for 40 to 44 states, depending on the year. Even if these data are valid, we still face the problem of standardizing the rates so that they are comparable. The usual focus is on industry composition, because rates differ among industries and states differ in their industry composition. But do the resulting rates provide valid comparisons of risk?

Methods: We identified 13 2-digit and 3-digit SIC industry categories for which the SOII presents LWDII rates in more than 40 states for 2003–2005. They accounted for about 1/3 of the employment in those states. We then estimated what the overall LWDII would be for that set of industries if each state's industry composition for them matched the national distribution. We reviewed how workers' compensation waiting periods related to the resulting rates. We also compared the LWDII rates to the fatality rates in those states for those industries.

Results: Louisiana had the lowest LWDII rate! Whether a state had a 3-day or 7-day waiting period had a very large effect on its rate; states with the former had rates that averaged 30% higher. The state LWDII rates had either no relation to fatality rates or a negative relation. For construction, the relation was negative and significant.

Conclusions: In theory, LWDII rates reported to BLS should not be affected by features of the state WC program. The frequent negative relationships of LWDII rates with fatality rates suggest that there may be cultures of good or bad compliance with reporting rules. States with better compliance may also be states where compliance with good safety practices is better as well, although this requires further study.

Session: **B4.0**
Title: Emergency Responders Safety
Moderator: Timothy Pizatella

B4.1
Title: Fireground Command Decision Making: Understanding the Barriers Impacting Situation Awareness
Author: **Gasaway RB**

Introduction: Every day fire fighters are called upon to perform dangerous duties in high-stress, unpredictable environments. One component that can facilitate a safe outcome is for the fireground commander to maintain a high level of situation awareness (SA). Challenges with SA are among the highest-ranked contributing factors in the National Fire fighter Near Miss Reporting System incidents and frequently cited as a factor in NIOSH LODD investigation reports. This study identified 93 potential barriers to fireground commander SA and seeks to (1) identify which barriers create the greatest challenge to commander SA, (2) how commanders overcome their most challenging SA barriers, and (3) best practices to prevent barriers from impacting commander SA.

Methods: The project will use a multiple card sort technique where commanders rank 93 SA barrier statement cards on a continuum from minor challenge to major challenge. A series of progressive sorts results in the identification of their top three most challenging SA barriers. The sorts will be followed by retrospective interviews of commanders' lived experiences with each of their top three most challenging SA barriers, seeking to understand why those SA barriers were selected as the most challenging, how commanders have overcome those SA barriers, and what advice the commanders have for avoiding their most challenging SA barriers.

Results: Study results will include a listing of the commanders' most challenging SA barriers, the identification of clusters of relationships among various barriers (e.g., distractions, interruptions, feeling overwhelmed), and narrative descriptions of the lived experiences where commanders were challenged by their highest-rated SA barriers.

Discussion: The most challenging barriers to commander SA, as well as relationships among barriers, will be discussed. Lessons learned from the data analysis will include seeking explanations of the findings and a list of recommendations from expert commanders for reducing the impact of SA barriers.

B4.2
Title: Correlation Relationship of Fire fighter Anthropometry, Hand Grip, and Lateral Thumb Pinch Peak Strength Measurement
Authors: **Spahr J**, Hause M

Introduction: Maximum handgrip and finger pinch strength measurement testing has been used as a tool in the clinical assessment of hand injuries, evaluation of the effectiveness of various postsurgical or treatment procedures, assessment of worker ability to return to work, and as an indirect measurement of physical fitness. Hand and finger strength also has a direct application in the industrial design of tool and equipment interfaces involving the use of the whole hand or in the design of hand intensive tasks to minimize injury and their associated costs. Limited anthropometry, hand grip, and finger pinch strength data is available to characterize the performance of healthy fire fighters.

Methods: Anthropometric measurement of 300 career and volunteer fire fighters was performed to collect body size data about the gender; age; height; weight; arm span; forearm breadth; hand, palm, and finger size; wrist and forearm circumference; and hand dominance.

Body measurements were collected using standard anthropometry tools including digital weight scale, tape measure, calibrated anthropometer and breadth caliper, and finger circumference gauge. Force measurements were collected using a 90-kg capacity hydraulic hand dynamometer and a 28-kg capacity mechanical pinch gauge. Test subjects performed three grip and three lateral pinch strength exertions with their dominant hand to determine peak strength force measurements.

Results: Compared to gender-based normative clinical standards for U.S. civilians, the fire fighters in this study demonstrated above average peak hand grip and peak lateral pinch strengths in their dominate hand. Grip and pinch strengths were consistently greater for men than for women. Forearm circumference was highly correlated with peak hand grip strength and lateral pinch strength force in both males and females.

Conclusions: Anthropometric and biomechanical information is provided that is useful for health assessment and safety apparel design for fire fighters.

B4.3
Title: Identifying and Preventing Traumatic Injuries in Hazardous Material Events, the Experience of 14 Hazardous Substances Emergency Events Surveillance System States
Authors: **Orr M**, Kelley C

The Agency for Toxic Substances and Disease Registry (ATSDR) has supported the Hazardous Substances Emergency Events Surveillance (HSEES) system since 1990. Data are collected by participating state health departments on acute releases and threatened releases of hazardous substances and the resulting public health impact. These data are used by the states and ATSDR to design prevention activities aimed at reducing death and injury in first responders, employees, students, and the general public, as well as reducing releases of high-risk substances (i.e., chlorine, ammonia, and mercury). In 2005 there were 14 participating states that collected data on over 8,000 incidents and 2,000 injured persons, of which 69 died. In 2005, trauma constituted 6.9% of all injuries sustained in hazardous materials events. Of the 221 trauma-related injuries, 71 were chemical-related, 141 were not chemical related, 3 were both chemical and nonchemical, and 4 were of unknown cause. Trauma was more frequently involved in transportation

hazmat events, where the likelihood of a vehicular accident increased the risk for nonchemical-related trauma injuries. Using the latest available data, a subset of hazmat incidents involving trauma victims will be evaluated. The focus will be to identify the characteristics of those injured, the causal factors, industries and substances involved, and to make recommendations for where to target prevention activities. Case studies will be presented to elucidate lessons learned and gather audience feedback.

B4.4
Title: NIOSH's Fire Fighter Fatality Investigation Program Raises Awareness of Quiet Alarms
Authors: **Stein R**, Merinar T, Haskell W, Berry Ann R

Inaudible or barely audible PASS alarm signals were reported in the NIOSH FFFIPP investigation of four fire fighter fatalities occurring between 2001 to 2004. Subsequent laboratory testing of PASS by the National Institute of Standards and Technology's (NIST) Fire Research Division subsequently showed that a sound reduction begins to occur at temperatures as low as 300° F (150° C). NIST has reported that fire fighters routinely spend time at temperatures up to 100 °C (212°F) and often encounter much higher temperatures such as the peak conditions of Thermal Class III exposure (260 °C (500°F)). The sound reduction of the PASS was found to be common among devices certified as compliant to National Fire Protection Association (NFPA) 1982, Standard on Personal Alert Safety Systems (PASS), 1998 and earlier editions.

The NIOSH FFFIPP notified the NFPA Technical Committee on Electronic Safety Equipment shortly after realizing the PASS concerns. To alert fire and emergency services personnel, the NFPA issued a December 5, 2005, notice entitled, "PASS alarm signals can fail at high temperatures." NIOSH participated on the NFPA Technical Committee on Electronic Safety Equipment to assist in their successful effort to establish more robust PASS performance requirements for inclusion in the 2007 edition of the NFPA 1982 standard. Both NIOSH and the Safety Equipment Institute (SEI), as the certifier to NFPA 1982, solicited users' reports regarding instances of faint or inaudible PASS alarms; however, no such reports have been received.

PASS designs meeting the new, more robust requirements of the 2007 edition of the NFPA 1982 standard have been certified by SEI. Fire fighters and other emergency responders should continue to activate and wear PASS in hazardous areas but should always be aware of conditions affecting their own safety. PASS devices should be used to supplement personnel tracking and accountability.

Session: **B5.0**
Title: The Relationship of Organizational Culture, Climate, and Safety
Moderator: Robyn Gershon

B5.1
Title: Narratives in Safety and Health Communications
Authors: **Ricketts M**, Shanteau J

Introduction: Research in many settings has shown that narrative communications have exceptional power to persuade and affect peoples' decisions. This suggests that safety and health messages might be more effective if they include narratives, such as brief stories about people who have been injured. The purpose of this study was to determine if safety communications that include stories about injuries result in superior behavioral compliance when compared with traditional abstract safety messages. To study the effects of narratives in a controlled laboratory setting, participants completed a product assembly task. Compliance with safety messages was the dependent variable.

Methods: Teams of two participants assembled a swing set using written instructions that contained relevant safety messages. Fifty-four teams were randomly assigned to three conditions: (1) story-based safety messages, (2) concrete nonstory safety messages, and (3) traditional abstract safety messages. Compliance with safety messages was defined as the number of compliant components in the finished swing set.

Results: After adjustment for covariates, story-based messages resulted in a 20% improvement in compliance, compared with concrete nonstory and traditional abstract messages. Covariates included age, gender, (log) childcare experience, equipment assembly experience, presence of observer, and a final covariate related to timing of experimental sessions conducted by different experimenters.

Discussion: Stories about injuries improved safety behavior even though the stories were brief and not designed to be particularly engaging. In contrast, there was a lack of correspondence between observed behavior and many surrogate measures such as ratings of risk and delayed recall for warnings. This finding suggests caution is in order when using self-report and

other surrogate measures to evaluate interventions. A program of research is being developed to extend the findings of this laboratory study using field evaluations of safety and health in occupational settings.

B5.2
Title: The Role of Organizational Policies and Practices in Injury Prevention and the Management and Prevention of Work Disability
Author: **Amick III B**

Introduction: Employers, labor, and government are each interested in identifying the key organizational policies and practices (OPP) important in injury prevention. While current research has focused on safety climate or safety culture as key indicators of the organizational context, the proposed research examines the role of organizational policies and practices that are important in injury prevention and the management and prevention of work disability. The current research presents a psychometric evaluation of a 52-item OPP survey of over 400 firms in Ontario.

Methods: A survey of 472 firms in the education, hotel, and healthcare sectors in Ontario was conducted in 2003 and 2004. Building on the Michigan Disability Study we measured the following dimensions with 52 items: people-oriented culture, active safety leadership, safety training, safety diligence, disability case management, proactive return to work, ergonomic policies and practices and labor-management climate. A confirmatory factor analysis was conducted based on the a priori measurement model and appropriate model fit statistics. Based on the factor analysis, a series of scales was analyzed using the Multitrait Analysis Program and classic reliability statistics.

Results: Based on the confirmatory factor analysis, five scales and 26 items were identified with reasonable reliabilities: people-oriented culture, active safety leadership, ergonomics policies and practices, disability management, and safety practices. Each scale had reasonable Cronbach.

Discussion: In earlier research, we showed the importance of organizational policies and practices in predicting return to work. In this analysis, we sought to identify a short-form of the Michigan Disability Questionnaire in a large sample of firms. Five scales and 26 items were identified as important. For researchers interested in capturing organizational context, we suggest this 26-item questionnaire. We further discuss the importance of organizational support in injury prevention and disability management.

B5.3
Title: Safety Culture in Extended Care: The Innovation Project
Authors: Thomas-Olson L, **Mughal W**, Harrison D, Helal N, Duke K

Introduction: The most significant risk to healthcare workers is sustaining a musculoskeletal injury (MSI); MSIs continue to be the most prevalent injury type in healthcare. In healthcare, the provision of education and training has been the MSI intervention of choice for many years. Published research and industry experience show that providing training alone does not have a lasting effect on risk of MSIs to healthcare workers. This project aimed to involve front-line workers in the development and delivery of initiatives aimed at improving the safety culture in their work environment.

Methods: An extended care unit was identified as the "best performer" over the past few years with consistently low rates of injury. While it had received the same type and similar number of equipment to reduce risk of injury to care staff, the best performer experienced greater successes than some other care units. The Innovation Team observed work tasks and practices at the best performer unit. The team developed, piloted and administered a comprehensive survey instrument at both the intervention and control units at pre- and post-intervention periods. Three interventions were delivered to the intervention unit within the scope of this project.

Results: Workplace injury indicators for each unit did not change significantly over time. However, analysis of survey data revealed seven questions reaching significant difference over time between the two units. The questions included communication with peers and leadership, morale, and management support for safety. Finally, a gap analysis of the pre- and post-intervention data revealed a 44% reduction in the number of significantly different indicators (36 vs. 76) over the course of the project.

Conclusion: The change in the gap analysis, as well as the positive change in perceptions of management behavior may be the leading edge of a culture shift toward a positive safety culture.

B5.4
Title: Inter-Rater Reliability Assessment of an OH&S Management System Audit Tool
Authors: Mughal W, **Matheson A**, Thomas-Olson L, Spiwak R, Wasdell M

Introduction: The auditing process for occupational health and safety (OH&S) systems has been examined in the literature. Many organizations verify their OH&S performance through the routine performance of safety audits. Inter-rater reliability has been defined as the level of similarity between scores given by different raters for a work environment. There is a paucity of published literature examining the validity and reliability of available tools.

Methods: This project assessed the performance of a healthcare-specific OH&S program auditing tool. Objectives included determining the inter-rater reliability and validity levels of the audit tool for use in ratings of performance ("In Place") and for type of information used to establish ratings ("Source"). Two independent auditors conducted audits individually in four departments using a novel audit tool. This tool incorporated the same concepts described by OHSAS 18001. The tool has 270 criteria grouped into five sections. Data for each criterion was examined for inter-rater reliability for each section using the Kappa statistic.

Results: Findings obtained from the Kappa analysis revealed substantial inter-rater agreement for the Source data, while the In Place data revealed variable results.

Discussion: High Kappa scores for the Source data were expected as the tool indicated typical information sources to be used. Low Kappa scores for the In Place variable indicated differences in the way in which each auditor rated at each department. This incongruence would suggest that audited performance of any given department would vary by different auditors. This finding represents a need to further examine the design of the audit tool and associated methodology. Implications of the findings include the possibility of actual performance of a department as a confounder, as well as the impact of varying the sources of information. Future research is also discussed.

Session: **C1.0**
Title: Ladder Safety
Moderator: Hongwei Hsiao

C1.1
Title: Prevalence of Hazards Associated With Falls From Stepladders and Targets for Intervention
Authors: **Ronk CJ**, Dennerlein JT, Perry MJ

Introduction: Falls are a leading cause of fatalities in construction, and ladder fatalities have increased in recent years. There are many factors associated with falls from portable ladders; however, targets for intervention are unclear. Our goal was to measure the prevalence of known hazards in the construction environment in order to later conduct a targeted intervention.

Methods: An assessment tool was developed to measure compliance with portable ladder use best practices using items compiled from standards, guidelines, and reviews with safety professionals and researchers. Trained researchers observed stepladders at 19 sites of eight general contractors in the Commonwealth of Massachusetts. Ladders were scored on overall condition (n = 772), setup (n = 401), workers' movements (n = 140), and completion of tasks (n = 160) while using ladders.

Results: 96% of stepladders were Type I rated and free of defects. 87% had their bottoms clear of tripping hazards and 95% had spreaders locked. For the workers' movements score, 73% maintained three points of contact, 87% moved slowly, 49% had hands free, and 92% checked stability prior to climbing. For the completion-of-tasks score, 88% of ladders were the proper height for the job task, 91% of workers faced the ladder, 86% stayed within the horizontal support (i.e., belt-buckle rule), and 77% used minimum forces.

Discussion: Our assessments showed that most of the sites had stepladders of good quality and their setups regularly had spreaders locked. However, full compliance with best practices was not seen for several factors especially having hands free while climbing and using minimum forces. As a next step, we plan to focus on these delinquent areas as part of a targeted intervention to reduce falls from portable construction ladders.

C1.2
Title: Portable Ladder Tool Development and Validation—Quantifying Best Practice in the Field
Authors: **Dennerlein J**, Ronk C,Perry M

Introduction: While many efforts have developed specific design standards for ladders, many of the causes for falls from ladders are related to the use of practices. Therefore, we developed and tested a tool that assesses portable ladder best practices.

Methods: The questions were compiled from standards, guidelines, and review with safety professionals and researchers. Implemented on a hand-held computer, the assessment tool consisted of a series of checklists categorized in four best-practice categories: product condition, setup, moving on and working on a ladder. Three trained individuals scored a set of photos and videos depicting 25 ladder quality, 20 ladder setups, 10 moves on ladders, and 13 working on ladder observations (78 total).

Results: The resulting best-practices assessment tool contained 31 and 33 questions for all four observational classes for the step and extension ladders, respectively. Scoring all four categories takes approximately 2 to 3 minutes to complete. The practice assessment tool had good agreement across and within raters. For the yes/no responses to the 78 ladder observations, the inter-rater agreement ranged from 79% to 97% across the four observation classes and the three raters. The corresponding Kappa coefficients ranged from 0.41 to 0.83 with half greater than 0.75 indicating good to excellent agreement across the raters. For the one rater who completed that task twice with six-weeks between evaluations, the reproducibility of scores were excellent with percentage of yes/no responses in agreement greater than 89% and Kappa coefficients greater than 0.78.

Conclusions: The tool provides a method to quantify best practices associated with ladder use. Implementation can assist both the researcher and the practitioner in the prevention of falls related to ladder use.

C1.3
Title: Can a CSA Standard Certified Type-2 Ladder Design Hold a 0.41m Free Fall?
Authors: **Varrasso B**, Vi P

Introduction: One ideal to prevent the risk of falls is to tie-off to a ladder rung so that the users can maintain 3-point contact when working. To test the feasibility of this ideal, it is important to test the strength of the rungs to determine if the rung can handle the forces associated with a fall.

Methods: A 7.62 m CSA Type-2 aluminum extension ladder was placed against a work surface at an angle of 75 degrees. A 100 kg mass was hung from the ladder, raised 0.41 m vertically, and then released. To test the strength of the ladder rung, two tie-off methods were applied: (1) the mass was hung from a cable attached directly to the center of a rung approximately 6.1 meters from the base support, and (2) the mass was hung from a rope wrapped around both side rails at the same height as in the first method. The portable ladder was secured top and bottom to prevent the ladder from sliding under load.

Results: When six dropped tests of a force of ~5.4 KN was applied to the center of the rung, visible damage to the rung was observed. However, the ladder rung did not shear in half or release the load. Another six dropped tests were conducted using the rope-wrapped-around-the-rails method. There was no observable damage to the ladder rung and rails under dynamic load.

Conclusions: A typical aluminum CSA Type 2 ladder under load did not fail when the rope-wrapped-around-rails method was used. Therefore, the feasibility of working on ladder can be possible if the users use the rope-wrapped-around-the-rails method and fully secure the ladder at the top and bottom. Further studies should be conducted to verify this finding.

C1.4
Title: Effect of Ladder Types on Energy Expenditure, Forearm Force Exertion and Climbing Behavior
Author: **Vi P**

Introduction: Fixed vertical ladders can present safety risks for slips and falls because of their design, the ladder's located, and exposure to environmental factors (wet/icy weather and bird droppings). Adding to this risk is the potentially higher energy expenditure and high forearm exertion required to climb a ladder in a vertical orientation. The main purpose of this project was to evaluate the differences in climbing behavior, energy expenditure, and forearm exertion when climbing fixed vertical ladders and portable extension ladders.

Methods: Twenty workers participated in this study. A simulated ladder climbing task was used to investigate the energy expenditure and forearm force exertion while climbing on a 20-ft portable extension ladder

(placed at 75 deg to a work surface) and a fixed vertical ladder. While performing a ladder-climbing task, participants were video taped, and heart rate and forearm force exertion of the forearm flexor muscles were quantified.

Results:

- Climbing on portable and fixed ladders required a mean energy expenditure rate of 11.4 kcal/min and 13.1 kcal/min, respectively (significantly different at $p < 0.05$).
- The forearm force exertion was also found to be significantly ($p < 0.05$) lower when participants climbed on the portable ladders.
- Ten percent (10%) of the 20 participants used a 3-point contact technique when climbing the vertical fixed ladder. For portable ladder climbing, however, 80% of the participants maintained 3-point contact.

Conclusions: Due to the higher energy expenditure, greater forearm force exertion, and 2-point contact climbing technique, repetitive climbing on a vertical fixed ladder is more likely to increase the occurrence of whole body fatigue, localized forearm muscle fatigue, and higher risk of slip and fall than climbing on a portable ladder. Given these findings, it is recommended that workers should use appropriately secured portable ladders when the work environment permits.

Session: **C2.0**
Title: Intervention Evaluation in Healthcare Settings
Moderator: James Collins

C2.1
Title: Musculoskeletal Injuries Resulting From Patient-Handling Activities Among Hospital Workers
Authors: **Pompeii L**, Lipscomb H, Dement J, Schoenfisch A

Introduction: We evaluated musculoskeletal injuries resulting from patient-handling tasks at a large tertiary care medical center prior to the implementation of a policy change calling for 'minimal manual lifting' of patients. We sought to define circumstances surrounding patient-handling injuries, identify risk factors for injury, and potential preventive measures.

Methods: Data were obtained through the hospital's human resources department and their self-insured workers' compensation program from 1997 through 2003. Poisson regression was used to generate crude rates and adjusted rate ratios of patient-handling injuries among workgroups. The employee's description of the injury was used to determine the activity of the worker at the time of injury.

Results: One-third (n = 861) of all musculoskeletal claims resulted from patient-handling tasks. Over 80% of the patient-handling injury burden were among inpatient nurses (48%), nurses' aides (24%) and radiology technicians (11%). Infrequent patient-handling injuries were identified among staff who should not have this exposure, including hospital unit secretaries. Based on injury rates, nurses' aides (8.8/100 FTEs) were at particularly high risk, as were some smaller work groups including emergency medical technicians (10.3/100 FTEs), patient transporters (4.3/100 FTEs), and morgue attendants (2.2/100 FTEs). We estimated that 40–60% of patient lifting and transferring injuries could be prevented through the use of mechanical lift equipment. However, at least 40% of injuries, including those resulting from repositioning or turning a patient in a chair or bed, pulling a patient up in bed, and some transfers, would most likely not be prevented.

Discussion: The use of mechanical lift equipment could significantly reduce the risk of some patient-handling injuries, but additional interventions need to be considered that address other patient-handling tasks. Small work groups at high risk should not be neglected in prevention efforts.

C2.2
Title: The Importance of Observational Methods in Intervention Evaluation: Patient-Handling Injuries at Two Hospitals Before and After Implementation of Patient Lifting Equipment
Authors: **Schoenfisch A**, Lipscomb H, Pompeii L, Dement J

Introduction: While randomized controlled trials are considered the 'gold standard,' results are not always generalizable; furthermore, efficacy of this study design in a workplace setting can be limited. We report early experiences evaluating a policy shift to a 'minimal-manual lift environment' at a medical center and associated community hospital. This intervention to reduce patient-handling injuries included phasing in patient lift equipment in late 2004.

Methods: Human resources and workers' compensation data from 1997–2005 were linked, providing reported injuries and time at risk. Annual injury rates and adjusted rate ratios were calculated using Poisson regression to establish 9-year trends.

Regular site visits and communication (with ergonomists, unit managers and staff) provided knowledge of changes in administrative policies, as well as hospital- and unit-level differences in program implementation, adoption, and promotion.

Results: Compared to the medical center, the community hospital had overall higher rates of patient-handling injuries [adjusted RR 1.9; 95% CI (1.6–2.2)] and lost-workday injuries [adjusted RR 2.9; 95% CI (2.0–4.3)]. Restricted-workday injuries, however, were lower at the community hospital [adjusted RR 0.3; 95% CI (0.2–0.5)].

At the medical center, adjusted rates of patient-handling injuries decreased from 3.8/100 full-time equivalents (FTEs) in 1997 to 1.8/100 FTEs in 2004. At the community hospital, adjusted injury rates rose sharply from 2000 to 2002 [maximum 2.4; 95% CI (0.9–6.1)], followed by a sharp decline after 2002, but prior to the policy implementation/equipment use. Nonpatient-handling injury rates did not change significantly over the 9-year period at either hospital. Observed trends likely reflect concurrent occupational medicine practice and return-to-work policy initiatives.

Conclusion: These experiences underscore the importance of observational methods in intervention evaluation.

C2.3

Title: Evaluation of a Comprehensive Slip, Trip, and Fall Prevention Program for Hospital Employees

Authors: **Bell J**, Collins J, Wolf L, Grönqvist R, Chiou S, Chang W-R, Sorock G, Courtney T, Lombardi D, Evanoff B

Introduction: In 2006, the Bureau of Labor Statistics (BLS) reported the incidence rate of lost-workday injuries from slips, trips, and falls (STFs) on the same level in hospitals was 35.8 per 10,000 FTEs, which was 60% greater than the average rate for all other private industries combined (22.4 per 10,000 FTEs). The objective of this ten-year (1996–2005) longitudinal study was to describe STF injury events and evaluate the effectiveness of a comprehensive STF prevention program in three acute care hospitals.

Methods: The comprehensive prevention program included analysis of injury records to identify common causes of STFs, on-site hazard assessments, changes to housekeeping procedures and products, introduction of STF preventive products and procedures, general awareness campaigns, programs for external ice and snow removal, flooring changes, and slip-resistant footwear for certain employee subgroups.

Results: The hospitals' total STF workers' compensation claims rate declined by 58% from the preintervention (1996–1999) rate of 1.66 claims per 100 FTEx to the post-interventionintervention (2003–2005) time period rate of 0.76 claims per 100 FTEs (adjusted rate ratio = 0.42, 95% CI: 0.33–0.54). STFs due to liquid contamination (water; fluid; slippery, greasy, and slick spots) were the most common cause (24%) of STF claims. Food services, transport/EMS, and housekeeping staff were at highest risk of an STF claim in the hospital environment. Nursing and office administrative staff generated the largest numbers of STF claims.

Discussion: STF injury events in hospitals have a multitude of causes, and the work conditions in hospitals are diverse. This research provides evidence that implementation of a broad-scale prevention program can significantly reduce STF injury claims.

C2.4

Title: Evaluation of the Impact of Workers' Compensation Sponsored Interventions on Musculoskeletal Injuries in Nursing Homes

Authors: **Park RM**, Bushnell PT, Bailer AJ, Stayner LT

Introduction: Nursing home workers experience among the highest rates of musculoskeletal injury, mostly to the back. In 2006, private nursing care facilities had a rate of back injuries causing days away from work that was 3.9 times the national average. Efforts have been made to redesign patient-handling tasks, and engineering solutions have been implemented such as adjustable-height electric beds, powered lifting and transfer devices, and redesign of facilities.

Methods: The Ohio Bureau of Workers' Compensation (BWC) sponsored a safety and health intervention program that included training, consultation, and grants up to $40,000 to cover 80% of the cost of new equipment purchases. This study evaluated these interventions by merging BWC data on interventions, injury claims, and employer payroll for all Ohio nursing homes during 1995–2004.

Results: A $1,000 per worker equipment purchase resulted in a 53% reduction in back injury rate. Assuming an equipment life of 10 years, this translates to a $1,933 reduction in claim costs per worker

($1,249 if a 5% discount rate is applied). Training courses were associated with a significant 10% decline in back injury with an estimated saving of $109 per worker for the average-sized NH over the typical 3-year follow-up period in the study. Injury rates did not generally decline with consultation although interpretation is clouded by possible confounding, misclassification, and bias due to nonrandom management participation. In a subset of nursing homes, greater resident acuity and higher resident-to-staff ratios increased risk of injury. Equipment purchases had a greater impact for nursing homes with a resident-to-staff ratio greater than 2.0, a $1,000 expenditure per employee produced a $2,994 reduction ($1935 if discounted at a 5% rate).

Discussion: Equipment purchases are cost effective for prevention of back injuries in nursing homes.

Session: **C3.0**
Title: Characterizing and Preventing Injuries to Hispanic Workers
Moderator: Cammie Chaumont Menéndez

C3.1
Title: Hand Injury Outcomes in Hispanic Workers: Translation and Validation of the DASH Questionnaire
Authors: **Forst L**, Rospenda K, Mejia A, Morello J

Introduction: Hispanic workers suffer 2–4 times the rate of work-related amputations compared to other groups. There is anecdotal evidence that Hispanic patients have worse outcomes after a workplace hand injury. The purpose of this research is to establish a tool for evaluating health and quality-of-life outcomes in immigrant Hispanics from Mexico after a workplace hand injury.

Methods: The Disabilities of Arm Shoulder and Hand (DASH) questionnaire was translated into Mexican Spanish using standard methods. Thirty-five hand-injured, Mexican-born workers were recruited to test the prefinal version. Participants completed the newly translated DASH survey. They were probed on individual questions; they also underwent a history and physical exam based on the AMA Guides to the Evaluation of Impairment in order to evaluate retention of other psychometric properties and to try to correlate DASH measures with other measures that are typically used to determine impairment and disability in individual cases.

Results: Internal consistency, test-retest reliability and validity in the constructs of "overall problem," "overall pain," "ability to function," "ability to work," and "ability to work versus unable to work due to upper limb problem" was high and similar to these measures in the original English-language questionnaire.

Discussion: A final version of the DASH will soon be available for use in studying injury and treatment outcomes of occupational injuries of the upper extremity in Spanish-speaking individuals of Mexican origin that immigrate to the U.S. to work. We are evaluating further adaptation of the AMA Guides to be adjunctive in outcomes assessments of this vulnerable population.

C3.2
Title: Exploring the Excess Burden of Traumatic Workplace Injury to Hispanic Workers in Heavy Manufacturing
Authors: **Pollack K**, Rane S, Slade M, Cantley L, Vegso S, Taiwo O, Fiellin M, Cullen M

Introduction: With a steady increase in the number of Hispanics in the U.S. workforce, there is a need for more research exploring the risk and distribution of traumatic injuries to these workers. Prior research has explored injuries to Hispanic employees in agriculture and construction; however, little attention has been given to the manufacturing workforce. The objective of this research is to determine if Hispanic workers in a heavy manufacturing environment have a higher risk of occupational injury compared to their Caucasian and African-American counterparts when performing the same job and to evaluate if there are racial/ethnic differences in the nature and severity of injury.

Methods: Data for hourly employees at all U.S. plants on the payroll in 2006 (N = 26,573; 13% are Hispanic) were obtained to investigate injuries that occurred during the preceding five years. Multivariate logistic regression, adjusted for job, gender, age, and time on the job, was used to calculate odds ratios and 95% confidence intervals for all traumatic injuries, and separately for OSHA-recordable injuries. The analysis was also repeated for acute injuries and MSD-related injuries separately, and for a subset of Hispanic workers for which additional data on job demand and socio-demographic characteristics were available.

Results: Hispanic workers are at increased risk of traumatic workplace injury (OR: 1.50; 95% CI 1.17–1.93). Further sub-analyses are being conducted to

identify the job-stratified injury rates, distribution of injuries, and potential sources of variability for the observed association.

Discussion: This research provides evidence that the burden of injuries to Hispanic manufacturing employees warrant more attention. Modifiable risk factors should be considered for future targeted interventions, along with further analyses incorporating mixed-methods to gain a better understanding of the circumstances of injury.

C3.3
Title: Preventing Hispanic Fatalities
Author: **Casini V**

Introduction: The Bureau of Labor Statistics estimated there were 19.6 million employed Hispanics in 2006, making up almost 14% of the U.S. workforce. By 2016, the Hispanic workforce is expected to increase to nearly 27 million, an increase of almost 30%. Since 1992, the number of Hispanic worker fatalities has steadily increased. In 2006, Hispanic workers experienced a high number and rate of deaths, with 937 fatalities and a rate of 4.7/100,000 workers, compared to a rate of 3.9 for workers of all races/ethnicities. In an effort to reduce this fatality rate, the NIOSH Fatality Assessment and Control Evaluation (FACE) Program has included Hispanic worker fatalities as a target for investigation.

Methods: The FACE Program investigates fatal workplace incidents with the goal of identifying effective prevention measures. Through on-site fatality investigations, FACE personnel collect agent, host, and environmental information from the pre-event, event, and post-event phases of the fatal incident. The FACE program is a case-series design to facilitate descriptive analysis of the incidents and the development of preventive recommendations.

Results: To date, NIOSH personnel and state programs with NIOSH cooperative agreements have investigated 240 fatal occupational incidents resulting in the deaths of 249 Hispanic workers, occurring mainly in agricultural and construction. Problems identified include assignment to dangerous tasks, language and cultural barriers, lack of training, false credentials used by youth to gain employment, assignment of youth to tasks prohibited by child labor laws.

Discussion: FACE results indicate that training in safe work procedures and hazard recognition should be provided in a language and at a literacy level that all workers can comprehend. Employers should fully evaluate worker competency and age before assigning work tasks. Employers should consider the cultural issues when communicating safety information.

C3.4
Title: Fatal Occupational Falls Among Hispanic Construction Workers, 1992–2006
Authors: **Dong S**, Men R, Fujimoto A

Introduction: Falls are the leading cause of death in construction, accounting for about one-third of all work-related deaths in this industry. In recent years, although the overall death rate of construction workers has declined, the number of deaths among Hispanic construction workers has increased. The safety and health of Hispanic workers is a critical challenge for the construction industry due to implementation, enforcement, and language barriers among Hispanic workers. This study aims to address important issues concerning this vulnerable population.

Methods: Two large national datasets, the Census of Fatal Occupational Injuries and the Current Population Survey collected by the U.S. Bureau of Labor Statistics, were used for this study. Univariate and multivariate analyses were conducted using SAS (version 9).

Results: The number of deaths resulting from fall injuries among Hispanic construction workers increased dramatically during the study period. Fatal falls accounted for nearly 40% of the total deaths among Hispanic workers, much higher than the 31% for non-Hispanic workers. Fatal falls were the most prevalent among younger Hispanic workers. In 2006, nearly half of the victims of fatal falls were less than 35 years old among Hispanic workers compared with about 20% among non-Hispanics in the same age group. During the study period, 99% of fatal falls among Hispanic workers were caused by falls to a lower level, which was higher than the percentage for non-Hispanic construction workers.

Conclusions: Hispanic construction workers, especially younger Hispanic workers, have a higher risk of work-related falls than their non-Hispanic counterparts. Prevention strategies to reduce fall injuries and fatalities should focus on young Hispanic construction workers.

Session: **C4.0**
Title: Needlestick Injuries Among Healthcare Workers
Moderator: Letitia Davis

C4.1
Title: Blood and Body Fluid Exposure Risks in Operating Room
Authors: **Myers D**, Dement J, Epling C, Hunt D

Introduction: The risk of blood and body fluid (BBF) exposures in operating rooms was analyzed by various properties of the surgical procedures.

Methods: A two-year retrospective cohort study was conducted in one university hospital. All surgical procedures (n = 60,583) performed during 2001–2002 were included. Administrative data were linked allowing examination of 389 BBF exposures. Stratified BBF exposure rates were calculated; Poisson regression models were used for detailed analyses of risk factors. Surgical procedures and hours of procedure duration were used as denominators to generate rates. Risks were examined separately for suture-related and nonsuture-related BBF percutaneous exposures.

Results: OR personnel reported 6.4 BBF exposures per 1,000 surgical procedures (2.6 per 1,000 surgical hours). BBF exposure rates increased with estimated blood loss, (17.5 exposures per 1,000 procedures with 501–1000 cc blood loss and 22.5 exposures per 1,000 procedures with > 1000 cc blood loss), number of personnel ever working in the surgical field (20.5 exposures per 1,000 procedures having ≥ 15 personnel ever in the field), and surgical procedure duration (13.7 exposures per 1,000 procedures lasting 4 to < 6 hours, 24.0 exposures per 1,000 procedures lasting ≥ 6 hours). Associations were generally stronger for suture-related exposures.

Discussion: Our findings support the need for prevention programs targeted to mitigate risks for BBF exposure posed by high blood loss (e.g., use of use of blunt sutures and a neutral zone for passing surgical equipment) and prolonged duration of surgery (e.g., double gloving to defend against high frequency of glove perforation associated with long surgical cases). Prevention measures may differ for suture- and nonsuture-related BBF exposure events. Further investigation is needed to understand risks posed by surgical procedures of long duration.

C4.2
Title: Cost of Needlestick Injuries and Subsequent Hepatitis and HIV
Authors: **Leigh P**, Gillen M, Franks P, Sutherland S, Nguyen H, Steenland K

Background: Physicians, nurses, and other healthcare workers (HCWs) are at risk of bloodborne pathogens infection from needlestick injuries, but costs of needlesticks are little studied.

Methods: We used the cost-of-illness and incidence approaches. We used the perspective of the medical provider (medical costs) and the individual (lost productivity). Data on needlesticks, infections from hepatitis B and C (HBV, HCV), and human immune-deficiency (HIV) among HCWs, as well as data on per-unit costs were culled from research literature, Centers for Disease Control reports, and Bureau of Labor Statistics reports. We also generated estimates based upon time-trends, classifications of at-risk occupations, and scenarios for source-patients. These data and estimates were combined with assumptions to produce a model that generated base-case estimates and sensitivity analyses involving 16 scenarios. Future costs were discounted by 3%.

Results: We estimated 654,500 needlesticks in 2004 of which 49% generated costs. Total medical costs were $108.8 million of which 96% resulted from testing and prophylaxis and 4% from treating long-term infections (34 persons with chronic HBV, 145 with chronic HCV, and 1 with HIV). Lost-work productivity generated $83.0 million, for which 58% involved testing and prophylaxis and 42% involved long-term infections. Combined medical and work productivity costs summed to $191.8 million. Costs-per-needlestick were $597 and costs-per-employed-HCW-at-risk were $25. Sensitivity analysis suggested a range on total costs from $85.3 million to $374.0 million.

Conclusion: Detailed methodology was developed to estimate costs of needlesticks and subsequent infections for hospital-based and nonhospital-based healthcare workers. Our model will be useful for future research assessing costs and benefits of reducing needlesticks.

Published by CURRENT MEDICAL RESEARCH AND OPINION, September, 2007

C4.3

Title: Development of an Evidence-based Evaluation Framework for a Safety Engineered Needle Program

Authors: Mughal W, **Chua P**, Ciconte R, Thomas-Olson L

Introduction: Needlestick injuries (NSIs) are a recognized source of exposure to bloodborne pathogens for nurses. The literature identifies a number of important factors that are integral to the success of NSI prevention strategies. Only one study published has recently demonstrated a comprehensive approach to evaluation. The paper describes the findings of a thematic analysis conducted on focus group data with healthcare workers to identify critical measures for SEN program performance.

Methods: The project involved a participatory action research methodology involving 13 Canadian registered nurses that use SENs as a regular part of their work in various acute care units across the organization. Thematic analysis was conducted on focus group data to identify convergent ideas.

Results: Participants reported a range in perceptions of exposure risk due to needlesticks in their environments. Respondents identified a number of facilitators to SEN usage including ease of access to SENs, awareness and education, and encouragement to use SENs. Barriers to SENs usage included lack of education and training, lack of SENs availability, and lack of familiarity with the devices. Numerous control measures available to avoid NSIs were identified, all of which were key elements of the implemented SENs program.

Discussion: Overall, findings were positive. The relative importance associated with education and training was encouraging. The apparent low rate of training in some areas was surprising given the high profile of initial sessions. Access to clinical educators may explain this difference. These findings were used to develop a SENs program survey, which will be used to acquire cross-sectional data. These data will be compared to objective measures of program performance. An assessment of convergent validity will be conducted by comparing scale scores to captured objective measures including rates of NSIs in the work environments, sick time usage, and overtime usage.

C4.4

Title: Blood Exposure in the Home Care Workplace: Comparing Risks Among Registered Nurses and Personal Care Assistants

Authors: **Lipscomb J**, Sokas R, McPhaul K, Scharf B, Barker P, Alison T

Introduction: Little is known about sharps injury rates among RNs and personal care assistants (PCAs) delivering care in the home. These providers perform many of the same procedures as hospital workers, but in a less predictable environment. RNs working in the home are covered by the 2000 U.S. Needlestick Safety and Prevention Act; while PCAs who assist clients with activities of daily living (ADLs) are typically not covered. The purpose of this analysis is to characterize blood exposure in home care work and to compare the risk of blood exposure among both groups.

Methods: RNs were surveyed by mail (n = 794; response rate = 47%) and PCAs in person (n = 941; response rate 85%). Both surveys asked about past year sharps and mucous membrane exposure, in addition to a number of work schedule questions. To estimate and compare the risk of injury between the two occupational groups, past year sharp and mucous membrane exposure rates were calculated. Rate were calculated using full-time equivalent (FTE) as the denominator based on self reported hours they spend in the field during a typical week.

Results: PCAs describe many opportunities for blood exposure while assisting clients with ADLs and home making. Preliminary data suggest that RNs and PCAs experienced similar rates of sharp and mucous member injuries in the past year. Data will be presented comparing the rate and circumstances surrounding RN and PCA blood exposure.

Discussion: The U.S. 2000 Needlestick Safety and Prevention Act does not extend coverage to nonmedical personnel (such as the PCAs) who provide care in the home. Our findings should stimulate policy discussion regarding whether OSHA coverage should be extended to this occupational group. In addition, discussion is needed regarding the most appropriate denominator for calculating blood exposure rates in this population.

Session: **C5.0**
Title: Assessing the Safety Experience in Coal Mining
Moderator: Gail McConnell

C5.1
Title: From Scotia to Brookwood, Fatal U.S. Underground Coal Mine Explosions Ignited in Intake Air Courses
Author: **Dubaniewicz Jr. T**

The National Institute for Occupational Safety and Health, Pittsburgh Research Laboratory, conducted a study of past mine explosions to identify the ignition locations and ignition sources responsible for the most severe explosion events resulting in death. Since the Scotia disaster of 1976, many fatalities from underground coal mine explosions have been linked to nonpermissible electrical equipment ignition sources located in intake air courses. With few exceptions, explosion-protected equipment is generally not required in intake air courses of gassy underground coal mines in the U.S. Cigarette lighters were another prevalent ignition source for fatal explosions ignited in intake air courses. Several mine rescue/recovery teams have encountered electrical ignition hazards. The study provides evidence that intake air courses of gassy underground coal mines fit the description of certain hazardous (classified) locations described in the U.S. National Electrical Code®. Class I Division 2 or Zone 2 explosion protection techniques may be used to design intake air equipment so that it does not present an ignition source under normal operation, before mine power is shut down in emergency situations. To protect rescue/recovery personnel, nonpermissible circuits in intake air courses that are likely to remain energized during emergencies (e.g., battery-powered equipment) should be protected by more stringent Class I Division 1, Zone 1, or Zone 0 techniques.

C5.2
Title: Effect of Mine Size on the Rate and Type of Fatal Accidents in Underground Coal
Authors: **McWilliams L**, Lenart P, Hall E

Introduction: There have been numerous changes in the U.S. underground coal mining industry over the last 27 years. The number of active mining operations has decreased substantially, accompanied by declining employment. What has been the impact of these changes on fatality rates?

Methods: The number of underground coal mines, employee hours, and fatalities reported to the Mine Safety and Health Administration from 1980–2006 were used in this study. Mining operations were stratified by employment size: (1) small (less than 20), (2) medium (20–49), and (3) large (50+).

Results: From 1980 to 1999, the number of underground coal employee hours declined by 65% from 222 to 77 million hours. The number of mines decreased by nearly 77%, (2,407 to 792). Large underground operations experienced their greatest decline in the early 1980s, while small operations experienced substantial declines in the first half of the 1990s. This decline in the number of mines has continued into the 21st century. By 2006, there were 654 underground coal operations. The number of employee hours for small operations reached a 27-year low (3.7 million hours).

The underground coal fatality rate was equal to 90.6 per 100,000 full-time equivalent (FTE) workers in the 1980–1984 time period. By 1995–1999, the rate had dropped to 48.3 fatalities per 100,000 FTEs. From 2003–2006, the overall fatality rates were 21.0 (large), 42.8 (medium), and 157.8 (small) per 100,000 FTE workers.

Discussion: While overall fatality rates have generally been declining over the last 27 years, the rates for small mines continue to be high. Fatality rates associated with roof falls, powered haulage accidents, and ignitions or explosions tended to be significantly higher for small underground coal operations compared to medium and large operations.

C5.3
Title: Expectations Training for Self-Contained Self Rescuers in Escape From Underground Coal Mines
Authors: **Kowalski-Trakofler K**, Brnich M, Vaught C

In 2006, several major incidents occurred at underground coal mines in the United States. These incidents resulted in nineteen worker fatalities. In each case, miners used their self-contained self-rescuers (SCSRs) while escaping, or attempting to escape, their mine. NIOSH developed a switchover procedure to change from one unit to another in an emergency. In addition, NIOSH researchers conducted a study to investigate the human issues in SCSR use. The goal of the study was to develop training that would educate miners regarding what they could expect from their units in an escape. Information was obtained from miners who had experience wearing SCSRs, SCSR manufacturers, and researchers. Results determined nine key areas of concern for miners wearing an SCSR: starting the unit, heat generated by the

chemical beds particularly in chem.-ox apparatus, coughing, taste, the quality of the air the SCSR provides, breathing resistance, nose clips, goggles, and the behavior of the breathing bag. In addition, researchers reviewed the literature on human response under duress. This presentation discusses the development of the SCSR switchover procedure including a demonstration of the process. The expectations study is discussed and the resultant training that was developed is presented. The presentation also explains the impetus for the study, which was the SCSR training mandated in the Miner Act of 2006.

C5.4
Title: Workers' Compensation Insurance Costs Associated With Rockfall Injuries in Underground Coal Mines
Authors: **Bhatt S**, Mark C

Introduction: Over 400 underground coal miners are injured each year by rock falls in the United States. NIOSH has determined that installing roof screens is the most effective method to reduce the incidence of rockfall injuries. However, cost is one barrier to the increased use of screen. The cost of installing screen can be partially offset by savings in Workers' Compensation Insurance costs. In order to quantify the potential savings from decreasing rockfall rates, NIOSH undertook a study of the process of setting insurance rates.

Method: The study focuses on Pennsylvania and Illinois coal mines. Sources of information included the Pennsylvania Coal Mine Compensation Rating Bureau (CMCRB), the National Council on Compensation Insurance (NCCI), MSHA, insurers, and the Census Bureau. Using actual losses, payroll and accident data for three years, scenarios were developed for estimating the experience modification factors and insurance costs for hypothetical mines. In Pennsylvania, two small mines, each employing 70 miners, were compared. The mine that installs roof screen experiences fewer injuries than the mine that does not install screen, because rockfall injuries are eliminated. The CMCRB formula was used to estimate difference in the experience rating modification for the two mines. For two large Illinois mines (314 workers each), the NCCI formula was used to estimate the rating modification.

Results: If the screening mine can reduce claim losses by 10%, it could reduce its compensation insurance premiums by 7%. A 25% reduction in losses results in 18% premium reduction. These savings would have amounted to $72,000 and $185,000, respectively, in 2005 for Pennsylvania. The reductions of 16% and 30% in losses could mean savings of 13% and 23% in premiums, amounting to $887,000 and $1,569,000, respectively, in 2007 for Illinois.

Discussion: Roof screens may improve safety and reduce workers' compensation costs.

POSTER SOCIAL

Construction Safety

P01
Title: Self-Reported Postures and Task Parameters within the Construction Industry that Lead to Instability Upon Standing
Authors: **DiDomenico A**, McGorry RW, Blair MF, Huang Y-H

Introduction: Falls within the construction industry are numerous and potentially have severe injury outcomes. Loss of balance is a primary causal factor for injuries related to falls. One contributor may be movement necessary to transition from a working posture to a standing position. The movement can affect physiological systems and it is unclear as to which postures evoke the strongest response and make it difficult to remain stable.

Methods: A written survey was administered to ~150 construction workers within building trades. Using input from subject matter experts, the research team developed survey items regarding occupational postures, levels of instability upon standing, and factors that affect balance. Instability was rated on a 5-point Likert scale. Questions were also included to identify which task parameters were believed to make maintaining balance most difficult.

Results: Eleven working postures were evaluated with a mean stability rating of 4 (SD 0.26), indicating a somewhat stable rating. Squatting resulted in the most reported instability with a mean of 3.78. Protective measures were identified with nearly half (47.1%) of the participants signifying that they hold on to an object to maintain balance. Other protective measures included, for example, pausing after standing up (37.8%). The top three factors that made maintaining balance difficult were fatigue (52.5%), standing up fast (46.4%) and working on an uneven or irregular surface (43.9%).

Discussion: Construction workers studied had good to excellent self-reported balance but still indicated that they had occurrences of instability upon standing. Due to the hazardous work environments at construction sites, maintaining stability while working is crucial. It is unknown if workers accurately perceive the level of instability during a workday. Future research will compare these findings with objective measures of stability and determine how well subjective measures represent actual risk.

P02
Title: Incidence Patterns of Lost Time Injuries within a Large Population of Construction Companies
Author: **McVittie D**

Ontario's construction industry consists of almost 60,000 employers, ranging from very large to very small. The Lost-Time Injury experience and Insured Hours Worked for this large population was examined to discern multi-year incidence patterns over an 8-year period.

The data on Lost -Time Injuries, and Insured Hours Worked was extracted for all firms that reported any LTIs during the period 1998-2002. Each year's cohort of injury-incurring firms was followed for 4 additional years to observe which ones incurred injuries in subsequent years. The proportion of firms that incur multiple years with higher than average LTI rates are shown.

Approximately 3% of the injury-incurring construction firms (or 0.021 % of all construction firms) experience higher-than-average LTI rates in 5 consecutive years.

Most construction firms that incur an LTI in any given year are unlikely to incur another one for several years. The cohort of injury-incurring firms in any year consists primarily of firms that did not have any LTIs in the prior year and are unlikely to have another one in the next year.

The pattern is very consistent within the different multi-year cohorts examined in this study.
The significance of these findings impacts on targeting company-level interventions.

Regulatory agencies and prevention organizations can focus high-intensity interventions on a relatively small population of firms that have consistently "worse-than-average" experience in order to maximize the effect of limited resources.

Regarding the large number of companies which incur a single LTI, and which may not likely incur another one for several years, a more time-sensitive approach is needed.

Conventional public health model approaches can be integrated with a more focused intervention strategy

P03
Title: Improvements in Injury Rates in Construction - 1998-2006
Author: McVittie D, **Varrasso B**

The overall rate of lost time injuries in Ontario's construction industry has improved by more than 33% from 3.48 /200,000 hrs in 1998 to 2.34/200,000 hrs in 2005.(2006 and , if available, 2007 data will be included).

Three major types of accidents account for 95% of all LTIs in construction: overexertion/repetitive motion struck by/against objects, and falls.

The rate of improvement for each of these major types of accidents during the period 1998-2006:

LTI rate improvement
Overall LTI rate 33%
Overexertion/repetitive motion 31%
Other single traumatic event: injuries 30%
Falls 39%

Other single traumatic event injuries include struck by, struck against objects, contact with objects, caught in/on/between objects.

The increased emphasis on fall prevention during this period appears to be having a positive impact on reducing the incidence of fall-related injuries.

The other types of accidents are also improving despite unprecedented growth in construction employment (up 70% since 1998).

Charts showing the pattern of change during this period are provided.

P04
Title: Claim Persistence and Cost Measures for a Large Population of Construction Disability Cases
Author: McVittie D, **Fiorini D**

Data on all lost time injury claims registered with the WSIB for the period 1998-2006 inclusive were extracted to examine the proportion of claims from any given year which incurred costs in any subsequent

year(s). The total costs for those claims in each of the subsequent years were also extracted.

The proportions of each year's cohort of claims which incurred costs in subsequent years were determined. The average costs per original year claim were also determined for each subsequent payment year. The analysis shows some minor increase in the proportion of claims incurring costs in subsequent years (suggesting that "simple easy-to-prevent injuries are diminishing more rapidly than more difficult ones). Cost analysis shows some quite variable results.

(Data to be provided in tables and charts)

P05

Title: Preventing Worker Deaths and Injuries from Contacting Overhead Power Lines with Metal Ladders

Author: **Romano N**

Introduction: A NIOSH review of the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI) data from 1992–2005 identified at least 154 electrocution deaths that resulted from contacting overhead power lines with portable metal ladders (excluding truck-mounted and aerial ladders). Of these 154 deaths, 36 involved a person of Hispanic origin (CFOI data for all years exclude New York City; the data for 2005 are preliminary).

Methods: The NIOSH Fatality Assessment and Control Evaluation (FACE) Program identifies and studies fatal occupational injuries, with the goal of identifying effective prevention measures. Through on-site fatality investigations, FACE personnel collect agent, host, and environmental information from the pre-event, event, and post-event phases of the fatal incident.

Results: A review of NIOSH FACE cases between 1987 and 2007 identified 11 investigations involving the deaths of 12 workers that occurred while working around overhead power lines and using metal ladders. Ladder contacts with power lines usually occurred during erection, lowering, or relocation of the ladder. Some examples of preventive recommendations from these investigations are: (1) employers eliminating use of conductive ladders, (2) employers developing a comprehensive safety and training program in language(s) and reading levels of the workers, (3) manufacturers affixing bilingual labels with graphics to provide hazard warnings and instructions.

Conclusions: Evidence collected during FACE investigations suggests that the victims may not have been fully aware of the hazards to which they were exposed, and that employers did not have adequate safety programs and training to address this hazard. In order to lower fatality rates, workers must be informed of the potential hazards present and should receive training to perform their tasks in the safest possible manner.

P06

Title: Review of Research on Disability in Construction

Authors: **Becker P**, DiSalvo C

Introduction: Numerous articles have been published in the last 5 years reporting causes and conditions of disability (and particularly disability prior to normal retirement age) among construction workers. In some cases these articles note risk factors associated with these disabling conditions. An overview of the reported disability experience of construction workers can help focus on controlling hazards contributing to these disabilities.

Methods: Review peer review literature in peer review journals and government reports on incidence and risk factors associated with disability among construction workers. Construct a table summarizing these findings.

Results: There is now substantial evidence that there are several leading causes of disability among construction workers. Identification these conditions and associated risk factors focuses attention on priority areas for control.

Discussion: There is wide anecdotal evidence that many construction workers retire early due to disabling conditions. This poster provides baseline data confirming the need for the development of focused research on early disability among this population. We may find the need to develop a contrarian hypothesis about aging and physically demanding work which counters the prevailing hypothesis that aging causes workers to fall short of strenuous job demands. The alternative hypothesis might be that strenuous work is prematurely aging (and disabling) a particular workforce (worn out worker.)

P07

Title: Crane-Related Fatalities in Construction, 1992-2006

Author: **McCann M**

Introduction: Recent tower crane collapses with multiple deaths in New York City and Miami have generated concern about crane safety and the risk to the public in general. The purpose of this study is to analyze the causes of crane-related deaths in construction.

Methods: Crane-related deaths were identified by selecting all construction records from 1992-2006 with source or secondary codes of "crane" (343*) from the Census of Fatal Occupational Injuries Research File of the Bureau of Labor Statistics. The records were analyzed for causes of death and occupation.

Results: A total of 315 crane-related worker deaths were identified, about 21 deaths per year. Major causes of death were contact with overhead power lines (32%), falling/collapsing cranes (19%), struck by crane parts or loads (except falling booms) (23%), struck by falling crane booms (14%), and caught in/between (7%). Less than 10% of the crane deaths involved tower cranes. The main occupations of workers killed were construction laborers (30%), crane and tower operators (16%), supervisors/ managers/administrators (13%), other heavy equipment operators (7%), and mechanics (5%). In the overhead power line contact deaths, 29% of contact involved the crane boom, and 19% involved crane cables. Only about one-third of the CFOI narratives for falling/collapsing cranes indicated the cause of the collapse. Reasons listed included insufficient ground support, excessive loading, mechanical problems, and high wind. About 60% of the falling crane boom deaths occurred while assembling or dismantling the boom or part of the boom.

Discussion: Recommendations include: (1) a permit system for working near overhead power lines; (2) required state certification of crane operators; (3) following recommended procedures for assembly, disassembly and rigging of cranes; (4) following manufacturer's limits for loads; and (5) not working under (or allowing pedestrian or vehicle traffic under) suspended crane loads.

P08

Title: Nail-Gun Injuries Treated in Emergency Departments—United States, 2001-2005

Authors: **Jackson L**, Lipscomb H

Introduction: Speed, ease of use, and ready availability have made pneumatic nail guns a common tool used in work settings such as residential construction and wood-product fabrication. In addition, the tools are now readily available to consumers, extending to the public what had been primarily a potential work-related hazard.

Methods: To characterize nail-gun injuries in work and nonwork settings, injuries treated in U.S. hospital emergency departments (EDs) were studied by using the U.S. Consumer Product Safety Commission's (CPSC's) National Electronic Injury Surveillance System (NEISS) and the NEISS occupational injury supplement (NEISS-Work) maintained by the National Institute for Occupational Safety and Health (NIOSH).

Results: During 2001-2005, an average of approximately 37,000 patients with injuries related to nail-gun use were treated annually in EDs, with 40% of injuries (14,800) occurring among consumers. In addition, in 2005, nail-gun injuries among consumers were about three times higher than in 1991 (4,200)—approximately a 200% increase. In 2005, most injured consumers and workers were men. The median age for injured workers was 27 years, and 35 years for consumers. The diagnosis associated with 87% of the nail-gun injuries was either wound with a foreign body or puncture wound.

Discussion: ED injury estimates provide a national perspective on the injuries received from nail guns and indicate how injuries from tools used in work and nonwork settings can overlap. Although training regarding safe work practices might reduce nail-gun injuries, use of sequential-trip triggers is likely to be more effective. The current voluntary ANSI standard only addresses availability of the sequential-trip triggers. Distribution of new nail guns with sequential-trip triggers without the optional contract-trip triggers might help reduce nail-gun injuries.

P09
Title: Direct-Fired Construction Heater Emissions Study
Authors: **Hopkins R**, Sahai D

Introduction: Direct-fired construction heaters release carbon monoxide (CO) and carbon dioxide (CO2) into the air where people work. Elevated levels of CO or CO2 pose hazards to workers. The hazard may be greater for individuals with pre-existing medical conditions such as heart and lung disease, and for the fetus in pregnant workers. CO and CO2 concentrations were measured on construction sites to ascertain if the ventilation practices were adequate.

Methods: Heated construction sites in Ontario were tested for levels of CO2, and CO during the winter of 2003/2004. Samples were taken of the ambient air and of the flue gas of each heater.

Results: Five heaters out of 84 produced ambient readings above the CO TLV of 25 ppm, reaching up to 95 ppm. Eleven heaters out of 84 produced ambient readings at or above the CO2 TLV of 0.5% (5000 ppm), reaching up to 1.2%. There were no locations where the O2 was measured below 19.5%. CO and CO2 levels were generally higher at ceiling level. Infrared heaters emitted an average of 10 times more CO than did the salamander type heaters. Ambient readings of CO and CO2 were higher in tight buildings (buildings with few openings to the outdoors).

Conclusions:
1. CO and CO2 emissions can exceed their TLVs in tight buildings. Large industrial sites did not show these higher concentrations, nor did tarped-in sites. Even when well constructed, tarped-in sites apparently were not "tight."
2. Adequate ventilation requires meeting combustion requirements and removing emission gases. Workers must keep openings for ventilation clear, so emission gases do not build up.
3. Concentrations of CO and CO2 need to be monitored more diligently in tight buildings.
4. All workers with pre-existing medical conditions and female workers that are pregnant need to be careful about exposures when in tight buildings.

Work Organization and Safety Climate

P10
Title: Hurt at Work in America: An Examination of Workplace Injury Through the 2002 General Social Survey and NIOSH Quality of Worklife Module
Authors: **Smith T**, Kao J, DeJoy D, Murphy L, Rathbun S

Introduction: American workers continue to suffer work-related injuries resulting in economic consequences, social costs and diminished health. This presentation will address NOIRS objectives including the need to further promote NORA (through evidence of disparities between work occupations) and the presentation of a tool that can be used to assess, quantify and compare injury risks (2002 General Social Survey and NIOSH Quality of Worklife module). Further, this study examines socio-demographic, organization and work factor relationships associated with workplace injury.

Methods: This study used data from the 2002 GSS and NIOSH QWL survey, which assessed factors associated with socio-demographic characteristics, occupation, industry, work organization, supervision, climate, and injury. The target population for the GSS was non-institutionalized, English-speaking adults (18+) in the continental U.S. For this study, the sample was restricted to currently employed adults who worked 20 or more hours per week and were not self-employed. The final sample included 1525 workers.

The outcome variable utilized in the study was HURTATWK, which assessed the number of injuries suffered by respondents on the job during the past 12 months. A Poisson regression model was utilized. Independent variables included socio-demographic variables, employment characteristics, organization characteristics, and worklife and psychosocial measures.

Results: In the study, 172 (11.3%) respondents reported injuries. Approximately 4% of respondents reported multiple injuries. Bivariate analyses were completed illustrating significant relationships associated with gender, age, race, occupational group, and yearly income. Poisson regression analyses showed that work organization and climate variables made important contributions to explaining injury involvement.

Conclusions: Although specific demographic and employment category variables are associated with

work injury experience, the present results highlight the contribution of climate and work organization factors. These findings also underscore the value of collecting quality of work life data on a regular and systematic basis.

P11
Title: The Effect of Plant-And Department-Level Job Satisfaction and Job Stress on Occupational Injury Rates: Use of HR Survey Data
Authors: **Souza K**, Slade M, Cullen M

Introduction: Self-reported job strain, stress, and other psychosocial workplace exposures have been linked to health outcomes, including workplace injury. These exposures are most often measured through self-report by the individual worker.

For this study, aggregated data from a human resource (HR) survey administered to over 50,000 workers employed by a U.S. aluminum manufacturer has been used to create group-level (e.g., department-level, plant-level) indicators of job satisfaction, job strain, and job demand. Individual and contextual factors may both contribute to the risk of occupational injury.

Methods: Data describing the relationship between acute, traumatic occupational injuries among hourly workers and these group-level variables will be described. First, these relationships will be presented in ecologic models of injury rates adjusted for potentially confounding factors such as workforce, department, and plant characteristics.

Next, a multilevel modeling approach will be presented, investigating the relationship between individual injury rate and group-level job variables such as satisfaction and job stress, adjusting for other individual and group-level potential confounders of the relationship.

Results: Incidence rate ratios for the independent contribution of group-level indicators of job satisfaction and job stress will be presented and discussed.

Discussion: The potential utility of HR survey data, such as that used in this analysis, for the analysis of injury data within worker cohorts will be discussed. This approach, the use of aggregated survey data at the group level, will also be contrasted to a more typical approach to the conceptualization and measurement of job strain at the individual level, as exemplified in most uses of the Karasek model of job strain.

The advantages of examining the group level variables in both ecologic and multilevel models will be briefly discussed.

Home Health Care Worker Injuries

P12
Title: Health and Safety Hazards in the Home Healthcare Setting
Authors: Gershon RM, **Canton AN**, Samar SM, Westra LJ, Sherman M, Damsky MR, Qureshi KA

Introduction: Home healthcare is the fastest growing sector in the health care industry, with an anticipated growth of 66% over the next ten years and over seven million patients served each year. With over one million home care workers in the U.S. providing care to an increasingly frail and elderly population, it is important to identify risk factors that could affect the health and safety of workers in this setting. Risk management in this area is especially problematic because each home is, in essence, a "worksite," yet all the necessary healthcare workplace protections may not be in place or readily available.

Methods: A convenience sample of 1561 paraprofessionals (home health aides, attendants, and personal care workers) completed a risk assessment survey. The questionnaire was designed to assess the health and safety hazards associated with the delivery of home healthcare.

Results: HHCWs reported a range of potentially hazardous household conditions in their clients' homes, including unsanitary conditions and vermin [cockroaches (33%), bedbugs (6%), mice/rats (23%)]; air pollutants [animal hair (21%), cigarette smoke (29%), dust (19%), irritating chemicals (17%), mold/dampness (10%)]; and slips/tips/falls hazard [excessive clutter (17%)]. Aides reported an average of 2 injuries per year related to slips/trips/falls and 4 upper extremity injuries per year. Safety equipment was rarely available.

Conclusion: Both home healthcare workers and home care patients appear to be at potential risk for a variety of health hazards/exposures in the clients' homes. Given the growing population of both home health care workers and recipients, it is important to document this risk as an important first step in injury prevention and management.

P13

Title: Violence in the Home Healthcare Setting

Authors: Gershon RM, **Samar SM,** Canton AN, Westra LJ, Pearson JM, Damsky MR, Sherman M

Introduction: Home healthcare workers (HHCW) perform valuable services under conditions that are difficult, with potential occupational exposure to a wide range of health hazards, including violence and the threat of violence. By the very nature of their work, HHCWs may be at an increased risk of verbal and physical abuse. Working in relative isolation within a patient's household, and without benefit of protections we take for granted in the acute care setting, HHCWs may be vulnerable to violence-related adverse outcomes, including psychological and physical injury.

Methods: Survey data from a large convenience sample of HHCWs (N = 1088) employed in the home healthcare sector in New York State was collected and analyzed. Descriptive statistics were calculated for the sample to determine the rate of exposure to violence or the threat of violence.

Results: The sample was comprised predominantly of middle age (mean = 43 years) women (93%), with an average tenure in homecare of 8.3 years. A large proportion of respondents (33%, n = 354) reported that they had experienced verbal abuse on their current job, nearly 10% (n = 104) reported being physically threatened, and 8% (n = 85) reported both verbal abuse and being threatened with physical harm. Risk factors for violence in the homecare setting included: illicit drug use in the home (6%, n = 66), presence of guns in the home (2%, n = 24), aggressive pets (7%, n = 72), aggressive family members (11%, n = 124), and aggressive clients (10%, n = 105).

Discussion: These data indicate a fairly substantial prevalence of exposure to verbal abuse and threat of physical harm among a large sample of HHCWs. Research on interventions designed specifically for this setting is needed to help identify effective strategies.

P14

Title: Home Health Care Registered Nurses and the Risk of Percutaneous Injuries

Authors: **Gershon RM**, Westra LJ, Samar SM, Canton AN, Pearson JM, Damsky MR, Qureshi KA, Sherman M

Introduction: Within the healthcare sector, the fastest growing segment is home care. Patients are entering home care from hospitals "sicker and quicker," thus requiring a greater acuity of care. Procedures, including intravenous administration, tracheostomy care, chemotherapy, dialysis, etc., that were formerly only performed in the acute care setting are now performed in home care. These more invasive procedures involve needled devices, thus increasing the risk of needlestick injury. To estimate the risk and to identify risk factors for needlesticks and other percutaneous injuries (PI) a survey of home healthcare registered nurses (RNs) was conducted.

Methods: A 94-item self-administered mailed risk assessment questionnaire was completed by New York State nurses.

Results: 95% of 738 responding HHC RNs were female with an average of 22 years of experience. 129 RNs reported a total of 168 PI in the prior three years, a rate of 8%; of these 123 were needlesticks (6% rate). The underreporting rate was 46% and 35%, respectively. Three nurses (0.4%) reported three bite injuries. Most of the injuries involved hollow bone needles and lancets. Needlestick injuries commonly occurred because of sudden patient movements, lack of safety needle devices, improper disposal, equipment failure, and recapping. A general lack of safety devices was reported.

Conclusion: The exposure rates seen here approximate some recent hospital-based RN rates and underscore the potential risk to this group of workers. Tailored interventions suitable for this setting need to be identified and implemented.

P15

Title: Prevalence of Back Injuries in Home Healthcare Workers

Authors: Gershon RM, **Pearson JM**, Samar SM, Canton AN, Westra LJ, Damsky MR, Qureshi KA, Sherman M

Introduction: As with most healthcare workers, home healthcare workers (HHCW) are an aging workforce. This may increase their risk of occupational injury,

especially strains and sprains, as their work involves care giving to an increasingly frail and elderly and immobile patient population. To better understand the risks and risk factors for upper extremity injuries in home healthcare workers, an anonymous facilitated survey was conducted.

Methods: A 62-item survey was constructed following extensive preliminary development steps. The survey was administered to a convenience sample of home healthcare aides (HHCA) employed in New York City.

Results: A total of 1561 aides completed the survey. The annual incidence of upper extremity injuries was 4% (n = 59), with most of these reported as back injuries. The majority of the injuries resulted during the delivery of patient care (57%, n = 34) including ambulating, bathing, toileting, and transferring (bed/chair). A smaller percentage (6%) of the injuries were reported to be related to carrying the equipment bag. Five injuries were the result of slips/trips/falls, and three occurred while traveling to and from the patients.

Conclusion: While rates appear low, the actual number of adverse events was great. Given that there are an estimated 1.2 million aides and other paraprofessionals employed in the formal home care sector (i.e., Medicare-certified agencies) and an additional 1-2 million employed in the informal sector, the magnitude of injuries is large; extrapolated out there would be 40,000 such injuries per year in a sample of just one million aides. Risk reduction strategies need to be developed and applied to this at-risk workforce.

P16
Title: Injury in the Nursing Workforce: Associations with Organizational Safety Culture and Turnover
Author: **Taylor J**

Introduction: Poor organizational culture and inadequate staffing are contributors to needlestick injuries in the nursing workforce.

Increased nurse turnover creates longer hospital stays and higher costs. Its effect on nurse injury is unknown. Annual turnover costs are approximately $1 million per hospital and create lost productivity and workforce instability.

We sought to explore the relationship between nurse injury and nurse perceptions of organizational safety climate as assessed by the Safety Attitudes Questionnaire (SAQ).

Methods: The study defined nurse injury as a needlestick, splash, slip, trip, or fall in one year. Seventy-eight of 737 nurses experienced an injury of this type.

The main explanatory variable was the average nursing unit score on the 6 SAQ domains. A high score indicates greater agreement of a positive safety climate.

This study presumed individual responses of the nurses on the same unit to be dependent. Multilevel logistic regression models with a random intercept for the nursing unit were used to account for this clustering.

Results: In the random intercept logistic regression models, the following results were seen:

- For each 10% increase in the turnover rate, the odds of nurse injury increased (OR: 1.94, $p<0.05$).
- For each 10-unit increase in the average SAQ Safety domain score, a 39% reduction in the odds of nurse injury was observed (OR: 0.61, $p<0.05$).
- For each 10-unit increase in the average SAQ Morale domain score, a 27% reduction in the odds of nurse injury was observed (OR: 0.73, $p<0.05$).
- For each 10-unit increase in the average SAQ Stress domain score, the odds of nurse injury increased (OR: 3.47, $p<0.001$).

Discussion: The SAQ historically has demonstrated associations between organizational safety climate and patient injuries. This study extends the utility of the SAQ to nurse injury.

Workplace Violence

P17
Title: Staff and Management Perceptions of Hospital Workplace Violence Prevention Programs
Authors: **Nocera M**, Casteel C, Smith J, Goldmacher S, O'Hagan E, Blando J, Peek-Asa C

Introduction: Health care providers working in psychiatric units and emergency departments (EDs) have among the highest rates of workplace violence. Training has been recognized as a means of reducing injury risk and increasing staff confidence in working with aggressive patients. We compared the perceived

quality of workplace violence prevention (WVP) training programs and policies between management and staff in EDs and psychiatric units in two states.

Methods: Data were collected through interviews with 442 staff and 226 nurse managers from a random sample of hospital EDs and psychiatric units in California and New Jersey. California has a statewide mandate requiring specific training provisions to reduce violence against workers, while New Jersey (at the time of the study) was governed solely by federal OSHA guidelines. Chi-square statistics were used to compare perceived quality of WVP programs between management and staff.

Results: More staff than management reported their WVP policies to be "excellent" to "very good" ($p<.05$). ED staff reported higher ratings of their WVP policies ($p<.01$), while psychiatric unit staff reported higher ratings of their WVP training ($p<.01$), compared to management. In California, ED staff rated their WVP policies "excellent" to "very good" ($p<.01$), and psychiatric staff reported their training programs "excellent" to "very good" ($p<.01$), compared to management. Psychiatric staff reported that they felt more secure in their unit than ED staff ($p<.001$), and California ED staff felt more secure in their unit than ED staff in New Jersey ($p<.01$).

Conclusions: Staff and management perceptions of the quality of WVP policies and training programs differed between states, suggesting that legislation mandating comprehensive WPV security plans can result in improved worker satisfaction. Psychiatric staff felt more secure in their units, suggesting that WVP training programs used in psychiatric units could benefit emergency departments.

P18

Title: Physical and Psychological Trauma to Emergency Department Workers due to Violence from Pediatric Patients and Visitors

Authors: **Gillespie G**, Gates D, Miller M, Howard PK

Introduction: Violence in healthcare is a significant problem, occurring four times more often than in private industry. Among the highest at-risk healthcare workers are those in emergency departments (EDs). Research indicates that there are physical and psychological consequences to violence including pain, injury, and negative emotional reactions. Yet, there is a lack of research regarding whether those working in pediatric settings suffer these consequences after a violent incident. The purpose of this qualitative study was to describe the physical and psychological traumatic consequences of verbal and physical violence from pediatric patients and visitors.

Methods: Semi-structured interviews with 31 healthcare workers from an urban pediatric ED were audio taped and transcribed. Data were analyzed to identify the workers' personal responses after violent events.

Results: Participants reported both physical and psychological responses following physical and verbal violence. Violence was most likely to occur from patients being seen for mental health complaints, from the parents of a chronically ill child, and from the parent after a child's death. Physical responses included increased heart rate, flushed face, insomnia, shakiness, adrenaline rush, and the need to pace. Psychological responses included being afraid, embarrassed, irritated, and offended. Responses included the avoidance of patient perpetrators or the child of a family perpetrator. Participants believed they have few, if any, alternatives other than to accept the violence. Participants reported a greater degree of emotional and physical support from colleagues with events of physical violence compared to verbal violence.

Discussion: Healthcare workers in a pediatric ED were recipients of both verbal and physical violence. The negative consequences experienced were similar to those reported by ED workers providing care for adult patients. Interventions need to be developed to prevent violence when possible and prevent the negative consequences when violence does occur.

P19

Title: NIOSH Workplace Violence Initiative Intramural Research

Authors: **Hartley D**, Amandus H

Introduction: The NIOSH Workplace Violence Initiative was started in 2002 as a result of a congressional appropriation. Congress directed NIOSH "...to develop an intramural and extramural prevention research program that will target all aspects of workplace violence and to coordinate its efforts with the Departments of Justice and Labor." This poster summarizes the NIOSH Intramural program.

Methods: National surveys were conducted using three distinct survey frames: National Crime Victimization Survey Workplace Risk Supplement; National Electronic Injury Surveillance System assault victim followback; and Survey of Occupational Injuries and Illnesses employer supplement. Surveys

focused on security, policies/practices, training, incident reporting, and estimating workplace violence prevalence.

Current field studies include: Workplace violence prevention intervention evaluation for effectiveness of a problem-oriented police program to reduce robberies/robbery-related assaults in retail establishments; an intervention evaluation of the effectiveness of a Violence Prevention Community Meeting to reduce patient-on-nurse violence in Veterans' Health Administration psychiatric facilities; a study of prevalence of risk factors and workplace violence prevention policies among teachers/school staff; and evaluation of taxicab incidents and safety equipment. Additional efforts include the NIOSH Federal Task Force and stakeholder meetings.

Results: For each survey at least half of the respondents answered yes to: "Is the workplace open to the public?" For two surveys, guards/police protection was the top security measure. Currently, the retail field study is conducting data collection with one police department. The Veterans' Health Administration project is conducting data collection with three hospitals, another five are close to IRB approval. The teacher/school staff project developed a partner working group to revise the survey instrument and assist with project implementation.

Conclusions: The survey results and field studies currently being conducted at NIOSH provide the basis for implementing and evaluating workplace violence interventions in several different industry sectors.

Agriculture

P20
Title: A Decade of Progress: Childhood Agricultural Safety and Health Research
Author: **Hard DL**

Introduction: The NIOSH Childhood Agricultural Safety and Health research grants are a component of the NIOSH Childhood Agricultural Injury Prevention Initiative, started in FY 1997 by an act of Congress. The goal of the Initiative is to reduce the risk of fatal and non-fatal injuries to children who live on, work on or visit farms.

Methods: NIOSH-funded research grants under the NIOSH Childhood Agricultural Injury Prevention Initiative were reviewed by: (1) topic area(s) addressed by grants funded within the request for proposals (RFP) and (2) identifying research needs and gaps.

Results: Thirty-two Childhood Agricultural Safety and Health research grants were funded from 1997 to 2006. Twelve research grants addressed "educational interventions/evaluations" and seven research grants targeted minority populations, primarily Hispanic/ migrant youth (and/or their families). Six of the research grants specifically targeted the North American Guidelines for Children's Agricultural Tasks (NAGCAT), a resource developed to assist parents in assigning farm jobs to their children 7 - 16 years of age, living or working on farms. The NAGCAT was developed by the National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS), which is another component of the NIOSH Childhood Agricultural Injury Prevention Initiative. Two research grants addressed agricultural youth surveillance issues, and two research grants evaluated the impact of two different organizational farm safety day camps for children.

Discussion: The majority of the grants were targeted toward educational interventions for youth. However, analysis indicates that about 22% of the total research grants which have been awarded to-date targeted minority youth agricultural populations for injury prevention. Evaluations of large-scale national/ international educational programs for youth have been conducted. Research gaps identified include childcare and play/recreation areas, incentives for adults to protect youth, economic and social consequences of youth working on farms, model programs for youth training and an update on a national research agenda.

P21
Title: Agricultural Injury Among Rural California High-School Students
Authors: **McCurdy S**, Xiao H, Kwan J

Introduction: Agricultural work is an important cause of fatality and nonfatal injury among adolescents on U.S. farms. There are few data describing agricultural work and injury experience for this group.

Methods: We conducted an observational longitudinal study of agricultural work and injury among rural high school students at 10 rural California public high schools with programs in agricultural studies. Subjects completed an annual survey addressing demographic characteristics, and school course work in agricultural safety, work, and injury experience.

Results: The initial group of students enrolled comprises 1783 subjects. The mean + SD age is 15.6 + 1.27 y; 72.2% are male, 56.7% are White, and the remainder is primarily Hispanic. One-third live on a farm. Parents and teachers were cited as the most important source of agricultural safety information. Over 90% agreed or strongly agreed that safety precautions were important and necessary, even if they slowed tasks. Agricultural injuries occurred nearly exclusively among the 946 (53.1%) subjects working on a ranch or farm in the preceding year. In this group, 115 (12.2%) reported an injury characterized by need for medical care or at least one-half day of lost or restricted work or school time.

After adjustment for hours worked, ethnicity, and sex, we observed significant associations for agricultural injury with hours worked (dose response with OR 7.33 for 1500+ h/y) and various farm work activities (OR 2.26 for tractor operation; OR 2.31 for working with large animals; OR 3.05 for riding in the back of an uncovered pickup truck).

Discussion: Rural California high school students working on farms perform a full range of farm tasks and are at risk for agricultural injury. Prevention programs should focus on tasks involving machinery or animals.

Heat and Physiological Stress

P22

Title: Effects of Heat Stress on Risk Perceptions and Risk Taking

Authors: **Chang C-H**, Logan J, Bernard T

Introduction: Previous studies found that acute heat stress exposure led to workplace accidents and injuries. The current study proposed that risk-related processes are the psychological mechanisms underlying the effects of heat stress. Heat stress reduces individuals' risk perceptions (thinking dangerous behaviors as not risky) and increases risk-taking behaviors, which in turn result in accidents and injuries.

Methods: Six male adults voluntarily participated in the study. Participants were exposed to heat stress at 50°C and 20% relative humidity for 2 hours a day, 5 consecutive days. The risk-related processes were assessed at three times: Baseline (prior to exposure on day 1), post initial exposure (after one-hour of exposure on day 1), and post acclimatized exposure (after one-hour of exposure on day 5). The Safety and Health Subscale from the Risk Attitude Scale (5-point Likert Scale, Weber et al., 2002) and the Balloon Analogue Risk Task (Lejuez et al., 2002) were used to assess risk perceptions and risk-taking behaviors, respectively.

Results: Risk perceptions after initial exposure (M=3.6) reduced significantly from baseline (M=4.0; Z=-1.9), whereas they did not change significantly after acclimatization (M=4.0) from baseline (Z=-.2). Additionally, risk-taking behaviors after initial exposure (M=42.2) increased significantly from baseline (M=40.7; F(1,4)=11.4). Conversely, there was no significant change in risk-taking behaviors after acclimatization from baseline (M=41.5).

Discussion: Initial heat stress exposure reduced participants' risk perceptions about the health/safety-related activities and increased their risk-taking behaviors. However, heat stress had minimal effects on these processes after acclimatization. This suggested that risk-related processes may explain the effects of heat stress on careless behaviors. Gradual acclimatization may reduce the impact of heat stress on workplace accidents and injuries.

P23

Title: Evaluation of the Physiological Stress Imposed by a Prototype Fire Fighter Ensemble with Additional Chem/Bio Hazard Protection

Authors: **Williams J**, Roberge R, Coca A, Powell J, Shepherd A, Stull J, Shaffer R

Introduction: Fire fighters experience a disproportionate number of fatalities due to cardiovascular events and related heat stress. The Technical Support Working Group (TSWG) asked NIOSH to conduct an evaluation of the physiological "burden" of a prototype fire fighter ensemble (PE) with additional chemical/biological hazard protection which included a hose assembly to reroute expired SCBA air into the jacket for cooling purposes.

Methods: The PE was compared to a standard ensemble (SE). During ensemble testing, subjects (n=10) were required to exercise at ~50% VO2max. Subjects were instrumented such that heart rate (HR), body core temperature (Tcore), regional skin temperatures (Tsk), and electrocardiogram (ECG) were continuously monitored during testing. Testing was performed in an environmental chamber at 23°C, 50% RH.

Results: Tcore and Tsk data suggest that there is no difference in the thermal stress imposed on the subject between the PE and the SE. However, average weighted Tsk, HR, and exercise duration suggest that an elevated thermal stress was experienced by subjects wearing the PE with the hose attached compared to subjects wearing the PE without the hose or wearing the SE.

Discussion: The rationale for this seemingly paradoxical result is not clear but is probably due to factors other than thermal stress. Regardless, the results indicate that the PE with hose attached imposed a greater physiological "burden" than the PE without the hose attached or the SE. This increased "burden" may be due to the fact that the additional chemical and biological hazard protection encapsulates the wearer and further reduces the opportunity for heat exchange with the environment. However, it is also apparent that the additional protection offered by the PE with or without the hose still allows the wearer to exercise continuously at a moderately high rate for at least 20 minutes.

Surveillance

P24

Title: A Survey of National Occupational Injuries: The Need to Strengthen National Standards

Author: **Lu JL**

Introduction: The occupational health and safety standards in the Philippines were formulated in 1978. Joint effects exerted by the Bureau of Working Condition, the ILO Manila Office and the tripartite sectors bore fruit in August 1989 when the Secretary of Labor and Employment approved the revisions. From then on, no update and no amendments have yet been made. The objective of this paper is to present the National Occupational Injury survey of the Philippines, and then to provide recommendations to be done to reduce occupational injuries.

Methods: Secondary Data Gathering.

Results: Based on the Occupational Injuries Survey at the National level, the total number of occupational injuries of all nature was 299,760 where a total of 160,940 came from the national capital region. The highest occurred in the manufacturing sector with a total of 192, 610 cases. Disabling occupational injuries totaled 48,700. Of these, 260 were fatal, 160 were permanent total disabilities, 1,970 were permanent partial disabilities, and 46,320 were temporary total disabilities. Again, the manufacturing sector topped all other industries accounting for 30,660 cases. Of the total occupational injuries, about 48,700 consisted of disabling disabilities. Cuts, lacerations, punctures primarily caused these, and avulsions followed by strains, sprains, dislocations, and fractures.

Discussion: The state of occupational safety in the country is very dismal with a high prevalence of injuries. The type of disabling injury is as follows: one in every 1.42 injuries resulted in temporary total disabilities; one in every 427 accident injuries resulted in permanent partial disabilities, one in very 320 injuries resulted in death, and one in every 3.4 injuries resulted in medical treatment or first aid cases. Most of the accidents were due to mechanical processes. There is a need to review and revise the 1989 occupational safety and injury legislation of the Department of Labor and Employment as it lags behind the introduction of new work processes and new technologies in various companies.

P25

Title: The California Fatality Assessment and Control Evaluation (FACE) Program 1992-2005: Fatal Work Injuries Among Hispanics in Los Angeles County

Authors: **Styles L**, Cierpich H, Harrison R, Rogge J

Introduction: The California Department of Public Health, in collaboration with the National Institute for Occupational Safety and Health, has established the California Fatality Assessment and Control Evaluation (FACE) Program for the surveillance and investigation of fatal work injuries. The California FACE Program focuses on Los Angeles County, where approximately 20% of all work-related fatalities in California occur. The goal of the FACE Program is to prevent fatal work injuries by identifying high-risk work processes, developing prevention strategies, and informing those who can intervene in the workplace. This presentation will focus on fatal work injuries among Hispanics, who are among the fastest growing segments of the U.S. workforce.

Methods: The California FACE Program uses multiple sources of notification for the rapid identification of work-related injury fatalities. Cases for investigation are selected based on several factors, including the NIOSH FACE priority conditions of machine-related, youth under 18 years of age, highway/street work zone, and Hispanic workers.

Results: The work-related injury death rate for Hispanic workers during 1992-2005 was 3.8/100,000 workers compared with a rate of 2.7 for non-Hispanic workers. Deaths among foreign-born Hispanic workers were about 83% percent of the Hispanic work-related injury death total in 2005, up from 65% in 1992. Homicide was the most frequent event leading to work-related injury death among Hispanic workers from 1992 though 2005, followed by transportation-related, and falls. The most work-related injury deaths of Hispanic workers occurred in the construction (22%), services (20%), and retail trade (16%) industry sectors.

Discussion: The California FACE Program has completed almost 200 in-depth fatality investigations since 1992, and approximately half of these involve Hispanic workers. Select investigations will be highlighted, and recommendations for prevention will be discussed.

P26

Title: Pilot Surveillance Methods for Injuries Among Day Laborers

Authors: **Lowry S**, Seixas N, Blecker H, Hecker S, Camp J, Arbabi S

Introduction: Injuries among day laborers are high, although these data are difficult to obtain due to informal work and transient populations. Two alternative approaches to injury surveillance among day laborers were explored: a hospital-based trauma registry, and active injury reporting in two day labor centers.

Methods: Hospital-based regional trauma registry was used to identify work-related injuries, 2001-2006. The database includes demographics and injury characteristics, however no further information on employment. Patient charts were reviewed to ascertain work characteristics and day labor status. Work-related cases were stratified by Hispanic ethnicity (87% of day laborers are Hispanic immigrants), and by presence of a social security number (~75% of day laborers are undocumented). Forty cases were abstracted in each stratum. Day labor status was coded for each case. Injury report forms were made available at two day labor hiring centers and solicited at weekly safety trainings from September through December 2007.

Results: Of the 1298 work-related injury cases identified, 89% were male; 86% were non-Hispanic. Four percent of non-Hispanics and 23% of Hispanics were missing social security number. Among Hispanics lacking a SSN, a larger fraction were day laborers compared to other groups. Employment information was largely missing from all groups. Over a 3-month period, 12 injury reports were received; more in response to specific inquiries than general requests, calling into question the validity and comprehensiveness of this approach.

Conclusions: Neither of these approaches to injury surveillance appears to be effective under the current systems. Trauma registry data lack work-related information, and only include severe injuries. The report form approach proved to be non-systematic and incomplete. Despite limitations of both approaches, they each provide insights into the problems associated with precarious work risks. Recommendations for improving surveillance among contingent workers are provided.

P27

Title: Deriving a Valid Description of the Epidemiology of Serious Non-Fatal Work-Related Injury—A Demonstration Project

Authors: **Cryer C**, Samaranayaka A, Davie G, Langley JD

Introduction: Descriptions of non-fatal compensated injuries tend to reflect injury that results in disability, which includes many instances of temporary disability. The purpose of this paper is to present a methodology of describing work-related non-fatal serious injury that reflects threat to life rather than disability.

Methods Population: People living in New Zealand aged 15 to 84 working for income. Source data: Workers' compensation data (ACC) were linked to hospital discharge data (NMDS) (motor vehicle-related injuries were excluded) and used to identify serious disabling traumatic injury cases.

Results: There were 763,539 work-related injury ACC claims and 297,859 injury cases identified from NMDS data (all activities) during the period 2002 to 2004 (ACC data) and 2000 to 2005 (NMDS). Of these, 16,098 records were linked. All discharges considered in this work were first admissions. All claims were new claims. There were 1,143 serious threats to life cases from these sources that occurred in the 3 years considered; i.e. on average 381 per year. This contrasts with around 70 work-related fatal injury deaths per year. A brief summary of other findings include: rates increase after age 54, particularly in the

eldest age group (65-84); males having higher rates than females; several high-risk industries, including mining and agriculture, forestry, fishing. The most frequently occurring external cause was falls.

Discussion: The epidemiological description of serious threat-to-life traumatic injury provides government and non-government agencies, for the first time, with a picture of the burden of these serious injuries. This information can be used as a starting point for further work to inform priority setting, planning, policy making, surveillance, and monitoring. This complements the usual epidemiological description of work-related non-fatal injury based solely on worker's compensation data sources that represent disabling rather than threat to life injury.

P28
Title: Survey of Safety Indices and Control Chart Drawing in Tehran Oil Refinery Company
Author: **Ahmadi Asour A**

Introduction: Safety is always one of the most important subjects for researchers and safety experts. Control of accident and the observation of safety have direct and indirect effects on product efficiency and economics.

Method: This study was performed in Tehran refinery and the rate of accidents from 1993-1995 was investigated. Through a survey of documents and medical files of workers, the rate of accidents was investigated and evaluated by safety indices.

Results: Rate of FSI was calculated at 1.87, 1.3, and 0.8, with standard of 1.4. Therefore, the rate of FSI was high in 1993, but was lower in later years and had negative growth. This growth is indicated through activities of safety professionals to educate and to inform workers. Also, calculation of SAFE-T-SCORE in mentioned years in comparison with each other was -3.5 and -3.8, that is indicative of more regard to safety. UCL and LCL calculation and drawing of control chart indicated that 90% of accidents occurred lower than the UCL.

Conclusion: Education had a decreasing effect on the rate of accidents.

Key word: accident, refinery, Tehran, control chart, safe t-score

Motor Vehicle Safety

Title: P29
Characterization of Available Data on Injuries and Fatalities Associated with All-Terrain Vehicle Use in Occupational and Recreational Settings
Authors: **Franke K**, Sahmel J

Introduction: All-terrain vehicles (ATVs) are currently used by several occupational groups, including forestry, agriculture, construction, and law enforcement. The number of injuries and fatalities associated with ATV use is rising among recreational users and injuries and fatalities continue to occur among occupational users as well. We performed a review of available data on the overall rate of injury and fatality risk, as well as specific risk factors, associated with the use of commercially-available all terrain vehicles. Our analysis also compares recreational to occupational incidents, compares ATV to utility vehicle (UTV) incidents, and categorizes the types of injuries incurred.

Methods: We reviewed injury and fatality data from the Bureau of Labor Statistics, the Consumer Product Safety Commission's National Electronic Injury Surveillance System, and other regional and national data sources. Data was stratified by variables of interest and analyzed for significance. We limited our analysis of consumer data to ages 16 through 65 for better comparison to the working population.

Results: Results were analyzed by age, sex, level of training, and terrain characteristics at incident location when data were available. We then calculated relative risk estimates and p-values to determine statistical significance.

Conclusion: We can conclude that the majority of ATV-related injuries occur during recreational use; however, occupational use is increasing and should be a focus of injury prevention programs. In addition, UTVs provide a safer alternative to traditional 4-wheel ATVs, which in turn are safer than 3-wheel ATVs.

P30
Title: Washington FACE Program Truck Driver Injury Fatalities
Author: **Clark R**

Introduction: The occupation of "truck driver" is recognized as one of the most hazardous occupations. The current study characterizes patterns of truck driver injury fatalities in Washington State for the 10-year period 1998 – 2007.

Methods: The Washington Fatality Assessment and Control Evaluation (WA FACE) Program, funded by a grant from the National Institute for Occupational Safety and Health, is a statewide surveillance system to track incidents, evaluate trends, investigate incidents, and distribute prevention information about work-related fatal injuries. Each victim of a fatal work-related incident is assigned a case ID and then demographic information and an incident narrative description, as well as coded data including ICD-9 E-codes, occupational codes (SOC), and industry classification codes (NAICS) are entered in an Access database.

Results: The Washington FACE Program identified a total of 888 work-related fatalities between 1998 and 2007. Of this total, 123 (14%) occurred to victims whose occupation was identified as "truck driver." The majority of truck driver fatal incidents consisted of motor vehicle crashes (81 incidents) of which truck versus other motor vehicle traveling on a public roadway (30 incidents) or left the roadway and crashed (51 incidents). Forty-two truck drivers died in non-crash type incidents which included, among others, being struck by falling freight during truck loading and unloading (14), being struck by another vehicle or their own unattended vehicle while out of their truck (10), and falls from truck or loading dock (5). Fatalities were widely distributed among industries with the highest numbers in freight trucking (62), construction (12), and logging (10). This presentation will describe victim demographics and incident patterns, as well as several incident descriptions and recommendations for prevention.

Conclusions: The occupation of "truck driver" presents many hazards to the working population. Fatality injury prevention efforts should be targeted to address these hazards. Interventions to prevent fatal injuries should be targeted to truck drivers, their employers, and the affected industries.

Older Workers

P31

Title: Prevalence of Visual and Hearing Impairment Among Older U.S. Workers: The National Health Interview Survey, 1997-2004

Author: **Davila EP**

Introduction: Population aging and delayed job retirement are rapidly augmenting the number of older U.S. workers, increasing the risk for workplace injuries due to their likely high prevalence of sensory impairment. The present study evaluated the proportion of older (>65 years of age) U.S. workers reporting vision and/or hearing impairment by occupational groups.

Methods: Analyses of self-reported visual impairment (VI), hearing impairment (HI), either VI or HI, and concurrent impairment (HI+VI) by occupation were conducted on 5,590 older workers representing approximately 3.9 million older U.S. workers in the 1997-2004 nationally representative National Health Interview Survey.

Results: The majority of workers reported their race as White (86.5%) with approximately equal proportions of females and males. Nearly half of these workers reported having more than a high school education (46.8%). The overall prevalence rates of HI were approximately three times those of VI (33.4 % vs. 10.2%, respectively). The prevalence of VI+HI and either impairment was 5.2% and 38.4%, respectively. Relative to all workers farm operators and managers had significantly higher prevalence rates of sensory impairment [HI (53.9%), either HI or VI (57.3%), and concurrent VI+HI (12.1%)]. Other groups with significantly higher prevalence of sensory impairment compared to all workers included: mechanics and repairers [HI (46.6%), either HI or VI (53.1%)] and motor vehicle operators [HI (36.4%), either HI or VI (45.7%)].

Conclusion: Given the greater risk for injuries among the sensory impaired and the high prevalence of sensory impairment among older workers, workplace screening, and accommodations for older workers are warranted.

General Injury

P32

Title: Oral-Maxillofacial Injuries Among Active Duty U.S. Military Personnel, 1996-2005

Authors: Mitchener T, **Canham-Chervak M**, Jones B

Introduction: Oral-maxillofacial injuries can lead to deformity and malfunction, greatly diminishing quality of life and worker productivity. Data suggest that over 10% of civilian emergency room visits are due to craniofacial injuries. The size and scope of oral-maxillofacial injuries in the military is not well understood. This study reports Department of Defense rates of oral-maxillofacial injuries, causes of oral-maxillofacial hospitalizations, and recommends approaches to improving surveillance, research, and prevention.

Methods: Active duty military personnel who sought inpatient or outpatient treatment for one or more oral-maxillofacial injuries from 1996-2005 were identified in the Defense Medical Surveillance System using International Classification of Disease, 9th Revision, Clinical Modification (ICD-9-CM) diagnosis codes associated with oral-maxillofacial injuries. ICD-9-CM diagnosis codes were divided into two categoriesoral-maxillofacial wounds and oral-maxillofacial fractures. Multiple visits for the same diagnosis within 60 days of the initial visit were excluded to reduce the effect of follow-up visits.

Results: The oral-maxillofacial fracture rates for men were consistently 1.5 to 2 times higher than those for women. Unlike fractures, wound rates for men and women were similar over time. Active duty personnel under age 25 had the highest rates of both oral-maxillofacial fractures and wounds. Falls (27%) were the leading cause of oral-maxillofacial injury hospitalizations in 2005. Falls were 2.5 times more common than the next causes, war/enemy (11%) and land accidents (10%).

Conclusions: Military and civilian populations would benefit from a surveillance system that incorporates not only medical care data, but also dental care data. There is also a need for additional quality intervention studies on the strategies to prevent oral and craniofacial injury. Fall prevention should be considered as a strategy for reducing oral-maxillofacial injuries.

P33

Title: Concentrations of PM 2.5 in a Faculty Hospital in Turkey

Authors: **Erdogan MS**, Yurtseven E, Erginöz E

Introduction: Respirable particulates (RP) with aerodynamic parameter smaller than 10 μm (PM10) are easily inhaled and deposited within the respiratory system. RP are divided into a coarse and a fine fraction; the latter is smaller than 2.5 μm in diameter (PM2.5). Fine particles are generally more harmful to the respiratory system than coarse particles. Particulate exposures in hospitals may serve as a carrier for virus transmission since viral adherence to particles may occur. This exposure therefore poses a special threat to the people who visit the hospital. We attempt to characterize the indoor PM 2.5 concentrations in selected places of the hospital, where people gather.

Methods: Indoor air PM 2.5 was measured using light scattering monitor-nephelometer (manufactured by Thermo) 1.5 m above the ground for an 8-hour duration. Samples were collected at 3 lecture halls, the waiting room, and 3 rooms of the main laboratory in Cerrahpasa Medical Faculty of Istanbul University, Turkey. The lecture halls included in the study are located in one of the hospital buildings and have an audience capacity of 300, 150, 100, respectively. These were randomly selected out of 8 lecture halls of the faculty in total.

The main laboratory has a waiting room with the capacity of 70 people and it is always the most crowded space of the hospital. The rooms were selected randomly out of the following categories: "room with 1 personnel working," "2 personnel," and "more than 2 personnel." All the measurements were taken in the weekdays when the facilities were used as normal.

Results: The average/maximum PM 2.5 levels of lecture halls with the audience capacity of 300, 150, 100 were 53.0/200.9, 53.4/132.0, 30.6/100.2, respectively. The average/maximum PM 2.5 levels of the waiting room and 3 different rooms of the main laboratory with 1 personnel, 2 personnel and 3 personnel working were 160.1/367.2, 23.8/63.9, 30.9/105.1, 15.9/126.0, respectively.

Conclusion: There is no accepted permissible exposure limit for indoor PM 2.5. EPA experts provide one limit for the outdoor concentration and suggest that the indoor limit must not exceed 50 % of the indoor limit. According to this advice from experts, our results are too high and immediate measures should be taken.

Emergency Response

P34

Title: Effect of Boot Weight and Material on Gait Characteristics of Men and Women Fire Fighters

Authors: **Chiou S**, Turner N, Zwiener J, Weaver D, Spahr J, Pan C

Introduction: According to NFPA, there were an estimated 83,400 fire fighter injuries in 2006, and overexertion and falls accounted for approximately half of those injuries. Fire fighters have traditionally worn heavily insulated rubberized boots as protective footwear. These boots can add an extra 10 pounds to a fire fighter, which may increase their risks for overexertion and fall injuries. The objective of this

study was to determine the effect of boot weight and material on fire fighters' gait characteristics and lower extremity movements.

Methods: Fifteen men and fifteen women fire fighters (31.3±5.2 years) were tested for regular gait or gait while carrying hose while wearing different rubber or leather boots of varying weights. A motion-analysis system and two force platforms were used to quantify gait and posture changes associated with different boots. Spatio-temporal gait parameters and body dynamics of fire fighters were evaluated during simulated firefighting tasks.

Results: The Repeated Measure ANOVA revealed significant gait changes associated with boot types, including reductions in cadence and increases in percentage of double-stance time with heavier boots ($p<0.001$). The increases in the time when both feet were in contact with the floor suggest greater energy cost and a longer time was needed for the body to re-establish stability from one step to another. There were significant reductions in sagittal range of motion at ankles ($p<0.001$) and increases in hip internal and knee external angles ($p<0.01$) when wearing rubber boots. As the weight of boots increased, ankle ranges of motion decreased.

Discussion: This study demonstrates that boot types affect fire fighters' gait characteristics and lower extremity kinematics. Findings from this study are useful for fire fighters and boot manufacturers in boot selection and design modifications, to reduce biomechanical stresses of the lower extremity and to improve gait performance.

Intervention Evaluation

P35

Title: The Sacred Vocation Program: A Meaning-Centered Intervention to Reduce Injuries in Health Care

Authors: Amick III B, **Tullar J**

Introduction: A recent systematic review (Amick et al, 2007) highlighted the limited number of well-designed interventions to reduce injuries in health care settings. The Sacred Vocation Program (SVP) was designed to change the meaning of work for health care workers. The SVP intervenes at both the individual and organizational level. First, the SVP attempts to connect healthcare workers with meaning from their work through a series of peer group sessions. Second, employees engage in a participatory action research process to suggest changes to the worksite to support them and allow them to engage in meaningful acts with patients and co-workers.

Methods: Patient care assistants, those with the most direct care with patients in hospitals, from a large health care system in the Dallas area participated in the SVP. A non-randomized field trail was implemented over a 2-year period; one group participated in the SVP (n=203) and one group did not participate (n=318). The intervention was guided by a theory of change that has as a key outcome injuries. Injury data was collected from-on-going injury surveillance systems in the health care system and is not based on self-reports. Exposure time was determined by use of both payroll records and the identification of the work units the employees worked on. Multi-level logistic regression models were estimated to determine if participation in the SVP reduced the risk of injury.

Results: Injury rates were significantly reduced among SVP participants post-intervention compared to other employees with the same job. In unadjusted models the odds ratio was 0.44 (95% CI 0.2-0.98). In adjusted models (adjusted for job tenure, the odds ratio was still significant at 0.45 (95% CI 0.2-0.99).

Discussion: This research shows that interventions that target changing job content can reduce workplace injuries in a population with significant injury problems.

P36

Title: A Communication-Based Train-the-Trainer Program as an Injury Prevention Tool

Authors: **Smith A**, Chen P

Introduction: Leadership plays an important role in injury prevention in any organization. For example, Zohar (2004) found that employee perceptions that supervisors support safety negatively related to occupational injuries. Research also supports that climate for error management and climate for safety communication predict safety behaviors and accidents on the job. The present study describes an intervention targeted at teaching supervisors in the construction industry how to support a climate for safety communication with their employees.

Methods: The intervention took place at a large mechanical contractor in the northeast. Slides describing how to give appropriate feedback, positive recognition, and daily verbal exchanges emphasizing safety were added to the company's existing foreman orientation materials. Thirty-six site-level supervisors (e.g. superintendents, project managers) participated

in a train-the-trainer session introducing the new foremen orientation materials, practiced delivering the materials, and were taught adult learning principles to incorporate into their orientation delivery to maximize foreman learning and engagement with the material. In addition, the site-level supervisors were introduced to a communication audit to be completed twice a month to support foreman transfer of training.

Results: The post-intervention assessment of communication climate and employee injuries will be conducted next month. These results will be ready for presentation in October. Pre-training and post-training surveys of participants indicated that utility perceptions of the train-the-trainer session were moderately high, most supervisors felt that the new content would improve safety on the job, and most participants intended to use the adult learning principles taught in their future delivery of the foreman orientation materials.

Discussion: Interventions targeted at employee injury prevention in a construction setting should involve both the foreman level and the support of site-level management. We hope to report that training supervisors on how to support safety communication will have an impact on worker perceptions and injuries on the job.

Economics of Injury Prevention

P37

Title: The Economic Evaluation of a Worksite Intervention to Improve the Ergonomics of Seated Environments

Authors: **Amick, III B**, Derango K

Introduction: A recent systematic review (Tompa et al, 2007) highlighted the limited number of economic evaluations of occupational health and safety interventions. We report the results of the economic evaluation of an injury prevention intervention.

Methods: A non-randomized field trail was implemented over a 15-month period; one group received a new chair and office ergonomics training, one group received on-the-job training and a third group acted as a control group receiving the training at the end of the study. Health assessments (SF-36 Pain Scale) were made at 2- and 1-month pre-intervention and 3-, 6- and 12-month post-intervention. At the public sector worksite, (a department of revenue services), economic data was collected on revenues on a monthly basis for one-year pre-intervention and one-year post-intervention. At the private sector site, (a medical insurance company), economic data was collected in a call center on calls/hours and in a claims service center on claims per hour and claims quality. Regression models were estimated to determine the impact of the intervention on productivity and the cost-benefit flow.

Results: At the public sector worksite, the intervention results in an 18% increase in productivity. It was estimated that about 30% of the effect was health-mediated. Further, it was calculated that the benefit ($25,398) to cost ($1,032) ratio was 25:1. At the private sector site there was an 8.3% increase in productivity in the call center with again about 30% explained by health. The benefit ($2,506) to cost ($1,032) ratio was only 2.5:1.

Discussion: This research at two worksites shows that economic evaluations can be conducted of worksite interventions and that there are tremendous economic benefits to ergonomic interventions to prevent injuries. Interestingly only about 1/3 of the productivity increase can be directly attributed to the health improvements associated with the intervention.

DAY TWO: WEDNESDAY, OCTOBER 22, 2008

Session: **D1.0**
Title: Injury Prevention in Construction - I
Moderator: Matthew Gillen

D1.1

Title: Diffusion of Modular Home Installation Safety Work Practices as a Result of Field Research

Authors: **Fullen M**, Takacs B, Becker P

Introduction: While conducting training a faculty member learned of hazards unique to modular home installation and investigated them as part of a case study. No previous research has been conducted on modular home installation safety hazards. This study included field research observations, video and photograph collection, interviews, and questionnaires. The study identified the hazards faced by workers that appear to be specific to modular home installation, recommends ways to improve worker safety, and suggests areas for future research.

Methods: This research involved conducting field research of four modular home installations as well as collecting worker, supervisor, and owner survey data regarding safety during the installation process. The field research results identified hazards specific to the industry.

WVU developed and diffused industry-specific safety training based on the hazards identified as well as developing safe alternatives that included alternative work practices, use of existing technologies, as well as the introduction of conceptual tool designs. WVU also developed conceptual designs of two devices.

Results: The field research identified industry-specific hazards including the hoisting of heavy house modules with the use of a hydraulic crane, unique fall hazards, crushing hazards created by working under a tilt-up roof to secure it while a crane suspended the roof. The companies had not addressed any of the industry-specific hazards identified.

The hazards identified resulted in the development of training material that is currently being delivered through instructor-led and web-based training and is being evaluated for applicability and effectiveness.

Discussion: The process of installing a modular home is complex and dangerous. Site conditions, foundation location, and the type and size of the house can affect the potential for injury to employees. However, diffusion of knowledge through training, changes in house design, new technologies, and regulation could make this industry and process safer.

D1.2
Title: Viability of Tying Off to Residential Roof Trusses for Fall Protection During Truss Erection
Authors: **Fiorini D**, Garritano E

Introduction: Erecting preconstructed trusses in residential low-rise construction poses a challenge with respect to fall protection for the workers involved. Trusses need to be spread out along the roof, lifted into place, and braced to accept sheathing. In order to lift and brace the trusses, workers can be exposed to a fall of greater than 3 m (10 ft.) to the inside of the house. This study investigates the use of the trusses themselves as a viable fall arrest anchor while lifting and bracing all the trusses.

Methods: A residential frame was built with two walls approximately 7 meters apart (24 ft) on which trusses were erected. An end wall was built between the two walls parallel to the trusses. Trusses were erected in accordance with current practice. A rigid 100 kg (220 pounds) test mass was hung from the truss system, raised, and allowed to free fall. The truss system was observed for its ability to the dynamic forces associated with arresting the mass. The truss system bracing was modified until it was able to support the fall-arrest forces.

Results: To support the dynamic arresting forces, truss bracing must support tensile loads in addition to compressive loads. This was accomplished by using metal strapping over the braces secured into the truss chords. The toes of the trusses were stabilized by nailing two common nails adjacent to each side of the toe on the wall (allows adjustment to the truss but prevents lateral kick-out). Tie off points at truss joints were found to be stronger than at mid chord positions.

Discussion: Adequately braced trusses can be stable and strong enough to withstand the forces associated with arresting the fall of a 100-kg mass (at a 7-m, or 24-ft clear span).

D1.3
Title: Train-the-Trainer Training—A Case Study
Authors: **Smith A**, Chen P, Rosecrance J

Introduction: Leadership plays an important role in injury prevention in any organization. For example, Zohar (2004) found that employee perceptions that supervisors support safety negatively related to occupational injuries. Research also supports that climate for error management and climate for safety communication predict safety behaviors and accidents on the job. The present study describes an intervention targeted at teaching supervisors in the construction industry how to support a climate for safety communication with their employees.

Methods: The intervention took place at a large mechanical contractor in the northeast. Slides describing how to give appropriate feedback, positive recognition, and daily verbal exchanges emphasizing safety were added to the company's existing foreman orientation materials. Thirty-six site-level supervisors (e.g., superintendents, project managers) participated in a train-the-trainer session introducing the new foremen orientation materials, practiced delivering the materials, and were taught adult learning principles to incorporate into their orientation delivery to maximize foreman learning and engagement with the material. In addition, the site-level supervisors were introduced to a communication audit to be completed twice a month to support foreman transfer of training.

Results: The post-intervention assessment of communication climate and employee injuries will be conducted next month. These results will be ready for presentation. Pretraining and post-training surveys of participants indicated that utility perceptions of the train-the-trainer session were moderately high, most supervisors felt that the new content would improve safety on the job, and most participants intended to

use the adult learning principles taught in their future delivery of the foreman orientation materials.

Conclusions: Interventions targeted at employee injury prevention in a construction setting should involve both the foreman level and the support of site-level management. We aruged that training supervisors on how to support safety communication will have an impact on worker perceptions and injuries on the job.

D1.4

Title: Demonstration of Proximity Warning Systems (PWS) to Reduce Worker Exposure to Asphalt Trucks at Highway Paving Operations

Authors: **Beaupre JE**, Merinar TR, Fosbroke DE

Introduction: Between 1992 and 1998, the Census of Fatal Occupational Injuries (CFOI) reported 841 fatalities in the highway and street construction industry (Standard Industrial Classification 1611), accounting for 11% of all construction deaths over this period. The majority of fatalities in this industry occurred in work zones with 95% of the fatal events involving vehicles and equipment. In 318 of these fatalities (38%), a worker-on-foot (WOF) was struck by a vehicle, typically while backing (51%). The primary injury source for these WOF fatalities was a truck (61%). The objective of this study is to evaluate the efficacy of proximity warning systems (PWS) in reducing WOF exposure to dump trucks at asphalt paving operations.

Methods: The project involved the installation and evaluation of PWS on asphalt delivery trucks. Control and treatment data collection occurred for 6 to 8 days at each company. PWS, including sonar, radar, and camera, were installed on eight asphalt trucks at each of three companies. Data collection methods included global positioning system (GPS) receivers, video observations, and direct observations with the addition of alarm activation data on the treatment sites.

Results: Based on preliminary analysis of direct observation data, the site exposure rate declined by 18.8% from the preintervention rate of 30.3 (95%CI: 35.5–25.1) exposures per hour to the post-intervention rate of 24.6 (95%CI: 29.6–19.6) exposures per hour.

Discussion: Data show a reduction of WOF exposure to equipment, based on preliminary results gathered from direct observations at the site level. Though not statistically significant, these site-level results provide evidence that installation of PWS on asphalt delivery trucks can reduce worker risk to backing construction equipment. More detailed analysis of truck level video, alarm activation, and GPS data are being conducted.

Session: **D2.0**

Title: Examining the Risk Factors Associated with Slips and Falls

Moderator: Wen Chang

D2.1

Title: Bilateral Lower Extremity Response to Unexpected Slips

Authors: Moyer BE, Redfern MS, **Cham R**

Introduction: Slips that occur at heel contact have been shown to be associated with the greatest risk of falls. Previous slip research has primarily focused on the response of the perturbed leg. The goal of this talk is to present an overview of bilateral lower extremity responses to unexpected slips, focusing on the characterization of the trailing leg's biomechanics.

Methods: Twenty-eight healthy participants, divided into a younger (20–33 years) group and an older (55–67 years) group, were exposed to two conditions. First, baseline gait trials (a known dry environment) were collected. Second, a slip was unexpectedly induced at heel contact of the leading foot using a diluted glycerol contaminant. Bilateral force plate and motion data were collected to conduct inverse dynamics analyses.

Results: Four slip-related trailing leg strategies were identified. These strategies included responses ranging from a minimal disruption of swing phase to a premature (~50 ms after toe off) interruption of the trailing leg's trajectory. The trailing leg response was found to be associated with the corrective reaction generated at the knee in the leading/slipping leg. Intra-limb coordination between the hip and the knee was also evident in the trailing leg. The response of the leading/slipping leg preceded that of the trailing limb. Finally, determinants of trailing leg strategy included normal walking patterns and the dynamics associated with early stance during slips. These findings were similar in both age groups.

Discussion and Conclusions: In summary, both the leading/slipping leg and the trailing leg actively contribute to whole-body recovery responses to slips. Inter-limb and intra-limb coordination play an important role in maintaining dynamic stability in response to slips.

Acknowledgements: We would like to thank Dr. Furman for screening the participants. Funding was provided by NIOSH (R03OH007533 / R01OH007592).

D2.2

Title: Worker Slips and Falls in Limited Service Restaurants

Authors: **Courtney T**, Verma S, Huang Y-H, Chang W-R, Li K-W, Filiaggi A

Introduction: Slipping and falling (STF) are responsible for a substantial injury burden in the global workplace with slipperiness contributing to between 40 and 50% of fall-related injuries. Restaurant environments are challenged by STF. This study assessed individual and work environment factors related to slipping and/or falling in U.S. fast-food restaurant workers.

Methods: Ten fast-food restaurants in the Northeastern U.S. were recruited to participate. Employees' occupational slip and/or fall history within the past 4 weeks was collected by multilingual, written questionnaire. Age, gender, tenure, work hours per week, and shift length were also collected. Shoe type, condition, and visible shoe contamination were visually assessed. Participants were compensated, and the study was conducted under approval of an institutional review board. Floor friction was measured, and restaurants were ranked by global mean friction score. Multivariate logistic regression assessed the degree of association.

Results: One hundred twenty-six employees participated in the study (Rresp = 87.5%). Participants averaged 34.5 work hours per week, had a mean age of 30 years, and had worked in their restaurant location an average of 34.5 (median = 17) months. Lower restaurant friction ranking was significantly associated with a positive slip history within the last 4 weeks (OR = 0.839, 95%CI = 0.719–0.979). To put this in perspective, from the restaurant with the highest mean global friction rank to the restaurant with the lowest mean global friction rank, the odds of a positive slip history increased by a factor of 5.8.

Conclusion: Published findings of association between friction and slipping and falling, in actual work environments, are rare. In addition the majority of restaurant global mean friction scores were above levels typically specified. The findings underscore the importance of floor surface friction (compared to other factors) in the prevention of STF.

D2.3

Title: Design and Evaluation of Multi-Modal Methods to Follow-up Multilingual Fast-Food Workers in a Prospective Cohort Injury Study

Authors: **Verma S**, Chang W-R, Courtney T, Lombardi D, Huang Y-H, Brennan M, Perry M

Introduction: Internet, telephone, and written surveys were developed to collect the weekly slip experience of fast-food workers participating in a twelve-week prospective cohort study to examine risk factors for slipping at work. Acceptability and response rates for different methods were evaluated for a multilingual worker population.

Method: Sixty-five fast-food workers from five restaurants in Massachusetts and Connecticut were recruited to participate in a 12-week cohort study to examine risk factors for slipping. After completing the baseline survey, participants reported their slip experience every week for the next 12 weeks. Participants had a choice of reporting their weekly experience using either internet, telephone, or written method. For internet-based surveys an e-mail was sent each week with a link to the survey. For the telephone-based method, an interactive voice response system was developed where responses were recorded using telephone keypad and voice for open-ended questions. For the written method, weekly surveys and 12 self-addressed stamped envelops were given. All thee methods were developed in English, Spanish, and Portuguese. Participants were compensated, and the study was approved by an institutional review board.

Results: English, Spanish, and Portuguese were the primary languages of 33 (51%), 22 (34%), and 10 (15%) participants, respectively. Forty-two (65%) participants completed weekly surveys via telephone, 19 (29%) by internet, and 4 (6%) by written methods. Thirty-six percent of English speakers, 50% of Portuguese speakers, and 9% of Spanish speakers completed the surveys via internet. Loss to follow-up for written method was higher (44%) as compared to internet-based (26%) and telephone methods (24%). Additional results by age and education level will be discussed.

Conclusion: Few participants selected the written method to complete weekly surveys and reporting method may depend on primary language. Loss to follow-up was similar in telephone and internet-based methods.

D2.4

Title: Beware! Slippery Floor: An Interactive Game to Improve Floor Cleaning and Prevent Slips and Falls in the Food Industry

Author: **Quirion F**

Introduction: In Québec, the frequency of slips and falls on the same level is about twice higher for the food industry workers, 4.43 ‰, than the overall frequency of 2.25‰. The floors of institutional and restaurant kitchens are often greasy and thus slippery. If floor cleaning could be improved, then the floors should be less slippery. Based on this hypothesis, the IRSST (Québec) has promoted research activities aiming at preventing slips and falls through the improvement of floor cleaning.

Method: Since 1997, laboratory investigations allowed us to identify optimal floor cleaning conditions for different flooring-fat combinations. Field investigations also confirmed that improving floor cleaning reduces floor slipperiness. However, field visits indicate that workers receive very little training on the subject of floor cleaning. Thus, laboratory results and field observations were used to develop training tools that promote good floor cleaning practices.

Results: A selection guide was developed to help owners and managers choose adequate floor cleaners and to convince them of the importance of good floor cleaning practices. The "Beware! Slippery floor" interactive game was developed to train young workers or students in the workplace or at school. The game is easy to play and the knowledge acquired can be evaluated through a quiz section. These tools are available for free on a Web site dedicated to the promotion of good floor cleaning practices (www.qinc.ca/entretien).

Discussion: It is too early to evaluate the impact of these training tools on the incidence of slips and falls in the food industry. We hope that the number of teachers and health and safety instructors using these tools will continue to increase over the years.

Session: **D3.0**

Title: Nonfatal Injury Prevention Activities in Other Countries

Moderator: Larry Jackson

D3.1

Title: A Method to Calculate the Period Prevalence of Workers Receiving Compensation Benefits

Author: **Phaneuf R**

Introduction: A procedure has been developed to answer the question "How many people are on workers' compensation in our region?" In other terms, calculate the daily prevalence for workers receiving workers' compensation for the last several years, then summarize the period prevalence on a monthly and yearly basis and do so for several subgroups for age and sex. The critical data available includes: the date of the insurance claim, the number of calendar days for which a claim was maintained prior to the returning to work. The last day of compensation was assumed to be the date of the event plus the number of days where the person received benefits.

Methods: An sql formula was developed that calculates the number of workers absent on each day of our study period: 1999 through 2005, using Microsoft Access©. The solution requires looking at each of the 45,254 declared cases occurring between 1997 through 2005 and counting the number of cases where work absence was present for each of the 2,557 days during the study period, then summarizing the daily results on a monthly and annual basis.

Results: The average annual prevalence work loss increased about 650 persons in 1999 to nearly 900 in 2005. In 1999 the proportion of women was 26%, but in 2005 the proportion changed to 34 %. Overall more than half of the increased yearly prevalence is attributable to women, while nearly 75% is among workers over 40 years of age.

Conclusion: Period prevalence approximates the burden of occupational trauma better than incidence data especially when there are structural changes in the workforce such as the proportion of workers in the manufacturing sectors, as well and age and sex. The compilation of prevalence data offers additional opportunities to analyze occupational health statistics.

D3.2

Title: Patterns of Severe Work-Related Traumatic Hand Injury in the People's Republic of China

Authors: **Jin K**, Lombardi D, Courtney T, Sorock G, Perry M, Li M, Pan R, Wang X, Lin J, Liang Y

Introduction: In this study we describe the type, location, and severity of acute traumatic hand injuries of 560 workers treated in 11 hospitals in three cities in the PRC over a two-year period.

Methods: A structured questionnaire was used to collect participants' information. A log-linear model was constructed to delineate relationships between injury frequency and interest variables. A logistic model was used to seek interest variables contributing to injury severity.

Results: Participants ranged in age from 16–64 with a mean age of 31.7 (SD 10.5). Approximately 74.4% were men, 85.4% of participants were employed in manufacturing industries (machinery, fabricated metal products, and motor vehicles). 51.7% of injures were to the left hand. The index finger was the most frequently injured digit in both hand and the highest severity occurred in the right thumb. 68.3% of participants had only a single type of injury: 29.7% were crushes, 25.7% were amputations, and 18.5% were fractures. Injuries in food products (79.2%), furniture (72.2%), nonmetallic mineral products (71.4%) and wood products (70.6%) were more severe in nature. Powered machines were involved in 59.5% of injuries. Manufacturing (OR 21.2, 95% CI 9.8–45.5), gender (male vs. female, 7.6, 3.4–16.7), powered machine (OR 5.0, 2.1–12.0) and company size (employee $\leq$ 100 vs > 100, OR 3.8, 2.9–4.9) significantly affected injury frequency. The severity of injury was impacted by gender (male vs. female OR 0.61, 95% CI 0.37–0.98), powered machine (OR 2.21, 1.31–3.74).

Discussion: The present study suggests that powered machines in the manufacturing industries are the primary source of severe hand injuries in hospitalized workers.

D3.3

Title: Prevalence and Predictors of Work-Related Injuries Among Children Laboring in the Streets of Latin America

Authors: **Pinzon-Rondon A**, Koblinsky S, Hofferth S, Pinzon C

Although children are working in streets throughout the world, child labor is most prevalent in the developing world, including Latin America. Currently, little is known about the prevalence and nature of child street labor injuries and about factors associated with these injuries. This study investigated the occupational injuries of Latin American child street workers, as well as factors that predict their occurrence.

Methods: Participants in this cross-sectional study were 584 children between 5 and 18 years of age who worked in the streets of Bogota (Colombia), Lima (Peru), Quito (Ecuador), and Sao Paulo (Brazil). Interviewers administered an oral questionnaire to children engaged in begging, selling, performing, and car washing/guarding which addressed child demographic characteristics, working conditions, and lifetime injuries. Descriptive analyses as well as multivariate analyses using binomial logistic regressions were conducted.

Results: Two-thirds of study children had been displaced from their home regions. Forty percent of child street laborers reported significant injuries, including scratches (20%), cuts (16%), burns (9%), car accidents (9%), sprains (5%), and amputations (< 1%). Logistic regression analyses (controlling for individual and environmental factors) revealed that longer work hours, older age, performing, being male, nonminority status, and residence in Quito significantly increased the risk of occupational injury. For example, each additional hour of work increased injury risk by 1%, and each additional year of age increased the injury rate 6%.

Conclusion: Children working in the streets are at a very high risk of suffering an occupational injury. Findings underscore the need for interventions to reduce such injuries, including enforcement of anti-child labor laws; social/health services to address displacement and child injury; campaigns stressing the importance of child safety and education; mandatory, skill-oriented education; and increased family incomes.

D3.4
Title: Development and Evaluation of an Intervention Study to Prevent Injuries at Work Among Stevedores in Havana
Authors: **Aguirre CR**, Roque IA

Aim: To develop and evaluate an education-based intervention for prevention of work injuries among stevedores in Cuba.

Methods: The methodology was developed in three stages: diagnosis, intervention, and evaluation. During the diagnosis phase, injury counts and rates from 1998–2002 were examined for each port terminal (enterprise) in Havana. Two enterprises with the largest number of injuries were selected as the intervention site (Haiphong enterprise) or control (Juan Manuel). Job tasks and safety behaviors were analyzed and safety checklists developed. Interventions focused on reducing human error and were developed based on both quantitative and qualitative techniques and consultations with workers, health and safety groups, and employers. Training was conducted only at the intervention enterprise. Pre and post-intervention questionnaires of worker knowledge, attitudes, and practice were administered, as were observational studies of on-site safety behavior and comparison of injury rates.

Results: The intervention site experienced increases in worker knowledge (48%), recognition of hazardous situations (26%), and observed safety behavior (21%). The corresponding differences in the intervention compared to control site were 59%, 50%, and 40%, respectively. Stevedores from intervened enterprise increased 15 % or more in knowledge compared to workers in the control enterprise and increased 10% or more in hazardous-situation recognition. The number of accidents also decreased in intervention enterprise over the last 4 years and the prevention fraction (PF) was 46 %.

Conclusion: The intervention site had greater improvements in safety knowledge, attitudes, and practice compared to the control and also had decreased injury rates. This study demonstrates that increases in safety behavior in the work environment are possible among workers through improved training. These activities should also be reinforced by passive strategies in order to obtain better results.

Session: **D4.0**
Title: Identifying and Characterizing Injuries in Agriculture
Moderator: James Harris

D4.1
Title: Statewide Surveillance of New York Farm Injuries: An EMS-based Method
Authors: Earle-Richardson G, **Brower M**, Jenkins P

Introduction: There are unique challenges associated with occupational injury surveillance within agriculture. This study employs an innovative approach for tracking agricultural injuries and fatalities, comparing emergency medical services (EMS) ambulance report data with active community surveillance data. If EMS data proves to be as complete as active surveillance data, review of EMS ambulance reports may provide an efficient and cost-effective way of tracking agricultural injury and fatality events.

Methods: Ambulance reports from ten highly agricultural counties in New York are compiled by the state's data management agency and are reviewed for farm-related events. Additionally, active community surveillance is ongoing through three channels: (1) monthly telephone calls to 36 county officials (e.g., sheriffs, coroners, EMS coordinators) throughout the study counties, (2) newspaper review for farm incidents, and (3) correspondence with the New York State Department of Health's Center for Fatal Occupational Injuries.

Results: At the time of this submission, only data from the community surveillance methods had been analyzed. Forty-five agricultural events were documented in the study counties between January 2007 and February 2008: nine fatalities and 36 injuries. EMS services were utilized in 41 of these 45 cases (91% of the time). Falls (2), runovers (2), and being struck by an object or animal (2) were the most common causes of fatality. Nonfatal injuries were most commonly attributable to rollovers (9), being struck by an object or animal (7), runovers (6), and falls (6). Ambulance report data will be presented, and challenges encountered during data collection will be discussed.

Discussion: Preliminary findings demonstrate the diversity of occupational hazards in agriculture and underscore the need for improved injury surveillance. Establishment of a surveillance system using pre-existing ambulance report data would allow for

effective large-scale agricultural injury and fatality data collection.

D4.2

Title: Occupational Injury Rates and Treatment Patterns Among Migrant and Seasonal Farm Workers in the Northeast

Authors: **Earle-Richardson G**, Brower M, Jenkins P, May J

Background: Migrant and seasonal farm workers are thought to be at increased risk for occupational injury and illness. Previous research in seven Northeastern states revealed an estimated occupational injury incidence rate of approximately 8%. However, uncertainties remained regarding the represenativeness of this data due to collection methodology (migrant health center (MHC) and emergency room (ER) medical chart review). The proportion of farm workers using these sources of care was unknown, and it was unclear whether a large proportion of farm workers injured on the job obtained no medical care at all. To address these questions, the Northeast Center conducted an additional study in two of the seven original states.

Methods: In New York and Maine, researchers conducted: (a) an occupational injury and illness survey with farm workers, (b) MHC chart review, and (c) hospital ER chart review. From survey results, proportions of occupational morbidity by treatment location were calculated. A correction factor was then computed to adjust chart review occupational injury and illness rates.

Results: Proportions of morbidity by treatment location did not differ significantly between New York and Maine and were combined for this analysis. Farmworker surveys documented 55 work-related injuries among 1,103 survey subjects. Of those injured, 30 (54.5%) were treated at MHCs. Of the remaining injuries, seven (12.7%) were treated at ERs, 10 (18.2%) were treated at some other location (e.g., at home, by a relative, by a chiropractor), and eight (14.5%) were untreated. Other results pertaining to farmworker healthcare access will be discussed.

Discussion: It is evident that a chart-review based surveillance system (preferably incorporating both MHC and ER data), combined with a correction factor, provides an effective method of estimating occupational illness and injury rates in this population. With this validating evidence, results from the seven-state study will be presented.

D4.3

Title: Impact on the Agricultural Industry: Animal-Related Injuries

Authors: **Gerberich S**, Ryan A, Erkal S, Renier C, Alexander B

Introduction: While agricultural injury has been identified among the major causes of occupational injury mortality and morbidity, data have been limited pertinent to the magnitude, consequences, and risk factors for animal-related injuries—a major source of morbidity among agricultural operations.

Methods: Comparable demographic, exposure, and injury data were collected for 1999 and 2001 among agricultural household members of all ages in a five-state region. Nested case-control studies examined exposures for risk of injury among those < 20 years of age. Causal models facilitated survey design, data analyses, and interpretation of results; Directed Acyclic Graphs guided multivariate modeling and adjustments were made for age, gender, total hours of farmwork, nonresponse, and within-household correlation.

Results: From 7,420 households (84% response of eligible), a total of 5,045 injury events were reported among all ages (32,603 persons; < 20 years, 51%); 1,016 (20.1%) were animal-related (31.8 per 1,000 persons). For those cases < 20 and 20+ years of age, 48% and 46%, respectively, resulted in lost work time on their agricultural operations (20% and 16%, one week or more).

Respectively, for 1999 and 2001, case-control multivariate analyses (Odds Ratios [OR] and 95% confidence intervals [CI]) revealed increased risks for those < 20 years of age working with dairy (1.4, 0.9–2.2; 1.5, 0.9–2.5), 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), beef (2.0, 1.4–2.9; 2.0, 1.4–2.9), swine (1.6, 1.0–2.7; 1.4, 0.8–2.4), and poultry (1.2, 0.6–2.4; 2.7, 1.7–4.5). The overall risk for children and youth working with any animals was OR = 4.5, CI = 2.8–7.12. Specific activities involved in working with these animals are associated with these risks.

Discussion: Animal-related injury has a major impact on the agricultural operation household members and the agricultural operations, in general. Results serve as a basis for further research and appropriately designed interventions.

D4.4
Title: Injury Severity Related to Overturn Characteristics of Tractors
Authors: **Myers M**, Cole H, Westneat S

Introduction: Early studies of injuries associated with overturns indicated that more fatalities occurred when a tractor overturned beyond 90° (continuous roll) relative to the impact plane. No population-based study has been conducted that compares the severity of fatal and nonfatal injuries between a 90° roll and a continuous roll for both ROPS-equipped and non-ROPS tractors.

Methods: A Kentucky Farm Tractor Overturn Survey was administered in 2002, in which 6,063 randomly selected farm operators responded to questions that differentiated between tractors that were equipped versus not equipped with a ROPS in the event of a tractor overturn. From this population, 541 reported experiencing a tractor overturn. Overturn characteristics were collected that included to the side (90°), upside down (180°), beyond upside down (> 180°), and to the rear for both ROPS-equipped and non-ROPS tractors.

Results: Of the 541 most recent overturns reported in this study, 505 of the respondents reported the overturn characteristics of the tractor, 86 of which were ROPS-equipped and 505 with no ROPS. For side overturns, 66% occurred with the ROPS-equipped tractors and 48% occurred with non-ROPS tractors. The percentage of deaths related to these side overturns was, respectively, 1.6% and 3.7%. There were no deaths related to overturns beyond 90° for ROPS-equipped tractors whereas there were 6.6%, 5.4%, and 6.8% of fatal overturns, respectively, for 180°, > 180°, and rear overturns. Regarding 90° side overturns, 13% resulted in nonfatal injuries with an average of 1 day of hospitalization for ROPS-equipped tractors, and 22% resulted in nonfatal injuries with an average of 18 days of hospitalization for non-ROPS tractors.

Discussion: The results from this study indicate that a ROPS is effective at stopping an overturn at 90°, which is associated with a reduction in the severity of injury in the event of a tractor overturn.

Session: **D5.0**
Title: Motor Vehicle Safety
Moderator: Audrey Reichard

D5.1
Title: Sleep Apnea and Motor Vehicle Crashes—A Systematic Review and Meta-Analysis
Authors: **Greenberg M**, Phillips B, Tregear S, Tiller M, Rizzo M, Hegmann K, Anderson G

Introduction: Obstructive sleep apnea (OSA) is characterized by a reduction or cessation of breathing during sleep coupled with symptoms including excessive daytime sleepiness. Consequently, individuals with OSA who operate motor vehicles may pose a threat to road safety.

Methods: Data from published studies that have addressed the association between obstructive sleep apnea and motor vehicle crash were synthesized. Relevant articles were identified using sensitive search strategies applied to 13 electronic databases. Additional hand searches of bibliographies were also performed. A priori criteria for article inclusion were: (1) English language publications, (2) full-length articles, (3) controlled (case-control or cohort) study design, and (4) enrolled ≥ 10 patients. The quality of all included studies was determined using a revised version of the Newcastle/Ottawa Scale. Random-effects meta-analysis was used to pool data from different studies. Sensitivity analyses to test the robustness of our findings included the use of cumulative random-effects meta-analysis. Publication bias was tested for using the "trim and fill" method.

Results: Our searches identified 17 relevant articles all of which provided evidence rated in the low-to-moderate range. Meta-analysis found that individuals with OSA have a substantially increased risk for a motor vehicle crash (Crash Risk Ratio = 2.72, 95% CI: 1.30–5.72: $p = 0.008$). The risk of an individual with OSA experiencing a motor vehicle crash is between 30% and 47.2% greater than individuals without the disorder.

Discussion: Risk factors for crash among individuals with OSA included the presence and degree of subjective daytime sleepiness, severity of sleep-disordered breathing during sleep, blood SaO2 levels, and BMI. OSA increases the risk for motor vehicle crashes. This risk is of special concern for drivers of commercial vehicles as these vehicles usually require special driving skills.

D5.2
Title: Using Technology to Improve Driver Behavior
Author: **Fleishman H**

Introduction: The use of telematics in fleet management has been employed as a method to give managers data and statistics on employee driving behavior. With this data, the desired outcome for managers is two-fold: (1) to accurately portray significant statistics on employee driving behavior, and (2) to leverage these statistics to effectively mitigate risky driving behavior. This presentation will focus on the latter, delving into the utilization of technology as a practical approach towards reducing risky driving behavior and, ultimately, road accidents.

Methods: To test the hypothesis, GreenRoad Technologies' deployed its Safety Center system into T-Mobile UK service vehicles in late 2006. The system consisted of a dashboard monitor to provide real-time feedback to the driver to indicate driving behavior using light signals (green, yellow, red) and an embedded sensor that detects 120 different driver maneuvers across five categories—speed, braking, acceleration, lane handling, and turning—all via algorithms that analyze raw motion data and convert it into meaningful data corresponding to driver behavior and patterns. These results were collected over six months and then compared to driver safety statistics to measure their significance.

Results: The findings indicate that in six weeks, the T-Mobile UK Fleet had reduced risky driving behavior (characterized as "red" driving) by 50%, and after two months the accident rate declined by 23%. Over a six-month period, driving improved dramatically from 69% red drivers and 10% green drivers to 35% red drivers and 38% green drivers.

Discussion: While the implementation of technology to reduce risky driving behavior will continue to evolve in the next several years, the adoption of such technology, as it stands now, has significantly proven to reduce road accidents due to better driving behavior, ultimately saving fleet managers money on vehicle repair.

D5.3
Title: The Effect of Passengers on Large Truck Collisions Involving Older Male Drivers
Authors: **Bunn T**, Slavova S, Bathke A

Introduction: The effect of passengers on at-fault vs. not-at-fault large truck collisions (LTCs) involving older male drivers is unknown.

Methods: A retrospective population-based case-control study was conducted to determine whether the presence of passengers decrease the likelihood that a driver will be at fault in a LTC. Cases were identified as male drivers, 50 years of age and older, in at-fault LTCs, and controls were male drivers, 50 years of age and older, in not-at-fault LTCs using the Kentucky Collision Report Analysis for Safer Highways (CRASH) electronic database from 2000–2006. Unit type classifications included: trucks and trailers, truck-single unit, truck-tractor and semitrailer, and truck-other combination. All vehicles were designated as commercial vehicles in the CRASH file. Multiple logistic regression was performed.

Results: One or more passengers, 4-lane highways, and daytime driving were protective factors for a male driver > 50 years of age to be at fault in a LTC. In contrast, drivers sixty years of age and older, posted speed limits of under 45 mph compared to speed limits > 55 mph, and curvy and graded/hillcrest roads increased the odds that the driver would be at fault in a LTC.

Discussion: The presence of passengers had a protective effect on older adult male driver LTCs. The results of this study have the potential to inform and influence public policy in regard to the presence of passengers and their positive protective effect on large truck drivers, particularly in long-distance driving performed by solo drivers vs. team drivers in commercial trucking operations.

D5.4
Title: Global Collaboration to Improve Worker Safety on Roads
Authors: **Hingston J**, Fingerhut M, Pratt S

The National Institute for Occupational Safety and Health (NIOSH) and stakeholders in the United States and abroad are working together within the new National Occupational Research Agenda (NORA). For the past 10 years, NORA has served as a framework to guide occupational safety and health research, not only for NIOSH but for the entire U.S. occupational safety and health community. NORA has had

substantial impact in the United States. NIOSH and partner governmental agencies have funded NORA research annually at increasing levels, rising from $15 million in 1996 to $130 million in 2005.

Building on the success of NORA, the second decade of NORA is using a sector-based approach, which includes all employers, all workers, and all workplaces. NIOSH and its partners have formed eight Sector Research Councils, gathering all sectors into these eight groups. Each council includes participants from academia, industry, labor, and government and will draft strategic and subsector-based research goals, objectives, and action plans. These agendas will provide guidance to the entire occupational safety and health community for moving research to practice in workplaces. In addition, a Cross-sector Research Council will be formed to identify opportunities for common research (e.g., musculoskeletal disorders) across sectors. Global collaborations is an important cross-cutting theme for all sectors. In our global village, the sharing of solutions to common problems can increase the health and safety of workers on all continents.

This presentation will illustrate the benefits of global collaborations in the Transport Sector to prevent road injuries to workers globally. An online library of best practices in place globally has been developed, and partners are gathering at an international conference in 2008 to plan additional implementation and evaluation activities.

Session: E**1.0**
Title: Training in Construction
Moderator: Thomas Bobick

E1.1
Title: Informal Training in Small Construction Work Systems
Authors: **Smith-Jackson T**, Kleiner B, Artis Sa, Baldev D, Hughes C, Lancaster G

Introduction: Companies with 20 or fewer workers make up a majority of the construction industry, yet few efforts have focused on providing compatible methods to facilitate safety training. Small construction companies comprise a disproportionate number of injuries and fatalities within the construction industry. This study was conducted by the Center for Innovation in Construction Safety and Health (CICSH) to identify ecologically valid training methods for small construction work systems.

Method: This research effort combined qualitative and quantitative approaches to conduct a needs analysis of very small construction companies to identify barriers to and preferences for training. Qualitative methods using interviews and focus groups provided a list of requirements or themes supporting a preference for informal training and barriers to the use of other types of training approaches. Quantitative methods revealed preferences for flexible training methods and a supportive safety climate. Analyses included content analysis, principal components, regression, and heuristic review by external evaluators.

Results: Informal training was found to be the most compatible training approach for these environments. The manner in which the training should be conducted is unique to this work system. We applied a research-to-practice approach developed by the CICSH, which supported development of guidelines and strategies associated with integration of risk perception, work-family dynamics, and situated learning in construction environments were identified.

Discussion: This research identified an informal training approach that is unique to construction environments that meet the following criteria: fewer than 20 workers, workers connected by family/friendship, interference of personal dynamics during the work day, limited time and resources, and poor safety climates. A situated training strategy was identified that was reported by several workers in a number of different ways. Best practices of the situated training strategy were also identified. Future efforts will focus on informal training frameworks.

E1.2
Title: Construction Safety Training Issues for New Construction Employees
Authors: **Hubbard B**, McGlothin J, Hubbard S, Mena I, Soendjojo A

Introduction: The construction industry has a large number of work-related deaths, and previous studies suggest that workers may be most vulnerable to construction injuries and fatalities at the beginning of their career in construction, when they have the least experience on the construction site. To minimize the threat to new employees, adequate safety training programs are a necessary part of construction work. This research is a pilot study to identify issues that

may affect the impact of safety training on new employees.

Methods: To address the issues associated with safety training programs for new employees, a series of three surveys was conducted with student interns in the construction industry. Students completed surveys (1) prior to OSHA 10-hour safety training, (2) after the OSHA 10-hour safety training and before working on the construction site for their first internship, and (3) after working on the construction site for their first internship.

Results: The results of these surveys indicate both benefits and limitations of existing training. Findings confirm that safety training can play an important role in safety and can familiarize new employees with potential construction hazards. However, one significant limitation of existing safety training is that it requires an understanding of construction terminology that many inexperienced workers do not have. Furthermore, the findings indicate that even workers with some exposure to construction may not understand terminology associated with construction specialties, such as electrical. The lack of understanding of basic terms used in the OSHA training indicates a significant issue for the trainer and the training process.

Conclusions: This pilot survey suggests that safety training may be enhanced by providing clear definitions and pictorial explanations of construction terminology that may be unfamiliar to new employees. Additional research may provide a better understanding of the issues that affect new employees and how these issues can be addressed through safety training material.

E1.3

Title: Diffusion of Fall Hazard Safety Training for Hard-to-Reach Residential Construction Workers Through the Internet and Utilizing New Media

Authors: **Fullen M**, Takacs B, Shambaugh N

Introduction: The numbers of workers in the residential construction industry are on the rise. Falls have continually been the largest contributor to residential construction worker deaths and injuries. These workers are largely self-employed or working for small companies. These individuals are difficult to reach through traditional methods. This research proposed to use the internet to reach this group and engage them in the curriculum development cycle.

Methods: An instructional design research method known as Type I Developmental Research was utilized to study the methodology, product, implementation, and outcomes for this program throughout the design, implementation, and evaluation stages. Two complete cycles of design, implementation, and evaluation cycles have been evaluated. Type I developmental research treats the design-development-evaluation process as a form of inquiry and does so by embedding traditional research methods into the development project and utilizes the case study method (Richey, Klein and Nelson).

The research questions are: (1) Does the training program addressing residential fall hazards and safety bring about individual or group behaviors that may reduce the likelihood of falls from heights on residential construction sites? (2) Does the technology-based availability and delivery of this training material increase trainee interest? (3) Does including residential construction worker, supervisor, and expert feedback into the developmental cycle of training development impact the relevance and acceptability of the residential fall protection training material?

Results: Initial results have shown that the newly developed material has brought about increased knowledge and fall protection usage. The availability of the training material on the internet has led to a broad diffusion and use of the training material, although most seekers of this material were trainers and safety professionals rather than workers. Finally, including workers and others in the training development cycle has impacted the relevance and acceptance of the material.

E1.4

Design and Preliminary Evaluation of a Fall Protection Curriculum for Apprentice Carpenters in Residential Construction

Authors: Kaskutas V, **Abraham R**, Dale AM, Lipscomb H, Gaal J, Fuchs M, Evanoff B

Introduction: Results of a comprehensive needs assessment were used to modify the fall prevention curriculum at a carpenter apprenticeship training program.

Methods: We conducted a comprehensive needs assessment via focus groups (n = 36), questionnaires (n = 1,026), and worksite audits (n = 197) to determine gaps in the apprentice carpenters' fall protection training. The current fall prevention curriculum was evaluated and training opportunities

identified. We used these data to develop learning objectives, lesson plans, and training methods. After initiating the revised curriculum, we solicited apprentice evaluation and feedback to guide ongoing curricular improvements.

Results: We found that apprentices perform tasks that place them at risk for falls before receiving training. Fall prevention learning objectives (n = 43) were integrated into early apprenticeship training and are reinforced throughout the four-year program. We used adult learning principles to emphasize hands-on experiences and integration of real-life stories. A portion of a framed structure of a residential construction site was fabricated to allow apprentices to observe and practice fall protection behaviors. Preliminary results show that 96% of early term apprentices agree that the residential prop is an effective training tool, and 81% state they will change their stepladder work habits as a result of training. The training appeared to impact many of the apprentices as evidenced by feedback, such as "I will use these safety tactics daily, I had no knowledge of them before" and "I learned a lot about my own interpretation of risks...risk perception is different than it seems at first."

Conclusions: Integration of needs assessment results and apprentice feedback was invaluable in revising a fall prevention curriculum. Working closely with the instructors to tailor learning experiences to best meet our learning objectives has provided preliminary positive results. Effectiveness of curriculum changes will be assessed through repeat questionnaires and worksite observations.

Session: **E2.0**
Title: Physical and Ergonomic Risk Factors Associated With Slips
Moderator: Sharon Chiou

E2.1
Title: Physics-Based Computational Modeling for Shoe-Floor-Contaminant Friction
Authors: **Beschorner K**, Lovell M, Higgs III CF, Redfern M

Introduction: While many devices quantify slipperiness of shoe-floor combinations, these devices are limited by their inability to reproduce a slip and by the dependence of coefficient of friction (COF) on the device. Computational modeling approaches may provide potential to efficiently quantify slipperiness across a range of testing conditions while considering complex loading patterns and shoe kinematics. The purpose of this abstract is to discuss recent research efforts by our group to develop computational physics-based models for shoe-floor-contaminant friction.

Methods: The computational friction model is based on a mixed-lubrication approach, where the normal load is shared by the contacting surfaces and the fluid. The contact region is solved with Hertzian mechanics, and the thin-fluid film region is solved with Reynolds Equation. Iterative methods determine the load supported by the fluid and the contacting surfaces based on the criteria that the summed force from the fluid and contact must equal the total applied force. COF values were determined using a linear rule of mixtures based on the load supported by the asperities and the fluid. The modeling approach is applied to a pin-on-disk apparatus and model output values are compared with experimental results for two different shoe materials.

Results: The analytical model predicted a nonlinear reduction in coefficient of friction consistent with experimental values for both shoe materials. The model was particularly accurate at high speeds where the fluid carried more of the load. The analytical model also predicted that the peak hydrodynamic pressure occurs just outside the contact region, and the peak contact pressure occurs in the center of the pin.

Discussion: The physics-based modeling approach described here predicts COF values, which match experimental results. This research aims to serve as a starting point towards developing similar analytical models for an entire shoe.

E2.2
Title: The Stochastic Distribution of Available Friction Coefficient for Human Locomotion
Authors: **Chang W-R**, Matz S, Chang C-C

The available friction coefficient for human locomotion is the maximum friction coefficient that can be supported without a slip at the shoe and floor interface. The required friction coefficient is the minimum friction coefficient needed at the shoe and floor interface to support human locomotion. A statistical model was recently introduced to estimate the probability of slip incidents by comparing the available friction coefficient with the required friction coefficient, assuming that both coefficients have stochastic distributions. The stochastic distribution of the required friction coefficient was recently investigated by this research team. The current paper

presents an investigation of the stochastic distributions of the available friction coefficient under dry, water- and glycerol-contaminated conditions as an input to the statistical model. In this experiment, a walkway with plain quarry tiles was constructed. Fifty tiles on this walkway were selected for friction measurements with the Brungraber Mark II using the Neolite liner under three different surface conditions. Two friction measurements were performed on each selected tile, one in each walking direction. The protocols for friction measurements and cleaning of the samples before friction measurements used in this study were previously developed and published in the literature by this research team. Barnett obtained 400 measurements of the available friction coefficient over 100 new tiles under the dry condition with the Horizontal Pull Slipmeter (HPS) and reported that the distribution of the available friction coefficient was near a Weibull distribution. In the current study, the Kolmogorov-Smirnov goodness-of-fit test was used to determine if the distribution of the available friction coefficient was a good fit with the normal, log-normal, and Weibull distributions. The results indicated that the available friction coefficient appears to fit the normal and log-normal distributions better than the Weibull distribution for the water and glycerol conditions.

E2.3

Title: Assessing Floor Slipperiness: The Effects of Friction and Perception on Gait

Authors: **Chang C-C**, Lesch M, Chang W-R

Introduction: Falls following slips are one of the leading causes of accidental injuries in the home and workplace. This study assessed floor slipperiness by investigating gait changes in response to sensory feedback received when walking on different combinations of floor surface material and contaminant conditions.

Methods: Five different floor materials were tested in random order. Participants wore a harness and were asked to walk repeatedly on each floor as quickly as possible without slipping. For each floor material, three surface conditions (dry, water, and glycerol) were tested. The available friction coefficient (ACOF) was measured by a PIAST slipmeter. After completing each test condition, participants rated slipperiness. The peak utilized friction values (Peak3) at the heel strike landing phase were calculated from the ground reaction force data collected using forceplates embedded under the walkway.

Results: A lower Peak3 value was observed only when floor ACOF was reduced to a certain amount. Some floors with similar ACOF, however, resulted in different Peak3 values. In addition, for some floors, when its ACOF changed from the dry condition (0.81) to the glycerol condition (0.19), the participants' peak3 value only reduced slightly from 0.2 to 0.18, which is close to the floor's available COF. By examining participants' perception ratings, however, individuals seemed to see only a small difference in the slipperiness.

Discussion: The analysis indicated that individuals could adjust their gaits to accommodate floor condition changes. However, ACOF may not be the only factor that affects an individual's gait. Differences in the visual characteristics of the floors and the proprioceptive feedback received while walking on the floor surfaces may have also influenced changes in gait which were reflected in the ground reaction force profiles.

E2.4

Title: Influence of Localized Muscle Fatigue of the Knee Joint on Kinematics and Kinetics Related to Slip-induced Falls

Authors: **Lockhart T**, Parijat P, Liu J

Existing epidemiological evidence suggests that localized muscle fatigue might be considered as an intrinsic risk factor that causes lack of balance control leading to falls. The goal of the study was to examine how localized muscle fatigue of the knee joint (quadriceps) alters gait parameters and joint kinetics (joint moment and power) that are related to slip propensity. Sixteen healthy young participants were recruited to walk across a vinyl floor surface in two different sessions (Fatigue and No fatigue). Kinematic and kinetic data were collected using a three-dimensional video analysis system and force plates during both sessions. An inverse dynamics model was developed to calculate the knee joint moment and power. In terms of gait parameters, the fatigue session results indicated a substantial increase in heel contact velocity (HCV) and required coefficient of friction (RCOF), as well as a decrease in the transitional acceleration of the whole body COM (TA), walking velocity (WV), and step length (SL). Furthermore, the results demonstrated an increase in the peak knee joint moment and peak knee joint power generation in the fatigue slip trials. There were four reported falls in the fatigue session. These findings provide new insights into the biomechanical relationship between localized muscular fatigue and joint kinetics and gait parameters linked with slip propensity. The study concluded that

localized muscular fatigue can be considered as a potential risk factor for slip-induced falls.

Session: **E3.0**
Title: Injury Assessment and Methods
Moderator: Suzanne Marsh

E3.1
Title: Modeling Occupational Low Back Injury Risk Due to Repeated Joint Loading
Authors: **Mughal W**, Morrison J, Robinovitch S

Introduction: Previous research has shown that peak loading and work history are correlated with risk of injury, although the relationship is not clearly understood. The purpose of this study was to develop a model that will predict probability of low back injury as a function of repetitive loading of the L4/L5 joint, joint material properties, and work history in residential care settings.

Methods: Low back injury data from a 5-year period were extracted from an employer's database and filtered to exclude repeat injuries. Focus groups identified and demonstrated the tasks regularly performed in residential care. Peak L4/L5 joint forces were calculated from a biomechanical model. By combining actual injury rates and biomechanical data, a low back injury model was developed using material fatigue theory to predict injury risk due to cumulative peak compressive loading.

Results: Biomechanical analyses revealed peak L4/L5 joint compressive forces of 467 N to 3811 N and peak anterior-posterior shear forces of 66 N to 471 N. A cumulative probability distribution curve was generated from the low back injury model to illustrate probability of injury over a working career. The model predicts 50% of residential care workers will experience a low back injury by their 8^{th} year of work and 95% by year 15.

Discussion: While fatigue failure models have been used previously to assess health effects of repeated shocks on vehicle operators, this study is novel in its application of a fatigue model to predict injury from manual handling tasks. While not validated, the model output compares favorably to historical injury onset characteristics of residential care workers. In addition, the value of L4/L5 ultimate compressive strength obtained from the best fit model compares favorably with values reported in the literature. Future work will test the model against other work populations.

E3.2
Title: Comparison of Injury Types and Severity Among Workers Admitted to Hospitals vs. Treated in Emergency Departments
Authors: **Dischinger P**, Smith G, Ho S, Auman K, Kufera J

Introduction: Little information is currently available concerning the nature of work-related injuries severe enough to require treatment in a hospital.

Methods: As part of a statewide surveillance of occupational injury, all workers either hospitalized or treated in Maryland emergency departments were identified, and an incident-specific database created for the years 2001–2004. ICD-9 codes were obtained from hospital discharge records. For those with multiple injuries, ISS scores were also computed.

Results: There were a total of 173,304 workers either treated in an ED or admitted to a hospital. The most common injuries were upper extremity injuries, followed by lower extremity injuries. Workers hospitalized were significantly older than ED cases (42 vs. 37, $p < .001$), and more likely to be men (82% vs. 68%, $p < .001$). Among those admitted, the primary upper extremity injury was forearm fracture (21%); for lower extremity injuries it was ankle/foot fracture (23%). In contrast, for ED cases the primary upper extremity diagnosis was finger laceration (28%); for lower extremity injury, ankle/foot sprain. For both ED patients and those hospitalized, the majority of injuries, based on ISS score, were minor (ISS 1-8); among those admitted, however, approximately one quarter had serioius injuries (ISS 9-75).

Significance: This is the first statewide injury surveillance study of serious occupational injuries and thus the first to identify the types and severity of such injuries. Although the majority may still be considered relatively minor in nature, some, like mild traumatic brain injuries and ankle/foot fractures, have been shown to have a major impact on long-term functional status and quality of life. This data can be used within the state to learn more about causative factors in order to prioritize prevention strategies.

E3.3

Title: Work-Related Physical and Psychosocial Exposures are Risk Factors for Incident Symptoms and Functional Impairment of the Hands and Wrists

Authors: Coomes J, Dale AM, Franzblau A, Descatha A, Strickland J, **Evanoff B**

Introduction: This study sought to identify independent personal, work-related, and psychosocial risk factors for incident cases of CTS, hand/wrist symptoms, and functional impairment in a working cohort.

Methods: We analyzed data from an ongoing study of musculoskeletal disorders among workers. At the time of this analysis, 682 of 898 eligible workers (76%) had completed surveys at both six and 18 months after hire. Questionnaires measured risk factors at 6 months, including demographic data, self-reported physical exposures assessed by the Nordstrom scale, and the Karasek scales for social support, job skill discretion, job decision-making authority, and job insecurity. Incident outcomes occurring between six and 18 months included new CTS defined as a reported clinical diagnosis or new typical symptoms defined by a Katz hand diagram, new hand/wrist symptoms causing at least moderate discomfort (greater than 5 on a 0–10 discomfort scale), and new functional impairment defined as work disability or change on the Levine functional status scale. We performed multivariate logistic regression to assess independent risk factors for the study outcomes of CTS, hand/wrist symptoms, and functional impairment.

Results: In our preliminary analyses of this ongoing study, we found that 5.6% of subjects met our case definition for CTS, 13.9% had hand/wrist symptoms of at least moderate severity, and 14.1% reported functional impairment. Independent predictors of the three study outcomes differed, but included job physical exposures (pinch, forceful grip, lifting/carrying objects > 2 lbs.), psychosocial factors (low job social support and job skill discretion), and personal factors (female gender, thyroid disorders).

Conclusion: Personal, work-related, and psychosocial factors were all independent predictors of incident cases of CTS, hand/wrist symptoms, and functional impairment. Efforts to reduce morbidity related to hand-wrist disorders in working populations should recognize the multifactorial nature of these disorders.

E3.4

Title: Etiology of Work-Related Electrical Injuries: A Novel Taxonomy and In-depth Narrative Analysis of Workers' Compensation Claims

Authors: **Lombardi DA**, Matz S, Brennan MJ, Smith GS, Courtney TK

Introduction: To provide new insight into the etiology of work-related electrical injuries, we developed a multi-stage case-selection algorithm to identify electrical-related injuries from workers' compensation claims and a novel customized coding taxonomy to identify the preinjury circumstances.

Methods: Routinely collected workers' compensation claims over a one year period from a large U.S. insurance provider were used to identify electrical-related injuries using an algorithm that evaluated injury cause information (two fields), nature of injury, accident description, and injury description narratives. Concurrently, we developed a customized coding taxonomy for narratives to ascertain the activity, source, initiating process, mechanism, vector, and voltage.

Results: Among the 586,567 reported claims during 2002, electrical-related injuries accounted for 1,283 (0.22%) of nonfatal claims and 15 fatalities. Most (72.3%) were male, average age of 36, working in services (33.4%), manufacturing (24.7%), retail trade (17.3%), and construction (7.2%). Body parts injured included the hands, fingers or wrist (34.9%); multiple body parts/systems (25.0%); and the lower/upper arm, elbow, shoulder, and upper extremities (19.2%). The leading activities were conducting manual tasks (55.1%); working with machinery, appliances, or equipment; working with electrical wire; and operating powered or nonpowered hand tools. Primary injury sources were appliances and office equipment (24.5%); wires, cables/cords (18.0%); machines and other equipment (11.8%); fixtures, bulbs, and switches (10.5%); and lightning (4.2%). No reported vector was involved in 85% and the work process was not self-initiated in 9.6% of cases.

Discussion: Injury narratives provide valuable data to overcome the limitations of precoded data, supplement traditional epidemiological data, and provide important information for understanding the etiology of work-related electrical injuries and developing prevention opportunities.

Session: **E4.0**
Title: Youth in Agriculture
Moderator: Susan Gerberich

E4.1
Title: Identifying Determinants of Being a Child Bystander on Midwestern Agricultural Operations
Authors: **Williams Jr. Q**, Alexander B, Gerberich S, Ryan A

Background: Agricultural work is dangerous employment, placing at risk not only workers but also those who live on the operation, particularly children who are bystanders. We evaluated the incidence and determinants of bystander injuries to children in the Regional Rural Injury Study - II (RRIS-II).

Methods: The RRIS-II followed 32,601 people (~85% of eligible) from rural communities in the Midwest for two 6-month recall periods in 1999/2001. Injury events involving children and adults, demographic, and exposure data were collected using computer-assisted telephone interviews. A nested-case-control study of children evaluated the determinants of being a bystander in high-risk agricultural environments. Narrative data were used to identify work-relatedness of children's injuries by cataloging narrative scenarios into bystander categories.

Results: Of the child injures (aged <20 yrs), 102 (22%) were bystanders. Fourteen were identified as indirectly work-related (working bystanders), 27 nonworking accomplice (passengers/tag-alongs), and 60 nonworking attendant (playing on the operation). Multivariate analyses revealed important associations between a parent's belief in his/her child's readiness to do chores, based on specific characteristics, and bystanding in several locations on the operation: child size matters near water 1.9 (1.1, 3.3), gender matters near driveways 1.6 (1.1, 2.5) and workshops 1.5 (1.0, 2.2). A parent's view of a safe age to operate tractors showed moderately increased odds of bystanding near animals, fields, water, workshops, and stored machines 1.1 (1.0, 1.13) for any of the aforementioned areas.

Conclusions: To best direct prevention efforts to protect young children from bystander injuries, it is imperative to specifically identify the mechanism by which the injury occurred. Since children are vulnerable to many of the same hazards as adults, but are far less capable of understanding all of the potential hazards. It is necessary to examine parental factors that may be associated with children's likelihood of bystanding in high-risk work environments.

E4.2
Title: Farm Chores Worked by Youth and Adherence to the North American Guidelines for Children's Agricultural Tasks
Authors: **Wilkins Jay**, Heaney Cathy, Ashida Sato

Introduction: In 1999, the North American Guidelines for Children's Agricultural Tasks (NAGCAT) were published to help adults in assigning and supervising chores for youth 7–18 years of age who work in agriculture. This abstract is based on work performed as part of our NIOSH-funded project "Adherence to the NAGCAT and Injury Risk Reduction."

Methods: During a recent 3-year period, 4-H youths (and their caregivers) were recruited into a study designed to evaluate the effectiveness of the NAGCAT to reduce agriculture-related injury risk. Relying on Participant Event Monitoring methodology, youth were expected to keep a daily diary of time spent doing farm chores, safety behaviors, adult supervision present, and relevant details of all injuries sustained during the 10-week followup period. In addition, parents/caregivers who were primarily responsible for chore supervision completed questionnaires that elicited information about health- and safety-related beliefs and attitudes, among other things.

Results: Of the 417 adult-child dyads agreeing to participate, 347 (83.2%) completed the necessary consent/assent forms, with 330 providing usable data. Based on the 31 chores relevant to central Ohio agriculture, participating youth (144 boys (mean age 13.8 years), 186 girls (mean age 13.6 years)) reported nearly 19,000 hours of work-related at-risk time. Wide variability was seen in both the frequency of working a chore (expressed as the mean number of work sessions per week) and in the duration of a work session (expressed as the mean number of minutes per work session). Adherence to NAGCAT work practice recommendations also varied widely. Some work practices, e.g., checking for people and obstacles in the work area, were almost always followed, while others, e.g., using a respirator, were rarely followed. Notable gender differences were seen with respect to all three measures, as will be described.

Conclusion(s): Our findings indicate exposure to injury hazards among youth who work in agriculture are quite variable. In addition, many central Ohio

youth work chores in a way that violate NAGCAT guidelines. The observed low adherence to many NAGCAT work practices suggests much needs to be done to increase risk-reducing safety behaviors among youth who work agriculture-related chores.

E4.3

Title: Enhancing Adherence to the North American Guidelines for Children's Agricultural Tasks

Authors: **Heaney C**, Wilkins JR, Ashida S

Introduction: In 1999, the North American Guidelines for Children's Agricultural Tasks (NAGCAT) were published to help adult caregivers in assigning and supervising chores for youth 7–18 years of age who work in agriculture. This study developed and evaluated an intervention to disseminate the NAGCAT in ways that enhance adherence to the guidelines.

Methods: Youth/adult dyads were recruited into the study. 4-H youths and their parents completed questionnaires that asked about injury history, work history, and health- and safety-related beliefs and attitudes. In addition, during the 10-week study period, youth were expected to keep a daily diary of time spent doing specific farm chores, safety behaviors, and any injuries sustained.

The youth/adult dyads were recruited from nine counties in Ohio. Five of these counties were designated as intervention counties. The parents in these counties received home visits from a project staff person who conveyed motivating information about NAGCAT and how the guidelines could be used to inform parental decision-making and behavior. The content of the presentation was informed by Protection Motivation Theory (PMT). PMT proposes that protection motivation is dependent on perceived susceptibility and severity of the threat (for example, the risk of injury) and the perceived effectiveness of possible responses for dealing with that threat (for example, performing safe tractor operation behaviors).

Results: Intervention dyads (n = 217) and control dyads (n = 130) were similar at baseline. Preliminary results suggest that parents in the intervention households experienced a greater increase in protection motivation than parents in control households. A limited number of chores were worked frequently enough to permit a preliminary evaluation of pre-post intervention differences in levels of adult supervision and chore-specific safety practices. Among these five chores, post-intervention mean adult supervision scores were significantly higher for four of the five chores. Analogous comparisons among control youth revealed no significant pre-post intervention differences.

Conclusion: A home visit intervention based on PMT principles can be effective in increasing parents' protection motivation and in enhancing adherence to some of the guidelines in NAGCAT.

E4.4

Title: Using Longitudinal Data Analysis Methods to Assess the Effectiveness of the North American Guidelines for Children's Agricultural Tasks in Reducing Childhood Agricultural Injury Risk

Authors: **Wilkins J**, He X, Heaney C, Ashida S

Introduction: In 1999, the North American Guidelines for Children's Agricultural Tasks (NAGCAT) were published to help adults in assigning and supervising chores for youth 7–18 years of age who work in agriculture. This abstract is based on work performed as part of our NIOSH-funded project entitled "Adherence to the NAGCAT and Injury Risk Reduction."

Methods: During a recent 3-year period, central Ohio 4-H youth (and their caregivers) were recruited into the two-arm trial. Relying on Participant Event Monitoring methodology, youth were expected to keep a daily diary of time spent doing farm chores, safety behaviors, adult supervision present, and relevant details of all injuries sustained during the 10-week followup period.

After 3 weeks of diary maintenance, intervention households were visited by a trained "interventionist" who delivered a standardized Microsoft PowerPoint presentation to the primary caregiver to convey motivating information about NAGCAT and how the guidelines could be used to inform parental decision-making and behavior relevant to the youth's agricultural chores. An intervention booklet containing the guidelines on the 31 chores most relevant to the target population was given to each intervention family.

Longitudinal data analysis methods were used to analyze the change in the mean injury rate per exposure minute over followup (log-linear GEE models accounted for the within-subject correlation). Numerators of weekly rates were the total number of work-related injuries sustained over all chores worked. Denominators of weekly rates were all minutes worked over all chores.

Results: A total of 417 adult-child dyads agreed to participate, with 347 (83.2%) giving informed consent/assent. Intervention households numbered 217 over 5 counties. Control households numbered 130 over 4 different counties. Intervention and control youth were similar at baseline with respect to several potentially confounding variables.

Injury rates were based on >500 work-related events. GEE modeling results indicated that, overall, rates among intervention youth were lower than those among control youth ($p < 0.05$). However, GEE models taking into account the timing of the intervention revealed no evidence of an intervention effect.

Conclusion(s): In-home delivery of the NAGCAT to adult caregivers who assign farm chores to youth may not be sufficient to reduce childhood agricultural injury risk.

Session: **E5.0**
Title: Assessing Injury Risk Factors
Moderator: Theodore Courtney

E5.1
Title: Gender Differences in Injury Patterns Among Workers in Heavy Manufacturing
Authors: **Cantley L**, Taiwo O, Slade M, Pollack K, Vegso S, Fiellin M, Cullen M

Introduction: Women comprise 46% of the paid U.S. labor force. They have been increasingly entering traditionally male-dominated jobs in construction, mining, and heavy manufacturing, although their representation in these sectors remains significantly lower than that of men. The objective of this research is to determine if female workers in a heavy manufacturing environment have a comparable risk of occupational injury compared to their male counterparts when performing the same job and to evaluate if there are gender differences in type of injury and severity of injury.

Methods: Using company-maintained human resources data linked with incident surveillance data for hourly workers at six aluminum smelters, injuries occurring over a 10-year period were analyzed. Multivariate logistic regression, adjusted for job and age category, was used to calculate odds ratios (ORs) and 95% confidence intervals for female versus male injury risk for all injuries, recordable injuries, and lost work-time injuries. The analysis was repeated for acute injuries and musculoskeletal disorder (MSD) injuries.

Results: Female workers in this industry have greater risk for sustaining injury after adjusting for age and job: OR 1.418 (1.340–1.499) for all injuries, OR 1.516 (1.296–1.546) for sustaining an injury requiring medical treatment, and OR 1.183 (0.852–1.643) for sustaining an injury resulting in lost work time. This excess risk for female workers persisted when injuries were stratified into acute and MSD-related categories for separate analyses.

Discussion: This study shows a clear difference in injury risk and injury severity between male and female workers. This supports the hypotheses that female workers are at higher risk for occupational injury and sustain more severe injuries than their male counterparts in a heavy manufacturing environment. Future research is needed to explore modifiable risk factors for targeted interventions.

E5.2
Title: Acute Injury and Heat Stress Level in an Aluminum Smelter
Authors: **Bernard T**, Fogleman M

Introduction: Heat stress is a commonly recognized hazard in hot industries including aluminum smelters. The occupational exposure limits are based on physiological capacity to maintain thermal equilibrium. While there is evidence that heat disorders and acute injuries are associated with increasing levels of heat stress, the risk has not been related to the occupational exposure limits.

Methods: In this study, 153 recordable and first aid cases over a 3-year period were related to the heat stress level. The cases were reviewed and classified as acute injury (e.g., laceration, muscle strain) (125 cases), acute musculoskeletal injury (subclassification of acute injury) (89 cases), and heat-related disorder (28 cases). From an evaluation of the heat stress conditions related to the outside ambient conditions at the hour of the case report to medical, the heat stress level was categorized as low (below the ACGIH TLV), moderate (from TLV to TLV + 3 °C-WBGT) and high (greater than 3 °C-WBGT above the TLV).

Results: Based on the staffing levels, a Poisson regression was used to compute the odds ratio (OR) of a case. As expected, the ORs for heat disorders were significant and were 25 and 158. For acute injuries at moderate and high heat stress, the ORs (95% CI) were

1.4 (0.9–2.2) and 1.7 (1.0–2.9); and 1.8 (1.1–2.9) and 2.4 (1.4–4.3) for acute musculoskeletal disorders (MSDs).

Discussion: The current TLVs seem to be well set for heat-related disorders. The ORs for acute injuries and acute MSDs also point to heat stress as being a factor in their occurrence.

E5.3
Title: *A Case-Crossover Study of Occupational Laceration Injuries in Pork Processing: Methods and Preliminary Findings
Authors: **Lander L**, Sorock G, Stentz TL, Eisen EA, Mittleman M, Hauser R, Perry MJ

Introduction: Despite prevention initiatives, the incidence of lacerations remains high in the meatpacking industry. This case-crossover study identified transient risk factors for lacerations in U.S. meatpacking plants. Transient exposures of interest included work equipment (sharpening, malfunction), work practices (unusual task, unusual method), and worker-related factors (rushing, distraction, tired, slipping).

Methods: Injured workers were recruited from two plants in Nebraska and Iowa. A telephone interview was conducted within 14 days of laceration to collect information on fixed and transient exposures that may have contributed to the injury. Case-crossover methodology was used to evaluate case and control data within the same subject, controlling for between-subject confounding. Mantel-Haenszel estimator for person-time data was used to estimate the relative risks of injury.

Results: A total of 362 workers experienced lacerations from April 2006 to October 2007, and 153 (42%) were interviewed (74% male, 41% Hispanic). Forty-eight percent of workers were injured by a knife or knifelike object such as scissors or bandsaw. Tool sharpening was associated with the highest relative risk of laceration (RR 91.6, 95% CI: 52.4–160.0), followed by slipping (RR 74.8, 95% CI: 30.5–183.3), equipment malfunction (RR 3.8, 95% CI: 2.8–5.3), and performing an unusual task (RR 3.7, 95% CI: 2.6–5.2). Being tired, distracted, or rushing were not significant risk factors for laceration. Gender, work experience, safety training, number of workers on the line, and hours of sleep were effect modifiers for several transient risk factors.

Discussion: Transient factors were associated with increased risk of laceration injuries in meatpacking. Given the variety of injury sources, intervention efforts should focus on engineering controls, improved personal protective equipment, administrative controls, and safety training to reduce the incidence of lacerations in meatpacking.

E5.4
Title: *A Descriptive Study of Workers' Compensation Claims in Washington State Orchards
Authors: **Hofmann J**, Snyder K, Keifer M

The occupational fatality rate in agriculture, forestry, fishing, and hunting of 29.6 deaths per 100,000 employed in 2006 was higher than any other industrial sector, and non-fatal injuries are also common. Orchard work is particularly hazardous; accounting for almost 40% of all workers' compensation claims in Washington's agricultural industry.

Methods: We conducted a descriptive study of workers' compensation claims filed in the main tree fruit growing region of Washington State for injuries that occurred in orchards between January 1996 and December 2001. Claims were classified by cause of injury for "associated source" and "accident type." Particular emphasis was placed on claims in the ladder category to facilitate sub-analyses of the etiology of ladder-related injuries.

Claim incidence rates by cause of injury were calculated based on the number of full-time equivalent (FTE) "Orchards: Fruit Tree Crops" workers in Washington State. We also investigated the costs of claims in each cause of injury category. A claim is classified as compensable if the worker sustains an injury resulting in time loss, disability, or loss of earning power in addition to medical care.

Results: A total of 13,068 non-rejected, State Fund claims were reported among orchard workers between 1996 and 2001. Most claimants were male (84%), and the mean age among claimants was approximately 35 years. The average annual claim incidence rate was 97.8 per 1,000 FTEs. Nearly one-third of all claims (n=4,020) were ladder-related injuries. Trees, branches, and vegetation were the next most frequent cause of injury (n=1,674). Over half of the claims related to trees, branches, or vegetation were eye injuries (n=944).

The total cost of claims included in this analysis was an estimated $50.5 million over the six-year study period. The median cost per claim was higher for

compensable claims than for non-compensable claims ($2,544 vs. $218). Although only 25% of claims were compensable (n=3,225), these claims account for 88% of the total estimated cost of all claims. Almost half of the compensable claims were related to ladders (n=1,549). Ladder-related claims were significantly more likely to be compensable than other claims in the dataset ($P < 0.001$, chi-square test). Ground-related injuries (e.g. trips and falls resulting in sprains or strains), motor vehicle injuries, and other musculoskeletal injuries also had a high proportion of compensable claims (38%, 33%, and 33% respectively). Ladder-related claims were far more expensive than any other category, with an average annual cost of $3.6 million. Sprains and strains were the most common type of ladder-related injury (38%, n=1,511).

Conclusion: This analysis demonstrates a compelling need to develop interventions to prevent ladder-related injuries among orchard workers.

* Winning submissions for the Liberty Mutual Student Paper Contest

Session: **F1.0**
Title: Injury Prevention in Construction - II
Moderator: David Fosbroke

F1.1
Title: Applying NIOSH Prevention Through Design to Electrical Hazards in Construction Work Environments
Authors: **Floyd HL**, Liggett D

Introduction: The construction industry represents 7% of the U.S. workforce, but accounts for 45% of occupational fatalities from electrical hazards. Prevention through Design is an initiative to address workplace hazard mitigation through design. NIOSH launched PtD on the premise that the U.S. is lagging in application of recognized hazard control measures. Engineering solutions that eliminate or reduce exposures are the most effective measures in safeguarding worker safety. ANSI Z10, Occupational Safety and Health Management Systems, provides a hierarchy of hazard control measures. Application of PtD in construction presents a great opportunity for reducing occupational electrical injuries.

Limitations of Existing Methods: NFPA70E, Standard for Electrical Safety in the Workplace, focuses on some control measures, but not those considered most effective in reducing exposure. Use of the most effective control measures is largely voluntary.

Results: Control measures to protect construction workers during installation and demolition are not addressed in a similar manner as maintenance and operating exposures. Some of the barriers include:

- Electrical experts not being familiar with safety management
- Belief that "qualified workers" do not make mistakes
- Designers not being familiar with workplace hazards and safe work practices
- Design firms' concern that addressing worker safety in the design process will increase liability
- Facility owners not understanding the cost of retrofitting safe work practices and other control measures after design is complete

Discussion: Avenues to better address electrical safety via PtD must be explored. Some opportunities include:

- Working to assure that electrical safety professional participate in the PtD initiative
- Influencing PtD in engineering education
- Developing further proposals to affect revision of existing recognized standards
- Demonstrating support for a new ANSI standard for guiding PtD application
- Working to aid in awareness and education on PtD benefits

F1.2
Title: Construction Safety Training Issues for Hispanic Construction Employees
Authors: **McGlothin J**, Hubbard B, Aghazadeh F, Hubbard S, Mena I, Bertot J, Huerta J, Player L

Introduction: Numerous studies indicate that Hispanic construction workers comprise a disproportionately high number of construction workplace fatalities. This research documents the findings of a pilot study exploring issues related to safety training for Hispanic construction workers, which comprise a growing segment of the U.S. construction workforce. This study is a continuation of the research on construction safety training issues for employees new to the construction industry.

Methods: A group of Hispanic construction workers in Louisiana was surveyed to determine workers' perceptions of construction safety, levels of safety training, familiarity with construction terms, and population characteristics.

Results: The survey found that 58% of the Hispanic workers had not taken any formal training in construction safety. Most Hispanic workers who did have training said that the training was given in Spanish or in both English and Spanish (90%). However, translating the course to Spanish does not address the limitations regarding comprehension of construction terminology. Many Hispanic workers are unfamiliar with the construction terminology used in Occupational Safety and Health Administration (OSHA) 10-hour training. Results indicated that no more than 20% of workers understood any of the terms used, and some terms were understood by only 3% of the workers surveyed. This lack of understanding of construction terminology could diminish the effectiveness of safety training and result in potentially unsafe working practices.

Conclusions: This pilot survey implies that safety training for Hispanic construction workers may be enhanced by providing pictorial storybook examples of construction terminologies combined with OSHA 10-hour safety training. Additional research is needed to understand and implement effective safety training strategies for Hispanic construction workers.

F1.3

Title: A Community-based Participatory Approach to Prevent Falls Among Latino Construction Workers

Authors: **Brunette M**, Azaroff L, Grullon M, Gagliardi M, Roelofs C, Shepherd S, Latowsky G, Matos C, Anziani D

Introduction: Latinos, the fastest growing ethnic group in the United States, are overrepresented in both fatal and nonfatal occupational injuries. The construction sector, with a large share of Latino workers (17%), is also one of the most dangerous industries, accounting for 20% of all occupational deaths. At the same time, falls are the leading cause of death at construction sites. Despite extensive research that has addressed fall prevention in construction, the number of fall-related fatalities continues to rise. In the United States, approximately one of five workers who die from falls on the job is Latino.

Methods: Fall prevention interventions shown to be effective in other settings may not be completely appropriate or accessible to the Latino workers. Interdisciplinary, participatory approaches are urgently needed to develop and evaluate measures for protecting the health of immigrant workers. The overall design of this project was based on the well-known framework for Community-based Participatory Research (CBPR) adapted here for occupational safety and health intervention research. This is a cyclical and iterative process involving academic and community partners at each step. The major hypothesis of our project is that CBPR involving city agencies, a labor organization, academia, construction safety experts, workers, contractors, family members, and Lawrence, MA, residents can develop an effective approach to prevent exposure to fall-related hazards affecting Latino construction workers. This initiative also aims to build a community-wide support system to carry on the program in the future.

Results: Here we present preliminary qualitative results of the first stage (assessment) of this community-based and community-directed project.

Conclusions: By involving employers, health care providers, government agencies, insurance companies, and the broader community with workers and their union, this project is offering the potential for sustainable, systemic change at the multiple levels required for intervention effectiveness.

F1.4

Title: Reducing Exposure to Pedestrians in Blind Zones

Author: **Barclay S**

Introduction: Reducing runover, backover, and work zone accidents to pedestrians can be done economically and quickly. Being struck by equipment results in some of the most traumatic and expensive accidents at the workplace. The current use of electronic devices, high-visibility equipment, and observers has had little statistical impact on reducing these types of injuries and may even contribute to increased exposure.

Hardhat-mounted mirrors have a potential to reduce this exposure to danger from being struck from behind. In recent years, mirrors have evolved from a safety device for cyclists to ones specifically designed for hardhats and industrial environments.

Methods: Washington State has enacted a law requiring "visual awareness" behind pedestrian workers, specifically those working as flaggers. One method recommended is the use of a mirror mounted to a hardhat. This is also recommended in some NIOSH Fatality Assessment and Control Evaluations.

Hardhat mirrors increase the field of view significantly and allow the wearer to scan, almost instantly, a full 360° with very little effort. This type of safety device could have a quantifiable impact on

backover injuries, as the most common denominator to pedestrian injuries involving equipment is the blind zone of the pedestrian.

Results: Most users report that helmet-mounted mirrors require some acclimation but that they would not want to go without one after becoming accustomed to them. This is still a relatively unknown device in industrial safety, so meaningful statistics are still to be proven.

Conclusions: Mirrors are considered an invaluable tool to heavy equipment, mobile machinery, and other vehicles. Hardhat-mounted mirrors add an element of safety to pedestrians that has been proven for decades in other industries. They are economical, commercially available, and address issues in ways not available from any other type of safety device.

Session: **F2.0**
Title: Workplace Violence in Healthcare Settings
Moderator: Marilyn Ridenour

F2.1
Title: Emergency Department Security Programs, Community Crime, and Employee Assaults
Authors: **Blando J**, McGreevy K, O'Hagan E, Worthington K, Valiante D, Nocera M, Casteel C, Peek-Asa C

Introduction: Violence against healthcare workers is a serious occupational health hazard, especially for emergency department (ED) employees. A significant degree of variability in security programs among hospital EDs occurs in part because of the absence of federal legislation requiring baseline security features. Nationally, only voluntary guidelines from the Occupational Health and Safety Administration (OSHA) for the protection of health care workers exist.

The purpose of this study was to examine ED security programs and employee assault rates among EDs with different financial resources, size, and background community crime rates.

Methods: This cross-sectional survey was conducted among large and small hospitals located in communities with low or high rates of community crime. Hospital financial data were collected through the state health department, and employee assault data were abstracted from hospital OSHA logs. Comparisons were made using a chi-square or Wilcoxon test.

Results: Small hospitals located in towns with low community crime rates implemented the fewest security program features despite having the second highest rate of assault-related OSHA recordable injuries among ED employees (0.66 per 100,000 staff hours).

Discussion: Due to the highly stressful workplace characteristics of ED medical care, the risk of employee assault is universal among all hospital sizes in all types of communities.

F2.2
Title: Hospital Employee Assault Rates Before and After Enactment of the California Hospital Safety and Security Act
Authors: **Casteel C**, Peek-Asa C, Nocera M, Smith J, Blando J, Goldmacher S, O'Hagan E, Valiante D, Harrison R

Introduction: In 1993, California enacted the Hospital Safety and Security Act, which mandated that hospitals implement security plans to reduce assaults against hospital workers by July 1, 1995. Since enactment of the legislation, no studies have examined changes in violent event rates to hospital employees.

Methods: Pre- and post-enactment employee assault rates in California (n = 116) emergency and psychiatric departments were compared with those in New Jersey (n = 50), where statewide workplace violence initiatives did not exist. The assault rate was the number of OSHA-recorded violent events per 100,000 employee hours per year. Violent events were abstracted from hospital OSHA logs or Employers' Reports of Occupational Injury or Illness. The total employee hours were obtained from each state's health department. Poisson regression was used to compare assault rates between a 3-year pre-enactment period (1993–1995) and a 6-year post-enactment period (1996–2001) using New Jersey hospitals as a temporal control.

Results: Assault rates among emergency department (ED) employees decreased 48% in California post-enactment compared to ED employee assault rates in New Jersey (rate ratio (RR) = 0.52, 95% CI = 0.31–0.90). Employee assault rates in California psychiatric units decreased 37% compared to New Jersey psychiatric units (RR = 0.63, 95% CI = 0.26–1.52). ED employee assault rates decreased in smaller facilities and for-profit-controlled hospitals post-enactment. Among psychiatric units, for-profit-controlled hospitals and hospitals located in smaller

communities experienced decreased assault rates post-enactment.

Discussion: Assault rates among ED and psychiatric unit employees decreased in California following enactment of the law compared to employee assault rates in New Jersey, where specific statewide legislation did not exist. Policy may be an effective method to increase safety to health care workers.

F2.3
Title: Evaluation of Workplace Violence at a Tertiary Hospital
Authors: Sánchez-Arcilla I, Muedra M, Fernandez EM, **Folgado DE**

Introduction: Twenty-five percent of violent actions in the workplace takes place at health centers. A plan to prevent violence and assist workers involved in this kind of situation was introduced in our hospital, an inner-city tertiary care center in June 2005.

Methods: Using the data obtained from the report of violent actions collected by the Occupational Medicine Department from June 2005 to July 2006, a descriptive longitudinal study was conducted.

Results: During the study period, 45 cases were registered. The average reporting delay for the cases was 2.9 days. Aggressions were more likely during the morning (44.44%), 40% took place during the afternoon-evening shift, and 13.33% during the night. 73.33% of the violent actions were verbal, 20% were both verbal and physical aggressions, and 6.6% were physical. 97.77% of the cases did not require any health leave. Nurses were the most affected category of employees (33.33%), followed by nursing assistants (22.22%), medical staff (20%), attendants (20%), and administrative staff (2.2%). Forty-four percent of the reported aggressions took place at the emergency department, 17.78% at medical offices, 28.89% in hospital wards (of which 61.54% took place at nurse's stations and 38.36% in patient rooms), and 8.89% at other places. Visitors were the most common source of aggression (57.77%), and in 42.22% of cases the aggressor was the patient himself. In all reported cases, the aggression was classified as "light."

Discussion: The incidence rate of aggressions found is lower than reported in other studies where the same risk factors were expected. There were no severe physical injuries. The findings make reference to the psychological health of the workers as well as the work environment. There were no cases that brought legal actions.

F2.4
Title: Workplace Violence Prevention in Public Sector Addiction Treatment Centers
Authors: **McPhaul K**, Lipscomb J, Geiger-Brown J, London M, Rosen J

Introduction: Workplace violence in healthcare and social services settings, especially public sector facilities, is on the rise. However, most employers are not addressing this problem in a systematic and effective way. Agreement exists on the primary elements of effective workplace violence prevention programs, and "best practices" are considered feasible. This paper examines the association between violence prevention strategies and the prevalence of three types of workplace violence (verbal aggression, client assault, staff assault) in State-run residential addiction treatment centers (ATCs), adjusting for characteristics of the direct care environment.

Methods: Thirteen ATCs in one northeastern state were the setting for a cross-sectional survey conducted as one risk assessment activity in a 5-year workplace violence intervention study. The intervention project consisted of focus groups that informed the survey and the intervention, an architectural survey, dissemination of findings to direct care staff and management, system level oversight, and organizational program audits at the completion of the intervention period.

Results: The survey, completed at work on work time, yielded a 77% response rate. Analysis of the cross-sectional survey for verbal threats indicated that before adjusting for the six background risk factors, 17% of the variance in verbal violence was explained by the block of eight violence prevention strategies. Adjusting for the six background risk factors in the direct-care environment increased the explained variance to 20%, indicating the importance of prevention strategies in reducing violence. In the final model, a staff's ability to use de-escalation procedures and clients' lack of procedures to make their concerns known to staff were significantly associated with verbal assaults.

Discussion: Workplace violence prevention activities, when perceived as effective by staff, are associated with fewer client acting-out behaviors, verbal violence, and physical assaults.

Session: **F3.0**
Title: Review of Comprehensive Injury Efforts
Moderator: Harlan Amandus

F3.1
Title: A Systematic Review of Occupational Health and Safety Interventions With Economic Analyses
Authors: **Tompa E**, Dolinschi R, de Oliveira C, Irvin E

Introduction: We review the occupational health and safety intervention literature to synthesize the evidence on the financial merits of workplace-based health and safety interventions and to assess the quality of economic analyses undertaken in this literature.

Methods: We identify relevant studies through several sources: structured searches in journal databases, existing systematic reviews of occupational health and safety interventions, a summary table of studies on office ergonomics, and studies identified by content experts. The quality of economic analysis within these studies was assessed, and evidence on the financial merits of interventions was synthesized within industry-intervention-type clusters using a best-evidence synthesis approach.

Results: Our search identified 72 intervention evaluations with economic analyses. In total, we identified 7 industry-intervention-type clusters with sufficient quality and quantity of studies to comment on the financial merits of such interventions and 17 industry-intervention-type strata with insufficient evidence. For two clusters, we identified strong evidence. Specifically, we found strong evidence that ergonomics and other musculoskeletal injury prevention interventions in the manufacturing and warehousing sector are worth undertaking in terms of their financial merits. We also found strong evidence that disability management interventions executed across multiple sectors are worth undertaking.

Discussion: Although few workplace-based occupational health and safety interventions undertake economic evaluations, we did identify 72 that considered both costs and consequences, or at least consequences in monetary terms. We found a number of shortcomings in this literature in terms of its use of economic evaluation methods. Our review of evidence and methods provides insight into which sectors and which types of intervention need to include economic evaluation in future work in order to advance evidence on the financial merits of workplace-based occupational health and safety interventions.

F3.2
Title: Foreign Workers' Safety and Health in the United States
Authors: **Akladios M**, Osornio M

The Occupational Safety and Health Administration (OSHA) is committed to improving safety and health in the workplace for workers regardless of nationality, race, gender, visa status, or age through regulations, standards, and programs. As a result, the number of workplace fatalities has dropped 20% in the last decade. However, the death rate of foreign workers has risen almost 35% in the same period. Various studies have found that factors such as language, education, and culture affect safety at work. Since, the Hispanic population is predicted to double by 2050, companies must act today to find methods to enhance the levels and conditions related to safety and health for these vulnerable workers. Various methods with a proven track record have been used to improve future trends for these workers. This paper discusses the different factors that affect foreign workers' safety perception in the United States and presents a variety of methods to improve these conditions based on proven case studies.

F3.3
Title: Safety and Health in the Wholesale and Retail Trade Sectors: Information Gaps and Research Needs
Authors: **Anderson V**, Nguyen L, Linn H

Wholesale and retail trade (WRT) operations are perceived to provide relatively low-risk employment for workers compared to heavier industry sectors such as construction, agriculture, manufacturing, mining, and transportation. That perception is largely borne by the numbers and rates of illnesses, injuries, and deaths for these entire sectors. However, certain activities within subsectors of WRT are more hazardous than others. For example, cashiers in retail establishments, particularly in convenience stores, small grocery stores, liquor stores, gas stations, and other specialty retail shops, face increased risk of death due to robbery-related violence. Workers in large home centers and warehouse-style superstores seem to be at higher-than-average risk of nonfatal injuries, particularly falls and musculoskeletal disorders. WRT workers in automobile and parts sales (retail) and in certain wholesale subsectors who drive motor vehicles over the highway may face increased risk of injury or death from crashes. Additionally, younger workers, older workers, women, and minority workers who are employed in large and increasing numbers in WRT companies may face higher-than-average risks in

some work environments. This review is intended to summarize the occupational injury, illness, and fatality experience in this broad and diverse slice of U.S. economic activity and review what is known about risks and prevention, with a view toward outlining what yet needs to be discovered about risks, prevention options, vulnerable populations, and emerging issues to address these high-risk activities in WRT subsectors through future research and prevention efforts. The purposes are to inform, suggest, encourage, and facilitate collaborations and partnerships among researchers and the many other individuals and organizations with a stake in protecting workers and promoting economic health in these critical sectors of U.S. industry.

F3.4
Title: A Systematic Review of the Effectiveness of Interventions to Prevent Agricultural Injury and Disease
Authors: **Cryer C**, Lilley R

Introduction: Agricultural injury and disease are significant contributors to the burden of occupational morbidity and mortality in Australasia. This paper presents the findings of a systematic review of the efficacy of interventions to prevent agricultural-related ill health.

Methods: A review was undertaken using literature databases, citation searches, and journal hand searches. The review built upon previous interventional reviews in agricultural injury: one each in adult and childhood injury. Papers published since these reviews were included. Relevant study types included controlled trials and observational studies. All studies were evaluated for methodological quality.

Results: 32 papers were identified for inclusion: 15 involved education interventions; 9 engineering, ergonomic, or personal protective equipment interventions; 2 health screening; 2 financial/ organizational interventions; and 4 mixed interventions. The educational interventions were evenly split between childhood and adult injury prevention. Seven randomized control trials were judged to have excellent methodological quality, and the remaining studies were of moderate quality.

Conclusion: The findings provided very limited evidence of interventions effective at reducing agricultural injuries. Moderate evidence was found for interventions that were effective at improving farm safety behaviors/knowledge but no supporting evidence for subsequent injury reductions. Few studies, mostly of poor rigor, were found that evaluated strategies to reduce farm exposures known to lead to agricultural health problems. Despite a lack of strong evidence for the establishment of an evidence-based agricultural intervention, potentially promising interventions and future directions were identified.

Session: **F4.0**
Title: Preventing Injuries Among Fire Fighters
Moderator: Stephen Miles

F4.1
Title: Preventing Deaths and Injuries of Fire Fighters Working Above Fire-Damaged Engineered Wood Floor Joists
Authors: **Merinar T**, Tarley J

Introduction: Fire fighters are at risk of falling through fire-damaged floors. Fires burning underneath floors can significantly degrade engineered wood floor systems with little indication to the fire fighter working on the floor. Engineered wood I-joists represent an emerging technology in the building sector that offers several advantages over traditional sawn lumber. It is estimated that engineered wood I-joists are used in over half of all new wood-frame construction.

Methods: The NIOSH Fire Fighter Fatality Investigation and Prevention Program conducts investigations of fire fighter line of duty deaths to identify causal factors and formulate recommendations for preventing future deaths and injuries. The program does not seek to determine fault or place blame but to learn from these tragic events and prevent future similar occurrences.

Results: Structure fires are the third leading cause of fire fighter fatalities, behind only CVDs and motor vehicle incidents. In the past 2 years, NIOSH has investigated 3 incidents involving 3 fire fighter fatalities and 1 injury in which the fire fighters fell through fire-damaged engineered wood floors containing I-joists. The use of engineered wood I-joists and other engineered wood products will continue to increase.

Conclusions: Evidence collected during NIOSH investigations suggest that fire fighters may not be adequately trained in recognizing the hazards of working above fire-damaged engineered wood floor systems. Fire fighters need to be trained to identify

the presence of engineered wood I-joists and actions they can take when engineered wood floor systems are encountered. Fire Departments need to identify structures within their jurisdiction containing engineered wood products through pre-incident planning and inspections and develop appropriate response procedures. Builders, contractors, and owners should consider protecting engineered wood I-joists by covering the underside with fire-resistant materials.

F4.2

Title: Preventing Fire Fighter Deaths and Injuries Caused by Failure to Wear Vehicle Safety Restraints

Authors: **Lutz V**, Romano N

Introduction: The National Fire Protection Association (NFPA) reports that motor vehicle incidents are consistently the second leading cause of on-duty fire fighter fatalities. A NFPA 30-year study (1977-2006) reveals that only 13% of the 406 fatal crash victims were wearing safety restraints, and 45 fire fighters died when they fell from a moving apparatus.

Methods: The NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) studies fatal fire fighter occupational incidents, with the goal of identifying effective prevention measures. Through on-site investigations, FFFIPP personnel collect agent, host, and environmental information from the pre-event, event, and post-event phases of the fatal incident.

Results: A review of FFFIPP investigations from 1998 - 2007 identified 63 motor vehicle related cases involving the death of 46 fire fighters where not being seated and restrained in a moving vehicle likely contributed to the fatality. Relevant findings from these investigations include: (1) fire departments often have established safety restraint standard operating procedures (SOPs) that are not enforced, and (2) there have been instances when fire fighters had to remove safety restraints to perform required tasks because of apparatus/equipment design and/or placement.

Conclusions: Evidence collected during FFFIPP investigations suggests that fire departments must not only develop, but need to enforce SOPs that require all occupants in moving apparatus to be seated and restrained at all times the vehicle is in motion. Manufacturers, fire departments, and those who refurbish emergency vehicles must take into consideration all movements needed to reach equipment and ensure that safety restraints can be worn by all occupants when performing required tasks.

F4.3

Title: Physiological Effects of Boot Weight in Men and Women Fire Fighters

Authors: **Turner N**, Chiou S, Zwiener J, Weaver D, Spahr J, Sinkule E, Haskell W

Introduction: Most fire fighters wear heavy rubber boots or lighter leather boots. Increases in oxygen consumption per kg of weight added to the foot may depend on gender, boot material, and whether or not subjects are wearing additional protective clothing or equipment.

Methods: Twenty-five men and 25 women fire fighters, while wearing full turnout clothing, a 10.5-kg backpack, gloves, helmet, and one of six randomly assigned pairs of fire fighter boots, walked for six minutes at three mph on a treadmill while carrying a 9.5-kg hose and then climbed a stair ergometer for six minutes at 45 steps per minute.

Results/Discussion: Minute ventilation (VE), oxygen consumption (VO2 and VO2kg), CO2 production (VCO2), and heart rate (HR) were measured, and an average of the breath-by-breath data from minute six was used for analysis. During treadmill exercise, boot weight had a significant effect ($p \leq 0.05$) on VO2, VO2kg, and VCO2 in men and women; boot weight had a significant effect ($p \leq 0.05$) on VE and HR for men only. In men, a 1-kg increase in boot weight caused a 9% increase in VE and 6 - 8% increases in VO2 and VO2/kg. The increase in VE observed in men could result in an approximate 8% decrease in service time for a 45-min SCBA cylinder. In women, 3% increases in VO2 and VO2/kg were observed. Gender differences observed during treadmill walking may be due to a decrease in women's stride length while carrying a load. During stair climbing, a 1-kg increase in boot weight caused a 3.5% increase in VO2 in men only ($p \leq 0.05$). This 3.5% increase is less than the 5% increase observed in a previous study of leather and rubber boots where subjects wore only gym shorts and may reflect a diminished effect of boot weight with full turnout gear.

F4.4
Title: Survey Evaluation of the Fire Fighter Fatality Investigation and Prevention Program
Authors: **Wassell J**, Peterson K, Amandus H

Introduction: In the Fire Fighter Fatality Investigation and Prevention Program (FFFIPP), NIOSH conducts investigations of fire fighter line-of-duty deaths to formulate recommendations for preventing future deaths and injuries. This evaluation was conducted to assess the effects of these recommendations on safety knowledge, attitudes, and behavior of fire fighters and to identify strategies for improvement.

Methods: During spring 2006, a Fire Department Survey was mailed to the Fire Chiefs of a stratified random sample of 3,000 fire departments across the country. The sample included the following specific groups: all 208 fire departments that had experienced a FFFIPP investigation as of December 31, 2003; a random sample of 215 fire departments where a fire fighter fatality had occurred but no FFFIPP investigation had been conducted; the 10 largest fire departments (by size of the protected population); and a stratified random sample of 2,575 fire departments where there had not been a fatality as of December 31, 2003. The survey consisted of 62 items related to standard operating procedures, standard performance requirements, fire fighter training, communication of safety practices and investment in safety equipment.

Results: The overall response rate for the survey was 54.9%. Most officers surveyed were familiar with NIOSH and have read a FFFIPP report; over half were not familiar with the FFFIPP investigation program itself. Fire department officers learn about FFFIPP recommendations primarily through NIOSH mailings, trade publications, and websites. NIOSH recommendations have been used by some 11,000 fire departments to update the content of their training programs.

Conclusions: The kinds of fire departments that most likely follow NIOSH's safety guidelines are career fire departments in large, urban jurisdictions in the Northeast. The most common recommendation from the survey is for improvements in the ways FFFIPP materials are disseminated and marketed.

Session: **F5.0**
Title: Safety Practice I
Moderator: Mahmood Ronaghi

F5.1
Title: Operator Presence System: From Design to Implementation
Authors: **Ammons D**, Powers J, Brand I

Introduction: Due in part to human factors concerns hydraulic stump cutters have historically not been equipped with an Operator Presence System. Manufacturers and dealerships provide extensive documentation on the proper operation and safe use of the machine. However, some operators who have not followed these procedures have been injured. An Operator Presence System could be useful in preventing accidents where the operator approaches the cutter wheel with the clutch still engaged. Such a system must permit productive operation without interfering excessively with operator interaction with controls and creating operator difficulties such as hand/arm fatigue. To solve this problem, NIOSH and Vermeer Manufacturing Company collaborated to investigate applying capacitive sensing technology to detect the operator at the controls of a stump cutter.

Methods: Vermeer and NIOSH agreed that NIOSH would investigate the feasibility of detecting an operator's location at the stump cutter controls. If this was determined to be feasible, Vermeer would refine and change the design as necessary and adapt it to hydraulic stump cutters. To this end, Vermeer provided NIOSH with various stump cutter components and general guidelines for mounting locations. NIOSH developed prototypes, conducted initial testing, and determined that sensing the operator's hand capacitively was probably feasible. Vermeer built from the successful work of NIOSH, made substantial improvements, and configured the design for use on hydraulic stump cutters. Field trials have now proven this design to be successful on the Vermeer SC252 and production has begun.

Results/Conclusions: The result of this successful collaboration between NIOSH and Vermeer will help reduce the likelihood of injuries to an operator who approaches the cutter wheel without first disengaging the cutter wheel drive. Details regarding the early developments of this safety system along with the mechanisms used to establish this partnership will be discussed.

F5.2

Title: Comparison of Anti-vibration Interventions for Use With Fastening Tools in Metal

Authors: **Dale AM**, Burwell A, Hoeckelman L, Braunschweig L, Kilwin J, Standeven J, Rohn A, Patton A, Shannon W, Kick T, Evanoff B

Introduction: Occupational vibration exposure is associated with neurological and musculoskeletal injuries to the upper extremity. Some laboratory-based studies have validated the effectiveness of different types of commercial vibration-damping materials. This study evaluates the effectiveness of several anti-vibration gloves and an anti-vibration wrap under actual working conditions in a large manufacturing setting.

Methods: Three experienced sheet metal workers performed five metal fastener installations for bare hand, an anti-vibration tool handle wrap, and five different anti-vibration gloves for a total of 105 installations. Vibration energy was recorded with two tri-axial accelerometers placed on the tool handle and one on the back of the hand and analyzed according to standard practice. Subjects completed a user questionnaire following each intervention.

Results: All six interventions showed reduced vibration measured on the hand, when compared to the bare hand condition (mean hand vibration range for interventions = 0.31–0.57 Gs; mean hand vibration on bare hand = 1.32 Gs; $p < 0.0001$). Vibration measured at the tool handle showed differences for only the anti-vibration wrap (1.20 Gs) when compared to the bare hand (1.68 Gs). The pilot for this study showed large variability of subjects' mean vibration values of the air bladder intervention (range = 0.84–3.33Gs) caused by improper inflation. Subjects reported variable subjective responses to each intervention, but preferred fingerless gloves and gloves with wrist support.

Conclusions: This study indicated that vibration damping gloves and wraps consistently reduced vibration values during the specific work conditions measured at the hand. While anti-vibration products are typically tested in laboratory settings, to assess the true protection levels testing should mimic working conditions. Because all interventions showed similar effectiveness, suggesting that choice of intervention should be guided by ease of use and worker preference.

F5.3

Title: Forklift-Related Injuries

Author: **Windau J**

Introduction: Each year, about 120 fatal work injuries result from operating or working near forklifts. Recent data show that these fatalities are on the rise. A substantial number of nonfatal injuries, many with long absences from work, also result from working in or around forklifts. Moreover, OSHA's powered industrial truck standard is one of the most frequently cited standards in certain industries.

Methods: Data from the BLS occupational injury and illness programs were used to compile information on fatal and nonfatal injuries involving forklifts. A number of variables were reviewed, including occupation, industry, and demographic characteristics of the fatally injured worker and circumstances surrounding the incident (activity of the worker at the time, location of the incident, and other objects or equipment involved). Narrative fields on the data records were examined to obtain additional information about the incident.

Results: Industries with the highest totals of forklift-related injuries included manufacturing, construction, transportation and warehousing, and wholesale and retail trade. The types of incidents in which workers were injured included being struck by the forklift, being struck by another object, being caught under an overturning forklift, and falls. About 65 percent of the fatality victims were performing an activity other than operating the forklift at the time of the incident.

Discussion: In addition to targeting forklift operators, prevention efforts must be directed towards workers who repair lifts, those who load and unload lifts, those riding on or working from forklifts, and others working in the area of forklifts.

F5.4

Title: Toward Safer Stairways: Evaluation of the Nose-to-Nose Method for Measuring Uniformity of Steps in a Flight of Stairs

Authors: **Jensen R**, Jensen L, Ross C

Many injuries result from falling on stairs. Experts on stairway safety agree that nonuniformity of steps on a flight is a major risk factor for falls. As a result, standards organizations have incorporated requirements for uniformity of step risers and tread depth. These assume the measurement system is capable of determining compliance. The state-of-the-art measurement system is a relatively new method

known as the nose-to-nose method. It involves measuring the distance between the noses of adjacent steps and the angle formed with the horizontal. From these measurements, the lengths of the riser and depth are calculated.

This study examined the concordance of compliance determinations for intra-observer repeatability and inter-observer reproducibility. The definition of compliance used the guidelines in the 2007 ANSI Standard for uniform risers and tread depths on flights of stairs. Six flights were randomly selected from stairs in three campus buildings. Two observers measured all six flights, twice each. Each step in the flights was marked in three places (left, center, and right), yielding 774 measurements. Cohen's Kappa statistic served as the indicator of concordance for the independently determined conclusions of compliance or noncompliance with the standard.

Results for repeatability of adjacent step risers indicated the first and second measurements by the observers agreed for 313 out of 336 compliance determinations (Kappa = 0.85). For repeatability of adjacent tread depth data, their first and second measurements agreed on 244 of the 300 compliance determinations (Kappa = 0.51). Results for maximum differences within a flight used the measurements taken in the center of each step. Of the 24 determinations of flights compliance, agreement was obtained on 23 for riser compliance; and on 22 for depth compliance. Procedures for improving reliability of stairway measurement will be discussed.

Session: **G1.0**
Title: Injuries Among Electric Utility Workers
Moderator: Richard Current

G1.1
Title: Work-Related Motor Vehicle Crashes Among Electric Utility Workers
Authors: **Fordyce T**, Kelsh M, Mezei G

Introduction: Few studies have specifically focused on work-related motor vehicle crashes, despite the large impact these accidents can have on worker morbidity and mortality. Only one study to date has specifically focused on crashes among electric utility workers. The objective of this pilot study was to examine the feasibility of using vehicle crash reports to more accurately define and describe work-related motor vehicle crashes and crash trends among electric utility workers.

Methods: Crash reports and data from personnel files were collected from three utilities for the years 2000, 2004, and 2005. Data were standardized into a consistent, common format for comparison purposes. Crash rates were expressed in terms of the number of crashes per 100 employees during a year of follow-up.

Results: The overall crash rate for the three utilities combined was 2.49 crashes per 100 employee-years. The rate of crashes has increased over time, but the increase is not statistically significant. The highest crash rates by occupation varied by utility, though office-based staff had the lowest crash rates across utilities. Employees under the age of 20 had the highest crash rate, and male employees had a significantly higher crash rate than female employees. Employees with less than 1 year of experience had the highest rate of crashes followed by workers with more than 20 years of experience.

Conclusions: The findings from this pilot study indicate that a larger study of vehicle crashes is feasible; however, the quality and completeness of crash and exposure data need to be improved. The crash data currently provided by the utilities frequently lacks complete information on the circumstances surrounding crashes and the occupants involved. These data may exist on hardcopy forms and are not incorporated into an electronic database, or they may not be routinely reported.

G1.2
Title: Factors That Distinguish Serious Versus Less Severe Strain and Sprain Injuries: An Analysis of Electric Utility Workers
Authors: Kelsh M, Fordyce T, Lau E, Mink P, **Morimoto L**, Lu E, Yager J

Introduction: Occupational sprain and strain injuries are one of the most common types of nonfatal occupational injuries and a significant source of lost workdays. This study examines factors associated with severe work-related sprain/strain injuries to the back, shoulder, and knees among electric utility workers using data from the Occupational Health Surveillance Database (OHSD).

Methods: A synthetic case control study was performed. Cases included all electric utility workers who had experienced a severe work-related sprain/strain injury to the back, knee, or shoulder. Primary controls were selected from all workers who had sustained a minor injury. Secondary controls were selected from employees with a minor sprain/strain injury to the back, knee, or shoulder. Multivariate

logistic regression models were used to estimate odds ratios and 95% confidence intervals.

Results: Middle and older age workers (< 40 years) were more likely to have experienced severe shoulder sprain/strain injuries (age 41–50: OR = 3.62, 95% CI: 1.71–7.65; age 51 and older: OR = 4.49, 95% CI: 1.89–10.67) and severe back sprain/strain injuries (age 41–50: OR = 1.70, 95% CI: 1.06–2.33; age 51 and older: OR = 1.5, 95% CI: 0.90–2.52). Line workers and maintenance workers had an increased risk of serious sprain/strain injuries. Gender and day of week were not significantly associated with sprain/strain injuries.

Conclusions: Increasing employee age was a strong predictor of both sustaining a back or shoulder injury, as well as requiring time away from work once the injury occurred, independent of years of experience on the job. Certain occupational groups, such as line workers, were not only at increased risk of acquiring sprain/strain injuries compared to office workers, but also of requiring time off from work after sustaining the injury. This study is limited by available data, but future studies may benefit from this preliminary examination of occupational and demographic characteristics associated with sprain/strain injuries among electric utility workers.

G1.3

Title: Work-Related Injury Trends Among Electric Utility Workers

Authors: **Fordyce T**, Kelsh M, Mezei G, Morimoto L

Introduction: Currently, only limited injury surveillance data for the electric utility workforce exist. To address this gap, an Occupational Health Surveillance Database (OHSD) for electric power utilities was established for epidemiologic monitoring and intervention program evaluation. The OHSD currently integrates 12 years (1995–2006) of personnel, injury, and claims data from sixteen electric utilities into a single database. The current data set includes more than 1,000,000 employee years of follow-up and more than 35,000 lost time and recordable injuries.

Methods: Injury rates were calculated by occupational and demographic factors and expressed in terms of injuries per 100 employees during a year of follow up. Confidence intervals assuming an underlying binomial statistical model were calculated where appropriate.

Results: Overall, injury rates have declined over the 12-year study period. Injury rates varied across utility occupations, from 0.38 per 100 employee-years for managers to 14.07 per 100 employee-years for meter readers. Meter readers, line workers, and welders had the highest observed injury rates. Compared with male workers, the risk of injury among female workers was lower overall, although their risk was higher in some nonoffice occupations than their male counterparts. Injury rates among younger workers were disproportionately high relative to their representation in the workforce. Sprains and strains were the most commonly reported injuries. The back and hand/fingers were the most commonly injured body regions, while injuries to the back, neck, and knees were the most severe.

Conclusions: Many of the trends observed among electric utility workers are similar to other service and manufacturing workers. Our results suggest that benchmarking and prevention efforts should be directed at specific occupational groups and specific injury types.

G1.4

Title: Development of an Electric Field Sensor for Electrical-Proximity and Contact Detection

Authors: **Zeng Shengke**, Powers John R, Newbraugh Bradley H

Introduction: The 998 electrocution deaths in 2003–2006 accounted for 5.8% of total U.S. occupational fatalities. Most victims (73.9%) had fatally contacted overhead power lines, wiring, or other electrical components. To protect workers from touching live wires, NIOSH developed a digital electrical proximity/contact sensor that workers wear for the purpose of alarming the worker and others as it detects the worker's proximity/contact to live wires.

Methods: The sensor senses 60-Hz electric fields emitted from live wires to a worker's wrist. The field level on the wrist increases as the worker goes closer to the wire. The sensor includes a pair of capacitive electrodes attached on one wrist that detects electric fields, a 60-Hz filter that rejects interference signals, and two amplifiers (with an adjustable gain) that amplify electric field signals. To determine whether the field variations on simulated human wrists are detectable by the above electrode/electronic setup, an experiment was conducted using the sensor to sense electric fields on 10 hog legs at low/high voltages.

Results: At 120 volts, the sensor with the gain of 64,931 sensed 1.3 microvolts on a hog leg as the leg was 100 centimeters away from an energized simulated power line, and 17.5 microvolts as the leg was moved to 1 centimeter to the wire. As the leg contacted the bare wire, the sensor measured 473.7 microvolts with the reduced gain of 3,135. At 9,000 volts, with the gain adjusted to 571, the sensor sensed 90.9 to 2,456.4 microvolts as the leg was moved the same distance as above.

Conclusions: The electrode/electronic setup has enough sensitivity and dynamic range to detect hog legs' electrical proximity and contact to an energized power line.

Session: **G2.0**
Title: Workplace Violence Risk Factors
Moderator: Hope Tiesman

G2.1
Title: Place Characteristics of Industries at High Risk for Worker Homicide
Authors: **Ta M**, Marshall S, Kaufman J, Land K, Casteel C, Loomis D

Introduction: Social influences on violence have implications for workplace exposure to violence. This study aimed to identify area-based socioeconomic factors related to presence of workplaces belonging to industries at high risk for worker homicide.

Methods: North Carolina workplaces were assigned to 2000 United States Census block groups (BGs) based on spatial location. Census BGs (n = 3925) comprised the unit of analysis and were categorized as containing none (referent), high (> 15%), medium (11%–15%), or low (1%–10%) proportions of high risk workplaces (HRWP), defined as industries reported in the literature to be at high risk for homicide. Thirty Census-derived variables were selected a priori as potentially predictive of violence and summarized using factor analysis. Three factors were extracted: poverty/deprivation, human/economic capital, and transience/instability. Multinomial logistic regression was used to assess the association between quartiles of the BG-level factor scores (mutually adjusted for each other) and the proportion of HRWP in each BG.

Results: All three factors (poverty/deprivation, human/economic capital, and transience/instability) were independent predictors of the proportion of HRWP. Increasing level of poverty/deprivation and transience/instability were associated with a higher proportion of HRWP (OR = 1.98, 95% CI: 1.47, 2.67 for 4th vs. 1st quartile of poverty/deprivation and OR = 1.77, 95% CI: 1.31, 2.37 for 4th vs. 1st quartile of transience/instability, comparing high to no HRWP). Increasing human/economic capital, on the other hand, was associated with a lower proportion of HRWP (OR = 0.65, 95% CI: 0.49, 0.87 for 4th vs. 1st quartile comparing high to no HRWP).

Conclusions: Areas with more poverty and transience, and less human capital, contain a higher proportion of HRWP. Social processes leading to diminished social control likely play a role in this relationship.

G2.2
Title: Burnout: The Risk of Physical Assault
Authors: **Pinder ED**, Gerberich SG, Alexander BH, Church TR, Hansen J-IC, Ryan AD

Introduction: Burnout, which can emerge from chronic stressors, has been associated with absenteeism and lower organizational commitment, cardiovascular disease, and sleep disturbances. Burnout is defined as an affective reaction to ongoing stress caused by the gradual depletion over time of an individual's energetic resources. These reactions in teachers can include negative attitude and cynicism towards students. Teachers may repeatedly react to disruptive and aggressive students with criticism and punishment, rather than using positive attention to control a situation. This can potentially lead to anger and defiance among students and, consequently, cause them to attack teachers. While burnout has been assessed in teachers, it has not been examined previously as a possible risk factor for physical assault.

Methods: A nested case-control study of licensed Minnesota educators (n = 290 cases and n = 867 controls) examined burnout, using the Shirom-Melamed Burnout Measure Version 2, as a risk factor for physical assault. Cases reported at least one physical assault in the past 12 months and reported on exposures from the month prior to assault. Controls reported on exposures from a randomly selected period of time in which they worked. Potentially confounding variables were selected for multiple logistic regression analyses, using directed acyclic graphs; re-weighting adjusted for nonresponse and unknown eligibility biases.

Results: Compared to those reporting "Infrequently" experiencing feelings of burnout, the risk of physical assault was increased for those indicating "Always" (OR = 2.64, 0.94–7.4), "Frequently" (OR = 1.71,

1.03–2.82), and "Sometimes" (OR = 1.11, 0.77–1.61), and decreased for those indicating "Never" (OR = 0.27, (0.07–0.93). Risk of physical assault increased for those educators in the 80th percentile scoring level compared to others (OR = 1.71, 1.20–2.44).

Conclusions: Burnout was associated with increased risk of physical assault. This is a first step in examining violence as an outcome for burnout for this population, and serves as a basis for further in-depth research.

G2.3

Title: Environmental Violence and Physical Assault Against Teachers

Authors: **Gerberich S**, Nachreiner N, Ryan A, Mongin S, Church T, McGovern P, Geisser M, Feda D, Sage S, Pinder E, Watt G

Introduction: Teachers are known to be at high risk for work-related violence; however, data specific to risk factors are limited. Data from a case control study were analyzed to determine the effect of reported environmental violence on work-related physical assault among educators working in kindergarten through grade 12 schools.

Methods: From the Minnesota license database, 26,000 randomly selected educators were screened for eligibility by mailed questionnaire; 6,180 were eligible for data collection. Phase 1 (12-month recall) identified eligible cases (n = 290) and controls (n = 867) and characteristics of the violent events; Phase 2 (case control, recall from the calendar month before the violent events for cases or a randomly selected month for controls) enabled identification of environmental exposures. Confounders were selected for multiple logistic regression analyses using Directed Acyclic Graphs with reweighting for nonresponse biases.

Results: Response rates for each phase were 84%. Assaults were primarily perpetrated by students (95%). Respective risks (ORs; 95% CIs) for physical assault increased for educators working in environments where they witnessed students involved in physical assault 1–3 (2.94, 1.95–4.43), 4–10 (6.61, 3.73–11.72), 10+ (15.66, 7.84–31.27) versus zero times; threat 1–3 (1.49, 0.97–2.27), 4–10 (4.07, 2.40–6.90), 10+ (8.25, 4.57–14.91) versus zero times; sexual harassment 1–3 (1.94, 1.30–2.89), 4–10 (3.31, 1.73–6.36), 10+ (9.97, 4.47–22.23) versus zero times; verbal abuse, 10+ versus zero times (3.86, 2.26–6.57); bullying, 10+ versus zero times (3.21, 1.89–5.46). Witnessing persons, other than students, engaged in violence was also important: physical assault 1–3, 4–10+ versus zero times (3.14, 1.67–5.88; 11.61, 1.78–75.64).

Discussion: Teachers were at increased risk for physical assault in environments where they witnessed students and others engaging in violent behaviors. Examination of such environments, in concert with other environmental characteristics, is essential for developing intervention efforts to protect educators and others in schools.

G2.4

Title: EMS Providers' Exposure to Violence

Author: **Heick RJ**

Introduction: Nearly half of patients involved in emergency department violence are transported by EMS personnel, making it likely that EMS providers would be at increased risk of exposure to violence and injury in the line of duty.

Methods: This cross-sectional study examined the relationship between assault injuries and patient restraint policies, looking at odds of physical assault and subsequent injury across multiple variables.

Results: Physical assault was reported by 147 (22%) of the 660 EMS providers who responded to the survey, with a total of 267 physical assaults reported. Physical assault was twice as frequent among paid providers versus volunteers. The patient was the most frequently identified perpetrator, with no significant difference found between paid and volunteer providers (p = 0.41). For both groups, the most common patient condition reported for patient-perpetrated assaults was use of alcohol or other drugs, followed by the "other or unknown" category. Nearly one third of assaults among paid and volunteer providers occurred while they were restraining or attempting to restrain a patient. Injury from physical assault was reported in 8% of paid and 7% of volunteer provider assaults (n = 26 injuries). No significant differences in training in handling of aggressive or combative patients were found between paid and volunteer providers. Training was not found to significantly decrease odds of physical assault. Written patient restraint policies were reported by 63% of paid and 42% of volunteer providers. Odds of physical assault decreased with law enforcement only policies (0.60, 95% CI 0.38–0.93) and increased when policies included chemical restraint (1.46, 95% CI 1.08–1.98).

Discussion: Exposure to violent or aggressive behavior is a significant problem for EMS providers.

Additional research is needed to examine assault circumstances, provider education related to violence, and law enforcement only policies.

Session: **G3.0**
Title: Evaluating Mining Safety Initiatives
Moderator: Robin Burgess-Limerick

G3.1
Title: Reduction of Fire Hazards on Large Mining Equipment
Author: **DeRosa MI**

Analysis of mining equipment fires from 1990 to 1999 shows that there were 340 large mining equipment fires, resulting in 72 injuries and five fatalities. Many of the fires resulted in the loss of equipment and all posed potential or real risks to the operator. In 97 cases, the fires raged out of control due to engine shutoff failure, even upon activation of the machine fire suppression system (30-s discharge time), due to the spraying of pressurized hydraulic fluid and fuel onto the engine hot surfaces. In other cases, even after engine shutoff, the fires reignited, fueled by the continued flow of flammable fluids, remaining in the lines, onto the engine hot surfaces. In many of the fires, flammable vapors, evolved during the spraying of pressurized and combustible fluids, penetrated the cab, violently igniting, forcing the operator to exit under very hazardous conditions.

The use of emergency evacuation lines in the fuel and hydraulic fluid systems, the use of fire-resistant hydraulic fluids, and methods to prevent the spraying of pressurized fluids onto the engine hot surfaces would greatly improve the chances of successfully suppressing large mining equipment fires. In addition, the use of systems for preventing the ignition of flammable vapors inside the cab and suppressing fires originating in the cab would greatly enhance operator safety. The National Institute for Occupation Safety and Health (NIOSH) recently conducted experiments on methods to reduce the fire hazards associated with large mining equipment.

These experiments evaluated the use of cab inerting systems (presently commercially available) to prevent the ignition of flammable vapors inside the cab and suppress fires originating in the cab while maintaining a breathable atmosphere for the operator to bring the equipment to a stop and safely exit the cab. NIOSH also has developed and evaluated various fire barriers to prevent the spraying of hydraulic fluids and fuel onto simulated turbocharger hot surfaces. The laboratory experiments are being accompanied by field studies. These methods may be viable additions to existing engine fire detection and suppression systems to greatly reduce large mining equipment fire hazards and enhance operator safety.

Industrial Hygienist, National Institute for Occupational Safety and Health, Pittsburgh Research laboratory; e-mail, mgd8@CDC.gov; tel. 412-386-4965

G3.2
Title: Making it Safer with Roof Screen: Evaluating the Invention Effectiveness of an Occupational Safety Communication Product in the Mining Industry
Author: **McConnell G**

Introduction: While occupational health and safety research fits within the larger umbrella of public health work, it has lagged behind in conducting evaluations measuring the impact or utilization of ideas, processes, practices, and products, or, alternatively, intervention effectiveness studies. In an effort to better integrate evaluation research with occupational health and safety efforts, researchers at the National Institute of Occupational Safety and Health (NIOSH) Pittsburgh Research Laboratory (PRL) implemented a process evaluation of a safety communication product for the mining industry, focusing on its marketing, dissemination, and content. *Make It Safer with Roof Screen*, a video module, was written, produced, and distributed by the National Institute of Occupational Safety and Health (NIOSH) Pittsburgh Research Laboratory (PRL) and describes the use of roof screen to prevent roof-fall injuries in underground coal mines.

Methods: This presentation will describe the implementation of a process evaluation of this translational effort that utilized a mixed-methods evaluation design, incorporating both quantitative and qualitative data collection methods.

Results: Quantitative data provided evidence that the anticipated audience was reached, that there was secondary distribution of the video, that the video was being used for the intended purpose, and that some recipients used the information to modify current roof screening or to begin roof screening at their mine. Qualitative data identified strengths and weaknesses in the content and distribution and marketing of the video.

Conclusions: Based on evidence collected via the various methods, the evaluator provided a number of

recommendations to the production team of *Make It Safer with Roof Screen*. The results of this evaluation can assist other occupational safety and health researchers in both the development and evaluation of future information translational efforts.

G3.3
Title: Evaluation of Peripheral Visual Performance When Using Incandescent and LED Miner Cap Lamps
Authors: Sammarco J, Gallagher S, Bartels J, **Reyes MA**

Introduction: Illumination plays a critical role in an underground miner's safety because miners depend most heavily on visual cues to recognize hazards. Mobile mining machinery, located in the miner's peripheral field-of-view (10° to about 60° off-axis), pose potential pinning and striking hazards. The main objective of this research was to determine if there were peripheral visual performance improvements for the detection of moving objects when using cool-white light-emitting diode (LED) cap lamps as compared to incandescent light bulbs commonly used in miner cap lamps. The second objective was to determine if age is a factor for peripheral visual performance. Recent research has indicated that the spectral power distribution of LEDs can improve visual performance for mesopic lighting conditions similar to those encountered in underground mines.

Methods: Thirty subjects participated in the study, ten subjects in each age group: younger (18 to 25 years), middle (40 to 50 years), and older (50+ years). Visual performance was quantified by the subjects' speed and accuracy in detecting the rotation of high-contrast circular targets located 3.83 meters (m) away at -20°, 40°, and 50° off-axis. Subjects pressed a switch to activate a visual tracking task intended to focus eye orientation to a target located 3.83 m away at 0 degrees. Next, one of the targets at -20°, 40°, and 50° would rotate. The subject would then release a switch upon detecting the rotation. The speed and accuracy of detection was measured.

Results/Conclusions: The results of the visual performance comparison between LED and incandescent cap lamps suggest that cool-white LEDs do improve peripheral visual performance by 15% to 20%. Age does appear to be a significant factor. The middle and older age groups' target movement detection time declined 87% and 65%, respectively.

G3.4
Title: Evaluation of Discomfort and Disability Glare From Incandescent and LED Miner Cap Lamps
Authors: Sammarco J, Mayton A, **Lutz T**

Introduction: The National Institute for Occupational Safety and Health (NIOSH) is conducting mine illumination research to determine if light emitting diode (LED) cap lamps can improve safety by reducing glare. Glare can impede a miner's ability to see hazards and to safely perform their work. Another objective is to determine if age is a factor for glare (average miner: 43 years old).

Methods: Three cap lamps were used to evaluate glare: an incandescent cap lamp, a commercially available LED cap lamp, and a NIOSH prototype LED cap lamp. Thirty NIOSH personnel from the Pittsburgh Research Laboratory (PRL) served as test subjects (three age groups, ten subjects in each group). Testing was conducted in the Mine Illumination Laboratory (MIL) of NIOSH PRL. The MIL is a simulated underground coal mine environment equipped with various test apparatus and instrumentation.

Results: The results indicate no statistically significant difference in discomfort glare among the incandescent and LED cap lamps. However, an analysis of variance for disability glare indicates that the LED cap lamps were superior for the older subjects. Disability glare scores for the oldest subject group improved 53.8% when using the NIOSH prototype LED cap lamp compared to the incandescent cap lamp and 36.5% compared to the commercial LED cap lamp.

Discussion: It appears that, given the conditions of this study, LED cap lamps will not increase discomfort glare and can enable significant improvements for disability glare for older workers. It is also evident that not all LEDs are created equal. The disability glare improved the best for older workers when they used the NIOSH prototype LED cap lamp which has a different spectral power distribution (SPD) (more short wavelength energy) than the commercial LED cap lamp. Therefore, for disability glare, the results suggest that the SPD is an important factor to consider in cap lamp design.

Session: **G4.0**
Title: Effects of Work Organization of Safety
Moderator: Max Lum

G4.1
Title: Risk Evaluation Index of Psychophysical Hazard Exposures in Electronics and Garments
Author: **Lu JL**

Introduction: An investigation of the effects of organizational factors in industries that use information technology in garments and electronics industries in the Philippines. It consisted of a cross-sectional study of 23 establishments and 630 respondents in both electronics and garment industries in export zones in Cavite and Laguna.

Methodology: This investigation used questionnaires, walk-through survey of industries, and interviews.

Results: The results showed differences between electronics and garment industries, and among industry sizes ($p = .05$). Work pressure was also 27% more likely to occur in electronics than in garments. The electronics industries were 62% more likely to have health and safety policies and 72% more likely to have better policies and benefits than the garment industries. On the other hand, the garment industry was 62% more likely to have hazardous work. Logistic regression showed that indeed organizational factors affect the health of women workers ($p = .05$).

Discussion: The overall physical health of workers was affected by overtime and mental work. Moreover, workers who have autonomy in making use of their own strategy to accomplish their work were likely to have higher level of physical health. Poor quality of work and exposure to hazardous work also increased chances of having low physical health among workers. Organizational factors and hazard exposures were also seen to affect specific illnesses such as low back pain, skin allergies, abortion, visual problems, and anemia ($p = .05$).

G4.2
Title: Is Current Workload Too Much for Nurses to Handle? Psychophysiologic Evidence From Hospital Settings
Authors: **Chen J**, Davis S, Wei P, Davis K, Daraiseh N

Introduction: National surveys consistently report that excessive workload was cited by hospital nurses as one of the top reasons for their high turnover rate, medical errors and poor well-being. However, little evidence is available to support that current hospital workloads exceed nurses' psychophysiological work capacity level. This study was to examine among female hospital registered nurses (RNs), whether their energy expenditure (EE), heart rate (HR) and work pace (WP) of a 12-hour day shift indicate psychophysiological strain.

Methods: A convenience sample of 145 female hospital RNs in Midwest completed a demographic survey, a work diary, and wore a physical activity monitor for a 12-hour day shift to continuously record their HR and WP (counted by extremities movement), which were later calculated to EE.

Results: The total EE of a 12-hour day shift was 7.32 ± 4 Mets/hour. The average HR was 97 bpm; 36% of RNs experienced HR of over 100 bpm throughout the shift. WP intensity was significantly higher in 8 a.m.–3 p.m. than in 3 p.m.–7 p.m. ($p = 0.008$), whereas EE intensity and HR constantly stayed at intense level without significant changes ($p = 0.080$ and $p = 0.419$, respectively). In addition, repeated-measures MANCOVA revealed that interaction among shift period, years of nursing experience, body discomforts at work were associated with the shift periods' difference of WP intensity (Wilks' Lambda 0.613, $p = 0.020$).

Discussion: RNs' WP intensity decreased over the shift hours while EE intensity and HR constantly stayed at strenuous level. Such finding indicates a pacing attempt by nurses to alleviate their psychophysiologic strain. The results should raise industrywide concerns about hospital nurses' health and patient safety. Staffing policy design and individual work/rest scheduling should take into account of nurses' psychophysiological work capacity level.

G4.3
Title: Safety Issues in the Workplace Confronting Those in Extended Shift Work
Authors: **Lu JL**

Introduction: The study looked into the occupational hazards and injuries among 500 workers in 10 semiconductor industries in Cavite Export Processing Zone in the Philippines.

Methods: The subjects included only those who were doing extended shift work beyond 8 hours, specifically 12 hours. Industries were classified as small-, medium-, or large-scale industries based on the number of workers in the company. This is a parametric study using stratified sampling where

instruments included workplace ambient monitoring, safety investigation, medical records review, survey questionnaires, and interviews.

Results: For the 500 workers given questionnaires, problems cited for work conditions included poor housekeeping, slippery floors, uneven floors, no machine guard, insufficient work area, and insufficient warehouse/storage area. These conditions may predispose a worker to accidents and injuries. The top five most frequent stressors for both male and female workers were overtime, fast-paced work, repetitive work, mental fatigue, and visual strain. The most prevalent injury was cuts and bruises at 65.5%. When hazards and injuries were associated for this group of extended shift workers, the results showed significant association between the following: noise with hearing loss ($p = 0.19$), poor illumination with eye strain ($p = 0.007$), muscle injury with vibration ($p = 0.46$), excessive work with low back injury ($p = 0.00$), slipping with poor housekeeping ($p = 0.021$), slippery floor with falls ($p = 0.32$), and with uneven floors ($p = 0.003$).

Discussion: The injury data from the medical clinic for one year indicated 27 cases of laceration, 25 cases of punctures, 9 cases of chemical burns, 4 cases of fractures, and 3 cases each of amputation and eye injuries. All these injuries occurred in the workplace due to lack of machine guards, improper use of tools, nonergonomically designed tools, fast workplace, and unsafe conditions. Three amputations of the middle crease of the hand extending to all fingers were also noted. From the baseline data, safety risk assessment index was proposed.

G4.4

Title: Health Outcomes Associated With Perceived Work Stress in Police Officers

Authors: **Gershon RM**, Barocas B, Canton AN, Li X, Vlahov D

Introduction: Law enforcement has long been recognized as a high stress/high strain profession. Work stress in policing, or "police stress," has been associated with certain health problems, including cardiovascular disease and depression, as well as maladaptive and antisocial behavior, such as problem drinking, hyperaggressiveness and violence. The purpose of our study was to estimate the effects of perceived work stress in police officers and to determine the impact of coping and coping styles on both perceived work stress and health.

Methods: An anonymous self-administered questionnaire was distributed to 1072 officers from a large, urban police department. The five-page, 132-item survey instrument addressed police stressors, perceived work stress, coping strategies, and stress-related outcomes. Sample recruitment took place during roll call at each of the Department's nine districts as well as at three other major divisions, including Headquarters. Of 1150 officers present at roll calls, 1072 (93.2%) questionnaires were completed and returned.

Results: Exposure to critical incidents, workplace discrimination, lack of cooperation among coworkers, and job dissatisfaction were significantly correlated with perceived work stress. Work stress, in turn, was significantly associated with adverse outcomes, including depression and intimate partner abuse. Officers who utilized negative or avoidant coping mechanisms reported both higher levels of perceived work stress and adverse health outcomes.

Discussion: Interventions that address modifiable stressors and promote effective coping and resiliency will probably be most beneficial in minimizing police stress and associated outcomes. Progressive police departments that actively implement innovative strategies (such as peer counselors, structural changes in administration, diversity programs, changes in hiring and training practices, adding critical incident management programs) may help minimize the risk of work stress among police officers.

Session: **G5.0**

Title: Systematic Review of Occupational Injury Literature

Moderator: Bradley Evanoff

G5.1

Title: Workplace Injury/Illness Prevention and Loss Control Programs: A Series of Systematic Reviews

Authors: **Brewer S**, King E, Amick B, Delclos G, Spear J, Irvin E, Mahood Q, Lee L, Lewis C, Gimeno D, Williams R

Introduction: This study sought to determine if injury/illness prevention and loss control programs (IPCs) are effective in reducing workplace injuries, illnesses or claims; and to describe the breadth of the literatures for the sustainability of safety culture/ climate and IPC measurement tools.

Methods: A systematic review of the IPC literature was completed to provide an evidence base for objective review. Scoping reviews were completed for objectives two and three. All objectives used the same search strategy. Full systematic reviews were not completed for objectives two and three because the literature was too immature to provide evidence based recommendations. Of the 12,393 articles identified and reviewed for relevance, 76 articles were considered relevant; these then underwent a quality assessment. Fifty-three articles were used in data extraction and 46 in evidence synthesis. A "best evidence" synthesis approach was used to synthesize the literature.

Results: Strong evidence for a positive effect of reducing or controlling injuries/illnesses was found for only one IPC, Return to Work/Disability Management Programs. A moderate level of evidence was found for five IPCs: supervisor practices, workstation adjustment and training, exercise, workstation adjustment, and ergonomics training. The categories of workstation adjustment and ergonomics training had no effect while supervisor practices, workstation adjustment and training, and exercise had a positive effect.

Discussion: Most high quality studies were in office environments. More high quality studies in a wider variety of business sectors need to be completed to determine effectiveness of IPCs in those settings. The safety culture/climate literature lacks intervention studies that establish an evidence base for their adoption by employers. IPC measurement tools are desired, but few scientifically validated tools are available for use in the workplace. Overall, there is a greater need to invest in research that examines the effectiveness of prevention programs.

G5.2

Title: Sharing Best Evidence: Results From Four Systematic Reviews of the Occupational Health and Safety Literature

Authors: **Irvin E**, Van Eerd D, Brewer S, Tompa E, Tullar J

Introduction: A systematic review provides a concise and transparent synthesis of research evidence, making it a valuable aid to practitioners and researchers as an objective synopsis of the literature on a particular topic. This presentation will summarize the results from four systematic reviews of the occupational health and safety (OH&S) literature covering the areas of: (1) participatory ergonomic interventions, (2) occupational health and safety interventions with economic evaluations, (3) workplace injury/illness prevention and loss control programs (IPCs), and (4) interventions in healthcare settings to protect musculoskeletal health. In addition we present an overview of the systematic review process developed and used by the Institute for Work & Health.

Methods: Each of the four reviews used essentially the same systematic review methodology, which will be described in this session. Briefly, comprehensive literature searches were completed and documents were screened for relevance. Next, quality was assessed and data was extracted from those that met relevance and quality criteria. A synthesis of the evidence from the literature was then compiled. In addition, the key role played by stakeholders in each of these reviews will be described.

Results: This presentation will focus specifically on those areas of convergence across the reviews and stakeholder uptake and engagement in the knowledge transfer process. For example, in one review we found strong evidence that disability management interventions executed across multiple sectors are worth undertaking for interventions with economic evaluations. We also found strong evidence for a positive effect of reducing or controlling injuries/illnesses for only one IPC, which was Return to Work/Disability Management (RTW/DM) Programs.

Discussion: This presentation will discuss key findings from four systematic reviews. In addition, we will indicate the challenges/benefits of conducting reviews of the OH&S literature. We also identify gaps in evidence across four research areas.

G5.3

Title: A Review of the Literature on Process and Implementation of Participatory Ergonomics

Authors: **Van Eerd D**, Cole D, Village J, Theberge N, St Vincent M, Irvin E, Keown K, Clarke J, Mahood Q, Cullen K

Introduction: Participatory ergonomic (PE) interventions are considered useful to reduce occupational injuries. This review of the literature summarizes evidence regarding context, barriers, and facilitators to implementation of PE interventions in workplaces to improve worker health by attempting changes in (1) work processes, (2) work tools and equipment, and/or (3) work and workplace organization.

Methods: A comprehensive literature search involved searching 17 electronic bibliographic databases, contacting content experts, reviewing relevant reference lists and hand-searching conference proceedings. Keywords were used to generate search terms covering the following broad areas: participatory, ergonomic, intervention, and health outcome. Peer-reviewed and grey literature documents were reviewed for relevance using title and abstract or full article. Relevant documents were reviewed for content and quality. Documents meeting quality criteria or with rich information on process, facilitators, and barriers to PE proceeded to data extraction and synthesis. Data were extracted on context, team structure and process, training, intervention, and facilitators and barriers.

Results: We found 2151 unduplicated references in our comprehensive literature search. Of these, 1895 were excluded as they did not describe a PE intervention. The remaining 256 documents were evaluated for content and quality. Of these, 52 documents met our content and quality criteria and moved to data extraction and synthesis. In these 52 documents, the interventions most often involved equipment/tool changes. Workers, supervisors, technical staff, and external advisors were most often team members of the PE process. Decision making was accomplished primarily through group consultation. Facilitators and barriers most often mentioned included resources, support of PE, communication, and training.

Conclusions: Data from 52 peer-reviewed and grey literature documents on PE interventions from many jurisdictions and industries suggests some consistency in process. Many facilitators and barriers were described though most focused on support of PE, communication, training, and resources. Recommendations for PE interventions are described.

G5.4
Title: Interventions in Healthcare Settings to Protect Musculoskeletal Health: A Systematic Review
Authors: **Tullar J**, Brewer S, Amick III B, Irvin E, Mahood Q, Pompeii L, Wang A, Van Eerd D, Gimeno D, Evanoff B

Introduction: The literature examining the effectiveness of occupational safety and health interventions on reducing musculoskeletal symptoms in healthcare settings is heterogeneous.

Methods: A systematic review of the literature used a best evidence synthesis approach to address the general question, "Do occupational safety and health interventions in healthcare settings have an effect on musculoskeletal health status?" This was followed by an evaluation of specific interventions. The initial search identified 8,465 articles which were reduced to 16 studies based on content and quality. A "best evidence" synthesis approach was used to synthesize the literature.

Results: A moderate level of evidence was observed for the general question. Moderate evidence was observed for (1) exercise interventions and (2) multi-component patient handling interventions. Insufficient evidence of effect was observed for other identified intervention categories.

Discussion: Few high quality studies were found that examined the effects of interventions on musculoskeletal health in healthcare settings. Most interventions were in hospitals, and only one intervention was in a long-term care setting.

DAY THREE: THURSDAY, OCTOBER 23, 2008

Session: **H1.0**
Title: Using Surveillance Systems to Identify Injury Characteristics in Construction
Moderator: David Fosbroke

H1.1
Title: Fatal and Nonfatal Injuries in Construction Industry, 1992–2006
Authors: **Dong S**, Men R, Fujimoto A

Introduction: The Center for Construction Research and Training (formerly known as the Center to Protect Workers' Rights) has been monitoring construction safety and health to provide a basis for more effectively targeting injury and illness prevention efforts since 1990. This presentation summarizes the trends in fatal and nonfatal work-related injuries among construction workers from 1992 through 2006, the most recent years for which data were available.

Methods: Several large national datasets collected by the U.S. Census Bureau and the Bureau of Labor Statistics were used for this study, including the Census of Fatal Occupational Injuries, Survey of Occupational Injuries and Illnesses, Current Population Survey, and County Business Patterns. SAS version 9 was used for the data analysis.

Results: The construction industry continues to account for a disproportionate share of work-related deaths in the United States even though work-related deaths rates decreased from 1992 to 2006. Rates of nonfatal injuries and illnesses with days away from work declined for the goods-producing industries overall, but rates for construction remained the highest of the four major production industries. Falls are still the number one killer in construction. Being struck by an object, falls to a lower level, and overexertion in lifting continue to be the leading causes of nonfatal injuries. Among construction occupations, construction laborers ranked the highest in number of deaths from injuries. Ironworkers and electrical power line installers had the highest average death rates. During the study period, work-related deaths among Hispanic workers increased dramatically along with the growth of Hispanics in the construction workforce.

Conclusions: Overall, the construction sector continues to face serious challenges with regard to safety and health. Intervention strategies should focus on the leading causes of work-related fatal and nonfatal injuries, as well as vulnerable populations.

H1.2

Title: Are Back Injuries in Carpenters Decreasing or Not?

Authors: **Lipscomb H**, Dement J, Kucera K, Silverstein B, Cameron B

Introduction: In light of significant declines over 15 years in work-related back injuries from overexertion and more modest declines in acute traumatic injuries among a large cohort of union carpenters, we explored healthcare utilization for back problems through their private insurance coverage during the same time period.

Methods: Data from workers' compensation (WC) records were linked on an individual basis with records of health care utilization through the union healthcare trust for a dynamic cohort of 18,768 carpenters from 1989–2003. Yearly utilization rates for back disorders, based on months of insurance eligibility, were calculated over the 15 years and compared to patterns of workers' compensation back injuries. Rates of private healthcare utilization were also calculated before and after a work injury adjusting for age and gender.

Results: Sixty percent of the cohort did not seek medical care for back disorders through either WC or their healthcare trust; 10% sought care in both systems. WC claims for overexertion injuries were 62% lower in 2003 than in 1989 while healthcare utilization through the trust for back disorders increased 108%. Private healthcare utilization rates increased among carpenters with more WC injuries (1.3 for one work injury, 1.6 for two, 1.7 for three, 2.2 for four). Utilization patterns through the trust were slightly different for individuals following an acute traumatic work-related injury compared to those with overexertion injuries.

Discussion: The patterns observed raise concern that some work-related care for back disorders could have shifted to the carpenters' healthcare trust, particularly in later years. In any event, the analyses demonstrate interplay across the two healthcare delivery systems in this working population with insurance coverage. Even with the robust data available, these issues are difficult to clearly understand.

H1.3

Title: Fractures in Construction: Activities, Events, Sources, and Disability Duration

Authors: **Courtney T**, Brennan M, Matz S

Introduction: The construction industry continues to experience high rates of disabling injuries (second among major industry groups in 2005). Our earlier work suggested that fractures were among the most disabling injuries in the construction industry. We examined the construction claims experience of a large workers' compensation insurer with national coverage to better understand the activities, events, sources, and disability duration of these fractures.

Methods: We identified 899 fracture cases using ICD-9 and Current Procedural Terminology (CPT) codes, in addition to injury narratives. Disability duration was calculated from indemnity payments data using previously published methods. We analyzed injury event narratives to classify contributing antecedents for fractures. BLS OIICS was used to code antecedent factors. Activities were coded using a version of the BLS CFOI activities coding scheme modified to contain more construction-relevant activities.

Results: The average disability duration for a construction worker with a fracture was 97 days (median = 8 days). The fracture locations with the longest disability durations were the lower leg (median = 68 days), shoulder/upper arm (67 days), and knee (49 days). The most frequent events resulting

in fractures were being struck by falling objects (19.7%), struck by slipping handheld objects (11.8%), and falling from a ladder (6.6%). Falling objects were most frequently pipes and ducts, beams, and structural slabs. Hammers, powered drills and jackhammers were the most frequently noted slipping handheld objects. Work on ladders and lifting or loading/unloading materials operations were among the activities in which workers with the longest disability durations were engaged.

Discussion: These findings illustrate the importance of incorporating narrative text analysis and pursuing more granular level assessments of coding in large datasets to better refine our understanding of traumatic injury events such as fractures in construction.

H1.4
Title: Relationships Between Medical Care and Paid Lost Time From Work After Work-Related Back Injury Among Washington State Union Carpenters
Authors: **Kucera KL**, Lipscomb HJ, Silverstein B

Introduction: Back injuries cause significant lost work time in construction. Beyond older age, differentiating those at risk of prolonged lost work time is difficult. We examined relationships between medical care provided for work-related back injuries due to overexertion and time off work among a cohort of carpenters.

Methods: Union records identified a dynamic cohort of 20,642 union carpenters who worked in Washington State from 1989–2003. These data were linked to Department of Labor and Industries workers' compensation files; data from this state-run program included records of medical care with diagnoses and provider type. Patterns of care received were examined by paid time loss status.

Results: Over 75,000 visits for medical care were identified over 15 years resulting from 2959 back injuries. Chiropractors (37%) and primary care providers (33%) were most frequent first providers followed by specialists (10%) and hospital/ER (9%); number of lost days differed significantly by first provider ($p < 0.05$). Thirty-eight percent of those out 31–90 days and 24% out > 90 days never received physical therapy (PT). Individuals out of work for > 90 days were less likely to see a PT in the 30 days post injury (prevalence ratio = 1.7); mean days to first therapy increased with increasing time away from work (25, 50, and 114 days, respectively, for < 30 days, 30–90 days and > 90 days). Mean number of PT visits in the 30 days after injury was greater among those out longer.

Discussion: Differences in cases based upon treatment in the first month after injury are worthy of further exploration. Although seeing a specialist as first provider was associated with delayed time away from work, being seen in an ER was not. Individuals with prior history of back problems may seek specialist care immediately after injury.

Session: **H2.0**
Title: Injury Experience of Public Safety Workers
Moderator: Anita Schill

H2.1
Title: Evaluating the Ambulance Patient Compartment as a Work Environment Using Digital Human Modeling Tools
Authors: **Ammons D**, Green J, Isaacs A, Moore P, Whisler R, White J

Introduction: Seat belts provided in most U.S. ambulances today do not allow emergency medical service (EMS) workers the mobility required to care for patients. As a result, EMS workers routinely work unrestrained in the patient compartment, daily risking their safety and health in the care of others. The use of mobile restraints, as previously tested by NIOSH, or the redesign of the workspace, as was done by the Winter Park (Florida) Fire and Rescue Department, offer opportunities to improve worker safety.

Methods: This research used digital human modeling tools to evaluate reach in both of these unique work environments. A matrix was developed to test three digital human body sizes, in two different work environments, each outfitted with two different restraint types: one fixed and one that allowed mobility. Each digital human then attempted to grab five different patient or equipment targets while remaining restrained. The underlying premise is that it is better to be restrained than unrestrained, and further, it is better to be restrained and seated than restrained but out of the seat.

Results: This study confirmed that severe limitations exist in today's ambulance environment as workers cannot reach the patient, or needed equipment, using the restraints provided. While mobile restraints offered a viable solution to this problem, the current configuration requires the worker to move substantial distances from the safety of the seat. The reconfigured workspace offered the worker a greater opportunity to

remain seated during patient care tasks though it alone did not solve all reach issues. With the addition of mobile restraint technology the models demonstrate the value of both changes.

Conclusions: Incremental improvement in worker safety can be achieved through innovative uses of mobile restraint systems in conjunction with the thoughtful placement and positioning of the worker, patient, and patient care equipment.

H2.2
Title: Occupational Injury Experiences of EMS Providers
Author: **Heick RJ**

Introduction: Occupational injury is a significant problem among emergency medical service (EMS) providers, affecting their ability to perform their duties. A national survey was conducted to describe the problem of occupational injury among EMS providers.

Methods: This study examined the most common types of nonfatal injuries and the activities and environments where injury most frequently occurred. This study also examined the impact of multiple variables on odds of occupational injury.

Results: Occupational injury in the last 12 months was reported by more than 29% of 660 survey respondents, with multiple injuries reported by 64% of those reporting an injury. Paid providers had higher odds for overall injury (1.83, 95% CI 1.25–2.66) versus volunteers. A positive association was found between the number of calls responded to per week and increasing odds of overall injury. Paid providers also had higher odds for back injury (1.94, 95% CI 1.03–3.66) versus volunteers. Odds for overall injury and back injury were not affected by age, gender, length of service, or number of calls per week. Motor vehicle crashes were reported by 7% of paid and volunteer EMS providers, with all reported injuries occurring among paid providers. Odds of involvement in a motor vehicle crash did not vary significantly by paid versus volunteer status (1.08, 95% CI 0.55–2.10). One hundred forty-seven respondents reported physical assaults while working. No significant difference was found between paid and volunteer providers for occurrence of physical assault (1.21, 95% CI 0.74–1.97) or injury from assault.

Discussion: The results of this study indicate that occupational injury among EMS providers is indeed a serious problem. This study clearly identifies a variety of injury issues, including the need to examine paid and volunteer providers as separate occupational groups when developing prevention programs.

H2.3
Title: Occupational Safety and Health for Public Safety Employees: Assessing the Evidence and Implications for Public Policy
Authors: LaTourette T, Loughran D, **Seabury S**

Introduction: The provision of public safety is one of the most important responsibilities of government, and workers charged with protecting the public, such as police officers and fire fighters, are routinely asked to put their own lives at risk. As such, it is no surprise that public safety employees face much higher than average fatal and nonfatal occupational injury rates.

Methods: This work provides an in-depth study of the adverse health risks facing public safety employees. We combined in-depth literature reviews and new data analyses to characterize the types, causes, frequency, and severity of different injuries and illnesses suffered by public safety employees of different ages. This work was complemented with a series of roundtable discussions with numerous safety personnel to better understand the opportunities and challenges facing policies intended to reduce injuries and illnesses among police officers and fire fighters.

Results: An important goal of policymakers is to determine ways to help protect public safety employees from work-related injury and illnesses without compromising their ability to do their work. However, achieving this goal is hampered by a lack of solid information on the causes and consequences of adverse health events experienced by safety personnel.

Discussion: Using these findings, we discuss what is currently known about the different health risks facing safety employees and examine how well safety and health promotion policies align with these risks. Finally, we discuss the current gaps in our knowledge base and provide some guidance for future research. The research was cosponsored by the California Commission on Health and Safety and Workers' Compensation and the National Institute for Occupational Safety and Health.

H2.4
Title: Contrasting the Transportation Safety Data for Emergency Medical Services With Other Commercial Vehicles
Author: **Levick N**

Introduction: To identify transportation safety data and data capture systems for EMS vehicles in contrast to commercial vehicles.

Methods: Search of published literature and online databases for EMS and commercial vehicle transportation safety data for years 1996–2005 via FMCSA and NHTSA, GES, and NASS. Analysis of data types of data captured nationally for these occupational environments.

Results: Estimates for ambulance fatality/mile traveled are 3–50 times large truck fatal crashes of 2.2/100 million miles traveled in 2005, with general estimates of 7.7 to 109 fatal crashes/100 million ambulance miles traveled. Estimates of 37 truck crashes injuries/100 million miles are well exceeded by ambulance estimates of crash injury of 308 to 4,360 injuries/100 million ambulance miles traveled. Ambulance in vehicle crash fatality percentage is double that for large trucks, with per vehicle fatality rates greater than three times higher for ambulance vehicles. The FMCSA data capture system provides extensive data on both numerator and denominator aspects of truck travel safety; however, EMS vehicles are exempt from the FMCSA data system. The NHTSA data fields captured for EMS were minimal with incomplete numerator data for both morbidity and mortality and virtually nonexistent denominator data.

Discussion: There appears to be wide disparity in the capture of transportation safety data between EMS and other commercial transport vehicles. The FMCSA database provides extensive detail on many aspects of truck safety—similar national data are not practically identifiable for EMS ground transport.

Conclusion: Ambulance transport is one of the most hazardous transport environments per vehicle and per mile traveled. Despite the high hazards of the EMS transport environment, comprehensive transportation safety data is not being captured nationally on the EMS transport system. Without this comprehensive data it is not possible to effectively define key safety determinants or measure the impact of safety interventions.

Session: **H3.0**
Title: Safety Practices II
Moderator: Guang Chen

H3.1
Title: Quantifying Workers' Hazard Identification Ability Using Fuzzy Signal Detection Theory
Author: **Abdelhamid T**

Safeguarding construction workers from occupational hazards, whether arising from traumatic, ergonomic, and/or exposure accidents, is part and parcel of the lean construction ideal of waste elimination. This research applies Fuzzy SDT, proposed by Parasuraman et al. (2000), to increase the applicability of conventional SDT analysis to construction settings where the definition of a signal event and its associated response do not follow a binary or dichotomous structure. Application of the methodology is demonstrated using a pilot study involving structural steel workers. Results from the sample of 10 ironworkers indicated the average sensitivity in identifying hazards was above average and that workers generally adopted a conservative strategy. Data analysis using conventional SDT model showed a marginally increased sensitivity, but with a very high variation. This result illustrated that fuzzy SDT model was more reflective of the ability of construction workers to identify construction hazards.

H3.2
Title: The Reducing and Avoiding Injury Initiative: The Alberta Experience
Authors: **Mughal W**, Wood N

Introduction: The Calgary Health Region is an integrated healthcare system with 29,000 employees and 2,300 physicians providing services to over 1.2 million people in the southern Alberta urban and rural regions. In 2007, the government ministry for Alberta healthcare provided the Region with almost $8.5 million to reduce and avoid injuries to healthcare workers. This project outlines the substantial undertaking in organizing, prioritizing and preparing for the development, delivery and evaluation of a comprehensive safe client handling program for the Calgary Health Region.

Methods: Administrative data was acquired and organized by pay period, cost centre, location and program to provide worked hours, sick time, overtime, injury incidence and injury burden. Normalized data were calculated and examined to identify areas most likely to benefit from the intervention. A project steering committee was struck along with project task

groups to manage specific issues such as education/training and equipment selection. A comprehensive marketing strategy is being developed, and collaborations are being identified with the patient safety group for developing a comprehensive and industry-relevant evaluation framework for the initiative

Results: A comprehensive framework for developing, managing and evaluating this initiative is required for an undertaking of this size. The methodology employed not only identify what is needed to select the appropriate equipment, but also to develop strategies to support the safe and effective use of the purchased equipment. The projected time frame for the initiative is four years.

Discussion: A comprehensive approach for preventing musculoskeletal injuries has been supported in the literature, and this project represents a comprehensive strategy not only in its intended effect, but also in its construct. This project has its foundations in evidenced-informed decision-making, and seeks to maximize the benefit from having multiple stakeholder groups involved in the initiative from the outset.

H3.3

Title: Building a Culture of Safety and Health Through Integrated Safety and Health Management System

Authors: **Evangelista-Alvarez B**, Recaña R, Laqui MG

Introduction: The Integrated Safety and Health Management System is not just mere an Occupational Safety and Health (OSH) compliance program nor an advocacy but also as an important tool to build a culture of safety and health. This program's primary goal is to establish the link between safety and health programs including environment with productivity as one of the indices. It also aims to identify and determine the various factors and variables contributing to the success of the company's safety and health program and their effects to its overall productivity and more so to the employee culture towards OSH.

Method: The integrated OSH management system is implemented through programs committed to the protection of the environment and the health & safety of workers and meeting all applicable environment, health and safety laws, regulations and other requirements the company subscribes to. The programs also recognize that by integrating sound environment, health and safety management practices into all aspects of the company processes and activities, technologically competitive products can be offered while conserving and enhancing resources for future generations.

Results: Continual improvement in our environment, health and safety management systems supported elimination of accidents, occupational injuries and workplace thereby creating a culture of safety and health. The subject of the research is a two-time winner of the Gawad Kaligtasan at Kalusugan Award, a national award for safety health given by country's Department of Labor and Employment.

Discussion: OSH programs presented would showcase linked safety and health programs including environment and productivity using integrated OSH and environment management system (ISO 14001, OHSAS 18001) and Zero Accident Program fully supported by combined effort of safety and health practitioners and workers with strong management support.

H3.4

Title: Development of an Integrated Dataset for the Health Workplace Initiative

Authors: Thomas-Olson L, Keen D, Brown MP

Introduction: QWL indicators have been identified in the literature as tools to help re-design work and make evidence-based organizational decisions. The use of "leading" and "trailing" indicators has been mentioned in the literature as a means of organizational health surveillance to determine the health of a workplace. Healthcare organizations maintain a number of internal databases with performance indicators from a variety of contexts. Published papers have noted that in order to gain insight into the "health" of a workplace, these internal databases should not be analyzed as independent, unrelated entities but rather regarded as components of a larger integrated model. The purpose of this project was to examine the feasibility of developing a comprehensive healthy workplace profile using patient and worker safety for the healthcare setting.

Methods: Data were extracted from administrative databases within a large healthcare organization for one calendar year to include patient safety adverse events, worker injury and organizational data. Datasets were integrated using department and sites as key fields. 1769 individual departments were identified within the final dataset.

Results: A total of 13 indicators were acquired, integrated and summarized. Data from four indicators were transformed into "full time equivalent" positions in order to contextualize costs associated with these variables. In addition to individual interpretations of each indicator, comprehensive tables with normalized and raw data were provided. Response to the initiative was very positive resulting in strategic goals reflecting these data integrated into the organization's performance tracking system.

Discussion: Despite the challenges with integration of multiple, independent datasets, data integration is possible, and valuable, for large healthcare organizations. This project was a substantial undertaking to help a large organization understand the range of risk and loss occurring within its various systems, and to move it closer to the goal of "healthy people, healthy workplaces."

Session: **H4.0**
Title: Evaluations of Safety and Health Management Practices
Moderator: Elyce Biddle

H4.1
Title: Does a Safety and Health Management System Contribute to a Safer Work Environment?
Authors: **Biddle EA**, Newell S, Hendricks S

Introduction: Managing occupational safety and health through management systems at the company level has become increasingly popular. However, little research has been conducted concerning the relationship between adopting a safety and health management system and the occupational injury and illness (OII) experience of an individual firm. This study examined the degree to which implementation of five key management system components contributed to a safer work environment.

Methods: Participating Fortune 200 companies were solicited to complete a two-module web survey. Module one requested annual OII rates. Module two requested self-rating on a scale of 1 (worst) to 4 (best) of the relative degree of implementation or the "percentage of process in place and completed toward established targets" for the following management system components:

Leadership Commitment and Support
Employee Involvement
Risk Identification and Elimination and Safe Practices
Accountability at All Levels
Continuous Improvements

Results: Of the 91 companies that provided annual OII data, 73 provided management system information. OII total case rates ranged from .29 to 9.2 (mean = 1.88) in 2005 and .15 to 10.05 (mean = 2.28) in 2004. Days away from work (DAFW) case rates ranged from .02 to 2.07 (mean = .57) in 2005 and .08 to 2.96 (mean = .54) in 2004. The average score measuring the degree of management system implementation was 2.55, from 2.08 for Accountability to 2.82 in Continuous Improvements. System components were positively correlated with coefficients of .46 to .84. OLS regression indicated that implementing a management system reduced OII rates. Component pair analysis identified Leadership and Accountability as the best predictors for controlling OII, and Risk Identification as the best predictor for controlling DAFW cases.

Conclusions: This study demonstrated that implementing a management system with these five components contributed to lower OII rates. Because the respondents are among the most safety-conscious global enterprises, the results may not be generalizable.

H4.2
Title: Development of a Comprehensive Working Alone Program for Community Care
Authors: Odin J, Keen D, Thomas-Olson L,

Introduction: Past approaches to managing risk of personal injury to staff working alone have employed various controls, including check-ins, use of technology, or policies. No other Canadian healthcare organization has developed a comprehensive program to reduce risk of injury to community healthcare workers who work alone in the community in both urban and rural settings. This project aimed to develop and trial a comprehensive safety program for healthcare workers working alone in community settings.

Methods: A request was made from the joint OH&S committee to address the risks of staff members working alone in community settings. Areas represented included home support, mental health, environmental health, licensing, home health, and public health. A steering committee was struck to include representation from union OH&S committee members, management, and Workplace Health and Protection Services. Areas examined included needs assessment, intake processes for clients, and relevant

policies and procedures. Staff participating in the Working Alone Program (WAP) trial completed pre- and post- intervention surveys to determine the effectiveness of the program.

Results: Core components of the program included risk identification checklists, active check-in/check-out procedures, use of technology, additional security services, and education and training regarding risk identification and controls. The WAP pilot sites reported overall success in implementing most required elements. Statistical analysis showed that perception of risk, access to safety resources and awareness of the hazard reporting process all demonstrated statistically significant improvement from pre- to post-intervention. The safety climate score also increased from pre- to post-intervention.

Conclusion: Short-term outcomes include improved documentation and control of risk, and greater level of communication regarding risk among the various occupations in the community setting. Long-term goals of this program are to reduce incidence of worker safety events and sustainable improvement in safety culture.

H4.3

Title: Proactive Management: A Multilevel Communication Intervention in the Construction Industry

Authors: **Moore JT**, Smith A, Cigularov K, Chen P

Introduction: Successful injury-prevention interventions should target all levels of the organization. Interventions focusing on psychosocial variables such as communication can add value to traditional safety programs. The present study describes an intervention targeted at increasing the frequency of safety communication skills across three levels (worker, supervisor, top management) at a general contractor in order to prevent injuries on the job.

Methods: The intervention took place at a general contractor in the Midwest. The first component involved training 24 foremen from five experimental jobsites on leadership communication skills using discussion, role plays, and goal setting. The second component involved meeting with the site-level supervision to explain how to support foreman transfer of training onto the job. The third component was aimed at the tradesman and laborer level of the organization, and involved a communication campaign with posters, safety talks, and paycheck stuffers supporting the importance of safety feedback and sharing near misses in injury and accident prevention.

Results: A pre-intervention assessment of communication climate and employee injuries was collected in October, indicating that the company most needed to improve on sharing near misses and daily verbal exchanges with supervisors. The post-intervention assessment is currently being collected. Pre- and post-training surveys of the foreman workshop indicated that the training changed participants' self-efficacy for giving positive recognition to their crews, and that affective reactions to the training were moderately high. Surveys of the communication campaign indicated that most employees felt the campaign was "very useful" or "somewhat useful" and that the safety talk materials were the workers' favorite component.

Discussion: We hope to see a reduction in injuries reported from the October assessment and an increase in reported frequency of supervisor safety communication skills by workers. Future research should examine the most effective ways to teach safety communication in contractor settings.

NOIRS 2008 Abstract Reviewers

NOIRS 2008 Abstract Reviewers

Magdy Akladios
University of Houston-Clear Lake

Alfred Amendola
National Institute for Occupational Safety and Health

John Bailer
Miami University

Jennifer Beaupre
National Institute for Occupational Safety and Health

Jennifer Bell
National Institute for Occupational Safety and Health

Elyce Biddle
National Institute for Occupational Safety and Health

Thomas Bobick
National Institute for Occupational Safety and Health

Warren Brown
DMAX Ltd.

Nelson Bryner
National Institute of Standards and Technology

Carri Casteel
University of North Carolina

Wen-Ruey Chang
Liberty Mutual Research Institute for Safety

Guang Chen
National Institute for Occupational Safety and Health

Sharon Chiou
National Institute for Occupational Safety and Health

Patrick Coleman
National Institute for Occupational Safety and Health

James Collins
National Institute for Occupational Safety and Health

Phaedra Corso
University of Georgia

Theodore Courtney
Liberty Mutual Research Institute for Safety

Richard Current
National Institute for Occupational Safety and Health

Susan Derk
National Institute for Occupational Safety and Health

Angela DiDomenico
Liberty Mutual Research Institute for Safety

Renguang Dong
National Institute for Occupational Safety and Health

David Fosbroke
National Institute for Occupational Safety and Health

Susan Gerberich
University of Minnesota – MCOHS/RIPRC/CVPC

Michael Goldcamp
National Institute for Occupational Safety and Health

Maggi Gunnels
U.S. Deptartment of Transportation

David Hard
National Institute for Occupational Safety and Health

James Harris
National Institute for Occupational Safety and Health

Daniel Hartley
National Institute for Occupational Safety and Health

Mathew Hause
National Institute for Occupational Safety and Health

James Helmkamp
West Virginia University

Kitty Hendricks
National Institute for Occupational Safety and Health

Scott Hendricks
National Institute for Occupational Safety and Health

William Horrey
Liberty Mutual Research Institute for Safety

Bradley Husberg
National Institute for Occupational Safety and Health

Lee Husting
Coordinating Center for Health Information & Service

Larry Jackson
National Institute for Occupational Safety and Health

Roger Jensen
Montana Tech of the University of Montana

Y. Kau
University of Michigan

Andrew Lincoln
MedStar Research Institute

Jennifer Lincoln
National Institute for Occupational Safety and Health

John Lloyd
VA Patient Safety Research Center

NOIRS 2008 Abstract Reviewers

Thurmon Lockhart
Virginia Polytechnic Institute and State University

David Lombardi
Liberty Mutual Research Institute for Safety

Virginia Lutz
National Institute for Occupational Safety and Health

Rich Maddox
Fire Department Safety Officers Association

Rammohan Maikala
Liberty Mutual Research Institute for Safety

Suzanne Marsh
National Institute for Occupational Safety and Health

Michael McCann
CPWR - The Center for Construction Research and Training

Eugene McKenzie
National Institute for Occupational Safety and Health

Cammie Chaumont Menéndez
National Institute for Occupational Safety and Health

Paul Moore
National Institute for Occupational Safety and Health

Priscah Mujuru
West Virginia University

Warren Myers
West Virginia University

Christopher Pan
National Institute for Occupational Safety and Health

Robert Park
National Institute for Occupational Safety and Health

Corinne Peek-Asa
University of Iowa

Kara Perritt
National Institute for Occupational Safety and Health

Michael Petroff
Fire Department Safety Officers Association

Linda Phillips
U.S. Department of Transportation

Lisa Pompeii
The University of Texas

John Powers
National Institute for Occupational Safety and Health

Marizen Ramirez
University of Iowa

Audrey Reichard
National Institute for Occupational Safety and Health

Scott Richardson
Bureau of Labor Statistics

LCDR Marilyn Ridenour
National Institute for Occupational Safety and Health

Nancy Romano
National Institute for Occupational Safety and Health

Mahmood Ronaghi
National Institute for Occupational Safety and Health

Frederick (Ted) Scharf
National Institute for Occupational Safety and Health

William (Karl) Sieber
National Institute for Occupational Safety and Health

Peter Simeonov
National Institute for Occupational Safety and Health

Robert Solomon
National Fire Protection Association

Philip Somervell
National Institute for Occupational Safety and Health

Hope Tiesman
National Institute for Occupational Safety and Health

Santosh Verma
Liberty Mutual Research Institute for Safety

Radoslaw Wasiak
Liberty Mutual Research Institute for Safety

James Wassell
National Institute for Occupational Safety and Health

Sharada Weir
University of Massachusetts Medical School

Helen Wellman
Liberty Mutual Research Institute for Safety

Amanda Young
Liberty Mutual Research Institute for Safety

The 4th National Occupational Injury Research Symposium

NOIRS 2008

October 21, 22, & 23, 2008
Sheraton Station Square
Pittsburgh Pennsylvania

The 4th National Occupational Injury Research Symposium

NOIRS 2008

October 21, 22, & 23, 2008
Sheraton Station Square
Pittsburgh Pennsylvania

The 4th National Occupational Injury Research Symposium

NOIRS 2008

October 21, 22, & 23, 2008
Sheraton Station Square
Pittsburgh Pennsylvania

The 4th National Occupational Injury Research Symposium

NOIRS 2008

October 21, 22, & 23, 2008
Sheraton Station Square
Pittsburgh Pennsylvania

The 4th National Occupational Injury Research Symposium

NOIRS 2008

October 21, 22, & 23, 2008
Sheraton Station Square
Pittsburgh Pennsylvania

The 4th National Occupational Injury Research Symposium

NOIRS 2008

October 21, 22, & 23, 2008
Sheraton Station Square
Pittsburgh Pennsylvania

The 4th National Occupational Injury Research Symposium

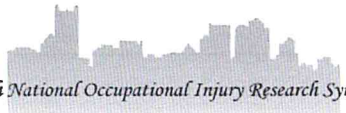
NOIRS 2008

October 21, 22, & 23, 2008
Sheraton Station Square
Pittsburgh Pennsylvania

The 4th National Occupational Injury Research Symposium

NOIRS 2008

October 21, 22, & 23, 2008
Sheraton Station Square
Pittsburgh Pennsylvania



The 4th National Occupational Injury Research Symposium

NOIRS 2008

October 21, 22, & 23, 2008
Sheraton Station Square
Pittsburgh Pennsylvania

Delivering on the Nation's promise: safety and health at work for all people through research and prevention

To receive NIOSH documents or more information about occupational safety and health topics, contact NIOSH at

1–800–CDC–INFO (1–800–232–4636)
TTY: 1–888–232–6348

E-mail: cdcinfo@cdc.gov

or visit the NIOSH Web site at www.cdc.gov/niosh

For a monthly update on news at NIOSH, subscribe to NIOSH *eNews* by visiting **www.cdc.gov/niosh/eNews.**

SAFER • HEALTHIER • PEOPLE™