NOIRS

National Occupational Injury Research Symposium

2011

October 18-20, 2011

Morgantown, West Virginia

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

CDC Workplace Safety and Health

NIOSH

Special Acknowledgement

NOIRS would not be possible without the support of our co-sponsors: The National Safety Council and the Liberty Mutual Research Institute for Safety.

October 2011

NOIRS 2011 Participants,

I would like to welcome you to the 2011 National Occupational Injury Research Symposium (NOIRS 2011). We are proud of the high quality slate of research and plenary sessions supporting this year's symposium theme, *Future Directions in Occupational Injury Prevention Research*. The conference agenda includes a broad and diverse range of cutting-edge occupational injury research from leading national and international scientists. NOIRS 2011 is the only forum exclusively dedicated to the presentation and discussion of the latest methods, findings, and translation activities related to traumatic occupational injury research and prevention. The multidisciplinary nature of occupational injury research makes it essential for NIOSH and its partners to bring together epidemiologists, engineers, statisticians, economists, health practitioners, safety specialists, and other scientists and professionals committed to the prevention of occupational injuries.

NOIRS would not be possible without the support of our co-sponsors: the National Safety Council and the Liberty Mutual Research Institute for Safety. I would like to recognize and thank each of these co-sponsors, not only for supporting NOIRS, but also for their continued support of NIOSH research and prevention programs.

As with the previous National Occupational Injury Research Symposia, this year's program promises to deliver an exciting agenda that represents the breadth and diversity of occupational injury research. NIOSH continues our emphasis on moving the results of research into preventive actions through our Research to Practice Initiative, and NOIRS 2011 will highlight numerous successes in transferring research to the workplace for prevention. Through the NOIRS, NIOSH continues to provide a forum for the presentation of state-of-the-art occupational injury research, and the opportunity to develop and foster partnerships and collaborations among various researchers, industry, labor, and other partners who share a common interest in the prevention of occupational injuries. Progress is being made in reducing the toll of workplace injury and death; however, it will take our sustained, collective efforts to further reduce the devastating impact that traumatic injuries have on workers, their families, and their employers. It is my hope that NOIRS 2011 will once again revitalize our energies to ensure all workers return home safely each day.

I offer my best wishes 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.

Enjoy the NOIRS 2011 Symposium!

John Howard
Director

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.

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 and placed on a message board next to the registration desk. All hotel rooms have voice mail. The telephone number for the Waterfront Place Hotel is (304) 296-1700 and their FAX number is (304) 284-0523. The hotel offers a self-serve business center that is open 24 hours/day.

Parking

The Waterfront Place Hotel offers valet parking along with self parking. Parking fees are $6.00 per day for registered guests and is posted to the guest room. The rate for non-registered guests is $8.00 per day. There are two parking garages, one located in front of the hotel and the other is attached to the back of the hotel.

Shuttle Service

The Waterfront Place Hotel offers complimentary shuttle service to downtown Morgantown, local restaurants, and the Morgantown Airport. Call the hotel's front desk to schedule shuttle service.

Pittsburgh Airport Shuttle Service

Complimentary shuttle service will be available from the Waterfront Place Hotel to the Pittsburgh Airport on Thursday afternoon, October 20, 2011. The buses will be located outside the hotel lobby, and will depart at 12:30, 1:00, and 1:30 p.m.

Speaker Room

A speaker preparation area is available for presenters to preview audio-visual materials. This area is located in the **Puskar Boardroom** on the main 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 **Waterfront's Grand Exhibit Hall, Salon B**, on **Wednesday, October 19, 2011, 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 2011 AT A GLANCE

DAY ONE
TUESDAY, OCTOBER 18, 2011

Time	Tuesday				
7:30 a.m. - 8:30 a.m.	Registration				
8:30 a.m. - 10:00 a.m.	Opening Plenary *Platinum Grand Ballroom*				
10:00 a.m. - 10:30 a.m.	**Break**				
10:30 a.m. - 12:00 p.m.	**Concurrent Sessions A**				
	A1 *Wharf A/B*	A2 *Salon A/B/C*	A3 *Waterfront*	A4 *Salon H*	A5 *Salon F/G*
	Surveillance I	**Fall Prevention in Construction I**	**Ergonomics of Work-related Injuries**	**Management Commitment and Organizational Performance**	**Agriculture, Forestry & Fishing**
12:00 p.m. - 1:30 p.m.	**Lunch**				
1:30 p.m. - 3:00 p.m.	**Concurrent Sessions B**				
	B1 *Wharf A/B*	B2 *Salon A/B/C*	B3 *Waterfront*	B4 *Salon H*	B5 *Salon F/G*
	Surveillance II	**Fall Prevention in Construction II**	**Machine Safety**	**Improving Safety at the Company Level**	**Motor Vehicle I**
3:00 p.m. - 3:30 p.m.	**Break**				
3:30 p.m. - 5:00 p.m.	**Concurrent Sessions C**				
	C1 *Wharf A/B*	C2 *Salon A/B/C*	C3 *Waterfront*	C4 *Salon H*	C5 *Salon F/G*
	Surveillance III	**Violence in Retail**	**Safety Climate I**	**Agriculture I**	**Construction Hazards**

NOIRS 2011 AT A GLANCE
DAY TWO
WEDNESDAY, OCTOBER 19, 2011

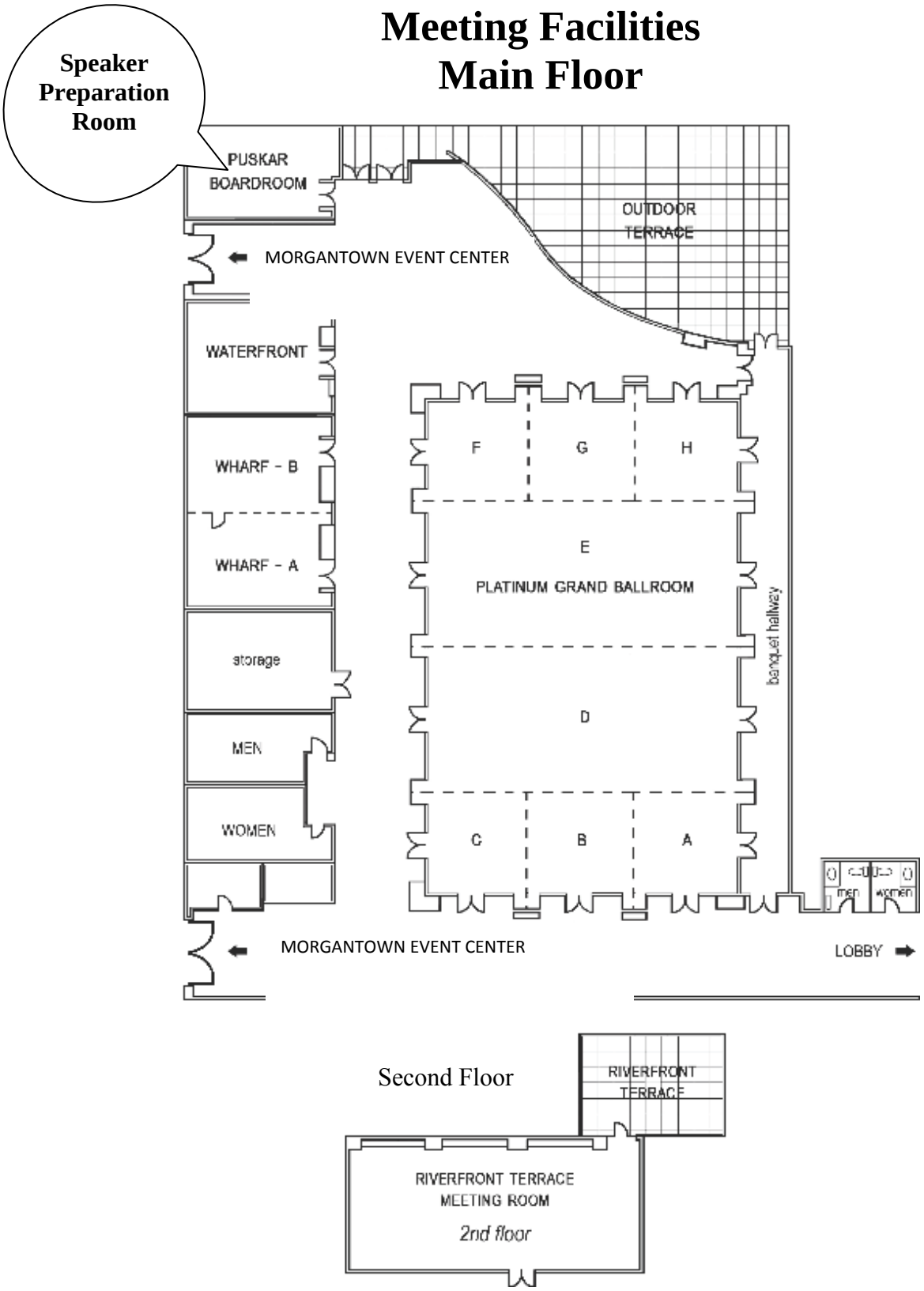
Time	Wednesday				
7:30 a.m. - 8:30 a.m.	Registration				
8:30 a.m. - 10:00 a.m.	**Concurrent Sessions D**				
	D1	D2	D3	D4	D5
	Wharf A/B	*Salon A/B/C*	*Waterfront*	*Salon H*	*Salon F/G*
	Underreporting of Injuries I	**Slips, Trips, and Falls**	**Ergonomics/ MSDs**	**Hazardous Work Environments**	**Motor Vehicle II**
10:00 a.m. - 10:30 a.m.	**Break**				
10:30 a.m. - 12:00 p.m.	**Concurrent Sessions E**				
	E1	E2	E3	E4	
	Wharf A/B	*Salon A/B/C*	*Salon F/G/H*	*Waterfront*	
	Underreporting of Injuries II	**Falls from Roofs and Ladders**	**Safety Climate II**	**Training, Drug Testing**	
12:00 p.m. - 1:30 p.m.	**Lunch**				
1:30 p.m. - 3:00 p.m.	**Concurrent Sessions F**				
	F1	F2	F3	F4	
	Wharf A/B	*Salon A/B/C*	*Salon F/G/H*	*Waterfront*	
	Underreporting of Injuries III	**Violence Among Educators**	**Fall Prevention**	**Mining**	
3:00 p.m. - 3:30 p.m.	**Break**				
	Concurrent Sessions G				
3:30 p.m. - 5:00 p.m.	G1	G2	G3	G4	
	Wharf A/B	*Salon A/B/C*	*Salon F/G/H*	*Waterfront*	
	Patient Lifting	**Vulnerable Populations**	**Work Schedules, Sleep, and Fatigue**	**Agriculture II**	
5:30 p.m. - 7:30 p.m.	***Poster Social*** Waterfront Place Hotel Grand Exhibit Hall, Salon B **Hors d'oeuvres will be served**				

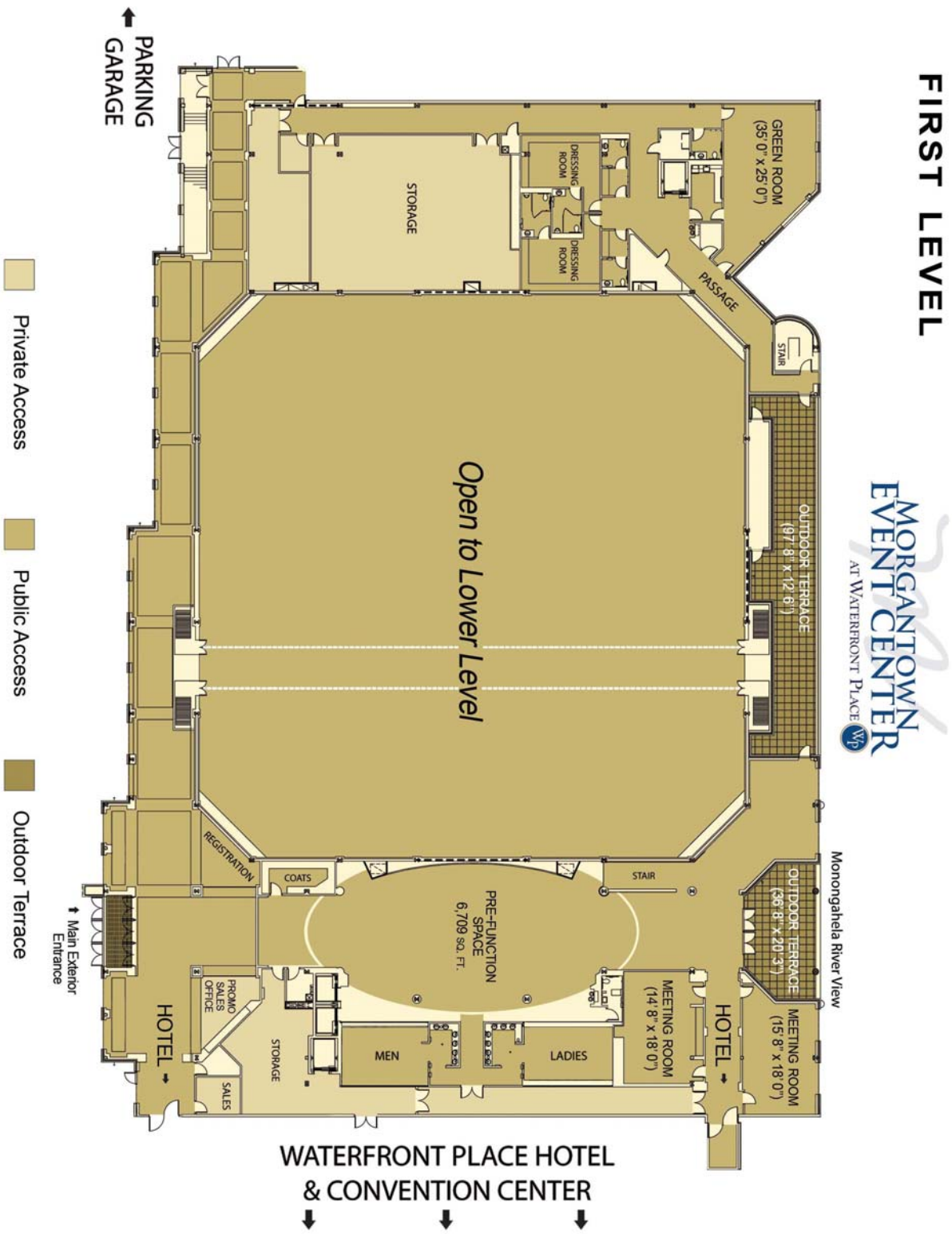
NOIRS 2011 AT A GLANCE

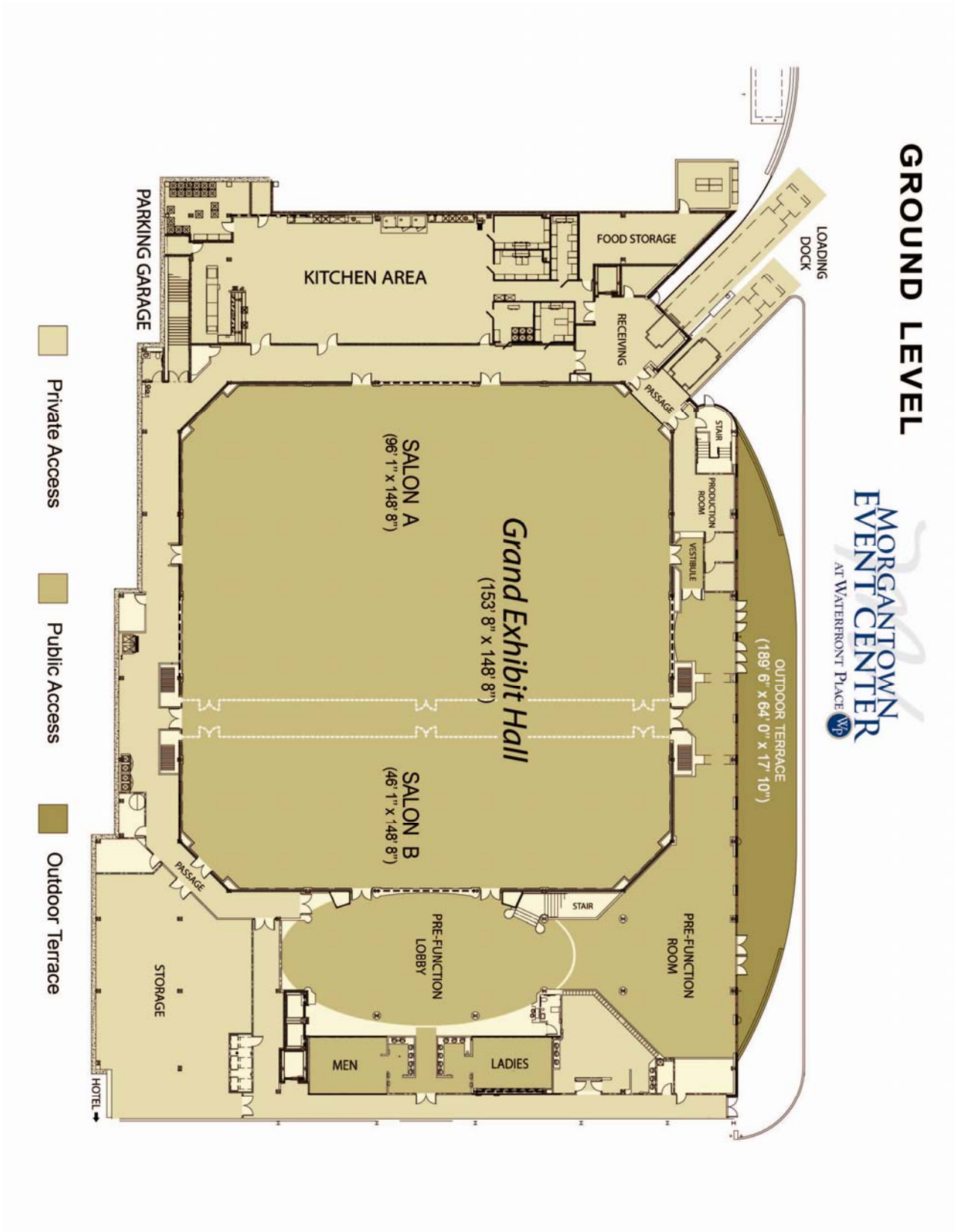
DAY THREE
THURSDAY, OCTOBER 20, 2011

Time	Thursday			
8:30 a.m. - 10:00 a.m.	**Concurrent Sessions H**			
	H1	H2	H3	H4
	Wharf A/B	*Salon A/B/C*	*Salon F/G/H*	*Waterfront*
	EMS/Fire Services	**Violence in Healthcare**	**Work Hours and Sleep**	**Hazard ID and Management**
10:00 a.m. - 10:30 a.m.	**Break**			
10:30 a.m. - 12:00 p.m.	**Closing Plenary** *Platinum Grand Ballroom*			

Waterfront Place Hotel
Meeting Facilities
Main Floor




FIRST LEVEL
MORGANTOWN EVENT CENTER
AT WATERFRONT PLACE
PARKING GARAGE
GREEN ROOM (35' 0" x 25' 0")
STORAGE
DRESSING ROOM
DRESSING ROOM
PASSAGE
STAIR
OUTDOOR TERRACE (97' 8" x 12' 6")
Open to Lower Level
OUTDOOR TERRACE (36' 8" x 20' 2")
Monongahela River View
MEETING ROOM (15' 8" x 18' 0")
MEETING ROOM (14' 8" x 18' 0")
HOTEL
REGISTRATION
COATS
STAIR
PRE-FUNCTION SPACE 6,709 SQ. FT.
Main Exterior Entrance
PROMO SALES OFFICE
STORAGE
MEN
LADIES
SALES
HOTEL
WATERFRONT PLACE HOTEL & CONVENTION CENTER
Private Access
Public Access
Outdoor Terrace


GROUND LEVEL
MORGANTOWN EVENT CENTER
AT WATERFRONT PLACE
LOADING DOCK
FOOD STORAGE
KITCHEN AREA
PARKING GARAGE
RECEIVING
PASSAGE
STAIR
PRODUCTION ROOM
VESTIBULE
OUTDOOR TERRACE
(189' 6" x 64' 0" x 17' 10")
SALON A
(96' 1" x 148' 8")
Grand Exhibit Hall
(153' 8" x 148' 8")
SALON B
(46' 1" x 148' 8")
PASSAGE
STAIR
PRE-FUNCTION LOBBY
PRE-FUNCTION ROOM
STORAGE
MEN
LADIES
HOTEL
Private Access
Public Access
Outdoor Terrace

ACKNOWLEDGEMENTS

NOIRS 2011 is being convened by the Division of Safety Research, NIOSH
Dawn N. Castillo, 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 2011

Conference Management Committee
Timothy J. Pizatella [Chair], Jane Andreaggi, James Collins, Tonya Rowan, Brenda Braddee-Roycroft, Christie Wolfe and Nancy Stout [Retired]

Scientific Review Committee
James Collins [Chair], Betty Champagne [Recorder]
Al Amendola, Sharon Chiou, Ted Courtney, Nils Fallentin, Dan Hartley, Kitty Hendricks, Jennifer E. Lincoln, Cammie Chaumont Menéndez, Kara Perritt, Dana Reinke, Marilyn Ridenour, Hope Tiesman, and Jeff Welsh

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Agenda Book
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NOIRS Website Design
NIOSH, Division of Safety Research
Joyce Spiker

NOIRS Logo Design
Katie Zeitz

Tuesday, October 18, 2011

7:30 a.m. - 8:30 a.m. **REGISTRATION** (Continental Breakfast)

8:30 a.m. - 10:00 a.m. **OPENING PLENARY SESSION** *Platinum Grand Ballroom*

"Future Directions in Occupational Injury Prevention Research"

Welcome: **Dawn N. Castillo, M.P.H.**
Director
Division of Safety Research, NIOSH

John W. Ruser, Ph.D.
Assistant Commissioner for
Occupational Safety and Health Statistics
Bureau of Labor Statistics
U.S. Department of Labor

Y. Ian Noy, Ph.D.
Vice President and Director
Liberty Mutual Research Institute for Safety

Benjamin C. Amick, III, Ph.D.
Scientific Director
Institute for Work and Health—Canada

John M. Howard, M.D.
Director
National Institute for Occupational Safety and Health

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

Tuesday, October 18, 2011

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

A1.0	**Surveillance I** Moderator: Dawn Castillo	**Wharf A/B**
10:30 a.m.	*Addition of New Codes into Administrative Data: A Discussion of the Process and Benefits for Occupational Health Surveillance*	Jennifer Taylor A1.1
10:50 a.m.	*An Accurate Semi-computerized Approach to Classifying Injury Narratives of Large Administrative Datasets into Bureau of Labor Statistics Occupational Injury and Illness Classification System (OIICS) 2-Digit Event Categories*	Helen Marucci-Wellman A1.2
11:10 a.m.	*The Revised Occupational Injury and Illness Classification System (OIICS)*	Janice Windau A1.3
11:30 a.m.	*Emergency Department–treated Injuries among U.S. Workers by Industry Sector*	Larry Jackson A1.4
11:50 a.m.	Questions and Discussion	

A2.0	**Fall Prevention in Construction I** Moderator: Angela DiDomenico	**Salon A/B/C**
10:30 a.m.	*Fall Prevention and Worker Mentorship at Residential Construction Sites*	Vicki Kaskutas A2.1
10:50 a.m.	*Outcomes of a Revised Apprentice Carpenter Fall Prevention Training Curriculum*	Bradley Evanoff A2.2
11:10 a.m.	*Innovation in Extension Ladder Angular Positioning*	Peter Simeonov A2.3
11:30 a.m.	*Effects of Motivation and Acclimation on Lateral Reach Distances while Standing on a Stepladder*	Angela DiDomenico A2.4
11:50 a.m.	Questions and Discussion	

Tuesday, October 18, 2011

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

A3.0	**Economics of Work-related Injuries** Moderator: Elyce Biddle	**Waterfront**
10:30 a.m.	*Uncompensated Consequences of Workplace Injuries and Illness: Long-term Disability and Early Retirement*	Robert Park A3.1
10:50 a.m.	*Using Lost Earnings to Relate Impairment Ratings and Disability Severity*	Seth Seabury A3.2
11:10 a.m.	*Experience Rating Smaller Employers: Does it Improve Safety?*	Frank Neuhauser A3.3
11:30 a.m.	*Excess Healthcare Costs Associated with Prior Workers' Compensation Activity*	Anasua Bhattacharya A3.4
11:50 a.m.	Questions and Discussion	

A4.0	**Management Commitment and Organizational Performance** Moderator: David DeJoy	**Salon H**
10:30 a.m.	*Effect of Rating of Management Attitude and Commitment on Injury Rate and Severity in Small- and Medium-sized Construction Companies*	Katherine Schofield A4.1
10:50 a.m.	*How Do Organizational Policies and Practices Affect Return to Work and Work Role Functioning Following a Musculoskeletal Injury?*	Benjamin Amick A4.2
11:10 a.m.	*A Pilot Study to Examine Some Psychometric Properties of a Measure to Assess Organizational Occupational Health and Safety Performance: The Organizational Performance Metric (OPM)*	Benjamin Amick A4.3
11:30 a.m.	*The Role of Management Commitment to Safety in Promoting a Healthy Workplace: Results from a National Survey of U.S. Workers*	James Grosch A4.4
11:50 a.m.	Questions and Discussion	

Tuesday, October 18, 2011

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

A5.0	**Agriculture, Forestry, & Fishing** Moderator: Larry Layne	**Salon F/G**
10:30 a.m.	*Fatalities in the U.S. Commercial Fishing Industry, 2000–2009*	Jennifer M. Lincoln A5.1
10:50 a.m.	*Fish Farmer Created Inherently Safer Technologies*	Melvin Myers A5.2
11:10 a.m.	*Commercial Fishermen and Personal Flotation Devices (PFDs): Preconceptions and Evaluations of Comfort*	Jennifer M. Lincoln A5.3
11:30 a.m.	*Progress in Preventing Fatal Occupational Traumatic Injuries in the U.S. Agriculture, Forestry, and Fishing Sector, 1992–2009*	George Conway A5.4
11:50 a.m.	Questions and Discussion	

12:00 p.m. - 1:30 p.m. **LUNCH** (Provided in the Foyer)

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

B1.0	**Surveillance II** Moderator: Kara Perritt	**Wharf A/B**
1:30 p.m.	*Occupational Injuries of Hotel Workers: Surveillance, Inspections and Best Practices*	Pamela Vossenas B1.1
1:50 p.m.	*Injuries among U.S. Food Services Industry Workers*	Larry Jackson B1.2
2:10 p.m.	*Young Worker Deaths: A Summary of NIOSH Surveillance and Investigative Findings*	Michael Goldcamp B1.3
2:30 p.m.	*Cluster Analysis of Unintentional Workplace Carbon Monoxide Exposures in the United States from 2000 to 2009*	Svetla Slavova B1.4
2:50 p.m.	Questions and Discussion	

Tuesday, October 18, 2011

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

B2.0	**Fall Prevention in Construction II** Moderator: Hongwei Hsiao	**Salon A/B/C**
1:30 p.m.	*Foremen Fall Prevention Curriculum Development and Pilot Testing*	Vicki Kaskutas B2.1
1:50 p.m.	*Leaders in Safe Construction: Development of a Contractor-focused Fall Prevention Program through Community-based Participatory Research*	Susan Shepherd B2.2
2:10 p.m.	*Fall Prevention Training to Hispanic Workers of Southern Nevada*	Pramen Shrestha B2.3
2:30 p.m.	*The Cost-effectiveness of Fall Arrest Systems in Construction: The Employer's Perspective*	Matt Gillen B2.4
2:50 p.m.	Questions and Discussion	

B3.0	**Machine Safety** Moderator: Al Amendola	**Waterfront**
1:30 p.m.	*Visual Feedback System to Improve Machine Controls Design*	Lisa Steiner B3.1
1:50 p.m.	*Research Partnership for Prevention of Machine-related Injuries: The National Machine Guarding Program*	Samuel Yamin B3.2
2:10 p.m.	*Machine Safety Research: The Road Ahead*	James Harris B3.3
2:30 p.m.	*Accident Prevention Techniques Adopted in Steel Re-rolling Mills*	Somendra Pal Rana B3.4
2:50 p.m.	Questions and Discussion	

Tuesday, October 18, 2011

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

B4.0	**Improving Safety at the Company Level** Moderator: Benjamin Amick	**Salon H**
1:30 p.m.	*Breakthrough Change in Workplace Safety*	Lynda Robson B4.1
1:50 p.m.	*Have Major U.S. Companies Adopted Prevention Through Design (PtD) Practices and Policies?*	Elyce Biddle B4.2
2:10 p.m.	*Is Occupational Injury Risk Higher at New Firms?*	Seth Seabury B4.3
2:30 p.m.	*A Randomized Controlled Study of Targeted Occupational Health and Safety Consultation or Inspection in Ontario Workplaces**	Sheilah Hogg-Johnson B4.4
2:50 p.m.	Questions and Discussion	
	*Intervention Evaluation Contest – Honorable Mention Paper	

B5.0	**Motor Vehicle I** Moderator: Stephanie Pratt	**Salon F/G**
1:30 p.m.	*Motor Vehicle Collision Injuries in Semi Truck Drivers vs. Passengers in the Sleeper Berth*	Terry Bunn B5.1
1:50 p.m.	*Experimental Test of Impact of Work-related Fatigue on Police Officer Vehicle Collision Risk*	Bryan Vila B5.2
2:10 p.m.	*Trends in Motor Vehicle Fatalities in the Oil and Gas Extraction Industry: Results from the Census of Fatal Occupational Injuries*	Kyla Retzer B5.3
2:30 p.m.	*Cost-effectiveness Analysis of Fatigue Management to Prevent Truck Collisions in the Oil and Gas Extraction Industry*	Melvin Myers B5.4
2:50 p.m.	Questions and Discussion	

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

Tuesday, October 18, 2011

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

C1.0	**Surveillance III** Moderator: John Myers	**Wharf A/B**
3:30 p.m.	*Occupational Injury Surveillance Using the Washington State Trauma Registry*	Jeanne Sears C1.1
3:50 p.m.	*Is Louisiana Really the Safest State?*	John Mendeloff C1.2
4:10 p.m.	*Investigation of Compliance with Safety Standards in the New England Tree Care Industry*	Alexandra Julius C1.3
4:30 p.m.	*Occupational ATV-related Injuries in Washington State's Agricultural Industry, 2004–2008*	Jim Helmkamp C1.4
4:50 p.m.	Questions and Discussion	

C2.0	**Violence in Retail** Moderator: Dan Hartley	**Salon A/B/C**
3:30 p.m.	*Translation of a Robbery Prevention Program for Small Retail Businesses: A Pilot Study*	Carrie Casteel C2.1
3:50 p.m.	*Event-related Risk Factors for Robbery-related Workplace Homicide*	Kelly Gurka C2.2
4:10 p.m.	*Fatalities among Taxicab Drivers in the United States, 1992–2008*	Cammie Chaumont Menéndez C2.3
4:30 p.m.	*Community-based Participatory Research with Vulnerable Worker Groups: Identification of Risk Factors for Workplace Violence among New York City Taxi Drivers*	Rebecca Reindel C2.4
4:50 p.m.	Questions and Discussion	

Tuesday, October 18, 2011

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

C3.0	**Safety Climate I** Moderator: Marvin Dainoff	**Waterfront**
3:30 p.m.	*Safety Climate and Fire Fighter Line-of-duty Injury and Illness: Development of a Conceptual Model*	David DeJoy C3.1
3:50 p.m.	*How to Measure Safety in the Construction Industry?*	Adri Frijters C3.2
4:10 p.m.	*Development and Validation of a Safety Climate Scale for the Trucking Industry*	Marvin Dainoff C3.3
4:30 p.m.	*Safety Climate Research, Intervention, and Training: Establishing a Five-year Agenda*	Gargi Sawhney C3.4
4:50 p.m.	Questions and Discussion	

C4.0	**Agriculture I** Moderator: Bruce Alexander	**Salon H**
3:30 p.m.	*Regional Rural Injury Study III: Short- and Long-term Work-related Consequences Associated with Injuries among Children on Agricultural Operations*	Bruce Alexander C4.1
3:50 p.m.	*An Overview of Youth Demographics and Injury Characteristics on U.S. Farms, 2009*	Kitty Hendricks C4.2
4:10 p.m.	*Economics of Preventing Agricultural Injuries to Adolescent and Adult Farm Workers: Surveillance, Exposure, and Intervention Effectiveness Data for Public School Teachers Trained to be Safety Advocates in Rural Schools*	Joan Mazur C4.3
4:30 p.m.	*Chore at Time of Fatal and Serious Injuries from Overturns of Non-ROPS and ROPS Tractors*	Henry Cole C4.4
4:50 p.m.	Questions and Discussion	

Tuesday, October 18, 2011

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

C5.0	**Construction Hazards** Moderator: Jennifer E. Lincoln	**Salon F/G**
3:30 p.m.	*Work Zone–Fatal Occupational Injuries at Road Construction Sites, 2003–2010*	Stephen Pegula C5.1
3:50 p.m.	*WORK ZONE: Internal Traffic Control Plans–A Field Intervention Evaluation in Hot-mix Asphalt Paving Operations: Preliminary Results*	David Fosbroke C5.2
4:10 p.m.	*Work-related Musculoskeletal Disorders in Construction, 1992–2009*	Sue Dong C5.3
4:30 p.m.	*Technology to Enable Real-time Pro-active Safety in Construction*	Jochen Teizer C5.4
4:50 p.m.	Questions and Discussion	
5:00 p.m.	**Adjourn Day One** (Dinner on your own)	

Wednesday, October 19, 2011

7:30 a.m. - 8:30 a.m. **REGISTRATION** *(Continental Breakfast)*

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

D1.0	**Underreporting of Injuries I** Moderator: Larry Jackson	**Wharf A/B**
8:30 a.m.	*Investigations of Undercounting in the Bureau of Labor Statistics' Survey of Occupational Injuries and Illnesses*	Eric Sygnatur D1.1
8:50 a.m.	*Comparing Injury Data from Administrative and Survey Sources: Methodological Issues*	Nicole Nestoriak D1.2
9:10 a.m.	*Employer Interviews: Exploring Differences in Reporting Kentucky Work Injuries and Illnesses in the Survey of Occupational Injuries and Illnesses and State Workers' Compensation Claims*	Polly Phipps D1.3
9:30 a.m.	*Injury Underreporting in the Construction Industry*	Sue Dong D1.4
9:50 a.m.	Questions and Discussion	

D2.0	**Slips, Trips, and Falls** Moderator: Wen-Ruey Chang	**Salon A/B/C**
8:30 a.m.	*Moving Upstream: Using Slipping as an Outcome Measure in Epidemiologic Research on Fall-related Injuries*	Theodore Courtney D2.1
8:50 a.m.	*Fixed and Transient Risk Factors for Slipping in U.S. Limited-service Restaurant Workers*	Santosh Verma D2.2
9:10 a.m.	*Slips, Trips, and Falls in Healthcare Workers*	Theodore Courtney D2.3
9:30 a.m.	*An Investigation of Stochastic Distribution of the Required Coefficient of Friction for Level Walking*	Wen-Ruey Chang D2.4
9:50 a.m.	Questions and Discussion	

Wednesday, October 19, 2011

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

D3.0	**Ergonomics/MSDs** Moderator: Cammie Chaumont Menéndez	**Waterfront**
8:30 a.m.	*Injury Data Analysis to Evaluate the Effectiveness of Ergonomic Interventions*	Tiffani Fordyce D3.1
8:50 a.m.	*Task-based Measurements to Evaluate Effectiveness of Interventions in Participatory Ergonomic Programs*	Ann Marie Dale D3.2
9:10 a.m.	*Using Pictograms and Training to Reduce MSD Hazard Behaviors in Kitchen Prep Workers: Lessons Learned in Doing Research in Hard-to-Reach Workers*	Benjamin Amick D3.3
9:30 a.m.	*Recent Findings from the NIOSH Upper Extremity Musculoskeletal Disorder Consortium Studies*	Bradley Evanoff D3.4
9:50 a.m.	Questions and Discussion	

D4.0	**Hazardous Work Environments** Moderator: Timothy Pizatella	**Salon H**
8:30 a.m.	*An Analysis of Workplace Fatalities in USW-represented Workplaces (2008–2010)*	Anna Fendley D4.1
8:50 a.m.	*Fire and Explosion Deaths in Construction, 1992–2007*	Michael McCann D4.2
9:10 a.m.	*Development of a Severe Injury Surveillance System for Hazard Identification and Guiding Technological Interventions*	Gerald Poplin D4.3
9:30 a.m.	*Making the Business Case for Using Inherently Safer Technology at the Drill Head in Oil Extraction*	Melvin Myers D4.4
9:50 a.m.	Questions and Discussion	

Wednesday, October 19, 2011

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

D5.0	**Motor Vehicle II** Moderator: James Collins	**Salon F/G**
8:30 a.m.	*Trends in Work-related Motor Vehicle Fatalities among U.S. Law Enforcement Personnel*	Hope Tiesman D5.1
8:50 a.m.	*Impact of In-vehicle Assist Systems on Rural Intersection Crossing Performance in Simulated Driving*	Christopher Drucker D5.2
9:10 a.m.	*Policies for Work-related Road Safety in the United Kingdom, France, and Sweden: Lessons for the United States*	Stephanie Pratt D5.3
9:30 a.m.	*Identifying Potential Safety Technology to Prevent Military Vehicle Crashes*	Keshia Pollack 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	**Underreporting of Injuries II** Moderator: Eric Sygnatur	**Wharf A/B**
10:30 a.m.	*Evaluation of Two Outcomes in a Case Matched Dataset: Amputations and Carpal Tunnel Syndrome*	Sara Wuellner E1.1
10:50 a.m.	*Undercounting of Work-related Amputations and Carpal Tunnel Syndrome in California: Evaluation of Multiple Data Sources*	Rachel Roisman E1.2
11:10 a.m.	*Use of Multiple Data Sources to Enumerate Work-related Amputations in Massachusetts: Preliminary Results*	Letitia Davis E1.3
11:30 a.m.	*Comprehensive System to Identify Occupational Burns*	Joanna Kica E1.4
11:50 a.m.	Questions and Discussion	

Wednesday, October 19, 2011

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

E2.0	**Falls from Roofs and Ladders** Moderator: Peter Simeonov	**Salon A/B/C**
10:30 a.m.	*Work-related Falls from Ladders: A Follow-back Study of U.S. Emergency Department Cases*	David Lombardi E2.1
10:50 a.m.	*Fatal Falls from Roofs in Construction, 1992–2009*	Sue Dong E2.2
11:10 a.m.	*Anchoring System for Guardrails on Flat Roofs for Roofers*	André Lan E2.3
11:30 a.m.	*Development and Evaluation of the NIOSH Multifunctional Guardrail System*	Thomas Bobick E2.4
11:50 a.m.	Questions and Discussion	

E3.0	**Safety Climate II** Moderator: Ted Scharf	**Salon F/G/H**
10:30 a.m.	*Analysis of Needlestick Injuries among Healthcare Workers in a Tertiary Hospital of China*	Xujun Zhang E3.1
10:50 a.m.	*Unintentional Needlestick Injuries in Livestock Production: A Case Series and Review*	Charles Jennissen E3.2
11:10 a.m.	*Changes in Sharps Injuries among Healthcare Workers: The Effect of HR 5178 (National Needlestick Safety and Prevention Act)*	Elayne Kornblatt Phillips E3.3
11:30 a.m.	*Using Occupational Culture to Create Effective Safety Training*	Elaine Cullen E3.4
11:50 a.m.	Questions and Discussion	

Wednesday, October 19, 2011

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

E4.0	**Training, Drug Testing** Moderator: Suzanne Marsh	**Waterfront**
10:30 a.m.	*A Systematic Review of the Effectiveness of Occupational Health and Safety Training*	Lynda Robson E4.1
10:50 a.m.	*A Multi-year Program Evaluation of the Impacts and Outcomes of OSHA Education Center Training on Worker Safety, Safety Program Development and Implementation*	Mark Fullen E4.2
11:10 a.m.	*Integrated Injury Prevention in Small Metal Industry Enterprises*	Pete Kines E4.3
11:30 a.m.	*Effect of Drug Testing Programs on Injury Rate and Severity in Small- and Medium-sized Construction Companies*	Katherine Schofield E4.4
11:50 a.m.	Questions and Discussion	

12:00 p.m. - 1:30 p.m. **LUNCH** (Provided in the Foyer)

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

F1.0	**Underreporting of Injuries III** Moderator: Letitia Davis	**Wharf A/B**
1:30 p.m.	*Overview of NIOSH Research on Occupational Injury and Illness Underreporting*	Larry Jackson F1.1
1:50 p.m.	*If You are Injured at Work, Would You Report It and Why? A Questionnaire to Assess Worker Incentives and Disincentives to Reporting Occupational Injuries*	Audrey Reichard F1.2
2:10 p.m.	*Did You Have a Work-related Injury or Illness? A Questionnaire to Assess Injured Workers' Employment Characteristics, Reporting Behavior, and Chronic Conditions*	Suzanne Marsh F1.3
2:30 p.m.	*Identification of Work-related Injuries in the Washington State Trauma Registry*	Jeanne Sears F1.4
2:50 p.m.	Questions and Discussion	

Wednesday, October 19, 2011

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

F2.0	**Violence Among Educators** Moderator: Cammie Chaumont Menéndez	**Salon A/B/C**
1:30 p.m.	*Work-related Violence Against Educators in Minnesota: Rates and Risks Based on Hours Exposed*	Chia Wei F2.1
1:50 p.m.	*Occupational Physical Violence Against Educators: A Case-control Study*	Susan Gerberich F2.2
2:10 p.m.	*Risk Factors for Workplace Violence among Pennsylvania Education Workers: Differences among Occupations*	Hope Tiesman F2.3
2:30 p.m.	*Electronic Workplace Aggression among Pennsylvania Teachers and Education Support Staff*	Shrinivas Konda F2.4
2:50 p.m.	Questions and Discussion	

F3.0	**Fall Prevention** Moderator: Ted Courtney	**Salon F/G/H**
1:30 p.m.	*Factors Associated with Use of Slip-resistant Shoes in U.S. Limited-service Restaurant Workers*	Santosh Verma F3.1
1:50 p.m.	*Perceptions of Slipperiness as a Function of Visual Cues and Available Coefficient of Friction*	Mary Lesch F3.2
2:10 p.m.	*Hazard Recognition Training to Prevent Falls among Ironworkers*	Ted Scharf F3.3
2:30 p.m.	*Field Evaluation of a Hands-on Training Program for the NIOSH Designed Guardrail System*	Mark Fullen F3.4
2:50 p.m.	Questions and Discussion	

Wednesday, October 19, 2011

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

F4.0	**Mining** Moderator: Jeffrey Welsh	**Waterfront**
1:30 p.m.	*Profitability and Occupational Injuries in U.S. Underground Coal Mines*	Christopher Mark F4.1
1:50 p.m.	*Need for an Intelligent Proximity Detection System in Underground Coal Mining*	Jacob Carr F4.2
2:10 p.m.	*Avoiding Collisions in Underground Mines*	Robin Burgess-Limerick F4.3
2:30 p.m.	*Internalizing Occupational Health Effects in the South African Coal Mining Sector*	George Thopil F4.4
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	**Patient Lifting** Moderator: James Collins	**Wharf A/B**
3:30 p.m.	*"Time" as a Barrier to the Use of Patient Lift Equipment: More Complex than "Minutes to Complete the Task"*	Douglas Myers G1.1
3:50 p.m.	*Evaluating the Effect of an Intervention to Prevent Patient-handling Injuries among Hospital Workers: Support for the Collection of Intermediate Measures of Intervention Adoption and the Integration of Quantitative and Qualitative Methods**	Ashley Schoenfisch G1.2
4:10 p.m.	*Safe Patient Handling: Implementing a National Program*	Michael Hodgson G1.3
4:30 p.m.	*VHA Evaluation of Safe Patient Handling Initiative*	Gail Powell-Cope G1.4
4:50 p.m.	Questions and Discussion	

*Intervention Evaluation Contest - Winning Paper

Wednesday, October 19, 2011

3:30 p.m. - 5:00 p.m. **CONCURRENT SESSION G (con't)**

G2.0	**Vulnerable Populations** Moderator: Thomas Bobick	**Salon A/B/C**
3:30 p.m.	*Temporal Patterns in Fatality Rates of Selected Retail Industries in the United States, 2003–2008*	Cammie Chaumont Menéndez G2.1
3:50 p.m.	*Cut-laceration Injuries and Related Career Groups in New Jersey Career and Technical Education*	Derek Shendell G2.2
4:10 p.m.	*Systematic Review of Intervention Practices for Depression in the Workplace*	Andrea Furlan G2.3
4:30 p.m.	*Preventing Injuries among Hispanic Construction Workers in the United States*	Linda Forst G2.4
4:50 p.m.	Questions and Discussion	

G3.0	**Work Schedules, Sleep, and Fatigue** Moderator: David Lombardi	**Salon F/G/H**
3:30 p.m.	*Hours of Work in the United States: Results from Three Waves of the General Social Survey*	James Grosch G3.1
3:50 p.m.	*Patterns of Sleep, Sleepiness, Fatigue, and Neurobehavioral Performance in Registered Nurses Working Successive 12-hour Shifts*	Jeanne Geiger Brown G3.2
4:10 p.m.	*The Impact of Nurses Work Schedules on Patient Mortality*	Alison Trinkoff G3.3
4:30 p.m.	*Improving Computer Break Schedules: The NIOSH Rest Break e-Toolbox*	Jessica Streit G3.4
4:50 p.m.	Questions and Discussion	

Wednesday, October 19, 2011

3:30 p.m. - 5:00 p.m. **CONCURRENT SESSION G (con't)**

G4.0	**Agriculture II** Moderator: David Hard	**Waterfront**
3:30 p.m.	*Injuries to Hired Crop Workers in the United States*	John Myers G4.1
3:50 p.m.	*Research to Action Promotes a Healthier Workplace on the Farm*	Sherry Wyckoff G4.2
4:10 p.m.	*A Campus-community Partnership for Tomato Workers' Health*	Ken Silver G4.3
4:30 p.m.	*Occupational Fatalities in Alaska: Two Decades, 1990–1999 and 2000–2009*	Jennifer M. Lincoln G4.4
4:50 p.m.	Questions and Discussion	

Wednesday, October 19, 2011

5:30 p.m. – 7:30 p.m. **POSTER SOCIAL**
Waterfront Place Hotel
Grand Exhibit Hall, Salon B

LIST OF FEATURED POSTERS

Surveillance

P01 *Toxicology Testing in Fatally Injured Workers: A Review of Five Years of Iowa FACE Program Cases*
Ryan Sullivan

Emergency Responder Safety

P02 *Work-related Injuries among Firefighters*
Oi-Saeng Hong

P03 *NIOSH Fire Fighter Fatality Investigation and Prevention Program*
Timothy R. Merinar

P04 *Injuries Sustained by Responders Involved in Acute Hazardous Substance Releases, 2001–2009*
Ayana Anderson

P05 *Critical Mass: Comparing Nuclear Exposure Injury Compensation Programs*
Gregory Winters

P06 *Ten Years Later–Still Learning about World Trade Center Responder Injuries and Illnesses*
Kara Perritt

P07 *Dying While Saving Lives and Protecting Property: A Comparison of Four Systems that Collect Traumatic Firefighter Fatalities*
Suzanne Marsh

P08 *Saving Lives at the Risk of the Provider: Fatal and Nonfatal Injuries among EMTs and Paramedics, 2003–2009*
Audrey Reichard

Emergency Department Injury Surveillance and Underreporting

P09 *Developing Questionnaires on Underreporting of Occupational Injuries and Illnesses–A Journey into the Abyss*
Audrey Reichard

P10 *Characteristics of Occupational Injuries Resulting in Hospitalization*
Larry Jackson

P11 *NEISS–Work Surveillance System Evaluation Part1: Retrospective Review of NEISS Non-work Injury Narratives for Misclassification of Occupational Injuries*
Susan Derk

Wednesday, October 19, *2011*

LIST OF FEATURED POSTERS (con't)

Emergency Department Injury Surveillance and Underreporting (con't)

P12 *Occupational Injuries among U.S. Workers Missed by Employer-based Reporting*
Claire Dye

Agriculture Safety

P13 *ROPS Attribute Identification by Channel Intermediaries*
Paul Keane

P14 *Work-related Pesticide Poisoning Analysis among Farmers in Jiangsu*
Tu Zhibin

P15 *Depression, Perceived Stress, and Nervios Associated with Injury in a California Farm Worker Population*
Hong Xiao

P16 *The Protective Mental Health Effects of Farm Workers among Aging Farmers*
Deborah Reed

P17 *Utilization of Cost-effective Rollover Protective Structures in NYCAMH Retrofit Program*
Eugene McKenzie

Construction Safety

P18 *NIOSH Development of a Multi-functional Guardrail System*
Eugene McKenzie

P19 *Labor/NIOSH Construction Research Partnerships*
Michael McCann

P20 *Evaluation of Maximum Impact Forces and Potential Instability during Various Methods of Exiting and Entering Scissor Lifts at Elevations*
Sharon Chiou

P21 *Preventing Worker Fatalities Due to Backing Road Construction Vehicles and Equipment–Lessons from the NIOSH Fatality Assessment and Control Evaluation (FACE) Program*
Nancy Romano

Mining Safety

P22 *Influence of Different Kneepads and Location of Work on Knee Stresses*
Sree Harsha Jampala

P23 *Machine Maintenance and Repair Injuries in Mining Mills and Preparation Plants*
John Heberger

Wednesday, October 19*, 2011*

LIST OF FEATURED POSTERS (con't)

Mining Safety (con't)

P24 *Comparison of Noise Reductions of Cap Mounted Muffs Fitted on a Traditional and Newly Designed Mining Helmet*
Brandon Takacs

P25 *Physiological Evaluation of Air-fed Ensembles during Exercise*
Nina Turner

P26 *A Case Study of Gold Fields Exploration's Effort in Establishing Zero Harm Safety Culture Within Its Corporate Safety Culture in Africa 2010/2011*
Jacob Aggrey-Odoom

Healthcare Safety

P27 *A Comprehensive Safe Lifting Program Influences Caregiver Injury Outcome and Resident Quality Indicators*
Patricia Gucer

P28 *Practitioner's Risk Exposure to Client Violence: A Test of Gender Sensitive to Case Assignment Practices*
Tony Lowe

P29 *Psychiatric Nursing Staff's Emotional Response in Relation to Severity of Patient Aggression*
Marilyn Ridenour

Workplace Violence

P30 *Causes of Non-robbery Related Homicides among Retail Workers, 2003–2008*
Srinivas Konda

Safety Program Effectiveness

P31 *Evaluation of the California Injury and Illness Prevention Program*
John Mendeloff

P32 *Are There Unusually Effective Health and Safety Inspectors?*
Amelia Haviland

P33 *Synthesis of Risk Reduction Methods for Occupational Safety and Health*
Roger Jensen

Safety Program Effectiveness in Vulnerable Populations

P34 *What Makes Safety Training Effective in Preventing Injury among Young Workers?*
Kristina Zierold

Wednesday, October 19*, 2011*

LIST OF FEATURED POSTERS (con't)

Safety Program Effectiveness in Vulnerable Populations (con't)

P35 *The Role of Supervisors in Preventing Injury among Working Teens*
Kristina Zierold

P36 *Adapt and Validate Spanish Ergonomic Job Exposure Tools*
Kellie Pierson

Economics of Injury

P37 *The Economic Burden of Occupational Fatal Injuries in the United States by Industry Sector, 2003–2006*
Elyce Biddle

P38 *Improving the Strategy for Demonstrating the Value of Occupational Safety and Health Activities*
Reepa Shroff

Motor Vehicle Safety

P39 *Selecting Male and Female Multivariate Anthropometric Models for the Design of Truck Cab Workspace*
Jinhua Guan

P40 *System Design of a Portable Exposure Assessment Device for Package Truck Drivers*
Shengke Zeng

NIOSH Safety Research Labs

P41 *NIOSH Safety Research Labs and Research Activities for Traumatic Injury Control*
Darlene Weaver

Thursday, October 20, 2011

8:30 a.m. - 10:00 a.m. **CONCURRENT SESSION H** (Continental Breakfast)

H1.0	**EMS/Fire Services** Moderator: Tim Merinar	**Wharf A/B**
8:30 a.m.	*The Nature of Injuries in the Fire Service*	Gerald Poplin H1.1
8:50 a.m.	*Partnering to Develop Ambulance Safety Standards*	James Green H1.2
9:10 a.m.	*The Incident Command System as a Fire Fighting or Emergency Response Risk Management Tool*	Murrey Loflin H1.3
9:30 a.m.	*Assessing the Cost-effectiveness of the Wellness-fitness Initiative (WFI)*	Regina Pana-Cryan H1.4
9:50 a.m.	Questions and Discussion	

H2.0	**Violence in Health Care** Moderator: Marilyn Ridenour	**Salon A/B/C**
8:30 a.m.	*Developing a Comprehensive Hospital Violence Surveillance System: Findings from a Baseline Needs Assessment*	Lisa Pompeii H2.1
8:50 a.m.	*Patient-related Violence Experienced by Workers in a Large Hospital System*	John Dement H2.2
9:10 a.m.	*Assaults in Healthcare: From Enumeration and Counting to Threat Assessment and Management*	Michael Hodgson H2.3
9:30 a.m.	*Employee Assistance Program Use for Intimate Partner Violence and Its Impact on Work Performance*	Keshia Pollack H2.4
9:50 a.m.	Questions and Discussion	

Thursday, October 20, 2011

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

H3.0	**Work Hours and Sleep** Moderator: David Lombardi	**Salon F/G/H**
8:30 a.m.	*Serious Police Injuries: The Association with Shift Work*	John Violanti H3.1
8:50 a.m.	*Sleep Duration, Body Mass, and the Risk of a Work-related Injury: Results from the U.S. National Health Interview Survey (2004–2009)*	David Lombardi H3.2
9:10 a.m.	*Long Working Hours and Sleep as Direct and Indirect Risk Factors for Work-related Injury–A Structural Equation Modeling Approach*	Anna Wirtz H3.3
9:30 a.m.	*The Organization of Crop and Horse Breeding Work in Central Kentucky and Its Relationship with Occupational Illness/Injury for Latino Farmworkers*	Jennifer Swamberg H3.4
9:50 a.m.	Questions and Discussion	

H4.0	**Hazard ID and Management** Moderator: Jennifer Bell	**Waterfront**
8:30 a.m.	*Proposal for Defining "Hazard" in the Context of Occupational Safety and Health*	Roger Jensen H4.1
8:50 a.m.	*Comparison of an Observational Hazard Assessment Tool with Traditional Approaches*	Richard Neitzel H4.2
9:10 a.m.	*Something Might be Missing from Your OHS Audit: Findings from a Content Validity Analysis of Five Audit Instruments*	Lynda Robson H4.3
9:30 a.m.	*The Psychometric Properties of the OSHA Audit Tool for Assessing an Organization's Safety and Health Management System*	David Gimeno Ruiz de Porras H4.4
9:50 a.m.	Questions and Discussion	

Thursday, October 20, 2011

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

"Using Evidence-Based Results to Change Industry Practice"

Moderator: **CAPT James Collins, Ph.D., M.S.M.E.**
Associate Director for Science
Division of Safety Research, NIOSH

Fred Schimmel, B.A.
Engineering Manager
SJC Industries

Hongwei Hsiao, Ph.D.
Branch Chief
Protective Technology Branch
Division of Safety Research, NIOSH

Richard Duffy, M.Sc.
Executive Assistant to the General
President for Health and Safety
International Association of Fire Fighters

Stephen M. Hubbard
Corporate Safety Director
&
Michele A. Jacobs, B. S.
Corporate Fleet Safety Manager
The Lane Construction Corporation

NOIRS 2011 List of Opening and Closing

Plenary Speakers

Benjamin C. Amick, III, Ph.D.

Dr. Ben Amick is the Scientific Director of the Institute for Work & Health. He has been affiliated with the Institute since 1996 as an Adjunct Scientist and 2002 as a member of the Scientific staff. He has served as co-investigator on multiple projects at the Institute. As scientific director, he provides guidance to scientific staff while continuing to perform his own research. He is currently investigating how organizations can change or improve their programs and policies to prevent injury and manage disability. He is also studying successful initiatives to improve health and safety from within organizations.

Dr. Amick is a Professor of Behavioral Sciences and Epidemiology at the University of Texas School of Public Health. He completed his Ph.D. in social epidemiology at The Johns Hopkins University School of Hygiene and Public Health and a Post-Doctoral Fellowship in chronic disease epidemiology at Yale University. He specializes in using social science theories and methods to better understand the causes of illness and disease in society. In particular, he is interested in finding ways to create public policy to address social inequalities and public health issues.

Overall, his research focuses on how to build healthy labour markets through an understanding of how to change policy, organizations, work conditions and the design of occupational health services.

Dawn N. Castillo, M.P.H.

Dawn N. Castillo was appointed as the Director of the Division of Safety Research (DSR) at the National Institute for Occupational Safety and Health (NIOSH) in July 2011. The Division serves as the focal point for the traumatic occupational injury research and prevention programs at NIOSH.

Prior to being appointed as Division Director, Ms. Castillo served as Chief of the DSR Surveillance and Field Investigations Branch, responsible for occupational injury data collection, analysis and interpretation. Ms. Castillo is an epidemiologist by training and has authored numerous articles, book chapters, and technical documents on occupational injuries.

Ms. Castillo was the fifth recipient, in 2004, of the James. P. Keogh award, an annual NIOSH award recognizing a current or former NIOSH employee for exceptional service to the field of occupational safety and health.

Ms. Castillo received a Master of Public Health in epidemiology from the University of California, Los Angeles.

CAPT James W. Collins, Ph.D., M.S.M.E.

Dr. James Collins is a Captain in the U.S. Public Health Service and is the Associate Director for Science for the Division of Safety Research (DSR), with the National Institute for Occupational Safety and Health (NIOSH).

Dr. Collins received his Ph.D. in Health Policy and Management from Johns Hopkins University and his Masters in Mechanical Engineering at West Virginia University and Bachelors in Mechanical Engineering from Georgia Tech.

He has 27 years experience as an Engineer and an Epidemiologist conducting laboratory and field research with NIOSH. His recent research has focused on safe resident lifting and slip, trip, and fall prevention in nursing homes and hospitals. As Associate Director for Science for the Division of Safety Research, he is responsible for the quality control of the research being conducted by the Division's approximately 75 staff members.

Dr. Collins received the 2010 James P. Keogh award for conducting rigorous scientific research to develop and test "best practice" interventions and for being an advocate for healthcare workers by promoting the widespread implementation of effective solutions to prevent patient-lifting and slip, trip, fall, and injuries in healthcare settings.

Dr. Collins is on the editorial board of the *International Journal of Injury Control and Safety Promotion*. He has authored 8 book chapters and published over 40 peer-reviewed manuscripts and NIOSH documents. His work has been published in *American Journal of Industrial Medicine, Injury Prevention, Ergonomics, Applied Ergonomics, Statistics in Medicine, Occupational Medicine: State of the Art Reviews, Professional Safety, Ohio Monitor, Robotics Engineering, Sensors, Journal of Safety Research, Journal of Occupational Accidents, Public Power Journal, and Business Society and Review*.

Richard M. Duffy, M.Sc.

Mr. Richard Duffy is the Assistant to the General President, Occupational Health, Safety and Medicine, International Association of Fire Fighters (IAFF), AFL-CIO, CLC, Washington, D.C.

Mr. Duffy holds a Master of Science (Health Science) in Environmental Health Science from the City University of New York, Institute of Health Sciences, Hunter College, and a Bachelor of Science; Environmental Science; Business Management from Davis and Elkins College. He has written numerous articles on fire service occupational health and safety programs.

His career began in 1976 as a Research Associate, INFORM, Incorporated, New York, New York. He was responsible for the research and writing of an occupational health and safety study of the primary copper smelting industry. He also participated in a National Science Foundation funded study at the Massachusetts Institute of Technology on the effects of public regulation on the copper wire industry, and participated in National Science Foundation funded occupational health and safety seminars for copper smelter workers in cooperation with the United Steelworkers of America.

In 1979 he became the Director, Department of Occupational Health and Safety, International Association of Fire Fighters (IAFF), AFL-CIO, CLC, Washington, D.C. where he directs the development and implementation of an occupational safety and health department for an international labor union. Mr. Duffy provides technical assistance and expert testimony to IAFF principal officers and local affiliates; organizes and conducts safety and health seminars; develops safety and health manuals and audiovisual materials; and provides liaison with professional and trade associations, federal agencies, and other organizations. He is also administrator of the IAFF John P. Redmond Foundation, which is responsible for studies and symposia on the occupational health and hazards of the fire service, and principal investigator and program manager for all government contracts and grants involving occupational health and safety.

In 2000 he became the Assistant to the General President, Occupational Health, Safety and Medicine, for the International Association of Fire Fighters, responsible for all the internal and external occupational health, safety and medical activities for the IAFF.

He is a member of numerous organizations focusing on fire service occupational health and safety programs.

John Howard, M.D.

Dr. John Howard is the Director of the National Institute for Occupational Safety and Health in the U.S. Department of Health and Human Services in Washington, D.C.

Prior to his appointment as Director of NIOSH, Dr. Howard served as Chief of the Division of Occupational Safety and Health in the California Department of Industrial Relations from 1991 through 2002.

Dr. Howard received his Doctor of Medicine from Loyola University of Chicago in 1974, his Master of Public Health from the Harvard School of Public Health in 1982, his Doctor of Law from the University of California at Los Angeles in 1986, and his Master of Law in Administrative Law from the George Washington University in Washington, D.C. in 1987.

Dr. Howard is board-certified in internal medicine and occupational medicine. He is admitted to the practice of medicine and law in the State of California and in the District of Columbia, and he is a member U.S. Supreme Court bar. He has written numerous articles on occupational health law and policy.

Hongwei Hsiao, Ph.D.

Dr. Hongwei Hsiao serves a Chief of the Protective Technology Branch with the NIOSH Division of Safety Research (DSR).

Dr. Hsiao received his degrees from Cornell University and the University of Michigan and has held engineering and management positions in the manufacturing industry and currently is an adjunct professor at West Virginia University.

Dr. Hsiao joined NIOSH in 1991 and was instrumental in expanding the NIOSH Human Factors and Safety Engineering Programs. He currently supervises research to develop high-risk injury hazard controls, such as preventing falls, crushing injuries, and protective criteria for special populations, using state-of-the-art digital modeling and field testing methods.

Dr. Hsiao is an editorial board member for nine journals, and has authored more than 130 publications and patents. An active strategic goal thinker and frequently invited program-development speaker, he is also a recipient of numerous prestigious scientific awards. He is a Fellow of the Institute of Ergonomics (U.K.) and an Honorary Fellow of the Human Factors and Ergonomics Society (U.S.).

Stephen M. Hubbard

Stephen M. Hubbard is the Corporate Safety Director for the Lane Construction Corporation based in Cheshire, Connecticut.

Stephen has over 25 years combined experience in highway and bridge construction. He was previously employed as safety manager for Rea Contracting in Charlotte, North Carolina. In his present position Stephen primarily focuses on safety management of OSHA compliance for 70 asphalt plants and projects in 11 states on the east coast and Texas with approximately 4000 employees.

Throughout his time in the construction field he has spent years working and developing programs that take safety to new levels to prevent accidents and injuries of employees and the traveling public.

In addition to general safety, Stephen has spent much time promoting the protection of employees and the general public through training for management and supervision in traffic control and transportation safety. To stay up to date on new technology and measures to reduce incidents, he has taken numerous OSHA safety classes.

Michele A. Jacobs, B.S.

Michele A. Jacobs is the Corporate Fleet Safety Manager for the Lane Construction Corporation with 25 years in the highway and bridge construction. She received her B.S. in Business Management from Fairleigh Dickinson University, Madison, NJ, in 1984.

Previously, Michele was the Safety Manager for construction and general industry for both Rea Contracting and Lane Construction for 20 years, and now specializes in Fleet Safety. Michele has developed numerous policies, training and systems to promote safety in the workplace. She has worked with outside organizations to research and network for best practices to constantly stay up to date on new technology and measures to reduce incidents, and has taken numerous OSHA safety classes. She has also developed and produced training videos pertaining to fleet safety topics.

Michele serves on the National Safety Council safety committee for transportation, and was a past safety committee member for the American Road and Transportation Builders Association (ARTBA). She has worked with NIOSH on past studies involving workers on foot in proximity to vehicles in construction workzones.

Y. Ian Noy, Ph.D., CPE

Dr. Ian Noy is Vice President, Liberty Mutual Group and Director, Liberty Mutual Research Institute for Safety. He holds a doctorate degree in Industrial Engineering from the University of Toronto, specializing in human factors. Prior to joining Liberty Mutual he was Director, Standards Research and Development with Transport Canada's Road Safety Directorate. He is a Board certified professional ergonomist (CPE) with 35 years of professional research and practice experience.

His career began in 1973 as a behavioural scientist at the Canadian Defence and Civil Institute of Environmental Medicine (DCIEM) working on a variety of military human-machine systems. In 1982 he joined Transport Canada as Chief of the Ergonomics Division to undertake traffic safety research to support the development of vehicle safety standards and other interventions.

Dr. Noy's R&D experience covers a broad range of areas, including traffic safety, workplace ergonomics, human-machine interface design and evaluation, human performance and training, and behavioural research. He has published over one hundred scientific and technical reports, and conference and journal articles. He has prepared and presented lectures in human factors on a variety of topics, including motor vehicle safety, human capabilities and limitations, human information processing and attention, anthropometry and workstation design, design of controls and displays, human factors in intelligent transport systems, and human performance and training. His applied research experience spans applications in the air, on the ground, and underwater, including military R&D. He has edited a book entitled, *The Ergonomics and Safety of Intelligent Driver Interfaces* (Lawrence Erlbaum & Associates, 1997). He also co-edited the *Handbook of Human Factors in Litigation* (CPC Press, 2004).

Dr. Noy is a Past President of the International Ergonomics Association (IEA). He is a Fellow of the Human Factors and Ergonomics Society (HFES), a past president and Honorary Fellow of the Human Factors Association of Canada/Association canadienne d'ergonomie (HFAC/ACE). Dr. Noy was the chairman of the 12th Congress of the IEA held in Toronto in 1994.

In 2001, Dr. Noy was awarded the U.S. National Highway Traffic Safety Administration's Award for Engineering Excellence. He is also the recipient of the International Ergonomics Association Distinguished Service Award, and the Human Factors and Ergonomics Society's Distinguished International Colleague Award.

John W. Ruser, Ph.D.

Dr. John W. Ruser has served as Assistant Commissioner for Safety, Health and Working Conditions at the U.S. Bureau of Labor Statistics since November 2006. He provides executive direction for the Census of Fatal Occupational Injuries, the Survey of Occupational Injuries and Illnesses and special epidemiological surveys.

Prior to his current position, Dr. Ruser was Associate Director for Regional Economics at the Bureau of Economic Analysis, U.S. Department of Commerce from 2002 to 2006 and led a research group on compensation and working conditions at the U.S. Bureau of Labor Statistics from 1995 to 2002. Dr. Ruser has written articles on workplace risk and insurance that has appeared in a number of economics and public health journals. He has also authored non-technical articles and book chapters on income measurement, compensation, and working conditions.

Dr. Ruser holds Ph.D. and M.A. degrees in economics from the University of Chicago and a B.A. in economics from Princeton University.

Fred Schimmel, B.A.

Fred Schimmel is a Senior Engineer and Compliance Officer for SJC Industries and Goshen Coach. He holds a bachelor's degree in mechanical engineering from the Purdue University.

SJC Industries is the second largest maker of ambulances in the United States with the brands of McCoy-Miller, Marque and Premiere. SJC recently introduced the industry's first side-loading ambulance.

Mr. Schimmel has been a member of the South West Fire District for over 28 years and served as Assistant Fire Chief for 5½ years and a Medic for 9 years. Mr. Schimmel is the Past President of the Ambulance Manufacturers Division (AMD) of the National Truck Equipment Association; Chairman of the AMD Technical Committee; and a member of the National Fire Protection Association 1917 Committee for ambulances.

Mr. Schimmel's work experience in the ambulance industry spans 31 years.

NOIRS 2011 List of Pre-Registered Participants

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

Pre-registered Participants

Jacob Aggrey-Odoom
Environmental Health & Safety Professional
Gold Fields Ltd, No 18 First Close
Airport Residential Area Accra
Accra
Greater Accra, Ghana 00233
AFRICA
Telephone: +233 244 341951
Email: Jacob.aggrey-odoom@gfexpl.com

Bruce Alexander, Ph.D.
Associate Professor
Department of Environmental Health Sciences
Masonic Cancer Center
University of Minnesota
1260 Mayo Memorial Bldg MMC-807
420 Delaware Street, SE
Minneapolis, MN 55455 USA
Telephone: (612) 625-7934
Email: balex@umn.edu

Harlan Amandus, Ph.D.
Chief
Analysis & Field Evaluations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1811
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5753
Email: HAmandus@cdc.gov

Al Amendola, PhD, P.E., C.P.E.
Chief
Safety Controls Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G800
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6386
Email: AAmendola@cdc.gov

Benjamin Amick III, Ph.D.
Scientific Director
Institute for Work and Health
481 University Avenue, Suite 800
Toronto, Ontario M5G 2E9 Canada
Telephone: (416) 927-2027
Email: bamick@iwh.on.ca
Professor
School of Public Health
University of Texas
1200 Herman Pressler Suite E 1009
Houston, TX 77030 USA
Telephone: (713) 500-9496
Email: benjamic.c.amick@uth.tmc.edu

Doug Ammons, B.S.
Computer Engineer
Technology Development Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G800
Morgantown, WV 26505-2845 USA
Telephone: (304) 285- 6223
Email: DAmmons@cdc.gov

Ayana Anderson, M.P.H.
Public Health Analyst
Surveillance and Registries Branch
Division of Health Studies
ATSDR
4770 Buford Highway, M/S F57
Atlanta, GA 30341 USA
Telephone: (770) 488-3906
Email: ARAnderson@cdc.gov

Jane Andreaggi, M.A.
Program Analyst
Program and Administrative Activity
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1901
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-5904
Email: JAndreaggi@cdc.gov

Jennifer Bell, Ph.D.
Research Epidemiologist
Analysis & Field Evaluations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1811
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5802
Email: JBell@cdc.gov

Anasua Bhattacharya, Ph.D.
Economist Fellow
Education and Information Division
NIOSH
Robert A Taft Laboratories
4676 Columbia Parkway, M/S C-15
Cincinnati, OH 45226 USA
Telephone: (513) 533-8331
Email: ABhattacharya1@cdc.gov

Elyce Biddle, Ph.D.
Research Economist
Analysis & Field Evaluations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1811
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-6015
Email: EBiddle@cdc.gov

Thomas Bobick, Ph.D.
Safety Engineer (Research)
Technology Development Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G800
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-5986
Email: TBobick@cdc.gov

Matt Bowyer
General Engineer
Fatality Investigations Team
Surveillance and Field Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5991
Email: MBowyer@cdc.gov

Pre-registered Participants

Brenda Braddee-Roycroft
Administrative Officer
Program & Administrative Activity
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1901
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5904
Email: BBraddeeRoycroft@cdc.gov

Terry Bunn, Ph.D., AAS
Director
Injury Prevention & Research Center
College of Public Health
University of Kentucky
333 Waller Ave., Suite 242
Lexington, KY 40504 USA
Telephone: (859) 257-4955
Email: tlbunn2@uky.edu

Jefferey Burgess, M.D., M.S., M.P.H.
Professor and Director
Community, Environment, Policy
Mel and Enid Zuckerman (MEZ)
College of Public Health
University of Arizona
1295 N. Martin Avenue
Tucson, AZ 85724 USA
Telephone: (520) 626-4912
Email: jburgess@email.arizona.edu

Robin Burgess-Limerick, Ph.D., C.P.E.
Associate Professor
Human Movement Studies
University of Queensland
Brisbane St. Lucia, Queensland 4072
AUSTRALIA
Telephone: +61 7 3365 4718
Email: robin@hms.uq.edu.au

Doug Cantis
Physical Science Technician
Technology Development Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G-800
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6013
Email: DCantis@cdc.gov

Jacob Carr, M.S.
Safety Engineer
Machine Safety Team
Electrical & Mechanical Systems
Safety Branch
Office of Mine Safety and Health
Research
Pittsburgh Research Laboratory
NIOSH
626 Cochrans Mill Road
Pittsburgh, PA 15236 USA
Telephone: (412) 386-6877
Email: JCarr1@cdc.gov

Virgil Casini, B.S.
Safety & Occupational Health Manager
Fatality Investigations Team
Surveillance and Field
Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6020
Email: VCasini@cdc.gov

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

Dawn Castillo, M.P.H.
Director
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1900
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5894
Email: DCastillo@cdc.gov

Betty Champagne
Secretary to the Deputy Director
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1900
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5894
Email: BChampagne@cdc.gov

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

Cammie Chaumont Menéndez, Ph.D. M.P.H.
Epidemiologist
Analysis & Field Evaluations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1811
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-6233
Email: CMenendez@cdc.gov

Guang Chen, M.D.
Epidemiologist
Analysis & Field Evaluations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1811
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-5995
Email: GChen@cdc.gov

Sharon Chiou, Ph.D.
Health Scientist
Safety Controls Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G800
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-6029
Email: SChiou@cdc.gov

Henry Cole, Ed.D.
Professor
Dept of Preventive Medicine
& Environmental Health
College of Public Health
University of Kentucky
Southeast Center for Ag Health
College of Public Health
342 Waller Avenue
Lexington, KY 40504-9842 USA
Telephone: (859) 323-6838
Email: hcole@uky.edu

Pre-registered Participants

CAPT James Collins, Ph.D., M.S.M.E.
Associate Director for Science
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1900
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5998
Email: JCollins1@cdc.gov

George Conway, M.D., M.P.H., DABPM, AME
Director
Alaska Pacific Regional Office
NIOSH
Grace Hall, Suite 310
4230 University Drive
Anchorage, Alaska 99508 USA
Telephone: (907) 441-3450
Email: GConway@cdc.gov

Helen Corns, M.Eng, M.S.
Quantitative Analysis Unit
Liberty Mutual Research Institute for Safety
71 Frankland Road
Hopkinton, MA 01748 USA
Telephone: (508) 497-0204
Email: helen.corns@libertymutual. com

Theodore Courtney, M.S., C.S.P.
Director
Center for Injury Epidemiology
Liberty Mutual Research Institute for Safety
71 Frankland Road
Hopkinton, MA 01748-1298 USA
Telephone: (508) 497-0200
Email:
theodore.courtney@libertymutual.com

Elaine Cullen, Ph.D.
President, Prima Consultants
Alaska Pacific Regional Office
NIOSH
4720 E Jim Hill Road
Chattaroy, WA 99003 USA
Telephone: (509) 238-6963
Email:
elainec@primaconsultingservices.com

Richard Current. B.S.A.E., P.E.
General Engineer (Research)
Technology Development Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G-800
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6084
Email: RCurrent@cdc.gov

Marvin Dainoff, Ph.D., C.P.E.
Director
Center for Behavioral Science
Liberty Mutual Research Institute for Safety
71 Frankland Road
Hopkinton, MA 01748-1298 USA
Telephone: (508) 497-0208
Email:
Marvin.Dainoff@libertymutual.com

Ann Marie Dale, Ph.D., O.T.R./L.
Occupational Therapist
Department of Internal Medicine - General Medical Sciences
Washington University-St Louis
Campus Box 8005
660 S Euclid Street
St. Louis, MO USA
Telephone: (314) 454-8470
Email: adale@dom.wustl.edu

Letitia Davis, Sc.D., Ed.M.
Director, Occupational Health Surveillance Program
MA Dept of Public Health
250 Washington Street, 6th Floor
Boston, MA 02108-4619 USA
Telephone: (617) 624-5626
Email: **letitia**.d**avis**@state.ma.us

David DeJoy, Ph.D.
Professor
Health Promotion and Behavior
University of Georgia
315 Ramsey Center
Athens, GA 30602-6522 USA
Telephone: (706) 542-4368
Email: dmdejoy@uga.edu

John Dement, Ph.D., C.I.H.
Professor
Division of Occupational & Environmental Medicine
Duke University Medical Center
DUMC 3834
2200 W Main Street, Suite 400
Durham, NC 27710 USA
Telephone: (919) 684-8136
Email: john.dement@duke.edu

Susan Derk, M.A.
Epidemiologist
Injury Surveillance Team
Surveillance and Field Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6245
Email: SDerk@cdc.gov

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

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

Christopher Drucker, M.S.
Doctoral Candidate
School of Public Health
University of Minnesota
717 University Avenue SE Apt #208
Minneapolis, MN 55414 USA
Telephone: (917) 653-0652
Email: druck029@umn.edu

Pre-registered Participants

Richard Duffy, M.Sc.
Executive Assistant to the General President for Health and Safety
International Association of Fire Fighters
1750 New York Avenue, NW
Washington, D.C. 20006-5305 USA
Telephone: (202) 824-1571
Email: rduffy@iaff.org

Claire Dye, M.S.P.H.
Associate Service Fellow
Injury Surveillance Team
Surveillance and Field Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5851
Email: CDye@cdc.gov

Bradley Evanoff, M.D., M.P.H.
Associate Professor of Medicine
Chief
Division of General Medical Sciences
Department of Internal Medicine
Washington University
Campus Box 8005
660 S Euclid Avenue
St. Louis, MO 63110 USA
Telephone: (314) 454-8638
Email: bevanoff@dom.wustl.edu

Anna Fendley, M.P.H.
Health, Safety & Environment
United Steelworkers
5 Gateway Center, Room 902
Pittsburgh, PA 15222 USA
Telephone: (412) 562-2359
Email: afendley@usw.org

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

Linda Forst, M.D., M.P.H.
Professor
Environmental & Occupational Health Sciences
School of Public Health
University of Illinois-Chicago
508 SPHW, M/C 922
2121 W Taylor Street
Chicago, IL 60612 USA
Telephone: (312) 355-3826
Email: Forst-L@uic.edu

David Fosbroke, M.S.F.
Statistician (Health)
Special Studies Team
Surveillance and Field Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1811
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-6010
Email: DFosbroke@cdc.gov

Adri Frijters
Research and Development
Arbouw
Postbus 213
3840 AE Harderwijk
The Netherlands
Telephone: +0031 3414 66271
Email: frijters@arbouw.nl

Mark Fullen, Ed.D., C.S.P.
Assistant Professor
Safety and Health Extension
West Virginia University
130 Tower Lane
Morgantown, WV 26506 USA
Telephone: (304) 293-3200
Email: m.fullen@mail.wvu.edu

Andrea Furlan, M.D., Ph.D.
Associate Scientist
Institute for Work and Health
481 University Avenue, Suite 800
Toronto, Ontario M5G 2E9 Canada
Telephone: (416) 927-2027
Email: afurlan@iwh.on.ca

Jeanne Geiger Brown Ph.D., R.N.
Co-Director
Work & Health Research Center
School of Nursing
University of Maryland
655 W Lombard Street, Suite 575
Baltimore, MD 21201 USA
Telephone: (410) 706-5368
Email: jgeiger@son.umaryland.edu

Susan Gerberich, Ph.D., M.S.P.H.
Mayo Professor and Director
MCOHS, RIPRC/CVPC,
Department of Environmental Health Sciences
School of Public Health
University of Minnesota
1260 Mayo Memorial Bldg MMC-807
420 Delaware Street, SE
Minneapolis, MN 55455 USA
Telephone: (612) 625-5934
Email: gerbe001@umn.edu

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

David Gimeno Ruiz de Porras, Ph.D.
Associate Professor
Epidemiology, Human Genetics & Environmental Sciences
School of Public Health
University of Texas – San Antonio
8550 Datapoint Drive, Suite 217
San Antonio, TX 78229 USA
Telephone: (210) 562-5511
Email: david.gimeno@uth.tmc.edu

Pre-registered Participants

Michael Goldcamp, Ph.D.
Epidemiologist
Special Studies Team
Surveillance and Field Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-5951
Email: MGoldcamp@cdc.gov

James Green, B.S.M.E., M.B.A.
Safety Engineer
Safety Controls Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G800
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-5857
Email: JGreen@cdc.gov

James Grosch, Ph.D.
Research Psychologist
Organizational Science & Human Factors Branch
Division of Applied Research & Technology
NIOSH
Robert A Taft Laboratories
4676 Columbia Parkway, M/S C24
Cincinnati, OH 45226 USA
Telephone: (513) 533-8167
Email: JGrosch@cdc.gov

Jinhua Guan, Ph.D.
Health Scientist
Safety Controls Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G800
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-6333
Email: JGuan@cdc.gov

Patricia Gucer, Ph.D.
Professor
Occupational Health Program
School of Medicine
University of Maryland
11 South Paca Street, 2nd Flood
Baltimore, MD 21093 USA
Telephone: (410) 706-7464
Email: pgucer@medicine.umaryland.edu

Kelly Gurka, Ph.D., M.P.H.
Assistant Professor
Department of Community Medicine
West Virginia University
PO Box 9151
Morgantown, WV 26505-9151 USA
Telephone: (304) 293-0253
Email: kgurka@hsc.wvu.ed

Debra Handlin
Management and Program Analyst
Office of the Director
NIOSH
1095 Willowdale Road, M/S 1901
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-5904
Email: DHandlin@cdc.gov

David Hard, Ph.D.
Agricultural Safety & Health Scientist
Analysis & Field Evaluations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1811
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6068
Email: DHard@cdc.gov

James Harris, Ph.D., P.E.
Safety Engineer
Safety Controls Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 800
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-6120
Email: JHarris@cdc.gov

Daniel Hartley, Ed.D.
Epidemiologist
Analysis & Field Evaluations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1811
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5812
Email: DHartley@cdc.gov

LCDR Mathew Hause
Engineer (OS&HS)
Safety Controls Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G-800
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5982
Email: MHause@cdc.gov

Ameila Haviland, Ph.D.
Statistician
RAND Corporation
4570 Fifth Avenue, Suite 600
Pittsburgh, PA 15213 USA
Telephone: (412) 683-2300 ext: 4461
Email: haviland@rand.org

John Heberger, M.A.
Behavioral Scientist/STEP Student
Office of Mine Safety and Health Research
Pittsburgh Research Laboratory
NIOSH
626 Cochrans Mill Road
Pittsburgh, PA 15236 USA
Telephone: (412) 386-6620
Email: JHeberger@cdc.gov

James "Jim" Helmkamp, Ph.D.
Senior Epidemiologist
Western States Office
NIOSH
Denver Federal Center
P.O. Box 25226
Denver, CO 80225-0226 USA
Telephone: (303) 236-5943
Email: JHelmkamp@cdc.gov

Pre-registered Participants

Kitty Hendricks, M.A.
Research Epidemiologist
Special Studies Team
Surveillance and Field
Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6252
Email: KHendricks@cdc.gov

Michael Hodgson, M.D., M.P.H.
Director
Office of Public Health &
Environmental Hazards
& Occupational Health
U.S. Department of Veterans Affairs
Veteran Health Administration
810 Vermont Avenue NW 13D
Washington, D.C. 20420 USA
Telephone: (202) 461-1041
Email: michael.hodgson@va.gov

Sheilah Hogg-Johnson, Ph.D.
Senior Scientist and Manager
Institute for Work and Health
481 University Avenue, Suite 800
Toronto, Ontario M5G 2E9 Canada
Telephone: (416) 927-2027 Ext: 2130
Email: shoggjohnson@iwh.on.ca

Oi-Saeng Hong, Ph.D., R.N.
Professor of Nursing
Director of Occupational Nursing
Department of Community
Health Systems
University of California
San Francisco, CA 94530 USA
Telephone: (4150 502-5581
Email:
OiSaeng.Hong@nursing.ucsf.edu

John Howard, M.D.
Director
NIOSH
Patriots Plaza Bldg, Suite 9200
395 E Street, SW
Washington, DC 20201 USA
Telephone: (202) 245-0625
Email: JHoward1@cdc.gov

Hongwei Hsiao, Ph.D.
Chief
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G-800
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5910
Email: HHsiao@cdc.gov

Stephen Hubbard
Corporate Safety Director
The Lane Construction Corporation
90 Fieldstone Court
Cheshire, CT 06410 USA
Telephone: (203) 235-3351
Email: shubbard@laneconstruct.com

Larry Jackson, Ph.D.
Chief
Injury Surveillance Team
Surveillance and Field
Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5980
Email: LLJackson@cdc.gov

Michele Jacobs, B.S.
Corporate Fleet Safety Manager
The Lane Construction Corporation
8205 Wilkinson Boulevard
Charlotte, NC 28214
Telephone: (704) 394-8354
Email: majacobs@laneconstruct.com

Sree Harsha Jampala, M.S.
Ergonomics & Safety Lab/
Mechanical Engineering
University of Utah
250 South 900 E, Apt 1A
Salt Lake City, UT 84102 USA
Telephone: (801) 810-7733
Email: sreeharsha.jampala@gmail.com

Charles Jennissen, M.D.
Department of Emergency Medicine
University of Iowa
2841 Skyview Drive NE
Swisher, IA 52338 USA
Telephone: (319) 384-8468
Email: Charles-jennissen@uiowa.edu

Roger Jensen, J.D., Ph.D.
Professor
Occupational Safety and Health
& Industrial Hygiene
University of Montana-Montana Tech
1300 W Park Street
Butte, MT 59701 USA
Telephone: (406) 496-4111
Email: rjensen@mtech.edu

Alexandra Julius, M.S.
Teaching Assistant
Dept of Environmental Conservation
University of Massachusetts-Amherst
160 Holdsworth Way
Amherst, MA 01002 USA
Telephone: (818) 212-4622
Email: alexkjulius@gmail.com

Vicki Kaskutas, O.T.D., M.H.S., O.T.R./L.
Instructor, Occupational Therapy
School of Medicine
Washington University
Campus Box 8505
4444 Forest Park Avenue
St. Louis, MO 63108-2292 USA
Telephone: (314) 286-1672
Email: kaskutasv@wustl.ed

Paul Keane, M.B.A.
Health Communications
Technology Development Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G800
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5901
Email: PKeane@cdc.gov

Joanna Kica, M.P.A.
Department of Medicine
Division of Occupational &
Environmental Health
Michigan State University
117 West Fee Hall
East Lansing, MI 48824 USA
Telephone: (517) 353-1846
Email: Joanna.kica@hc.msu.edu

Pre-registered Participants

Pete Kines, Ph.D.
Senior Researcher
Accident and Safety Research
National Research Centre for
the Working Environment
Lersoe Park Allé 105
Copenhagen, Denmark 2100
EUROPE
Telephone: +45 21 77 81 71
Email: pki@nrcwe.dk

Srinivas Konda, M.P.H.
Associate Service Fellow
Analysis & Field Evaluations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1811
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6011
Email: SKonda@cdc.gov

Elayne Kornblatt Phillips, Ph.D., M.P.H., R.N.
Director of Research
International Healthcare Worker
Safety Center
University of Virginia
P.O. Box 800764
Charlottesville, VA 22908-0764 USA
Telephone: (434) 979-8958
Email: ekp2e@virginia.edu

André Lan, P.Eng.
Research and Expertise Division
Institut de recherche Robert-Sauvé
en santé et en sécurité du travail
(**IRSST**)
505, de Maisonneuve Blvd, West
Montréal, Québec H3A 3C2 Canada
Telephone: (514) 288-1551 Ext: 342
Email: lan.andre@irsst.qc.ca

Larry Layne, M.S.
Statistician (Health)
Special Studies Team
Surveillance and Field
Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6008
Email: LLayne@cdc.gov

Mary Lesch, Ph.D.
Cognitive Engineer Researcher
Center for Behavioral Sciences
Liberty Mutual Research Institute
for Safety
71 Frankland Road
Hopkinton, MA 01748 USA
Telephone: (508) 497-0255
Email: mary.lesch@libertymutual.com

Jennifer E. Lincoln, B.S.F., M.S.S.M.
Health Scientist
Special Studies Team
Surveillance and Field
Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6185
Email: JELincoln@cdc.gov

Jennifer M. Lincoln, Ph.D.
Deputy Director and ADS
Alaska Pacific Regional Office
NIOSH
Grace Hall, Suite 310
4230 University Drive
Anchorage, Alaska 99508 USA
Telephone: (907) 271-2383
Email: JLincoln@cdc.gov

Murrey Loflin, A.A.S., M.S.
Associate Service Fellow
Fatality Investigations Team
Surveillance and Field
Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6253
Email: MLoflin@cdc.gov

David Lombardi, Ph.D.
SR Research Scientist
Center for Injury Epidemiology
Liberty Mutual Research Institute
for Safety
71 Frankland Road
Hopkinton, MA 01748 USA
Telephone: (508) 497-0210
Email: david.lombardi@libertymutual.com

Tony Lowe, Ph.D.
School of Social Work
University of Georgia
111Tucker Hall
East Campus Road
Athens, GA 30602-3602 USA
Telephone: (678) 377-6378
Email: tblowe@uga.edu

Virginia Lutz, W.S.O., C.S.E.
Safety and Occupational
Health Specialist
Fatality Investigations Team
Surveillance and Field
Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6342
Email: VLutz@cdc.gov

Pre-registered Participants

Christopher Mark, Ph.D.
Mining Engineer
Division of Safety
Coal Mine Safety & Health
U.S. Department of Labor
1100 Wilson Boulevard
Arlington, VA 22209 USA
Telephone: (412) 386-6522
Email: mark.christopher@dol.gov

Suzanne Marsh, M.P.A.
Statistician (Health)
Injury Surveillance Team
Surveillance and Field Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-6009
Email: SMMarsh@cdc.gov

Helen Marucci-Wellman, Sc.D.
Research Scientists
Center for Injury Epidemiology
Liberty Mutual Research Institute for Safety
71 Frankland Road
Hopkinton, MA 01748 USA
Telephone:(508) 497-0206
Email: helen.wellman@libertymutual.com

Joan Mazur, Ph.D.
Professor
Southeast Center for Ag Health & Injury Prevention/Prevention Medicine
University of Kentucky
Suite 1A
342 Walter Avenue
Lexington, KY 40504 USA
Telephone: (859) 323-6836
Email: jmazur@uky.edu

Michael McCann, Ph.D., C.I.H.
Director, Safety Research
Center for Construction Research & Training
Center to Protect Workers' Rights
8484 Georgia Avenue, Suite 1000
Silver Spring, MD, 20910 USA
Telephone: (202) 360-4157
Email: michael.mccann@att.net

Kelsey McCoskey, C.P.E., M.S.O.T.R./L.
Ergonomist
U.S. Army Public Health Command
5158 Blackhawk Road
Aberdeen Proving Ground, MD 21010 USA
Telephone: (410) 436-8864
Email: kimberly.s.hill1@us.army.mil

Eugene "Tony" McKenzie, Ph.D.
Safety Engineer (Research)
Technology Development Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G-800
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6064
Email: TMcKenzie@cdc.gov

John Mendeloff, Ph.D.
Professor, Graduate School of Public & International Affairs
University of Pittsburgh
Director, Center for Health and Safety in the Workplace
RAND Corporation
4570 Fifth Avenue, Suite 600
Pittsburgh, PA 15213 USA
Telephone: (412) 683-2300 ext 4532
Email: jmendel@rand.org

Timothy "Tim" Merinar, M.S.
Safety Engineer
Surveillance and Field Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5965
Email: TMerinar@cdc.gov

Stephen Miles
Safety and Occupational Health Specialist
Fatality Investigations Team
Surveillance and Field Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6276
Email: SMiles@cdc.gov

Paul Moore, B.S.M.E.
Chief
Fatality Investigations Team
Surveillance and Field Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6016
Email: PMoore@cdc.gov

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

John Myers, M.S.
Statistician (Health)
Special Studies Team
Surveillance and Field Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6005
Email: JRMyers@cdc.gov

Pre-registered Participants

Melvin Myers, M.P.A.
Adjunct Assistant Professor
Emory University
Dept of Environmental &
Occupational Health
Professor
College of Public Health
University of Kentucky
4916 Holland View Drive
Flowery Branch, GA 30542 USA
Telephone: (800) 369-2963
Email: melvinmyers@charter.net

Richard Neitzel, Ph.D., C.I.H.
Department of Environmental &
Occupational Health Sciences
University of Washington
4225 Roosevelt Way, NE, Suite 100
Seattle, WA 98105 USA
Telephone: (206) 221-5445
Email: meitzel@u.washington.edu

Nicole Nestoriak, Ph.D.
Bureau of Labor Statistics
U.S. Department of Labor
Suite 1950
2 Massachusetts Avenue, NE
Washington, D.C. 20212 USA
Telephone: (202) 691-7408
Email: Nestoriak.Nicole@bls.gov

Frank Neuhauser, M.P.P.
Executive Director
Center for the Study of Social Insurance
University of California—Berkeley
2420 Bowditch Street #5670
Berkeley, CA 94720-5670 USA
Telephone: (510) 643-0667
Email: frankn@berkeley.edu

Bradley Newbraugh
Physical Science Technician
Technology Development Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G800
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5997
Email: BNewbraugh@cdc.gov

Ian Noy, Ph.D., C.P.E.
Director
Liberty Mutual Research Institute
for Safety
71 Frankland Road
Hopkinton, MA 01748 USA
Telephone: (508) 497-0210
Email: ian.noy@libertymutual.com

Christopher Pan, Ph.D.
Safety Engineer (Research)
Safety Controls Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G800
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-5978
Email: CPan@cdc.gov

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

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

Stephen Pegula, M.S.
Economist
Office of Safety, Health,
and Working Conditions
Bureau of Labor Statistics
U.S. Department of Labor
Room 3180
2 Massachusetts Avenue, NE
Washington, D.C. 20212-0001 USA
Telephone: (202) 691-6166
Email: pegula.stephen@bls.gov

Kara Perritt, M.S.
Chief
Special Studies Team
Surveillance and Field
Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5943
Email: KPerritt@cdc.gov

Barbara Phillips
Secretary to the Director
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1900
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5894
Email: BPhillips@cdc.gov

Polly Phipps, Ph.D.
Office of Survey Methods Research
Bureau of Labor Statistics
U.S. Department of Labor
Suite 1950
2 Massachusetts Avenue, NE
Washington, D.C. 20212 USA
Telephone: (202) 691-7513
Email: phipps.polly@bls.gov

Kellie Pierson
Research Psychologist
Organizational Science
& Human Factors
Division of Applied Research
& Technology
NIOSH
Robert A Taft Laboratories
4676 Columbia Parkway, M/S C24
Cincinnati, OH 45226 USA
Telephone: (513) 533-8189
Email: KPierson@cdc.gov

Timothy Pizatella, M.S.
Deputy Director
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1900
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5894
Email: TPizatella@cdc.gov

Pre-registered Participants

Keshia Pollack, Ph.D., M.P.H.
Assistant Professor
Department of Health Policy and Management
Johns Hopkins Bloomberg School of Public Health
University of Johns Hopkins
624 N Broadway, Room 555
Baltimore, MD 21205-1996 USA
Telephone: (410) 502-6272
Email: kpollack@jhsph.edu

Lisa Pompeii, Ph.D.
Assistant Professor
Environmental and Occupational Health Sciences
Dept. of Epidemiology, Human Genetics & Environmental Sciences
School of Public Health
The University of Texas
1200 Herman Pressler RAS E617
Houston, TX 77006 USA
Telephone: (713) 500-9474
Email: lisa.pompeii@uth.tmc.edu

Gerald Poplin, M.S.
Doctoral Candidate
Senior Research Specialist
Epidemiology
University of Arizona
Medical Research Bldg RM 130
Campus PO Box 245215
1656 E. Mabel Street
Tucson, AZ 85724 USA
Telephone: (520) 626-9363
Email: poplin@email.arizona.edu

Gail Powell-Cope, Ph.D., R.N., F.A.A.N.
Acting Director
HSR&D/RR&D
Research Center of Excellence
James A. Haley VA
8900 Grand Oak Circle
Tampa, FL 33637-1022 USA
Telephone: (813) 558-3935
Email: Gail.Powell-Cope@va.gov

John Powers, Jr., B.S.E.E.
Chief
Technology Development Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G-800
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6219
Email: JPowers@cdc.gov

Stephanie Pratt, Ph.D.
Coordinator
NIOSH Center for Motor Vehicle Safety
CDC/NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5992
Email: SPratt@cdc.gov

Somendra Pal Rana
Labour Department
Office of Chief Inspector of Factories
D Block Ii Floor 5 Sham Nath Marg
Delhi, 110054 India
ASIA
Telephone: +911127875923
Email: somendra.rana@gmail.com

Deborah Reed, Ph.D.
College of Nursing
University of Kentucky
553 CON Building
760 Rose Street
Lexington, KY 40536 USA
Telephone: (859) 257-9636
Email: dbreed01@uky.edu

Audrey Reichard, M.P.H., O.T.R.
Epidemiologist
Injury Surveillance Team
Surveillance and Field Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-5916
Email: AReichard@cdc.gov

Rebecca Reindel, M.F.S., M.P.H.
Department of Environmental & Occupational Health
School of Public Health & Health Services
George Washington University
136 Kentucky Avenue, SE
Washington, D.C. 20003 USA
Telephone: (202) 693-1709
Email: reindel8@gmail.com

Kyla Retzer, M.P.H.
Epidemiologist
Alaska Pacific Regional Office
NIOSH
Grace Hall, Suite 310
4230 University Drive
Anchorage, AK 99508 USA
Telephone: (907) 271-2388
Email: kretzer@cdc.gov

CDR Marilyn Ridenour, M.P.H.
Nurse Epidemiologist
Analysis & Field Evaluations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1811
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5879
Email: MRidenour@cdc.gov

Lynda Robson, Ph.D.
Associate Scientist
The Institute for Work & Health
University of Windsor
481 University Avenue, Suite 800
Toronto, Ontario M5G 2E9 Canada
Telephone: (416) 927-2027 Ext: 2159
Email: lrobson@iwh.on.ca

Rachel Roisman, M.D.
Occupational Health Branch
California Department of Public Health
Building P, 3rd Floor
850 Marina Bay Parkway
Richmond, CA 94804 USA
Telephone: (510) 620-3606
Email: Rachel.roisman@cdph.ca.gov

Pre-registered Participants

Nancy Romano, M.S.
Safety and Occupational
Health Specialist
Fatality Investigations Team
Surveillance and Field
Investigations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1808
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-5889
Email: NRomano@cdc.gov

Mahmood Ronaghi, MSAE, MSME, M.B.A.
Research Safety Engineer
Safety Controls Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G800
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-6054
Email: MRonaghi@cdc.gov

Tonya Rowan, M.S.
Program Operations Assistant
Program & Administrative Activity
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1901
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5904
Email: TRowan@cdc.gov

John Ruser, Ph.D.
Assistant Commissioner for
Occupational Safety & Health Statistics
Bureau of Labor Statistics
U.S. Department of Labor
Postal Square Building
Room 3180
2 Massachusetts Avenue, NE
Washington, D.C. 20212-0001 USA
Telephone: (202) 691-6304
Email: ruser.john@bls.gov

Gargi Sawhney
Graduate Research Assistant
Dept of Psychology
MGB 250
Old Dominion University
Norfolk, VA 23529-0267 USA
Telephone: (757) 683-6159
Email: gargisawhney85@gmail.com

Frederick "Ted" Scharf, Ph.D.
Research Psychologist
Work Organization & Stress Research
Division of Applied Research
and Technology
NIOSH
Robert A Taft Laboratories
4676 Columbia Parkway, M/S C14
Cincinnati, OH 45226 USA
Telephone: (513) 533-8170
Email: TScharf@cdc.gov

Fred Schimmel
Engineering Manager
SJC Industries Corporation
1110 D I Drive
Elkhart, Indiana 46514 USA
Telephone: (574) 970-6701
Email: fschimmel@sjcind.com

Ashley Schoenfisch, M.S.P.H.
Research Analyst/Occupational
Epidemiologist
Division of Environmental and
Occupational Health Science
Duke University Medical Center
2200 W Main Street, Suite 400
Durham, NC 27710 USA
Telephone: (919) 684-8319
Email: ashley.schoenfisch@duke.edu

Katherine Schofield, M.E.H.A.
Doctoral Candidate
Dept. of Environmental
Health Sciences
University of Minnesota
1770 Bryant Avenue South #101
Minneapolis, MN 55403 USA
Telephone: (612) 205-5621
Email: kschofield@tbgmn.com

Seth Seabury, Ph.D.
Economist and Statistics
RAND Corporation
1776 Main Street
Santa Monica, CA 90407 USA
Telephone: (310) 393-0411 Ext: 6261
Email: seabury@rand.org

Jeanne Sears, Ph.D., R.N.
Senior Research Scientist
Dept. of Health Service
U-District Building, Box 354809
1107 NEA 45th Street
University of Washington
Seattle, WA 98105-4690 USA
Telephone: (206) 543-1360
Email: jeannes@u.washington.edu

Derek G. Shendell, D.Env., M.P.H.
Assistant Professor
Environmental & Occupational Health
School of Public Health
University of Medicine
& Dentistry of NJ
3rd Floor, SPH Bldg, PO Box 9
683 Hoes Lane West
Piscateaway, NJ 08854 USA
Telephone: (732) 235-5409
Email: shendedg@umdnj.edu

Susan Shepherd, Sc.D.
Research Industrial Hygienist
Dept of Work Environment
Kitson Hall, Room 200
1 University Avenue
University of Massachusetts—Lowell
Lowell, MA 01851 USA
Telephone: (978) 934-3258
Email: Susan_Shepherd@uml.edu

Pramen Shrestha, Ph.D., P.E.
Assistant Professor
Department of Civil and
Environmental Engineering
University of Nevada—Las Vegas
Box 454005
4505 S Maryland Parkway,
Las Vegas, NV 89154-4005 USA
Telephone: (702) 895-3841
Email: pramen.shrestha@unlv.edu

Pre-registered Participants

Reepa Shroff, M.S.
Associate
Mercer ORC Networks
1255 23rd Street, N.W. Suite 250
Washington, DC 20037 USA
Telephone: (202) 331-2642
Email: reepa.shroff@mercer.com

Ken Silver, S.M., D.Sc.
Associate Professor
Department of Environmental Health
East Tennessee State University
Lamb Hall Room 52
PO Box 70682
Johnson City, TN 37614 USA
Telephone: (423) 439-4542
Email: silver@etsu.edu

Peter Simeonov, Ph.D.
Safety Engineer
Safety Controls Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G800
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-6268
Email: PSimeonov@cdc.gov

John Sines
Information Specialist
Fatality Investigations Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G800
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-6105
Email: JSines@cdc.gov

Svetla Slavova, Ph.D
Assistant Professor
Department of Biostatistics
Injury Prevention and
Research Center
College of Public Health
University of Kentucky
333 Waller Avenue, Suite 242
Lexington, KY 40504 USA
Telephone: (859) 323-7873
Email: ssslav2@emai.uky.edu

Lisa Steiner, M.S.
Team Leader
Cognitive Engineering Team
Office of Mine Safety and
Health Research
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 152
Pittsburgh, PA 15236 USA
Telephone: (412) 386-6446
Email: LSteiner@cdc.gov

Nancy Stout, Ed.D.
127 Quail Road
Morgantown, WV 26508-0940 USA
Telephone: (304) 296-5362
Email: NancyStout@comcast.net

Jessica Streit
Psychologist
Division of Applied Research
and Technology
NIOSH
4676 Columbia Parkway, M/S C-22
Cincinnati, OH 41001 USA
Telephone: (513) 533-8107
Email: JStreit@cdc.gov

Ryan Sullivan, M.P.H.
Doris Duke Clinical Research Fellowship
Carver College of Medicine
University of Iowa
316 Grandview Court
Iowa City, IA 52246 USA
Telephone: (309) 368-7258
Email: ryansullivan55@gmail.com

Jennifer Swanberg, Ph.D.
Associate Professor
College of Social Work
University of Kentucky
139 West Short Street, Suite 200
Lexington, KY 40507 USA
Telephone: (859) 323-0585
Email jswanberg@uky.edu

Eric Sygnatur, M.A.
Economist
Office of Safety & Health Statistics
Bureau of Labor Statistics
U.S. Department of Labor
2 Massachusetts Avenue, NE
Washington, D.C. 20212 USA
Telephone: (202) 691-6273
Email: sygnatur.eric@bls.gov

Brandon Takacs, M.S.
Associate Professor
Safety and Health Extension
West Virginia University
PO Box 6615
Morgantown, WV 26508-6615 USA
Telephone: (800) 626-4748
Email: brandon.takacs@mail.wvu.edu

Jay Tarley
Safety and Occupational
Health Specialist
Fatality Investigations Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G800
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-5858
Email: JTarley@cdc.gov

Jennifer Taylor, Ph.D., M.P.H.
Department of Environmental &
Occupational Health
School of Public Health
Drexel University
Bellet Bldg, 13th Floor, MS 1034
1505 Race Street
Philadelphia, PA 19102 USA
Telephone: (215) 762-2590
Email: jat65@drexel.edu

Joshen Teizer, Ph.D.
Assistant Professor
School of Civil and
Environmental Engineering
Georgia Institute of Technology
790 Atlanta Drive NW
Atlanta, GA 30332-0355 USA
Telephone: (404) 894-8269
Email: teizer@gatech.edu

Pre-registered Participants

George Thopil
Doctoral Candidate
Graduate School of
Technology Management
University of Pretoria
Engineering 2 Building, Room 4-23
Lynnwood Road
Pretoria, Gauteng 0083
South Africa
Telephone: + 27124205939
Email: George.alexthopil@up.ac.za

Hope Tiesman, Ph.D., M.S.P.H.
Epidemiologist
Analysis & Field Evaluations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1811
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-6067
Email: HTiesman@cdc.gov

Alison Trinkoff, Sc.D., M.P.H., R.N., F.A.A.N.
Principal Investigator
School of Nursing
University of Maryland
655 West Lombard Street, Room 625
Baltimore, MD 21201 USA
Telephone: (410) 706-6549
Email: trinkoff@son.umaryland.edu

Nina Turner, Ph.D.
Physiologist (TL)
Technology Research Branch
National Personal Protective
Technology Laboratory
NIOSH
PO Box 18070
626 Cochrans Mill Road, Bldg 29
Pittsburgh, PA 15236 USA
Telephone: (412) 386-6633
Email: NTurner@cdc.gov

Santosh Verma, Sc.D., M.D., M.P.H.
Injury Epidemiologist
Center for Injury Epidemiology
Liberty Mutual Research Institute
for Safety
71 Frankland Road
Hopkinton, MA 01748 USA
Telephone: (508) 497-0213
Email: Santosh.Verma@libertymutual.com

Bryan Vila, Ph.D.
Professor of Criminal Justice
Director, Simulated Hazardous
Operational Tasks Laboratory
Sleep & Performance Research Center
Washington State University – Spokane
P.O. Box 1495
Spokane, WA 99210-1495
Telephone: (509) 358-7711
Email: vila@wsu.edu

John Violanti, Ph.D.
Professor
Dept Social & Preventive Medicine
270 Farber Hall
State University of NY—Buffalo
Buffalo, NY 14214 USA
Telephone: (716) 829-5367
Email: volanti@buffalo.edu

Pamela Vossenas, M.P.H.
Strategic Affairs
UNITE HERE
275 Seventh Avenue, 11th Floor
New York, NY 10001-6708 USA
Telephone: (212) 332-9318
Email: pvossenas@unitehere.org

James Wassell, Ph.D.
Associate Director for
Biostatistics Science
Analysis & Field Evaluations Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1811
Morgantown, WV 26505-2888 USA
Telephone: (304) 285-5946
Email: JWassell@cdc.gov

Darlene Weaver, M.O.H.S.
Tech Information Specialist
Safety Controls Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G-800
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6354
Email: DWeaver@cdc.gov

Chia Wei, M.S.
Doctoral Candidate
Div of Environmental Health Sciences
School of Public Health
University of Minnesota
1000 8th Street, SE #108
Minneapolis, MN 55414 USA
Telephone: (612) 868-1423
Email: weixx138@umn.edu

Jeffrey Welsh, B.A.
Associate Director for Science
Div of Mining Research Operations
Office of Mine Safety &
Health Research
NIOSH
626 Cochrans Mill Road
Pittsburgh, PA 15236 USA
Telephone: (412) 386-6602
Email: JWelsh@cdc.gov

Stacy Wertman
Safety and Occupational
Health Specialist
Fatality Investigations Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G800
Morgantown, WV 26505-2888 USA
Telephone: (304) 285- 6037
Email: SWertman@cdc.gov

Pre-registered Participants

Bryan Wimer
Associate Service Fellow
Safety Controls Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G-800
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6267
Email: BWimer@cdc.gov

Janice Windau, M.S.
Epidemiologist
Office of Safety, Health
& Working Conditions
Bureau of Labor Statistics
U.S. Department of Labor
Suite 3180
2 Massachusetts Avenue, NE
Washington, D.C. 20212 USA
Telephone: (202) 691-6160
Email: windau.janice@bls.gov

Gregory Winters
National Geospatial Programs
U.S. Geological Survey
U.S. Department of the Interior
12944 Augustus Court
Woodbridge, VA 22192 USA
Telephone: (423) 895-4656
Email: gregory.c.winters@gmail.com

Anna Wirtz, Ph.D.
Department of Environmental Health
Harvard School of Public Health
Harvard University
Landmark Center 3-49-7
401 Park Drive
Boston, MA 02215 USA
Telephone: (508) 596-4319
Email: awirtz@hsph.harvard.edu

Christie Wolfe
Program Operations Assistant
Program & Administrative Activity
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S 1901
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-5904
Email: SWolfe2@cdc.gov

Maggie Wong, R.N.
School of Nursing
The Monash University—Australia
24A, Block 3, Holford Garden
Tai Wai Shatin, Hong Kong
ASIA
Telephone: +852 9768 0591
Email: maggiewyc@hotmail.com

Sara Wuellner, M.P.H.
Epidemiologist
SHARP Program
Washington State Department of Labor &
Industries
PO Box 44330
Olympia, WA 98504 USA
Telephone: (360) 902-6727
Email: wues235@lni.wa.gov

Sherry Wyckoff, B.S.
Northeast Center for
Agricultural Health
Bassett Medical Center
1 Atwell Road
Cooperstown, NY 13326 USA
Telephone: (607) 547-6023
Email: swyckoff@nycamh.com

Hong Xiao, Ph.D.
Center of Health and Environment
University of California--Davis
One Shield Avenue
Davis, CA 95616 USA
Telephone: (530) 220-2237
Email: hgxiao@ucdavis.edu

Samuel Yamin, M.P.H.
Health Research Center
Park Nicollet Institute
3800 Park Nicollet Blvd. 2-South
St. Louis Park, MN 55416 USA
Telephone: (952) 993-1694
Email: Samuel.yamin@parknicollet.com

Shengke Zeng, Ph.D.
Biomedical Engineer
Safety Controls Team
Protective Technology Branch
Division of Safety Research
NIOSH
1095 Willowdale Road, M/S G-800
Morgantown, WV 26505-2845 USA
Telephone: (304) 285-6103
Email: SZeng@cdc.gov

Xujun Zhang, Ph.D.
President
Institute of Injury Prevention Research
Southeast University
Nanjing
Jiangsu Province 210009 China
ASIA
Telephone: +86 25 8327 2569
Email: xjzhang@seu.edu.cn

Tu Zhibin
Dept of Epidemiology and
Health Statistics
School of Public Health
Southeast University
87 Ding Jiaqiao Road
Nanjing
Jiangsu Province 210009 China
ASIA
Telephone: +86 25 8327 2569
Email: tuzhibin0516@163.com

Kristina Zierold, Ph.D.
Assistant Professor
Dept of Epidemiology &
Population Health
School of Public Health &
Information Sciences
University of Louisville
485 E Gray Street #229
Louisville, KY 40292 USA
Telephone: (502) 852-0251
Email: kmzier02@louisville.edu

NOIRS 2011 Abstracts

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NOIRS 2011 Abstracts

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DAY ONE: TUESDAY, OCTOBER 18, 2011

Session: **A1.0**
Title: **Surveillance I**
Moderator: Dawn Castillo, M.P.H.

A1.1
Title: ***Addition of New Codes into Administrative Data: A Discussion of the Process and Benefits for Occupational Health Surveillance***
Authors: Taylor J, Costello A, Davis B, Roman L, Porter J
Presenter: Jennifer Taylor, Ph.D., M.P.H.

Objectives:

1. Demonstrate how to get new data elements and codes into administrative hospital data.
2. Discuss the contribution of new codes to the field of occupational health surveillance.

Background: During the course of a grant focused on firefighter injury surveillance, we proposed the addition of Bureau of Labor Statistics Standard Occupational Classification (SOC) codes and the North American Industry Classification System (NAICS) to health data standards used for state-based claims data. These codes have wide ranging application to every occupational group and those who study them (e.g., federal government, private agencies, and academic partners). As a result, the use of hospital data for public health purposes will increase.

Methods: The process will be completed in three stages. The proposal has been submitted to X12N. X12N is responsible for the insurance transaction standards and the work products related to the implementation of the standards. Next, it will be voted on by the National Uniform Billing Committee (NUBC). NUBC is responsible for the maintenance of the Uniform Bill. Once the codes are incorporated in the Reporting Guide and approved by NUBC for the Uniform Bill, States will be notified of the changes and potential to implement collection of the codes.

Results: The proposal was passed through X12N during their January 2011 trimester meeting and is pending a vote by full X12N membership (June 2011) and NUBC (August 2011). Since the X12N vote was strongly in favor of the addition, we expect it to pass and be added to the Reporting Guide in October 2011.

Conclusion: This presentation will describe the process used to propose and add an external code set to administrative hospital data. Although the impetus for the proposal stemmed from firefighter injury surveillance, the process has broad implications and benefits for the entire occupational health surveillance field.

A1.2
Title: ***An Accurate Semi-computerized Approach to Classifying Injury Narratives of Large Administrative Datasets into Bureau of Labor Statistics Occupational Injury and Illness Classification System (OIICS) 2-Digit Event Categories***
Authors: Marucci-Wellman H, Lehto M, Corns H
Presenter: Helen Marucci-Wellman, Sc.D.

Objectives: The addition of narrative text information in electronic format to injury databases can be a useful adjunct to epidemiologic analyses and can provide valuable information about prevention. We have been developing methods for semi-automatic classification of injury narratives to enhance the use of injury narratives in large administrative databases.

Methods: Using 14,000 worker's compensation claims narratives pre-classified into Bureau of Labor Statistics Occupational Injury and Illness Classification System (OIICS) 2 digit event categories, we trained (training set = 11,000 narratives) and tested (test set = 3,000 narratives) various models (e.g. combining Fuzzy and Naïve algorithms, including other pre-coded variables as predictors, using various bad word lists, and morphing sequences). We had previously found the Fuzzy and Naïve algorithms each performed fairly well alone using a baseline set of parameters (sensitivity of 0.64 and 0.70 respectively for 2 digit classifications). However, they had poorer performance for a few difficult categories (sensitivity <0.50 for 5 of 18 two digit categories for both). In the current study we explore ways to improve accuracy.

Results: We discovered that when Fuzzy and Naïve agreed on a classification, 64% of the time, the sensitivity of the computer coded predictions was 0.85. Performing manual review of the remainder of the narratives, the combined (human plus computer) sensitivity was 0.90 and positive predictive value (PPV) was >0.90 for 11 of 18 2-digit event categories. Other changes, such as preparing a larger bad word list or preparing and morphing object-verb sequences with particular meaning for some categories, requiring more preliminary work, were able to improve computer coding results substantially for the difficult categories.

Conclusion: Naïve and Fuzzy Bayesian computer based algorithms can be used to reduce the manual review burden for classifying narrative data in large administrative databases without sacrificing accuracy.

A1.3
Title: ***The Revised Occupational Injury and Illness Classification System (OIICS)***
Authors: Windau J, Sygnatur E, Northwood J
Presenter: Janice Windau, M.S.

Objectives: The objective of this presentation is to apprise occupational injury data users of details regarding a major revision of the Occupational Injury and Illness Classification System (OIICS). The revised OIICS is designed to: capture workplace hazards resulting from technological changes that have taken place since the OIICS was initially released; include new or emerging workplace conditions; resolve existing coding issues; and provide for new data aggregations useful for injury prevention.

Methods: The revision involved a thorough review of: 1) a large number of proposals from stakeholders; 2) existing injury and illness data-both raw and tabulated; 3) the International Classification of Diseases, Tenth Revision (ICD-10); 4) regulations from the Occupational Safety and Health Administration (OSHA); and 5) a variety of other informational sources on occupational injuries and illnesses, workplace hazards, and equipment used in various industries.

Results: The revised OIICS was released in 2010 and will be used beginning with the compilation of Census of Fatal Occupational Injuries (CFOI) and Survey of Occupational Injuries and Illnesses (SOII) data for 2011. The revised OIICS provides additional categories for classifying musculoskeletal disorders and their associated work activity; various types of confined spaces; incidents in which a pedestrian is struck by a vehicle; and circumstances surrounding slips, trips and falls. The new manual also provides added guidance for more consistent coding.

Conclusions: The resulting classification system should provide information useful for injury prevention.

A1.4
Title: ***Emergency Department–Treated Injuries among U.S. Workers by Industry Sector***
Authors: Estes C, Jackson L
Presenter: Larry Jackson, Ph.D.

Objectives: Injury rates and characteristics can vary dramatically in different industries. Recently implemented industry coding of data collected through the National Electronic Injury Surveillance System occupational supplement (NEISS-Work), an emergency department (ED) surveillance system for work injuries and illnesses, provides a new source of data for understanding industry-specific work hazards.

Methods: Narrative data for business type, job type, employer name, and location were used to classify the industry of workers treated in 2007. Injury rates and 95% confidence intervals (CI) per 100 full-time equivalent workers (FTE) were calculated using workforce estimates from the Current Population Survey (CPS). Data for demographic, event/exposure and diagnosis characteristics were compared for injured workers across eight industry sectors defined by the National Occupational Research Agenda.

Results: In 2007, there were an estimated 3.4 million (CI = ±865,000) ED-treated work injuries at a rate of 2.4 (±0.6) injuries per 100 FTE. The highest injury rates occurred in agriculture [4.2 (±1.3)] and construction [3.7 (±1.4)]. The youngest workers (15-17 year olds) experienced the highest rate of injury in agriculture, whereas 18-19 year olds experienced the highest rate in other sectors. Contact with objects and equipment was generally the most common injury event, but bodily reaction and exertion were most common in healthcare. Workers in agriculture and construction experienced the highest rate of lacerations [1.1 (±0.4)], whereas workers in healthcare experienced the highest rate of sprains and strains [1.0 (±0.3)].

Conclusions: This is the first report to describe a complete NEISS-Work data year by industry. Our analysis shows that workers in different industry sectors encounter disparate safety hazards. By identifying industry-specific hazards, the NEISS-Work surveillance system can facilitate the development of appropriately targeted safety interventions and the distribution of limited injury prevention resources.

Session: **A2.0**
Title: **Fall Prevention in Construction I**
Moderator: Angela DiDomenico, Ph.D., C.P.E.

A2.1
Title: ***Fall Prevention and Worker Mentorship at Residential Construction Sites***
Authors: Kaskutas V, Dale AM, Lipscomb H, Evanoff B
Presenter: Vicki Kaskutas, O.T.D., M.H.S., O.T.R./L.

Objectives: Falls remain the leading cause of deaths in construction and account for many injuries on residential construction sites. The objectives of this research are to understand carpentry foremen's and workers' perceptions of fall prevention use, worksite training, and worker mentorship at residential construction sites.

Methods: We developed surveys to measure fall protection use and frequency, content, and usefulness of worksite training and mentorship. We administered this survey to 364 apprentice carpenters and 65 foremen. We also ran three focus groups with 26 apprentices at different stages of training, and three focus groups with 22 residential foremen employed by a local contractor. We summed results and computed central tendencies of survey data, and performed thematic analyses of focus groups. We also performed field observations of three annual safety meetings held by a large residential contracting firm.

Results: Carpenters at all levels are exposed to work at height; many do not understand their company's fall prevention plan. Apprentices want senior carpenters to show them how to apply what they learned in school; however, they often observe senior carpenters performing unsafe acts. Foremen are often not clear where OSHA standards end and company policy begins, noting it is difficult to always follow required fall prevention methods. Most apprentices receive daily communication from their foreman, but many want more direct mentorship and feedback. Foremen are uncomfortable giving positive feedback. Toolbox talks are given regularly and some are perceived as helpful. Apprentices resent a focus on documentation of training rather than relevance and quality. Some foremen address hazards that will be encountered that day, but most deliver the toolbox talk their contractor provided. Apprentices and foremen feel the productivity push and recognize tension between safety and production.

Conclusion: Many opportunities exist for improved fall prevention training and worker mentorship at residential construction sites.

A2.2
Title: ***Outcomes of a Revised Apprentice Carpenter Fall Prevention Training Curriculum***
Authors: Evanoff B, Kaskutas V, Dale AM, Gaal J, Fuchs M, Lipscomb H
Presenter: Bradley Evanoff, M.D., M.P.H.

Objectives: To measure changes in fall prevention behaviors following revision of fall prevention training in a union-based carpenters' apprenticeship program.

Background: Falls from heights are a leading cause of morbidity and mortality among construction workers, especially inexperienced workers and those performing residential construction.

Methods: We conducted a comprehensive needs assessment to identify gaps in apprentice carpenters' fall prevention training and guide curricular changes. Baseline questionnaires (n=1,025), focus groups, and worksite audits (n=197) measured fall experience, knowledge, risk perceptions, and residential worksite behaviors. A team of carpenter instructors and researchers revised the apprenticeship training to address gaps identified and integrate training methods preferred by this population. Questionnaires and audits were re-administered after modifying the curriculum.

Results: Post-intervention questionnaires (n=1,238) showed improvements in self-reported workplace fall safety behaviors. Items targeted in the training improved the most; specifically ladder use, leading edge work and personal fall arrest systems. From a possible safe behavior score of 25, scores increased from 12.7 at baseline to 15.0 at follow-up. Worksite audits (n=207) demonstrated significant improvements in fall safety behaviors compared to baseline. Overall compliance measured on a 52-item fall safety audit improved from 60% to 75%, with improvement seen in multiple domains. These behavior changes were statistically significant after adjustment for other factors affecting fall safety, including contractor size, time in trade, and the proportion of apprentices to journeymen on a worksite. Self-reported falls from height in the past year decreased from 16% to 13%.

Conclusions: Fall prevention behaviors improved with training designed to meet apprentices' learning needs and preferences. Our intervention was delivered through a union apprenticeship program; we believe that similar methods could be used to reach other groups of union

and nonunion workers. In order to decrease falls, the safe practices taught to inexperienced workers must be reinforced and encouraged at their worksites.

A2.3
Title: ***Innovation in Extension Ladder Angular Positioning***
Authors: Simeonov P, Hsiao H, Kim I-J, Powers J, Kau T-Y
Presenter: Peter Simeonov, Ph.D.

Extension ladders are associated with significant risk of fall injury. A leading cause for fall incidents is a ladder slide-out event due to positioning the ladder at suboptimal angles of inclination. Improved ladder positioning methods could reduce the risk of ladder falls and the related fall injury. The objective of the study was to evaluate the effectiveness of existing methods, as well as to develop and test innovative methods for extension ladder angular positioning.

Forty participants were tested, in a laboratory environment, using five ladder positioning methods with 4.88 m (16 ft) and 7.32 m (24 ft) ladders in extended and retracted positions. The positioning methods included a control condition (no instruction), two anthropometric methods - the current standard method (rung-referenced) and its alternative version (rail-referenced), and two instrument-assisted methods - a bubble level indicator and an innovative multimodal indicator providing both visual and audible signals. Performance measures included positioning angle (accuracy) and time (efficiency).

The results indicated that the anthropometric methods were effective in improving the extension ladder positioning accuracy; however, they were associated with considerable variability and reduced efficiency (50% more time than control). A major source of variability in ladder positioning angle, in addition to the differences in human anthropometry, was the ladder effective length, with shorter ladders being consistently positioned at shallower angles. The bubble level indicator was the most accurate positioning method (with very low variability), but with very low efficiency - required more than double the control time. The multimodal indicator improved both the accuracy and the efficiency of ladder positioning (33% less time than control).

Improvement of the current standard anthropometric method requires more precise instruction and training procedures. Workers may benefit from using instrument-assisted methods, which provide direct multimodal feedback for them to quickly position ladders at the correct angle of inclination.

A2.4
Title: ***Effects of Motivation and Acclimation on Lateral Reach Distances While Standing on a Stepladder***
Authors: DiDomenico A, Lesch MF, Chang C-C
Presenter: Angela DiDomenico, Ph.D., C.P.E.

Objectives: Guidelines for proper and safe use of stepladders recommend maintaining the body's center of mass within the ladder rails. Injuries still occur, however, because stepladders tip over due to overreaching. The current study explored the effect of motivation on lateral reach distances and hypothesized that novice users would reach further after becoming acclimated to working on stepladders.

Methods: Twenty-four male participants performed maximum lateral reaches on 6' and 12' stepladders. A motivated maximum reach distance was determined using a target and a modified method of limits procedure. Unmotivated maximum reach distance was collected at the beginning and end of the motivated trials. Reach distances were determined using a passive motion capture system. Forceplates located underneath the feet of the ladders were used to collect vertical forces.

Results: Averaged maximum lateral reach distance was 66 mm shorter on the 12' ladder. Acclimation led to a 35 mm increase in unmotivated reach distances and motivation using a target brought about a further increase of 66 mm. The interaction between ladder height and reach condition was not significant. Across all conditions, the sum of the forces under the contra lateral legs of the ladder reduced to 12-18% of the total vertical forces created by the individual and ladder. However, no significant difference in forces was found between the two unmotivated reaching tasks.

Conclusion: Inexperienced ladder users will extend their reach if provided a concrete task to perform. In addition, after a short period of acclimation users were able to reach further without significantly affecting the forces underneath the ladder. Further analyses will attempt to identify the modifications in technique that resulted in increased reach distances without a corresponding decrease in stability.

Session: **A3.0**
Title: **Economics of Work-related Injuries**
Moderator: Elyce Biddle, Ph.D.

A3.1
Title: ***Uncompensated Consequences of Workplace Injuries and Illness: Long-term Disability and Early Retirement***
Authors: Park R, Bhattacharya A
Presenter: Robert Park, M.S.

Background: Failure of workers' compensation (WC) to fully compensate all work-related conditions (lost wages and medical costs) is well known. Costs outside the compensation envelope could also result from early retirement, termination, or long-term disability.

Methods: From 45 large employers during 2002-2005, the population-at-risk for early retirement, long-term disability, or any termination prior to normal retirement, was enumerated. Poisson statistical models were fit for the rate of transition to early retirement, long-term disability status, or any early termination as a function of a worker's history of WC and other demographic predictors.

Results: Rates of early retirement or long-term disability varied extremely across industrial sectors and by employee status, with crude rates ranging from 0.005 to 6.3 per 100 FTE, possibly reflecting variable benefits structures. Employees with a WC claim in the prior year had increased rates of early retirement or long-term disability. For hourly, nonunion employees, the WC-associated rate ratio was 2.79 (95%CI=2.44-3.19); for hourly, union employees the rate ratio was 1.87 (95%CI=1.70-2.05); for salaried nonunion employees, the rate ratio was 5.36 (95%CI=3.79-7.57) but was not significant for the small salaried, union group. The effect varied across industry sectors and by type of medical insurance. Similar patterns were observed for any early termination, including long-term disability, but again widely varying by industry sector including some with inverse associations.

Discussion: Prior WC predicts altered rates of early retirement and long-term disability, and early termination. The wide variation in relative rates of termination by sector and employment status (hourly vs. salaried; union vs. nonunion), appears to reflect complex incentives regarding employee options and employer choices. These findings imply additional uncompensated costs: either for a) adverse events previously compensated by WC or b) uncompensated events in individuals more likely to have had other, WC-compensated episodes, i.e., workers in higher risk jobs.

A3.2
Title: ***Using Lost Earnings to Relate Impairment Ratings and Disability Severity***
Authors: Seabury S, Neuhauser F, Reville R, Nuckols T
Presenter: Seth Seabury, Ph.D.

Objective: To use empirical estimates of the lost earnings associated with disabling workplace injuries to assess the correlation between impairment ratings and measurable disability severity.

Methods: A retrospective cohort analysis of workers' compensation claims in California with a permanently disabling workplace injury, illness or chronic condition that received an AMA Guides-based impairment rating from June 1, 2005 through November 1, 2008. Sample included 22,226 claimants with data on impairment ratings linked to quarterly earnings data from state unemployment insurance records. Each claimant is matched to 1-5 workers with comparable earnings at the same firm (the uninjured "control" workers).

Results (preliminary): Overall, impairment ratings are predictive of disability severity as measured by lost earnings. Workers with impairment ratings of 5 had proportional losses of 16.5% on average (95% CI: 5.0% to 28.0%). By comparison, workers with impairment ratings of 10 or 15 had proportional losses of 23.0% (95% CI: 11.0% to 35.0%) and 31.3% (95% CI: 18.9% to 43.8%), respectively. Back injuries were typically associated with higher losses for a given impairment rating, particularly in the 1-5 rating range and particularly compared to shoulder injuries.

Conclusion (preliminary): Impairment ratings based on AMA Guides ratings are highly predictive of disability severity on average. Wide confidence intervals suggest that tying compensation to relatively small differences in impairment ratings (e.g., a single rating point) could lead to some inequities in compensation. The whole-person impairment ratings across body parts also appear to have limited value in terms of predicting disability severity.

A3.3
Title: ***Experience Rating Smaller Employers: Does it Improve Safety?***
Authors: Neuhauser F, Mendeloff J, Seabury S
Presenter: Frank Neuhauser, M.P.P.

Objectives: All jurisdictions set a premium threshold, below which employers are not experience rated. This threshold is meant to trade off the predictive value of past experience and the safety effect of experience rating. However, these trade-offs have been arbitrary

because there has been little reliable data to measure the safety impact of experience rating for employers, large or small. Because most employers are small, there is a substantial fraction of employers just above and below the thresholds. We examine whether the safety impact on smaller employers justifies raising the threshold (including fewer employers) or lowering the threshold (including more employers).

Methods: We obtained data on the experience of all insured California employers from 1993-2006, 6.8 million records. The data were at the Employer/Policy Year/Class Code level and included payroll, manual premium, actual premium, X-mod (if any), number of injuries/illnesses, paid medical, paid indemnity, incurred medical, and incurred indemnity. We identify all employers 1) within 20% of the experience rating threshold in any year that 2) had payroll but were not experience rated in the previous 2 years, and reported payroll in the selected year and the following year. Using a regression-discontinuity design we estimate the impact of becoming experience rated in year 't' on claims and cost in year t and year t+1 versus year t-1 and t-2. Those firms, very close to the threshold but not experience rated are used as the controls.

Results: This research is still in progress, the results will be available for the October NOIRS Conference.

Conclusions: Employers at or below the experience rating threshold has an indemnity claim, on average, once every 11 years. However, in California, a single, average indemnity claim would change the X-mod of an employer just above the threshold from .89 to 1.21 for three years. We expect that the results of the study will determine whether the safety is sufficiently important to motivate the California Rating Bureau to lower the threshold to include additional employers or alternately, raise the threshold to reduce the inefficiencies of large, mostly random variation in premium rates.

A3.4
Title: ***Excess Healthcare Costs Associated with Prior Workers' Compensation Activity***
Authors: Bhattacharya A, Park RM
Presenter: Anasua Bhattacharya, Ph.D.

Objective: The failure of Workers Compensation (WC) systems to cover eligible injuries and illnesses and inadequately compensating lost income and pain-and-suffering is well known. This work identifies another area of costs arising from work-related injuries and illnesses that fall outside the compensation envelope and are absorbed by group health insurance.

Methods: Thomson Reuters MarketScan databases that compiled medical insurance claims for about 45 large employers across diverse economic sectors and geographic regions were utilized. WC and other benefit system data, employee status and type of medical insurance were available. The utilization and cost of medical care was analyzed using two-part models. The first part, using logistic regression, modeled the probability of a worker having one or more medical claims, and the second part using linear regression modeled the total cost of those claims. The predicted average monthly medical costs were derived by retransformation using Duan's smearing factor.

Results: Individuals with prior WC claims were more likely to file a medical claim compared to those with no prior WC claims (OR=1.21). Females had 2.3 times the odds of their male counterparts for filing medical claims. Overall, average monthly medical expenditures increased with prior WC: in males by 18% and in females by 10.9%. These increases were observed in all sectors except finance. In manufacturing, durable, the percent increases with prior WC for males and females were, respectively, 27.7% and 16.6%; in the services sector, they were: 25.9% and 18%.

Conclusion: The results unambiguously illustrate that individuals with prior WC claims had higher probability of filing a group health medical claim and higher average monthly medical costs for all genders, age groups and regions in all sectors except finance. This suggests that a part of the employers liability costs related to WC gets shifted to the employee health plans.

Session: **A4.0**
Title: **Management Commitment and Organizational Performance**
Moderator: David DeJoy, Ph.D.

A4.1
Title: ***Effect of Rating of Management Attitude and Commitment on Injury Rate and Severity in Small- and Medium-sized Construction Companies***
Authors: Schofield K, Alexander B, Gerberich S, Ryan A
Presenter: Katherine Schofield, M.E.H.A.

Objectives: Hazards in the construction industry can be modified by human and organizational elements. We evaluated the impact of health and safety professionals' evaluations of management attitude and commitment to safety on injury rate and severity in construction workers employed by 1,360 construction companies that obtain workers' compensation from a single insurance carrier.

Methods: Hours at-risk, estimated from payroll, and injury claims were used to determine injury rates. Rating of management attitude was done by health and safety professionals in the carrier's internal loss control department upon initial visit to member companies and, periodically, thereafter. A company would have no rating until this initial visit occurred. Based on a standardized process to characterize the activities, safety measures, hazards of a company, and interactions between the company and loss control representative, a subjective attitude and commitment rating was assigned. Rate ratios (RR) and 95% confidence intervals (CI) were estimated as a function of injury rate using a time dependent Poisson regression model. Generalized estimating equations were used to account for correlated observations within companies over time. Models include confounding covariates of company size, union status, and trade.

Results: Ratings were categorized as: good; poor/needs improvement; and not yet rated. Compared to good, results for these categories, respectively, were RR=0.94 (CI=0.74-1.19) and RR=1.11 (CI=1.03-1.21) for overall injuries, and RR=1.15 (CI=0.85-1.55) and RR=1.13 (CI=0.99-1.28) for lost-time injuries.

Conclusion: Our results indicate subjective rating of attitude and commitment from a single visit may not be indicative of injury risk. However, workers were at increased risk of overall and lost-time injuries during the period prior to the contact with the health and safety professional.

A4.2
Title: ***How Do Organizational Policies and Practices Affect Return to Work and Work Role Functioning Following a Musculoskeletal Injury?***
Authors: Amick B, Steenstra I, Hogg-Johnson S, Katz J, Lee H, Brouwer S, Franche R-L, Bultmann U
Presenter: Benjamin Amick, III, Ph.D.

Objectives: Organizational-level policies and practices that promote safety leadership and practices, disability management and ergonomic policies and practices are considered key contextual determinants of return to work. The objective of this work to describe the role of organizational policies and practices in return to work (RTW) and work role functioning (WRF) and the mediating role of self-efficacy and work accommodation.

Methods: A worker cohort (n = 577) in Ontario, Canada was followed at one, six and twelve months post injury. Both RTW (yes/no) and WRF (WLQ-16) status (3 levels) were measured. Organizational policies and practices (OPPs) were measured (high vs. low) at one month post-injury. Pain self-efficacy and work accommodation were included in mediation analyses.

Results: OPPs predict RTW at 6 months (OR=1.85; 95% CI 1.12-3.07) and 12 months (OR=2.3; 95% CI 1.31-4.04) and WRF at both 6 (OR=2.25; 95% CI 1.49-3.40) and 12 months (OR=2.22; 95% CI 1.42-3.46). Offers of work accommodation mediate the relationship between OPPs and both RTW and WRF at both 6 and 12 months follow-up. Pain self-efficacy mediates the relationship between OPPs and RTW and WRF at 6 months. At 12 months only change in pain self-efficacy mediates the relationship between OPPs and WRF not RTW.

Conclusions: The findings support OPPs as key determinants both return to work and work role functioning. A better understanding is needed of how to measure and disseminate best practices for OPPs and how to facilitate work accommodation offers. Interventions to strengthen pain self-efficacy should be developed and tested.

A4.3
Title: ***A Pilot Study to Examine Some Psychometric Properties of a Measure to Assess Organizational Occupational Health and Safety Performance: The Organizational Performance Metric (OPM)***
Authors: Swift M, Amick B, Hogg-Johnson S
Presenter: Benjamin Amick, III, Ph.D.

Objective: Health and Safety professionals from Ontario Prevention System collaborated to produce a short, easy-to-administer questionnaire including eight questions could serve as a leading indicator of a firm's occupational health and safety (OHS) performance. These questions were deemed to be general enough to provide a description of any firms' OHS performance. We report the results of a pilot study designed to assess the following:

1. Are all eight of the questions psychometrically sound?
2. Are all eight items better described as a single factor or multiple, independent dimensions?
3. Does a relationship exist between injury and illness rates and the OPM?

Methods: There were 808 questionnaire responses corresponding to 676 firms due to multiple respondents from a firm.

Results: Item correlation between the eight items ranged from 0.30 to 0.56. The moderate correlations

imply the items are related but measuring different parts of an OPM. Internal Consistency of the eight items was good with a Cronbach's alpha=0.82. The Cronbach's alpha did not change when a single item was removed (0.79 - 0.82). A factor analysis (principal component) shows all 8 items loaded on a single factor with loadings from 0.43 to 0.69. Therefore all eight items form a single metric by summing all eight items together. We call this the OPM and it varies from 8 (lowest) to 40 (highest). Four OPM tiers (or Levels) were identified graphically from the OPM's percentage distribution. Negative Binomial regression was used to show a relation between a firm's historical claim rate and OPM Score (LR chi-square=3.05 with 1 DF Pr=0.08). There was a clear gradient showing increased risk of a higher claims rate as you moved from Tier 1 to Tier 4 with an overall claim increase of 25%.

Conclusion: This preliminary evidence suggests this short tool could be a useful indicator for organizations interested in quickly assessing the OHS performance capabilities of firms in a jurisdiction.

A4.4
Title: ***The Role of Management Commitment to Safety in Promoting a Healthy Workplace: Results from a National Survey of U.S. Workers***
Authors: Grosch J, Roberts R
Presenter: James Grosch, Ph.D.

Objectives: Research on safety climate has repeatedly pointed to the importance of management commitment to safety (MCS) in reducing workplace injuries. MCS is the degree to which management actively encourages and supports workplace safety. The goal of this study was to evaluate a brief, three-item measure of MCS that was included in a recent national survey of U.S. workers, in terms of its association with occupation/industry, quality of worklife, and safety.

Methods: Data for this study came from the 2010 General Social Survey (GSS) which is conducted regularly by the National Opinion Research Center (usually every two years) and collects data on a variety of topics, including work and health. The GSS is administered as a face-to-face interview and provides a representative sample of the civilian, non-institutionalized, U.S. adult population. In 2010, a quality of work life (QWL) module was added to the GSS by NIOSH. Topics covered included: occupation/industry, job characteristics (e.g., MCS, job demands, autonomy), and health (e.g., injury at work, back pain). MCS was measured with three items (e.g., "There are not significant compromises or shortcuts taken when worker safety is at stake.") and rated on a four-point Likert scale. The three-item MCS scale had an alpha coefficient of 0.87. In 2010, the QWL module was completed by 917 full-time workers and had a response rate of approximately 70%.

Results: Multiple regression analyses, controlling for working conditions and demographic variables, found significant associations between MCS and three measures of safety/health: being injured at work, experiencing back pain, and experiencing pain in the hands, wrists, arms or shoulders. In addition, MCS was moderately associated with several quality of worklife measures, including social support at work, trust in management, organizational fairness, and worker autonomy. More modest associations were found between MCS and organizational characteristics, such as company size, type of work shift, and occupation/ industry.

Conclusions: These findings reinforce the importance of MCS as a core dimension of safety climate. MCS can be reliably measured across occupations with a three-item scale and is associated with workplace injuries, as well as several qualities of worklife measures that may also play an important role in occupational safety and health.

Session: **A5.0**
Title: **Agriculture, Forestry, & Fishing**
Moderator: Larry Layne, M.A.

A5.1
Title: ***Fatalities in the U.S. Commercial Fishing Industry, 2000–2009***
Authors: Lincoln JM, Lucas D
Presenter: Jennifer M. Lincoln, Ph.D.

Objectives: To identify risk factors for mortality in the U.S. commercial fishing industry and to explore how they differ by fishery (defined by region and species sought). Fishermen consistently are reported as having one of the highest occupational fatality rates in the country.

Methods: The Commercial Fishing Incident Database (CFID) was developed to collect data describing all fatal traumatic injuries in the U.S. commercial fishing industry. Data were collected from multiple sources in each state, including U.S. Coast Guard. Analyses were performed using SPSS v.15.

Results: From 2000-2009, there were 504 commercial fishing deaths. The majority occurred after a vessel disaster (261 deaths, 52%) or a fall overboard (155 deaths, 31%). By region, 165 (33%) deaths occurred off

the east coast, 133 (26%) occurred off the coast of Alaska, 116 (23%) in the Gulf of Mexico, and 83 (16%) off the west coast. Six fisheries suffered 25 or more fatalities in the 10 year period accounting for 215, 43% of all fatalities. These fisheries were the Gulf of Mexico shrimp fishery (55 deaths), Atlantic scallop fishery (44), Alaska salmon fishery (39), Northeast multispecies ground fish fishery (26), Alaska cod fishery (26), and West Coast Dungeness crab fishery (25). These were also the fisheries with the highest fatality rate.

Conclusion: Drownings due to vessel disasters and falls overboard were the main incidents leading to fatalities. The Commercial Fishing Industry Vessel Safety Act of 1988 requires that vessels carry emergency equipment thus focusing on survival rather than primary prevention. To reduce fatalities in this industry, additional prevention measures tailored to the hazards found in these high-risk fisheries are needed. Safety improvements in the commercial fishing industry in Alaska occurred as a result of several interventions, including safety regulations, marine safety training, and fishery-specific interventions focusing on unique hazards of particular fisheries.

A5.2
Title: ***Fish Farmer Created Inherently Safer Technologies***
Authors: Myers M, Durborow R, Cole H, Westneat S
Presenter: Melvin Myers, M.P.A.

Objectives: The objectives are to (1) identify fish farmer-created designs for protecting against occupational hazard and (2) classify the effectiveness of these designs by a hierarchy of controls.

Method: More than 46 fish farm visits were undertaken during which simple solutions based upon farmer innovations were identified to protect against hazards. While most of these visits were on catfish and trout farms, other investigations were conducted on clam, baitfish, bass, salmon, and ornamental fish culture facilities. The innovations were evaluated for their effectiveness based upon a three-tier hierarchy of controls: (1) warning about, (2) guarding against, and (3) eliminating the hazards.

Results: Farmer created innovations in certain circumstances that have moved up to the top of the hierarchy include eliminating falls from elevations, finger amputations, hair entanglements, impalements, lifting, and electrocutions. Guarding against hazards included some traditional methods such as rollover protective structures, power-take-off guards, and ground-fault interrupter circuits. Farmers also guarded against hazards by elevating overhead power lines by 15 feet and placing impalement guards on top of short rebar electric fence posts.

Discussion: Since the farmers created the interventions that are effective at controlling hazards, other farmers are more likely to adopt the interventions since they are practical, low-cost, and simple. This reveals a design for prevention at the grassroots level. However, research is needed for some systemic hazards in aquaculture: non-slip surfaces, novel harvesting techniques from ponds, clearing stream intakes into trout farms of debris during storms and flooding, preventing need sticks during fish vaccination, and providing fall protections into water where concrete walls are present.

A5.3
Title: ***Commercial Fishermen and Personal Flotation Devices (PFDs): Preconceptions and Evaluations of Comfort***
Authors: Lincoln JM, Lucas D
Presenter: Jennifer M. Lincoln, Ph.D.

Objectives: The objective was to understand commercial fishermen's perceptions of the risk of falling overboard and to identify personal flotation devices (PFDs) they found comfortable to work in.

Methods: A cross-sectional survey measured perceptions of risk of falling overboard, experiences with falls overboard, and preconceptions about PFDs. Fishermen were then invited to wear and evaluate a PFD. One of six models was randomly assigned. Participants were asked to rate the PFD comfort after the first and 30th day of wear. Analyses were performed using SPSS v.15.

Results: Four hundred fishermen across four gear types participated. When asked "How much do you worry about falling overboard?" 24% (96) selected "very much." Only 5% (19) responded "not at all." Fishermen believed that their career chance of falling overboard was 36%. One half (200, 49%) stated that PFDs were "very effective" for surviving a fall overboard. Overall, 19% (79) reported that they "always" wore a PFD while working, but there were major differences between gear types (crabbers, trawlers, gillnetters, longliners).

Of the 214 fishermen who participated in the PFD evaluation, 190 (89%) completed the first evaluation and 146 (68%) completed the second. Overall comfort was rated on a scale of one to ten, with ten being the most comfortable. On the first evaluation, the top PFDs were: Hydrostatic Inflation Technology (HIT)

suspenders (8.0), secumatic suspenders (7.0), and foam bibs (6.9). Overall satisfaction varied widely across gear types. The HIT suspenders PFD was rated highest on both evaluations.

Conclusion: This study revealed that fishermen working with different gear types have varying perceptions of risk, attitudes and beliefs about PFDs, and preferences for PFDs. A "one size fits all" approach to increasing PFD usage in the fishing industry will not likely be effective. PFDs and messages about PFDs must be tailored to individual gear types.

A5.4
Title: ***Progress in Preventing Fatal Occupational Traumatic Injuries in the U.S. Agriculture, Forestry, and Fishing Sector, 1992–2009***
Authors: Conway G, Graziano K, Somervell P, Husberg B
Presenter: George Conway, M.D., M.P.H., DABPM, AME

Objectives: To reduce traumatic deaths and injuries in the U.S. agriculture, forestry, and fishing industry.

Methods: NIOSH and partners utilized initiative funding starting in 1991 to develop and/or refine surveillance for deaths and injuries in the agriculture, forestry, and fishing (AgFF) industry sectors, and based on analyses of these findings, developed a variety of targeted intervention programs (major ones will be described in summary). Trends in fatal injuries for U.S. AgFF were examined and compared vs. non-AgFF workers 1992–2009, using public-access files of the Census of Fatal Occupational Injuries (CFOI, BLS, USDOL). These trends were evaluated using both 3-year arithmetic mean comparisons and regression methods.

Results: Both AgFF and Non-AgFF deaths decreased during the interval of interest. However, the AgFF deaths decreased more frequently (from approximately 900 per annum at the beginning of the interval to 600 per annum at the end, a total reduction of 3315 deaths versus straightline projection of the 1992-1994 mean), 33% by linear regression methods, and 35% per comparison of arithmetic means for 1992-1994 vs. 2007-2009. This was significantly steeper ($p<.006$ per regression methods) from the non-AgFF deaths, which decreased 18.6% per regression or 19% per comparison of 3-year means. Mechanisms/categories and locales of deaths were also examined, elucidating particular progress made in preventing commercial fishing deaths in Alaska and tractor deaths nationwide.

Conclusion: Tangible progress has been made in reducing the frequency of U.S. AgFF deaths, but much remains to be done.

Session: **B1.0**
Title: **Surveillance II**
Moderator: Kara Perritt, M.S.

B1.1
Title: ***Occupational Injuries of Hotel Workers: Surveillance, Inspections and Best Practices***
Author: Vossenas P
Presenter: Pamela Vossenas, M.P.H.

Objective: Identify the leading injuries of hotel workers recorded on OSHA logs and from medical records of a full-service hotel employer from 12 sites across the United States and evaluate the current state of the literature on best practices and remedies for the corresponding workplace hazards associated with these injuries.

Methods: OSHA logs were obtained for 12 hotel properties for years 2005–2010 of one of the five leading U.S. hotel companies. Descriptive data from OSHA long entries were entered into a database and analyzed. Medical record data where obtained was added for further clarification on the nature of the injury, event/exposure and source of injury. Patterns of injuries by job title were identified. Literature search was performed to review articles on best practices associated with the nature of these injuries. OSHA inspection data is included.

Results: Repetitive motion injuries, strains/sprains, contusions, slips and trips and cuts and lacerations were the leading causes of injury with variance by department. Chemical exposure and bloodborne pathogens posed threats as well.

Conclusion: The majority of injuries is caused by known hazards with recognized remedies and can be prevented. This would reduce the risk of such injuries and the subsequent disability that can and does follow. Gaps in best practices were identified for some of the ergonomic hazards. Many of the ergonomic hazards identified did have recognized best practices that could easily be implemented by a corporation with employees at multiple sites although the research may have been done in other industries and not hotels. The hotel industry and many partners from academia, public health agencies, safety professional organizations, and the private sector, in addition to labor and management at these hotel sites, are at an important point in time

where there is potential for significant improvement through collaboration from multiple disciplines and sectors.

B1.2
Title: ***Injuries among U.S. Food Services Industry Workers***
Authors: Estes C, Jackson L
Presenter: Larry Jackson, Ph.D.

Objectives: Injuries are common among the nine million workers in the U.S. food services industry which employs a disproportionate number of young and inexperienced workers. To characterize injuries in the food services industry in 2007, we assessed emergency department (ED) treated injuries in a nationally-representative ED sample.

Methods: We characterized work injuries in the food services industry using data from the National Electronic Injury Surveillance System occupational supplement (NEISS-Work)-a national surveillance system for nonfatal occupational injuries and illnesses treated in U.S. hospital EDs. We compared data for injuries occurring at the 200 largest food service chains to smaller chains and other businesses. We calculated rates by using workforce estimates from the Current Population Survey (CPS).

Results: In 2007, there were an estimated 214,100 (95% confidence interval (CI) = ±44,000) ED-treated injuries among food services industry workers and a rate of 3.0 (CI = ±0.6) injuries per 100 full-time equivalent workers. About half of estimated injuries occurred at the largest 200 food service chains. Men and women experienced nearly equal rates of injury in this industry, whereas in the overall workforce injury rates among men were 50% higher than among women. Food services industry injuries were most often lacerations, punctures, and amputations (37%); sprains and strains (22%); contusions and abrasions (13%); and burns (10%). Rates of laceration injuries were considerably higher among 15-24 year old workers. Lacerations were more common among injured workers at smaller chains and other businesses than at the largest chains.

Conclusions: Workers in the food services industry continue to experience high numbers of injuries, often resulting from well recognized hazards. Addressing hazards through modifying work environments and improving safety practices is critical for reducing injury rates. Partnerships with food service companies and worker groups may help to raise awareness and mitigate common safety hazards.

B1.3
Title: ***Young Worker Deaths: A Summary of NIOSH Surveillance and Investigative Findings***
Authors: Goldcamp M, Perritt K
Presenter: Michael Goldcamp, Ph.D.

Objectives: Between the years 1994 to 2008, 815 working youth under the age of 18 years died in the U.S. Utilizing surveillance and investigation data, the National Institute for Occupational Safety and Health (NIOSH) has assisted in guiding and prioritizing research efforts that address these deaths.

Methods: The NIOSH surveillance program primarily uses Census of Fatal Occupational Injuries (CFOI) data, which are obtained from the Bureau of Labor Statistics. These data include information for all workplace fatalities in the U.S. Investigation efforts center on the NIOSH Fatality Assessment and Control Evaluation (FACE) program, which investigates workplace fatality events to gather information unavailable through other sources. FACE investigation reports were analyzed to provide descriptive statistical data.

Results: According to CFOI data for 1994 to 2008, 88% (714) of all working youth fatalities occurred to males. The fatality rate for youth was 3 fatalities per 100,000 full-time equivalent workers (FTE). Youth in the Agriculture, Forestry, and Fishing and Construction industries had the highest fatality rates (18 fatalities per 100,000 FTEs). Transportation events accounted for 48% (390) of all fatalities in these years.

Between 1986 and 2007, investigators completed 99 FACE reports on working youth fatalities (4% of 2,363 investigations). Ninety-three percent (92) of these reports were fatalities to males. Over a third (39) of all incidents involved a transportation event. Twenty-three fatalities (23%) involved youth working in a family business, primarily in Agriculture. The majority of fatalities were in the Agriculture (33, 33%) and Construction (18, 18%) industries. Forty-two (42%) investigation reports indicated a violation of Youth Labor Hazardous Orders.

Conclusion: This comprehensive review of NIOSH activities related to youth workplace fatalities will provide a description of factors common among fatality events. These results will assist policymakers and researchers in further efforts to reduce fatal injuries to young workers in the U.S.

B1.4
Title: ***Cluster Analysis of Unintentional Workplace Carbon Monoxide Exposures in the United States from 2000 to 2009***
Authors: Slavova S, Bunn T, Spiller H
Presenter: Svetla Slavova, Ph.D.

Objectives: Carbon monoxide is one of the common air polluters and a reason for about 15,000 emergency department visits for unintentional exposure every year. About 16,000 unintentional CO calls are placed every year to the U.S. regional poison control centers, with about 11% of the calls reporting exposures at workplace. Understanding the geographical and temporal distribution of the workplace exposures is important for the timely delivery of the prevention message to the populations at higher risk at a given time.

Methods: We did a retrospective study on unintentional CO exposures reported to the U.S. poison control centers from 2000 to 2009 to identify areas at higher risk for exposure and to further investigate the characteristics of the identified clusters. The scan statistics and SaTScan software were utilized to detect space-time clusters, assuming discrete Poisson model that accounts for the population at risk.

Results: U.S. poison control centers reported 163,435 CO exposures. There was a seasonal trend with recurring peaks in winter months, mainly January. Northern states (33 states, pop 153.3 million) had twice the number of reported exposures per 100,000/pop as southern states (18 states, Pop 141.4 million):7.8 vs. 3.8 respectively. Fifteen clusters were detected ($p< 0.001$) in northern states of which 10 (67%) occurred during cold weather months; 7 clusters were detected ($p<0.001$) in southern states of which 3 (42%) occurred during cold weather months. Most (45%) of the workplace exposures were during the winter months with a peak during January with northern states having higher rates of exposures. The existing seasonal and geographical trend suggests that the workplace exposures might be related to weather disasters like ice storms and hurricane that lead to power outages. Further investigation is underway.

Conclusion: Understanding the mechanism of workplace exposure will help to improve future education/prevention efforts.

Session: **B2.0**
Title: **Fall Prevention in Construction II**
Moderator: Hongwei Hsiao, Ph.D.

B2.1
Title: ***Foremen Fall Prevention Curriculum Development and Pilot Testing***
Authors: Kaskutas V, Dale AM, Lipscomb H, Evanoff B
Presenter: Vicki Kaskutas, O.T.D., M.H.S., O.T.R./L

Construction foremen can influence the fall safety of their crew by maintaining a safe worksite and mentoring safe behaviors. The objectives of this research are to develop and pilot test a fall prevention and safety communication training program for residential construction foremen.

Methods: We used survey results from 364 apprentice carpenters and 65 construction foremen and focus group feedback from 48 carpentry professionals to identify training priorities for a fall protection and mentoring program for residential construction foremen. Training objectives and lesson plans were developed by our team of researchers and apprenticeship trainers to address fall prevention plans, worksite auditing, abatement of fall risks, tool box talks, mentorship and feedback, and juggling safety with productivity. Ten foremen from one residential contracting company participated in the 8-hour pilot training led by two trainers with residential and safety expertise. We measured training usefulness and compared pre and post-training foremen and crew member surveys and worksite audits to evaluate the effect of the training.

Results: Foremen noted that the training was useful and they were likely to use the materials covered and recommend the training to colleagues. Overall safety compliance on the worksite audits improved slightly from 78% to 83%. Guard rails were used more frequently and they were always constructed correctly. Statistically significant increased personal fall arrest system use was reported by foremen; crew demonstrated decreased unsafe behaviors of standing on the top plate. Crew reported increased tool box talks, and increased focus on identification of risky work tasks and discussion of the best way to these tasks. Foremen reported that workers receive more day-to-day instruction from the foremen and the journeymen.

Conclusions: A fall prevention curriculum driven by a needs assessment demonstrated good potential to improve fall safety, worker mentorship, and ultimately increase worker safety.

B2.2
Title: ***Leaders in Safe Construction: Development of a Contractor-focused Fall Prevention Program Through Community-based Participatory Research***
Authors: Shepherd S, Azaroff L, Roelofs C, Brunette MJ, Marin LS, Grullon M, Parker E
Presenter: Susan Shepherd, Sc.D.

Objectives: Falls from heights are one of the most common causes of fatal and non-fatal injuries affecting U.S. construction workers, with Latinos at disproportionate risk. A community-based participatory research (CBPR) partnership (University of Massachusetts Lowell, Lawrence Community Connections, Laborers Local 175, City of Lawrence) developed "Leaders in Safe Construction (LISC)" to reduce fall hazards at jobs around Lawrence, Massachusetts, an area with a largely Latino workforce.

Methods: LISC is an adaptation of Fall Safe, one of the few programs demonstrated to reduce fall hazards at construction worksites. Fall Safe targeted large commercial contractors, while LISC targets small and large, commercial and residential contractors. LISC adapted the program to the Lawrence environment based on extensive discussions with local workers, contractors, and community leaders.

Results: Like Fall Safe, LISC coaches contractors over months to implement site inspections, hazard analyses, job planning, and fall prevention programs. To adapt the program for small contractors, LISC does not include health and safety committees or sophisticated data collection equipment. Site audits and walkthrough tools were adapted to include items appropriate to residential work. Silica dust exposure prevention was added for control (non-intervention) periods to meet the ethical need to help participants ameliorate urgent hazards.

In response to community input, LISC seeks to address hazards caused by disrespectful treatment by supervisors, fear of job loss in response to reporting hazards, and pressure to work without safe equipment. Participating contractors are required to develop and post non-retaliation and hazard reporting policies, and to inform workers about actions taken to address the hazards reported. Supervisors will participate in an innovative training program in respectful, culturally appropriate management practices.

Conclusions: The 12-month, 15-point program has enrolled 11 contractors of a recruitment target of 24. Quantitative data on observable hazards and qualitative data on the process are being collected.

B2.3
Title: ***Fall Prevention Training to Hispanic Workers of Southern Nevada***
Authors: Shrestha P, Joshi V, Menzel N
Presenter: Pramen Shrestha, Ph.D., P.E.

Objectives: Death and injury from falls are a long-standing and continuing problem in construction, responsible for at least a third of the construction deaths in the U.S. from 2005 – 2009. Hispanic workers have a higher fatality rate than any other group in the nation. The main objective of this training is to assess the effectiveness of fall prevention training to Hispanic workers in Southern Nevada.

Methods: An eight-hour training session with a two-hour lab was conducted in the Spanish language and focused on Hispanic construction workers. The training was a part of the Susan Harwood Grant provided by Occupational Safety and Health Administration (OSHA). The lecture class was interactive, and included a high number of site photos and videos. In the lab work, first, the participants' competencies in using the Personal Fall Arrest System (PFAS) were examined, then the participants were trained to use PFAS and fall prevention options such as guard rails, safety nets, scaffoldings, and ladders. A follow-up interview with each participant was conducted after eight weeks regarding the impact of training on their daily work behavior.

Results: The analysis of 80 competency forms showed that 29% of the workers were incompetent in physically using lifeline/lanyard, anchor points, and connectors. About 31% of the participants were incompetent in checking harness safety, and 21% were found incompetent in physically installing ladders as well as checking the ladder's safety. Based on the information gathered from follow-up interview of 50 respondents, it was found that 82% of the participants' jobs required fall prevention knowledge and skills, and 100% said that the training improved their fall prevention knowledge and skills. Among the participants, 98% of them said that they made changes to their fall prevention behavior as the result of the training.

Conclusions: The results showed that it is more effective to train the Hispanic workers in their native language. Majority of workers need fall prevention training in their work, and this training has helped workers to understand the possible fall hazards and preventative measures; in addition, this training made them more cautious.

B2.4
Title: ***The Cost-effectiveness of Fall Arrest Systems in Construction: The Employer's Perspective***
Authors: Pana-Cryan R, Gillen M
Presenter: Matthew Gillen, Ph.D.

Objective: In 2009, falls accounted for more than one-third of fatal occupational injuries in construction. Nearly half of all fatal falls in private industry were to construction workers. Personal Fall Arrest Systems (PFAS) are effective in preventing falls but are not widely used in residential construction. Up until December 22, 2010, residential construction firms were exempted from requiring fall protection by the Occupational Safety and Health Administration (OSHA). A new OSHA directive (STD 03-11-002) now requires the use of fall prevention approaches in residential construction. Our objective was to conduct a cost-effectiveness analysis of using PFAS from the employer's perspective, which includes costs and benefits incurred only by the employer.

Method: We used published data and cost-effectiveness methods to estimate injuries averted and the net cost of using PFAS as compared to implementing no intervention. The net cost includes the cost of using the PFAS and the cost of injuries averted as a result of using the PFAS. We calculated the cost per injury averted from the employer's perspective, which includes only the costs and benefits associated with the intervention that are incurred by the employer.

Results: Given our assumptions, that were mostly based on published epidemiological studies, preliminary results suggested that an employer could save $2,531 per fall arrested with the PFAS. We also identified opportunities for incorporating prevention through design elements in order to enhance the effectiveness of prevention "upstream."

Conclusion: We are expanding our analyses to develop the societal perspective, which includes all cost and benefits associated with the intervention, in order to identify additional opportunities for prevention. Based on our findings, we also hope this case study example can be used to begin a dialogue with potential partners who may be willing to help us to develop and disseminate lessons learned from using PFAS to others in residential construction.

Session: **B3.0**
Title: **Machine Safety**
Moderator: Al Amendola, Ph.D., P.E., C.P.E.

B3.1
Title: ***Visual Feedback System to Improve Machine Controls Design***
Authors: Steiner L, Burgess-Limerick R, Porter W
Presenter: Lisa Steiner, M.S.

Objectives: One of the contributing factors to mining injuries and fatalities is the close proximity mine workers perform their jobs in relation to their equipment, hazardous environment and other dynamic and unpredictable energy sources. In particular, the mine workers' interface with their equipment is critical to the selection of the correct control and movement of that control in the correct direction while performing the physical part of their job. These directional-control-response-relationship designs currently vary across equipment manufacturers even within a specific equipment category, such as roof bolting equipment. Determining the correct opr appropriate directional response relationship for equipment in a specific situation is not always straightforward. However there are feedback mechanisms that can be provided that may help operators either make correct decisions or to correct wrong actions more quickly.

Methods: An experiment was conducted as part of an effort to determine the directional compatibility of operation levers for roof bolting equipment. Sixteen experienced roof bolter operators were tested on a Fletcher Roof Ranger II Roof Bolting Machine. As part of the study, the feasibility of a visual warning system to alert operators of critical control movements and to alert other workers in close proximity of the moving equipment was conducted.

Results: The results of the study showed that there are directional control response relationships that are critical to the operation of equipment. The benefits of a visual feedback system were confirmed for both training of new operators and to aid experienced operators.

Conclusions: The roof bolter manufacturer has supported the outcome of these studies and their benefits of reducing injuries and fatalities. A discussion of these studies and the implementation of the feedback system along with the potential for reducing specific types of injuries will be presented.

B3.2
Title: ***Research Partnership for Prevention of Machine-related Injuries: The National Machine Guarding Program***
Authors: Parker D, Brosseau L, Yamin S
Presenter: Samuel Yamin, M.P.H.

Objectives: Metal fabrication workers are at high risk for machine-related injury. Despite downward trends in recent years, incidence rates for lost-time injuries (131.5 per 10,000) and amputations (2.1 per 10,000) remain elevated among workers in metal fabrication trades compared to private industry as a whole (106.4 injuries and 0.7 amputations per 10,000 workers), indicating a need for improved safety practices. Our prior NIOSH-funded research found significant improvements in machine guarding and safety audit measures (increases of 13% and 23%, respectively) when simple interventions were implemented in small metal fabrication businesses (5 to 100 employees). Innovative partnerships are critical to translate these findings into practice. The National Machine Guarding Program is a cross-sectoral collaboration formed between business and health research practitioners for this purpose.

Methods: Our partnership has worked to develop a widely-applicable, sustainable intervention to be delivered by insurance risk consultants. A standardized three-visit intervention will be implemented at 300 businesses in 15 states. Using a randomized study design, we will evaluate three outcomes: 1) Changes in hazard control within businesses; 2) Changes in rates of injury among intervention businesses versus controls; and, 3) Changes in measures of safety climate.

Results: As a partnership we have trained over 75 risk consultants in identification of machine-related hazards. In our previous study we determined that additional training would enable these field staff to conduct machine safety audits using statistically valid methods of randomization and to deliver a standardized intervention.

Conclusion: This translation research provides a new model for outreach to smaller businesses that rarely have resources for comprehensive safety programs. Cost-effective measures will enable businesses to build sustainable programs in machine safety, lockout/ tagout, and job safety analysis. If effective, this intervention would form the basis for new practice guidelines to be implemented nationwide.

B3.3
Title: ***Machine Safety Research: The Road Ahead***
Authors: Harris J, Etherton J, Current R, Amendola A
Presenter: James Harris, Ph.D., P.E.

Objectives: Machines are a necessary component of work life in the United States. Unfortunately, machine related injuries and fatalities continue to occur in the workplace. Since 1995, the National Occupational Research Agenda (NORA) has helped to guide occupational safety and health research in the U.S. The NORA Manufacturing Sector and Traumatic Injury Cross-sector have developed priority goals concerning machine safety. Specifically, the Manufacturing Sector has developed ten strategic goals for the next five to ten years. One of these strategic goals is to "...Reduce the number of injuries and fatalities due to contact with objects and equipment among workers in the manufacturing sector." The Traumatic Injury Cross-sector has similarly developed six strategic goals. One of these goals is to "...Reduce occupational injuries and deaths due to machines and industrial vehicles."

Methods/Results: When listed at the two-digit level of the North American Industrial Classification System (NAICS), the general machinery type "metal, woodworking and special material (source code 35)" was the leading source of "struck by, struck against, and caught-in" incidents (11,970) which led to days away from work in 2008. More specifically at the three-digit level in NAICS, "sawing machinery-stationary" resulted in 4380 incidents with days away from work in 2008. For 2009, there were 304 private industry manufacturing sector fatalities. Machinery was a primary or secondary source for 54 of these sector fatalities, and more specifically 20 were associated with "metal, wood-working and special material machinery" as a primary or secondary source.

Conclusion: Despite technological advances, workplace fatalities and injuries due to machinery still occur. Metal, woodworking and special material machinery within manufacturing have been identified as a leading source for nonfatal injuries. Multidisciplinary research efforts should address the unique circumstances surrounding injuries due to machinery in this group.

B3.4
Title: ***Accident Prevention Techniques Adopted in Steel Re-rolling Mills***
Authors: Rana SP, Goswami PK
Presenter: Somendra Pal Rana

Objectives: For the manufacture of a very thin strip or a strip with a high-quality finish, the stainless steel sheet that is called billet is re-rolled in a re-rolling mill to

make a stainless steel sheet of 18 gauge. The rollers of the re-rolling mill exert tremendous pressure over the sheet and there is a likely chance of breaking of stainless steel strip from the sheet. The objective of the study was to minimize the number of accidents in steel re-rolling mills due to ejection of the stainless steel strip.

Methods: Looking into the high rate of frequency and severity of accidents as well as pollution hazard in re-rolling and pickling mills, it becomes essential to make necessary arrangements for prevention of accidents in such type of industry.

Survey/inspection of a large number of re-rolling and pickling mills and allied units were carried out by the author in the year 2005-2009. During the course of inspection the working of these steel re- rolling and pickling mills was closely studied and monitored. A number of accidents involving re-rolling mills were investigated and subsequently remedial measures to prevent the occurrence of such accidents were suggested. Assessment of occupational safety and health system of these units was carried out and compliance level of the statutory requirements was also checked.

Results: Proper use of safety gadgets by workers, machine guarding and regular training brought down the risk to an acceptable level and discharged effluent to within permissible limits.

Conclusions: Electrochemical cleaning came out as a possible replacement of pickling process. An iron plate fitted on two spring loaded bolts just before the point of operation has come out as a good solution to capture the ejected strips. Use of hand, chest and neck guards has considerably reduced the number of accidents.

Session: **B4.0**
Title: **Improving Safety at the Company Levels**
Moderator: Benjamin Amick, III, Ph.D.

B4.1
Title: ***Breakthrough Change in Workplace Safety***
Authors: Robson L, Moser C, Amick B, Swift M, Hogg-Johnson S, Mansfield L, Pagell M, Shannon H
Presenter: Lynda Robson, Ph.D.

Objectives: The research literature on large change in workplace OHS performance ("breakthrough change" or BTC) is not well developed. The objectives of this exploratory study were to determine a) the incidence of breakthrough change (BTC) in Ontario firms and b) the critical success factors involved in BTC.

Methods: Mixed quantitative and qualitative methods were used. Phase 1 involved analysis of firm-level workers' compensation claim trajectories to identify putative incidents of BTC. The study sample consisted of the 2,599 Ontario firms with ≥ 75 FTEs over all of 1998-2008 and belonging to a sub-sector with 20 or more other such firms. A firm was considered to have undergone putative BTC if it had moved from a rank of 50% or higher (in terms of its claim rate relative to others in the same industrial sub-sector) in a three to seven year period commencing in 1998 to a rank of 20% or lower in a three to seven year period ending 2008. Brief interviews were conducted with key informants from firms displaying the putative BTC phenomenon to determine whether there had actually been intentional efforts to improve OHS. Phase 2 of the study used a multiple qualitative case study design with the following components: purposeful sampling of four diverse BTC firms; data collection through multiple interviews, review of documents (including archival firm data) and observations; and within-case and cross-case analyses.

Results: Through screening of the claims statistics, sixty-seven firms were identified as having undergone putative BTC. Attempts were made to contact the 32 firms where change had been more certain (based on their statistical profiles). Of the 15 respondents, each from a different firm, who agreed to be interviewed, twelve indicated there had been intentional and substantial, multi-faceted efforts to improve OHS. This leads to a conservative estimate of the incidence in BTC over 10 years as 4.6 per 1,000 firms. Phase 2 data collection from the four case study sites has been completed. Company statistics validated the claim statistics portrayal of BTC. Interviews with respondents at various levels of the organizations have provided multi-causal explanations for the changes observed. Early cross-case analysis has identified factors important for BTC at various levels: the external environment, technical sub-system, social sub-system and the individual.

Conclusions: Workers' compensation statistics can be systematically screened to identify firms that have undergone large improvement in OHS. Qualitative analysis can be used to identify factors important to this improvement.

B4.2
Title: ***Have Major U.S. Companies Adopted Prevention Through Design (PtD) Practices and Policies?***
Author: Biddle, E
Presenter: Elyce Biddle, Ph.D.

Introduction: Literature has indicated that integrating safety and health considerations into the design and development of systems meant for human use prevents loss of life and injury and minimizes destruction of health and property (NSC, 2007). However, little research has been conducted on the extent to which company policies stipulate that safety and health concerns are designed and built-in, rather than added after the job/product has been put into operation. Nor is there information regarding the extent to which the Prevention through Design (PtD) policy or practice "extends to product design, machine design, plant layout and condition of premises, selection and specification of materials, production planning, and duties of managers and employees" (Christensen and Manuele, 2000).

Methods: Data was collected through a partnership with ORC Networks, an international management and human resources consulting firm with a network of key health and safety leaders from 150 major, multinational corporations in a wide variety of industries. Their member organizations were queried about PtD principles and practices including purchasing practices, contracting practices, manufacturing processes, work processes, dedicated management systems, and leadership commitment.

Results: Over 75% of companies responding indicated that their company includes PtD principles in operations. Although an additional 11% indicated that they were not sure, half provided information concerning their PtD practices. Of companies with PtD, just over 50% required contractors or suppliers to use PtD principles and 40% required both. More interesting, 41% of firms with PtD in operations, have stopped a work process or construction to implement PtD principles.

Conclusions: The results have shown that there a fairly wide use of PtD principles in this subset of major U.S. based corporations. However, there remains a need for additional education concerning PtD as well as additional research to determine which elements and methods are most effective in reducing occupational injury.

B4.3
Title: ***Is Occupational Injury Risk Higher at New Firms?***
Authors: Seabury S, Mendeloff J, Neuhauser F
Presenter: Seth Seabury, Ph.D.

Objectives: This paper explores whether or not new firms have higher risk of occupational injuries. New firms are likely to be less familiar with regulatory requirements and best practices for safety, potentially increasing the risk of occupational injuries.

Methods: We use data on 146,815 single-establishment firms in Pennsylvania from 2001-2005 to study the relationship between the age of a firm and the likelihood and number of lost workday events experienced by workers. We use fixed-effect regression models to estimate the impact of an additional year of age on occupational injury risk. To control for the possible underreporting of injuries, which might be more common in newer firms, we also estimate the relationship conditional on having reported a prior injury. To test for the possibility that injuries lead to nonrandom attrition, we also estimate the relationship between injuries and firm exit.

Results: Using the full set of firms, there appears to be little overall correlation between firm age and risk. If anything, newer firms appear less likely to have lost workday injuries. When we condition on having at least one injury reported in 2000, however, we find that in later years the injury risk of firms declines with age. This pattern is consistent with systematic underreporting of injuries by new firms.

Conclusions: Newer firms appear to be associated with higher injury risk, but only when we control for possible underreporting of injuries.

B4.4
Title: ***A Randomized Controlled Study of Targeted Occupational Health and Safety Consultation or Inspection in Ontario Workplaces****
Authors: Hogg-Johnson S, Robson L, Cole D, Tompa E, Subrata P, Amick BC, Smith P, van Eerd D, Mustard C
Presentor: Sheilah Hogg-Johnson, Ph.D.

Introduction: From 2004 to 2008, the Ontario Canada prevention system ran the High Risk Firm Initiative, a targeted consultation or inspection program. While there is evidence to support inspection with enforcement as effective for reducing work injury, evidence to support consultation is limited. We set out to: 1) determine whether targeting of firms with either consultation or inspection was effective at improving

work injury outcomes; 2) describe interventions as delivered.

Methods: Randomized controlled parallel groups design. Population included all manufacturing firms registered with the Ontario Workplace Safety & Insurance Board in 2005. Firms ranked between 2nd and 10th percentile on a composite measure of health & safety performance were randomized to three arms for 2006: targeted for Health & Safety Association (HSA) consultation, targeted for Ministry of Labour (MOL) inspection, or services as usual (referent). Data included firm characteristics (size, years in business, region, Branches) and work injury claims outcomes from 2002 to 2008. Negative binomial generalized estimating equations modeled claim and disability day rates by study arm and year. HSA and MOL tracking system data characterized consultation and inspection activities.

Results: There were 2153 firms randomized into HSA (n=600), MOL (n=619) and referent (n=934) arms. Firm characteristics and 2002-2005 rates of work injury claims and disability days were similar across arms. Firm outcomes were significantly different across years, but study arm by year interactions were insignificant indicating similar trends across arms. Among firms allocated to HSA, 83% were contacted with 63% engaging with the HSA. HSA staff described their intervention as "light touch." Around 70% of firms targeted for inspection were inspected with orders written for 37% of them.

Conclusions: The apparent lack of benefit from targeting could be due to firm selection methods, extent of firm participation in targeting interventions, low intensity of the intervention or sensitivity of outcome measures available.

*Intervention Evaluation Contest - Honorable Mention Paper

Session: **B5.0**
Title: **Motor Vehicle I**
Moderator: Stephanie Pratt, Ph.D.

B5.1
Title: ***Motor Vehicle Collision Injuries in Semi Truck Drivers vs. Passengers in the Sleeper Berth***
Authors: Bunn T, Slavova S, Bush H
Presenter: Terry Bunn, Ph.D., AAS

Objectives: Fatality Assessment and Control Evaluation (FACE) program fatality investigations were conducted on two semi truck drivers who were fatally injured in motor vehicle collisions while resting in their sleeper berths. Both team drivers were not wearing their safety belts and were ejected from the vehicle upon impact. Based on these two cases, the objectives of the study were to determine if passengers in the sleeper berth were more likely to be injured in semi truck collisions compared to semi truck drivers in the driver seat.

Methods: A retrospective matched-pair cohort study was performed on KY CRASH data from years 2000—2009. The relative risk of injury in semi truck drivers (non-exposed group) and passengers in the sleep berth (exposed group) from the same vehicle was determined. Drivers and passengers in the same vehicle were matched to reduce potential bias and confounding effects due to variables specific to the vehicle and crash. Only drivers and passengers 16 years of age and older, and only non-parked vehicles were included in the study.

Results: There were 578 semi trucks included in the study (578 drivers and 578 passengers in the sleeper berth). Of the drivers, 61 drivers were injured (11%) and 3 died; 80 passengers were injured (14%), 7 fatally. The percentage of drivers that wore their safety belt was 98% vs. 14% for the passengers in the sleeper berth. The crude relative risk for passengers in sleeper berths to be injured in a motor vehicle collision was 1.31 (95% CI= 1.001-1.702) compared to drivers seated in the driver seat.

Conclusions: Passengers occupying the sleeper berth are more likely to be injured in a semi truck collision than drivers seated in the driver seat. Further analysis accounting for restraint use will be performed.

B5.2
Title: ***Experimental Test of the Impact of Work-related Fatigue on Police Officer Vehicle Collision Risk***
Author: Vila B
Presenter: Bryan Vila, Ph.D.

Motor vehicle crashes account for more than one-third of all police fatalities since 1990. Despite declining motor vehicle fatality rates for the general public, rates for police officers have trended upward during the past two decades. Most fatal police crashes involve collisions with other vehicles or fixed objects due to lane deviations and/or excessive speeds. Even though less than one third of police patrol officers work night shifts, 42% of their fatal crashes occur between midnight and 08:00.

Many police officers work irregular and extended shifts, primarily night shifts of 8, 10 or 12 hrs. which conflict with endogenous circadian rhythms for sleep propensity and waking alertness, and interfere with performance at night and the ability to sleep during the day. These adverse effects degrade driving ability under even the best of circumstances and are likely contribute to increases in police officer motor vehicle crash rates.

We used controlled laboratory experiments to assess the cumulative impact of consecutive night shift work on police officer vigilance and driving performance using N=29 (27 male, 2 female; age 37.1 ±6.3) active-duty police patrol officers working night shift schedules (10.7 hr. shifts, 5 on, 4 off). Participants' driving performance and vigilance was tested in the laboratory using high-fidelity driving simulators, psychomotor vigilance tests, and self-assessments of tiredness in two conditions: in the morning after the last of five consecutive night shifts; and at the same time of day after three consecutive days off duty. Order of conditions was randomized.

Our results showed that simulated driving performance, psychomotor vigilance, and subjective sleepiness were significantly degraded following the five consecutive night shifts when compared to three consecutive days off duty. This indicates that fatigue arising from consecutive night-shift work may contribute to the upward trend in motor vehicle crash-related fatalities among this occupational group.

B5.3
Title: ***Trends in Motor Vehicle Fatalities in the Oil and Gas Extraction Industry: Results from the Census of Fatal Occupational Injuries***
Authors: Retzer KD, Hill RD, Pratt SG
Presenter: Kyla Retzer, M.P.H.

Introduction: The oil and gas extraction (O&G) industry experiences an occupational fatality rate substantially higher than the rate for all U.S. industries (29.1 and 3.9 per 100,000, respectively). The most frequent fatal event in the industry is motor vehicle crashes, resulting in nearly 30 percent of all fatalities.

Methods: The Bureau of Labor and Statistics' (BLS) Census of Fatal Occupational Injuries database was queried for all fatal highway crashes in the oil and gas extraction industry during the years 2003-2008. Data were analyzed in SAS to identify patterns that will help to develop a motor vehicle safety initiative in the industry.

Results: During 2003-2008, 190 workers died in highway crashes, resulting in a fatality rate of 8.5 per 100,000 workers, compared to 1.0 per 100,000 workers for all U.S. industries (BLS). Workers from small companies (<20 employees) were 4.5 times more likely to die than were workers from large companies ($p<.05$). Workers from well servicing companies were 3.4 times more likely to die than were workers from oil well operators ($p<.05$). Fifty percent of the workers who died were driving a pick-up truck and almost half (49%) had been employed for less than one year with their current employer. A review of the narrative field showed that at least forty percent (n=76) of workers who died were not wearing their seatbelt at the time of the crash.

Conclusions: Interventions to increase seatbelt usage are needed in this industry, specifically among O&G workers who drive pick-up trucks as a part of their job. Motor vehicle safety initiatives need to be targeted towards well servicing companies and employees with less than one year of experience. Linkage of worker fatality and motor vehicle fatality surveillance systems would help researchers to better identify risk factors for occupational motor vehicle death.

B5.4
Title: ***Cost-effectiveness Analysis of Fatigue Management to Prevent Truck Collisions in the Oil and Gas Extraction Industry***
Authors: Myers M, Pana-Cryan R, Hill R, Retzer K
Presenter: Melvin Myers, M.P.A.

Objectives: Workers in oil and gas extraction are at increased risk of transportation-related occupational fatalities. In 2003-2005, almost 40% of the deaths in that industry were transportation-related, occurring mostly on highways. A little over a half of all single-vehicle crashes in the industry involve trucks, and 35% of these crashes are fatigue-related. Fatigue management programs have been proven effective in reducing crashes and related injuries. Our objective was to assess the cost-effectiveness of such a program in preventing single- and multiple-vehicle crashes involving trucks in oil and gas.

Method: We used published data and cost-effectiveness methods to estimate injuries averted and the net cost of implementing the intervention as compared to no intervention. We calculated the cost per injury averted from the societal perspective, which includes all costs and benefits associated with the intervention.

Results: Given our assumptions, preliminary results of analyses that included only single-vehicle crashes of large trucks showed that a fatigue management program can reduce the number of fatalities from 13 to 3 and the number of non-fatal injuries from 169 to 60 per year at a cost of $8,095 per (any) injury averted.

Conclusion: We are refining our assumptions and data and performing sensitivity analyses to better understand our results. We are expanding our analyses to include crashes of small trucks as well as multiple-vehicle crashes. We are also developing the employer's perspective, which includes only the cost and benefits associated with the intervention that are incurred by the employer, in order to identify potential additional opportunities for prevention.

Session: **C1.0**
Title: **Surveillance III**
Moderator: John Myers, M.S.

C1.1
Title: ***Occupational Injury Surveillance Using the Washington State Trauma Registry***
Authors: Sears J, Silverstein B
Presenter: Jeanne Sears, Ph.D., R.N.

Objectives: Traumatic injuries are a leading cause of death and disability among U.S. workers, yet state trauma registries are rarely used for occupational injury research. At least 21 state trauma registries, including the Washington State Trauma Registry (WTR), include an indicator of work-relatedness. The aim of this project is to explore and document the WTR as a resource for occupational injury surveillance.

Methods: The WTR, maintained by the Washington State Department of Health, contains mandatory reports for severe injuries (involving trauma team, interfacility transfers, 2+ inpatient days, or death) from all state-designated acute trauma facilities. 16+ year-olds injured in Washington during 1998-2008 were included. Years prior to 2003 were excluded from trend assessments due to changing WTR inclusion criteria.

Results: For the 11 years studied, the WTR contained a total of 145,893 reports for 125,627 unduplicated injury events, and of these 7.3% were indicated as work-related. Of work-related events, 52% occurred in an industrial setting, 10% on a street or highway, 5% on a farm, 5% at home, and 4% in a public building. There was no evidence of a decreasing trend in work-related traumatic injuries reported to the WTR from 2003 through 2008, using either raw reports or age-adjusted rates based on employed population estimates. 247 work-related fatalities were identified in the WTR, compared with 942 by Washington State's Fatality Assessment and Control Evaluation (FACE) program and 991 by the Census of Fatal Occupations Injuries (CFOI).

Conclusion: The WTR presents several limitations for surveillance, including incomplete injury coverage and inter-hospital variation in reporting practices. However, use of WTR data could contribute to planning and evaluation of occupational injury prevention programs, improved case ascertainment of severe occupational injuries, and identification of high-risk populations and emerging injury patterns. Adding industry and occupation information to the WTR would improve its utility for occupational injury research.

C1.2
Title: ***Is Louisiana Really the Safest State?***
Authors: Mendeloff J, Burns R, Kopsic J, Xia J, Fan X
Presenter: John Mendeloff, Ph.D.

Objectives: State level injury rates or fatality rates are sometimes used in studies of the impact of various safety programs or other state policies. How much does the metric used affect the view of relative occupational risks among U.S. states? This paper uses a measure of severe injuries (fatalities) and of less severe injuries (non-fatal injuries with days away from work, restricted work, or job transfer--DART)

Methods: We looked at the correlation between the average DART injury rate (from the BLS Survey of Occupational Injuries and Illnesses) and an adjusted average fatality rate (from the BLS Census of Fatal Occupational Injuries) in the construction sector for states for 2003-2005 and for 2006-2008.

Results: The correlations between the fatal and non-fatal injury rates were between -0.30 and -0.70 for all construction and for the subsector of special trade contractors. The negative correlation was much smaller between the rate of fatal falls from heights and the rate of non-fatal falls from heights. Adjusting for differences in the industry composition of the construction sector across states had minor effects on these results.

Conclusion: Although some have suggested that fatal and non-fatal injury rates should not necessarily be positively correlated, no one has suggested that the correlation is negative, which is what we find. We know that reported non-fatal rates are influenced by workers' compensation benefits and other factors.

Fatality rates appear to be a more valid measure of risk. Efforts to explain the variations that we find should be undertaken.

C1.3
Title: ***Investigation of Compliance with Safety Standards in the New England Tree Care Industry***
Authors: Julius A, Kane B, Bulzacchelli M, Ryan III HDP
Presenter: Alexandra Julius, M.S.

Arborists are exposed to many occupational hazards and experience more than three times the overall fatality rate of all U.S. workers. Investigations into fatal incidents lead to a better understanding of industry dangers. However, this knowledge does not extend to how tree workers operate when an injury or fatality does not occur. Current research regarding fatal and non-fatal injuries does not include the licensing status of the company at which the worker was employed. Given the highly skilled nature of the work involved, licensing and accreditation might ensure a minimum level of demonstrated safety practices.

Objectives: This study aims to 1. determine whether certification and accreditation in the tree care industry are associated with safer workplace behavior, 2. assess whether Tree Care Industry Association (TCIA) accredited companies maintain their expected level of safe work behavior, and 3. identify the most common safety standards tree workers violate.

Methods: Tree care companies in southern New England were divided into three categories: accredited, non-accredited with certified arborists on staff, and unlicensed with no certified arborists on staff. A stratified random sample of sixty-three companies was evaluated in the field by direct observation, assessing workers' adherence to industry standards. Safety standards addressed in this study included those referenced in the American National Standards for Arboricultural Operations (ANSI Z133.1-2006).

Results: Preliminary data analysis indicates that standards regarding safe equipment use are observed at varying levels of compliance in favor of licensing and certification, whereas there are low levels of compliance across all types of companies with the basic safety standards, such as the use of personal protective equipment (PPE).

Conclusion: Implications of findings include possible considerations for improvements on accreditation and certification processes. Further findings seek to address safety standards that are currently unclear or deficient.

C1.4
Title: ***Occupational ATV-related Injuries in Washington State's Agricultural Industry, 2004–2008***
Authors: Helmkamp J, Bonauto D, Spann C
Presenter: James Helmkamp, Ph.D.

Objective: Use Washington (WA) State Workers' Compensation (WC) State Fund data from 2004-2008 to describe injuries and WC costs among agriculture workers hurt while using ATVs at work.

Methods: Suspected ATV injury claims, those with OIICS source code 841 or by ATV keywords, were identified in the WA. WC electronic database and medical records were independently reviewed to determine a work-related ATV injury. If the claim met study criteria, claims were analyzed by nature, event, body part injured, and type of claim. Emphasis was directed at Crop Production-CP, Animal Production-AP, and Support Activities for Agriculture and Forestry-SA workers.

Results: Two hundred fifty-one claims were identified with 55% from workers in CP (109), AP (18) or SA (13). Of the 251, 16 were rejected, 153 were non-compensable, and 82 were compensable. 60% of the compensable claims (49) were in the three subsectors. The total paid-to-date (at 15 months) indemnity ($675,782) and medical ($651,496) costs represented 70% of the total compensable costs incurred. Fractures were the most common (49%) type of injury with a median medical cost of ~$5,700. Nearly 37% (18) of claims identified an overturn/rollover as the precipitating event, followed by caught in/struck by ATV at 27% (13). The highest median paid-to-date indemnity costs were for workers who slipped or fell ($11,217) from the ATV, while the highest median paid-to-date medical costs were to workers caught in or struck by the ATV ($10,081); workers injured in this manner had the highest median number of loss days at 217. The collective 5-year compensable injury rate among CP and AP workers was 21 per 100,000 FTEs.

Conclusion: This study represents the first effort to describe injuries to agriculture workers hurt while using an ATV at work. The types of injuries and precipitating events were similar to persons injured while using ATVs for recreational purposes.

Session: **C2.0**
Title: **Violence in Retail**
Moderator: Daniel Hartley, Ed.D.

C2.1
Title: ***Translation of a Robbery Prevention Program for Small Retail Businesses: A Pilot Study***
Authors: Hartley D, Casteel C, Peek-Asa C, Chronister T, Amandus H
Presenter: Carri Casteel, Ph.D., M.P.H.

Objectives: Violence is the third leading cause of workplace death in the United States. Retail industry workers are at greatest risk for workplace homicide, over two-thirds of which are committed during a robbery. Evidence-based programs to reduce robbery have shown great success in retail settings. However, retail businesses, especially small businesses, have implemented very few to none of the standard program recommendations. The objective of our study was to identify methods of disseminating evidence-based strategies for translation into effective program implementation in small businesses.

Methods: An evidence-based robbery prevention program was disseminated by the Oxnard, California Police Department (OPD). The robbery program was based on Crime Prevention Through Environmental Design principles, and includes employee training, cash management, lighting, visibility and access control components. The target population was small, independently-owned retail establishments. Interested businesses received training, an individualized on-site security assessment, and follow-up assessment to determine whether program recommendations were implemented.

Results: Between 2007 and 2009, 68 of 103 businesses (66.0%) enrolled in the program. Interested businesses were primarily corporate-owned with few crime problems. Recruitment strategies included targeting specific districts and high-crime areas (37.9%), approaching recently victimized businesses (30.1%), presenting to local community groups (10.7%) and referral from officers responding to calls for service (10.7%). Of the 68 businesses enrolled, 57.4% were trained and received an on-site security assessment, and 22 of these complied with program recommendations. Primary barriers to implementation included not wanting to purchase an appropriate safe for cash handling, clear windows of posters, and post program signage.

Conclusions: Engaging business owner interest in a low-cost robbery prevention program and sustaining program implementation was difficult, and no recruitment method was more effective than another. Future recruitment efforts will include identifying community support systems that can play a role in influencing business owner behaviors in program participation.

C2.2
Title: ***Event-related Risk Factors for Robbery-related Workplace Homicide***
Authors: Gurka K, Marshall S, Loomis D, Wolf S
Presenter: Kelly Gurka, Ph.D., M.P.H.

Background: Homicide is the leading cause of occupational fatality among women and second among men. Most workplace homicides occur during the commission of a robbery. Yet, few studies have examined risk factors for workplace homicide during the commission of a robbery.

Methods: A case-control study of North Carolina workplaces was conducted. Workplaces in which a homicide occurred during the commission of a robbery from 1994 to 2001 were compared to a sample of workplaces experiencing non-fatal robberies. Law enforcement officers were interviewed by telephone to identify characteristics of the robbery event. Logistic regression was utilized to calculated odds ratios (OR) and corresponding 95% confidence intervals (CI).

Results: Robberies with three or more workers present versus one employee were less likely (OR = 0.23, CI: 0.11, 0.46) to result in homicide, and robberies committed by three or more perpetrators versus one were more likely (OR = 7.56, CI: 3.45, 16.6) to result in homicide. Robberies during which perpetrators had firearms were significantly more likely (OR = 4.57, CI: 2.22, 9.40) to result in homicide as were robberies during which workers had firearms (OR = 20.1, CI: 4.20, 192). Perpetrators reported to be angry or aggressive were more likely (OR = 7.39, CI: 3.18, 17.2) to commit homicide during robbery. Likewise, perpetrators reported to be panicky or spooked were more likely (OR = 5.00, CI: 2.63, 9.51) to commit homicide. Robberies during which the perpetrator made directives were less likely (OR = 0.28, 95% CI: 0.12, 0.65) to result in homicide as were robberies during which workers complied with commands given by the perpetrator (OR = 0.09, CI: 0.04, 0.20).

Conclusions: In addition to reducing the risk of robbery itself, changes to staffing levels may afford workplace managers an opportunity to reduce the risk of homicide during robbery for workers. Though many event-related risk factors are not modifiable, employee training programs should be designed and evaluated that

incorporate employee responses tailored to situations in which risk of homicide is increased.

C2.3
Title: ***Fatalities among Taxicab Drivers in the United States, 1992–2008***
Authors: Chaumont Menéndez C, Amandus H, Konda S
Presenter: Cammie Chaumont Menéndez, Ph.D., M.P.H.

Background: Taxicab drivers have historically experienced a disproportionately high occupational fatality burden due to workplace violence. In the United States taxicab drivers had the highest homicide rates of any other occupation from 1996 through 2000. The objective of this study was to describe the temporal patterns in homicides among taxicab drivers using a national active surveillance system for fatal work-related injuries.

Methods: An analysis of homicide rates among all taxicab drivers and foreign-born taxicab drivers in the U.S. occurring from 1992 through 2008 was conducted using the Census of Fatal Occupational Injuries. Homicide rates were differentiated between all workers, taxicab drivers, and foreign-born taxicab drivers and evaluated for temporal patterns over the 17-year time span.

Results: The rate of homicides ranged from 0.08 per 10,000 workers (95% CI +/- 0.0002) in 1992 to 0.03 per 10,000 workers (95% CI +/- 0.00009) in 2008. For foreign-born workers the rate ranged from 0.10 per 10,000 workers (95% CI +/- 0.00002) in 1995 (the first year publishable rates could be calculated for foreign-born workers) to 0.05 per 10,000 workers (95% CI +/- 0.000005) in 2008. Among taxicab drivers, the homicide rate was 5.1 per 10,000 drivers (95% CI +/- 1.1) in 1992 compared with 1.3 per 10,000 drivers (95% CI +/- 0.19) in 2008. For foreign-born taxicab drivers, the homicide rate was 1.3 per 10,000 (95% CI +/- 0.26) in 1995 and 0.86 per 10,000 (95% CI +/- 0.17) in 2008.

Conclusions: Although occupational homicide rates have decreased for all workers and taxicab drivers, homicide rates remain >40-fold higher among taxicab drivers. Foreign-born taxicab drivers have not experienced disproportionately high fatality rates.

C2.4
Title: ***Community-based Participatory Research With Vulnerable Worker Groups: Identification of Risk Factors for Workplace Violence among New York City Taxi Drivers***
Authors: Reindel R, Goldsmith D, Edelsack P
Presenter: Rebecca Reindel, M.F.S, M.P.H.

Background: The New York Taxi Workers Alliance (NYTWA) represents 40,000 taxi drivers responsible for transporting passengers in the largest city of the United States. Driving a taxi is one of the most dangerous professions for both worker injuries and fatalities from acts of violence by the public. Under the auspices of the NYTWA, this research identifies risk factors for violence against New York City taxi drivers and examines current policies for violence prevention.

Methods: An interviewer-administered survey was developed and piloted utilizing input from NYTWA drivers, field experts and previous NYTWA collaborators. Over a nine-day period, surveys were conducted on a convenience sample of drivers who were approached at airport waiting lots, shift changes at gas stations, and the NYTWA office. Risk factors were identified through a self-reported questionnaire and analyzed using the Statistical Analysis Software (SAS). Violence indicators were analyzed against vehicle design, demographic and job characteristics, as well as self-perceived safety and stress indicators.

Results: Most (97.5%) of the 206 sampled drivers were foreign born; they represented 50 countries in six regions of the world. On average, drivers were 43 years old and worked 67 hours per week for eight years; 66% held at least a college education. Violence data indicated 31.5% of drivers have been robbed, 40.5% assaulted, 87.2% yelled at, 60.1% called racial slurs and 95% lost fares because passengers left the vehicle without paying.

Conclusions: Taxi driving remains a profession at great risk of workplace violence with little recognition by the public. Community based participatory methods are appropriate for working with vulnerable working populations. Data collection on injuries and safety prevention measures are needed to influence policy decisions that promote driver safety; involving workers in this process is critical.

Session: **C3.0**
Title: **Safety Climate I**
Moderator: Marvin Dainoff, Ph.D., C.P.E.

C3.1
Title: ***Safety Climate and Fire Fighter Line-of-duty Injury and Illness: Development of a Conceptual Model***
Authors: DeJoy DM, Smith TD
Presenter: David DeJoy, Ph.D.

Objectives: Firefighting is one of the most hazardous occupations in the United States. Firefighters are injured, suffer work-related illnesses, are hospitalized, are forced into early retirement, or die at higher rates than most other workers. Each year, approximately 100 firefighters die in the line of duty and 80,000 are injured. Despite advances in technology, personal protective equipment, engineering controls, and medical care, these numbers have not improved during the past 25 years. In this presentation, we describe the development of a model for examining how safety climate and related factors impact safety performance in firefighting.

Methods: Model development proceeded as follows. First, we examined how firefighting is organized and executed, including principal organizational structures, command and control systems, and dominant operational strategies and tactics. This included assessing firefighter selection and training, socialization, and assimilation. Next, we reviewed research on firefighter traumatic injury and illness to help pinpoint relevant social-organizational factors. This phase also involved reviewing the NIOSH data base of firefighter fatality investigations. Following this, we reviewed the general literatures on safety culture and climate with particular emphasis on high hazard occupations and high reliability organizations. Finally, using the information, we developed a preliminary conceptual model describing how safety climate and related factors influence safety behaviors and injury and illness outcomes among firefighters.

Results: The model features a hierarchical or multi-level structure that includes components representing task, work role, group, and organizational influences. The model is logically structured in terms of the climate – behavior – outcome sequence. Major components of the proposed model are presented as second order factors that each consist of multiple dimensions or first order factors. Sets of dimensions for each component are identified and presented.

Conclusion: Existing research is sufficient to delineate a fairly detailed model linking safety climate and related factors to safety performance in firefighting. Such a research direction is justified and should produce findings useful for improving firefighter safety.

C3.2
Title: ***How to Measure Safety in the Construction Industry?***
Authors: Frijters A, Swuste P
Presenter: Adri Frijters

Too many accidents happen in the construction industry globally. Retrospective methods are used to understand the causes and to reduce the number of accidents. However, the results are limited by imperfections in accident recording, and in research and analysis of accident causes. Therefore there is need for a prospective method to detect potential causes of accidents and to reduce the risks by the introduction of safety interventions. When (un)safe conditions of apparently normal situations are quantified, improvements can be made before accidents actually happen.

Five methods to identify unsafe conditions are compared, regarding their usefulness in the construction industry; the ‘TR safety observation method on building construction' (Finland), the ‘Injury Exposure Assessment' (USA), the ‘benchmark method' (Australia), the ‘checklist safety indicator' (Australia) and the ‘Disturbance Assessment method' (The Netherlands). The ‘TR safety observation method on building construction' is considered to be the most suitable method. The method is validated and easy to use in the operational phase of the building process. It is based upon a scenario approach. Comparing various work-places is easy with this method and the results will inspire the introduction of safety interventions.

This paper describes the results of a comparative research into methods, a field test using the Dutch version of the TR Method with the results and the introduction in the construction industry in the Netherlands in April 2010.

Keywords: Construction industry, TR Method, Measure safety

C3.3
Title: ***Development and Validation of a Safety Climate Scale for the Trucking Industry***
Authors: Huang YH, Zohar D, Robertson M, Garabet A, Murphy L, Powell R, Dainoff, M
Presenter: Marvin Dainoff, Ph.D., C.P.E.

Objectives: Safety climate identifies socially-shared perceptions among group members about the real or true priority of safety as opposed to its formally espoused priority by company management. Safety climate is defined as an employee's perception of the safety policies, procedures, and practices and the overall importance and true priority of safety at work. The significance of safety climate stems from its ability to predict safety behavior and safety related outcomes in a wide variety of settings. The purpose of the current study was to design a reliable and valid safety climate scale specifically for the trucking industry (on mobile lone workers -- truck drivers who typically drive alone for long periods of time). The study will help researchers to better understand how organizational safety climate impacts safety outcomes for employees who work alone and will provide new knowledge to improve the occupational safety for these types of workers.

Methods: Both qualitative and quantitative methods (i.e., in-depth individual interviews, cognitive interviews, pilot tests, survey implementation at truck stops and trucking companies, objective safety data collection) were employed to design the safety climate scale for the trucking industry.

Results: A total of 8095 drivers from eight trucking companies took the final survey, with response rates ranging from 36% to 76%. Three dimensions were suggested for each of the two levels: company and supervisor (Proactive Practices, Driver Safety Priority, and Supervisory Care Promotion for company level; Safety Promotion, Delivery Limits, and Cell Phone Disapproval for supervisor level). A reliability test, exploratory factor analyses, confirmatory factor analyses, and homogeneity tests were conducted to analyze the data. Objective performance metrics (e.g., crash rates, various violations) were collected to provide additional validation information.

Conclusion: The outcome of the study is a reliable and valid scale for measuring safety climate in the transportation/trucking industry.

C3.4
Title: ***Safety Climate Research, Intervention, and Training: Establishing a Five-year Agenda***
Authors: Sawhney G, Cigularov K, Chen P, DeJoy D, Huang Y-H, Kelloway K, Scharf T
Presenter: Gargi Sawhney

Objectives: Over the past decade, safety climate has become increasingly recognized as an important leading indicator of safe work practices in a variety of industries. However, the challenge of conducting research, diagnosing workplace problems, and promoting good interventions in this complicated area, has grown exponentially. In fact, there is still a dearth of research on the fundamental work of elucidating and carefully measuring safety climate and distinguishing this important construct from closely related concepts. In addition, workplace hazards and safe work practices vary substantially by industry and by specific occupations within industries. Therefore, it is important to develop and validate detailed measures for the specific conditions within different hazardous work environments, both to measure critical details related to safety climate, and to provide guidance to improve safe work practices under hazardous conditions.

To address these challenges in safety climate research, an all-day seminar and discussion will be convened by NIOSH at the 2011 Work, Stress, and Health Conference in May. The objective of this meeting is to establish a five-year research agenda with specific recommendations and priorities for consideration by researchers, safety managers, safety trainers, policy personnel, and others working in the field of occupational safety and health.

Methods: This objective will be accomplished by means of presentations and workgroup discussions examining the current state, challenges, and future directions for research, intervention, and training in safety climate. Participants will include six invited safety climate researchers, and over 30 other interested researchers and graduate students from Australia, Canada, Denmark, Finland, Hong Kong, South Africa, and the U.S.

Results & Conclusion: Findings from the meeting will be presented at NOIRS highlighting key challenges and recommendations regarding (a) theoretical and measurement issues in safety climate, (b) intervention strategies to promote safety climate, and (c) safety climate training for workers, front-line supervisors, and managers.

Session: **C4.0**
Title: **Agriculture I**
Moderator: Bruce Alexander, Ph.D.

C4.1
Title: ***Regional Rural Injury Study III: Short- and Long-term Work-related Consequences Associated with Injuries among Children on Agricultural Operations***
Authors: Gerberich S, Alexander B, Ryan A, Renier C, Church T, Masten A, McGovern P, Mongin S
Presenter: Bruce Alexander, Ph.D.

Objectives: To determine the short- and long-term physical, psychosocial, and economic consequences of injuries, incurred among children/youths, and the overall operation burden.

Methods: Baseline and follow-up data, collected in Minnesota, Wisconsin, North Dakota, South Dakota, and Nebraska for 1,474 eligible agricultural operation households, used computer-assisted telephone interview instruments. Two six-month injury data collection periods followed baseline collection; annual follow-up evaluation data were collected for two years. Comparing case and control households, analyses examined changes between baseline and follow-up. Directed acyclic graphs identified confounders for multivariable analyses; reweighting adjusted for response and eligibility biases. Respondents also rated work characteristics for each child in the household during 4 weeks prior to each interview. Cumulative logit models analyzed differences in these ordinal scales between case and control households, at each follow-up period, controlling for baseline.

Results: Respective child/youth case and control households, for the two six-month injury collection periods were: 1) 100 cases (122 Injuries), 366 controls; and 2) 115 cases (138 injuries), 414 controls; 35% of children and 7% of other household members lost agricultural work time; 5% and 7%, respectively, lost non-agricultural work time. One-year post-injury, case versus control households, had increased risk of lost time from operation-related work due to children's health issues (O.R. 2.1, 95% C.I. 1.1-4.1). Injured versus non-injured siblings in case households had lower hard work ratings at one-year post injury (O.R. 1.7, 95% C.I. 1.04-2.7). In control households, injured versus non-injured children completed work/chores less frequently (O.R. 1.5, 95% C.I. 1.00-2.2). When injuries were limited to 7+ restricted activity days severity, at two year post-injury, injured children were more likely than children in control households to work hard more frequently (O.R. 4.4, 95% C.I. 1.5-13.1).

Conclusions: Injuries among children on agricultural operations may affect work time and quality at the household level and among injured children.

C4.2
Title: ***An Overview of Youth Demographics and Injury Characteristics on U.S. Farms, 2009***
Author: Hendricks K
Presenter: Kitty Hendricks, M.A.

Objectives: To address the problem of injury to youth on farms in the U.S., the National Institute for Occupational Safety and Health (NIOSH) in partnership with the U.S. Department of Agriculture, National Agricultural Statistics Service (NASS), established the Childhood Agricultural Injury Survey (CAIS) surveillance system. This ongoing project has released CAIS data for the years 1998, 2001, 2004 and 2006. Newly collected data for calendar year 2009 were examined here.

Methods: The CAIS was based on a telephone interview of 50,000 randomly selected U.S. farm households. The 2009-CAIS collected information on nonfatal injuries to youth less than 20 years of age on farms for the 2009 calendar year. CAIS includes both work and non-work injuries occurring to youth living, working, or visiting on farms. In addition to injury information, prevalence data were collected on exposures to work, horses, all terrain vehicles (ATVs), and tractors for youth living on the farm.

Results: Preliminary results indicate that 27.6 million youth less than 20 years of age lived on, worked on, or visited farms in 2009. Of these, about one million youth (3.7%) lived on the farm. An additional 230,000 youth were hired farm workers (0.8%) and an estimated 26.3 million youth (95%) visited farms (11.6 million farm family relatives and 14.7 million unrelated visitors). There were an estimated 16,132 farm-related injuries during 2009 to youth less than 20 years of age. Forty-nine percent (7,958) of these injuries were to youth living in the farm household (rate: 7.7/1,000 household youth). Fifty-eight percent (9,285) of the total injuries were to males. Youth between the ages of 10 and 15 years incurred 44% (7,156) of all injuries.

Conclusions: Detailed results of injuries, exposures, household demographics, and injury rates from the 2009-CAIS will be presented.

C4.3

Title: ***Economics of Preventing Agricultural Injuries to Adolescent and Adult Farm Workers: Surveillance, Exposure, and Intervention Effectiveness Data for Public School Teachers Trained to be Safety Advocates in Rural Schools***

Authors: Mazur J, Cole H, Myers M, Swan G, Swan K, Isaacs S, Ibendahl G, Westneat S
Presenter: Joan Mazur, Ph.D.

Objectives: The goal of the Economics of Prevention (EOP) program is to prevent injury to youth aged 15-19 at highest exposure to four agricultural-related hazards: tractor overturns, crush injuries, closed head trauma, and hearing loss. An intervention of interactive simulations, Excel Cost Tools illustrate the individual and social costs of injury (Myers, Cole, Mazur & Isaacs, 2008). This study examines the effectiveness of the intervention on the following outcomes: (1) the prevalence of exposure to and injuries from [surveillance]; (2) behavioral intentions to work safely as measured by a stages of change measure validated in a prior 3-year study and (3) knowledge of the individual and social costs of these injuries.

Methods: A four-year, multi-state intervention-control study was conducted with pre-career college students enrolled in teacher preparation, agricultural economics or other college level courses (N= 418 intervention group/327 control group). Pre-post measures: (1) 30-item demographic, Farm & Rural Life Experience survey (FRLE), (2) a 39-item Thinking and Talking About Safety (TTS) stages of change and, (3) a 60-item Farm Safety & Economics knowledge measure.

Results: Demographic surveillance data show that many pre-career professionals have experiences with such injuries regardless of whether or not they have lived or worked on farms. A GLM composite analysis that pooled total scores found statistically significantly increases in the intervention groups as compared to the controls for both the behavioral intention proxy measure (TTS) and the knowledge measure (FSE). Interaction effects were evinced with live/work on farms and academic majors.

Conclusion: Pre-career professionals' increased awareness prepares them effectively as prevention advocates in the rural communities in which they work.

C4.4

Title: ***Chore at Time of Fatal and Serious Injuries from Overturns of Non-ROPS and ROPS Tractors***

Authors: Cole H, Westneat S, Myers M
Presenter: Henry Cole, Ed.D.

Objectives: Determine chores during farm tractor overturn injury events.

Method: A random sample survey of 6,063 KY farms identified overturns of 443 non-ROPS and 89 ROPS-equipped tractors and the chores involved.

Results: Chores that were known for 23 of 24 fatal non-ROPS tractor overturns included bush hogging = 6, public road travel = 6, farm road travel = 3; haying = 3. Fourteen died ≤ 1 hour and 9 others received EMT care. Of the four hospitalized farmers two lived 2 days, one 3 days, and one 14 days.

Sixty-eight non-ROPS tractor overturns resulted in non-fatal injuries that required hospital admission. Leading chores were bush hogging = 13, harvesting hay = 12, pulling logs = 7, off-road farm driving = 6, tilling land = 5, farm road driving = 4, public road driving = 4. Days hospitalized for 56 farmers and totaled 1,118 (M = 19.96, SD = 30.28). Days farm work lost for 48 farmers totaled 6,742 (M = 140.46, SD = 133.24). Seven were permanently disabled. Of 89 overturns of ROPS-tractors only one operator died when he was ejected while not wearing the seatbelt. Chore type was known for 61 cases. Leading chores involved were: bush hogging = 13; haying = 12, pulling logs = 7, off road farm driving = 6, tilling land = 5, farm road driving = 4 and public road driving = 4. Only 4 of the 89 operators required hospital admission with days in hospital respectively, 1, 3, 4, and 6 and workdays lost 30, 42, 60, and 90. None were permanently disabled.

Conclusion: This is the first population-based random sample study of tractor chores involved during operator fatal and non-fatal overturns of non-ROPS and ROPS tractors.

Session: **C5.0**
Title: **Construction Hazards**
Moderator: Jennifer E. Lincoln, B.S.F., M.S.S.M.

C5.1
Title: ***Work Zone–Fatal Occupational Injuries at Road Construction Sites, 2003–2010***
Author: Pegula S
Presenter: Stephen Pegula, M.S.

Using data from the Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) program, this research focuses on the events that precipitated at-work deaths at road construction sites in the United States from 2003 to 2010. Special emphasis is given to deaths that result from being struck by a vehicle or mobile equipment as these incidents account for almost half of all occupational fatalities at road construction sites. Other aspects of the fatality experience are also explored including the demographics of fatally-injured workers, the State of incident, the time and month of incident, and the occupations in which decedents were employed.

Detailed final data from 2008 and 2009 will be presented along with limited preliminary data from 2010. Data from 2003 to 2007 were originally published in the November 2010 edition of Monthly Labor Review. Findings include:

- 639 workers (2 percent of all fatal occupational injuries) were killed at road construction sites from 2003 to 2007
- 305 of these were from being struck by a vehicle or mobile equipment
- Texas, Florida, California, Georgia, and Pennsylvania had the highest number of deaths
- Deaths at road construction sites are more clustered around the traditional work hours and work days than all fatal workplace injuries

Identifying the specific hazards faced by workers at road construction sites, especially those that lead to fatalities, is the first step toward crafting comprehensive and effective prevention measures. Isolating the types of workers most frequently killed at road construction sites and commonalities among the location and time of the fatalities will help to further refine intervention strategies.

Research presented at this session is in the public domain and can be used with proper citation.

C5.2
Title: ***WORK ZONE: Internal Traffic Control Plans–A Field Intervention Evaluation in Hot-mix Asphalt Paving Operations: Preliminary Results***
Authors: Fosbroke D, Lincoln JE, Hause M
Presenters: David Fosbroke, M.S.F.

Workers at road construction sites risk fatal injuries from being struck by construction vehicles and equipment operating inside the workspace. Based on occupational fatality data and input from roadway construction industry partners, NIOSH initiated a research project to develop, implement, and evaluate interventions during hot-mix asphalt paving operations.

Objectives: This presentation describes the development, implementation, and preliminary evaluation of internal traffic control plans based on observations of paving operations across the United States.

Methods: Worker exposure, defined by objective risk factors and proximity to operating construction equipment, was observed at control sites and implementation sites. The study used a quasi-experimental control vs. intervention design, with control and intervention sites paired by construction company.

Results: Data were collected at construction projects run by seven different companies from West Virginia to California with a total of 87 data collection days (minimum of 6 hours per day). Average hourly worker exposures varied from a low of 10.3 at an intervention site to a high of 39.1 at a control site. Evaluation results were mixed. Average hourly exposure rates were 29.0 (95 percent confidence interval 25.5, 32.5) for controls sites vs. 29.4 (95 percent confidence interval 25.0, 33.8) for internal traffic control plan sites. Worker exposures were significantly lower at intervention than control sites for some intervention/control pairs, but in other cases exposures were greater at intervention sites than at control sites.

Conclusion: The mixed results may be partially explained by differences in how each company implemented the internal traffic control plan intervention, but further data analyses are planned to better understand variability in the effectiveness of internal traffic control plans in reducing worker exposure to operating construction vehicles and equipment.

C5.3
Title: ***Work-related Musculoskeletal Disorders in Construction, 1992–2009***
Authors: Dong S, Wang X, Daw C
Presenter: Sue Dong, Dr.P.H.

Objectives: Examine trends and patterns of work-related musculoskeletal disorders (WMSDs) among construction workers.

Methods: WMSDs were identified from the 1992–2009 Survey of Occupational Injuries and Illnesses based on the BLS case definition. Risk was measured by the number of WMSDs per 10,000 full time equivalents (FTEs) in which the denominators were obtained from the Current Population Survey. Stratified analyses were conducted to calculate occurrences, rates, and median days away from work (DAFW) by age, race/ethnicity, and construction occupation. Time series analysis was performed to examine the trend of WMSDs in construction over time.

Results: From 1992 to 2009, WMSDs accounted for more than 25% of the total DAFW cases in construction. Following the overall injury trends, WMSDs dropped from 54,235 in 1992 to 22,530 in 2009, a 58% decline regardless of employment fluctuation. However, in 2009 the rate of WMSDs for construction was still 23% higher than all industries combined. Among construction subgroups, masonry contractors consistently had a higher rate of WMSDs than other construction subsectors over time, and construction laborers, helpers, plumbers, and carpenters had a higher rate of WMSDs than the average of all construction occupations. For age groups, the highest risk of WMSDs was found among construction workers aged 35-44, but the proportion of WMSDs among those aged 55+ doubled in recent years reflecting an aging workforce. The rate of WMSDs for Hispanic construction workers was significantly lower than their white non-Hispanic counterparts, which suggests potential underreporting. Furthermore, about 65% of WMSDs were back injuries and more than 70% were due to overexertion.

Conclusion: The construction industry continues to face a higher risk of WMSDs. Ergonomic solutions that can reduce a major risk factor, overexertion, should be employed at construction sites, particularly for construction occupations and populations with a higher risk of WMSDs.

C5.4
Title: ***Technology to Enable Real-time Proactive Safety in Construction***
Authors: Teizer J, Reynolds MS
Presenter: Jochen Teizer, Ph.D.

The paper and presentation will focus on real-time proactive safety technologies as they are applied in the harsh construction environment. The paper and presentation will first review the latest safety statistics and trends in construction and explain why the safety performance of leaders in the industry differs from those who do not invest in safety. A novel framework that was developed with industry leaders for real-time proactive construction safety will be presented. It will show how the investment in real-time proactive safety technology can change the outcome and effectiveness of existing safety management policies within a construction organization. A few real-time proactive safety technologies will be introduced. Their performance, main benefits, current limitations, and return on investment will be illustrated through field trials that were conducted in the industrial construction environment. Their potential for application in other industry sectors will be discussed as well. Results to the following real-time proactive technologies will be presented: (a) Active and passive energy- harvesting proximity alert and warning devices, (b) real-time worker, equipment, and material location tracking, (c) data visualization in a real-time immersive 3D virtual reality environment, (d) site and confined space access control, (e) fully-automated blind spot measurement tool, and (f) advanced real-time 3D equipment simulators. An emphasis of this paper and presentation will also be on how workers react to the use technology (in particular when wearing location tracking devices) and how technology can be used to assist the data collection (of previously unrecorded events such as near misses), information generation, and knowledge sharing effort that is typically labor intensive, error prone, or non-existent. The final aspect of this paper and presentation will be used to illustrate how technology can be positively utilized in construction applications such as pre-task work planning, proactive hazard prevention, data recording, and in advanced learning and education modules.

DAY TWO: WEDNESDAY, OCTOBER 19, 2011

Session: **D1.0**
Title: **Underreporting of Injuries I**
Moderator: Larry Jackson, Ph.D.

D1.1
Title: ***Investigations of Undercounting in the Bureau of Labor Statistics' Survey of Occupational Injuries and Illnesses***
Authors: Sygnatur E, Ruser J
Presenter: Eric Sygnatur, M.A.

Objectives: Recent external studies find that the Bureau of Labor Statistics (BLS) Survey of Occupational Injuries and Illnesses (SOII) substantially underestimates the total number of workplace injuries and illnesses in the U.S. This paper describes the various dimensions of the undercount allegations, summarizes the recent studies, and provides an overview of on-going research conducted and funded by BLS to better understand the nature of the undercount findings.

Methods: The BLS is funding studies which include enumerating work-related amputations and carpal tunnel syndrome cases with multiple data sources; matching SOII to workers' compensation records; and interviewing employers about reporting practices on OSHA logs and to workers' compensation.

Results: This is an interim report on the progress and status of projects. The investigations began in 2009 at the request of Congress, and final results are expected in 2012.

Conclusion: BLS is undertaking and supporting research designed to understand and explain differences between its estimates and those of other systems. This research may suggest some ways that the SOII might be modified to provide a more complete workplace injury and illness count.

D1.2
Title: ***Comparing Injury Data from Administrative and Survey Sources: Methodological Issues***
Authors: Nestoriak N, Pierce B
Presenter: Nicole Nestoriak, Ph.D.

The Bureau of Labor Statistics' Survey of Occupational Injuries and Illnesses (SOII) is one of the more important sources of information on workplace injuries. Recent work comparing SOII case records to Workers' Compensation (WC) claims records from several states concludes that the SOII undercounts cases. Comparing WC and SOII data at the case level requires an adequate linking or matching of individual cases to determine which WC cases were missed by the SOII. One also needs to distinguish between WC cases which are missing from the SOII because they are not from SOII sampled establishments, as opposed to WC cases which are missing because of underreporting. That is, we require a sampling adjustment to account for the fact that the SOII is a survey rather than a census. Using Kentucky WC and SOII data, we illustrate some of the outstanding methodological issues behind this work. We describe our method for matching individual cases. We also describe the relative benefits of two different ways to make the sampling adjustment. One method attempts to identify which WC cases occur for employers with workplaces sampled by SOII; an alternative attempts an overall correction based on SOII sampling weights. These different methods help establish a range of estimates on the size of the undercount.

D1.3
Title: ***Employer Interviews: Exploring Differences in Reporting Kentucky Work Injuries and Illnesses in the Survey of Occupational Injuries and Illnesses and State Workers' Compensation Claims***
Author: Phipps P
Presenter: Polly Phipps, Ph.D.

Recent studies have cited discrepancies between the BLS Survey of Occupational Injuries and Illnesses (SOII) and State Workers' Compensation claims to support the assertion that the SOII undercounts injuries and illnesses among the American workforce. To explore reasons for possible discrepancies, we conducted over 50 qualitative interviews with employers responding to the SOII in the State of Kentucky. Our employer sample was selected based on industry, employment size, and low and high correspondence between reported SOII injuries and illnesses and Worker' Compensation claims records. The in-person interviews focused on possible measurement errors associated with establishment record keeping systems, respondent knowledge and experience, understanding of the survey request, as well as establishment characteristics. We present the results of the study, focusing on whether varying roles of respondents in SOII and WC reporting, understanding of reporting rules, records systems and survey timing, and injury and illness case complexity, as well as establishment characteristics and workplace practices, play a role in the discrepancies.

D1.4
Title: ***Injury Underreporting in the Construction Industry***
Authors: Dong S, Wang X, Daw C
Presenter: Sue Dong, Dr.P.H.

Objectives: To estimate the extent of injury underreporting in the construction industry, focusing on Hispanic workers and small construction establishments.

Methods: Five large, nationally representative data sources were analyzed: Survey of Occupational Injuries and Illnesses (SOII), Census of Fatal Occupational Injuries (CFOI), Current Population Survey, County Business Patterns, and Medical Expenditure Panel Survey. The SOII data from 1992 to 2006 provided the basis for estimates. Construction employment was matched to fatal and non-fatal injury distributions according to establishment sizes. Small establishments were defined as establishments with 10 or fewer employees. Self-employed workers and federal employees were excluded from the estimates as well as cases without establishment size or ethnicity information. Regression and ratio analyses were conducted and stratified by establishment size and Hispanic ethnicity.

Results: The fatality data (CFOI) suggest that construction safety had improved during the study period. Even though the percentage of fatal injuries in small establishments fluctuated, it was, in general, consistent with the proportion of same size establishments. In contrast to the fatality data, the proportion of non-fatal injuries reported in the SOII by small establishments was exceedingly low, especially for Hispanic workers. While almost half (46%) of Hispanic workers were employed in small establishments, a mere 12% of injuries were reported by such establishments, which was significantly lower than that of white, non-Hispanic workers (24%). It is estimated that the SOII data only captured 25% of severe injuries among Hispanic workers, and 60% among white workers in small construction establishments.

Conclusion: The contradictory patterns suggest that small construction establishments are more likely to underreport non-fatal injuries than larger establishments, particularly for Hispanic workers. Given the prevalence of small construction establishments in the U.S., efforts to mitigate underreporting and identify the extent of work-related injuries accurately should focus on these establishments.

Session: **D2.0**
Title: **Slips, Trips, and Falls**
Moderator: Wen-Ruey Chang, Ph.D.

D2.1
Title: ***Moving Upstream: Using Slipping as an Outcome Measure in Epidemiologic Research on Fall-related Injuries***
Authors: Courtney T, Verma S, Huang Y-H, Chang W-R, Li KW, Filiaggi A
Presenters: Theodore Courtney, M.S., C.S.P.

Objectives: Slipping, tripping and falling (STF) are responsible for a substantial injury burden in the global workplace. A major challenge to the study of occupational injuries such as STF in active work environments is the rarity of the outcome. Slipping is an important precursor to falling and subsequent injury though not every slip results in a fall or injury. We applied epidemiologic methods to study individual and work environment factors related to self-reported slipping in U.S. fast food restaurant workers.

Methods: Ten limited service restaurants in the Northeastern U.S. were recruited to participate. Workers' occupational slip and/or fall history within the prior 4 weeks was collected along with age, gender, job tenure, work hours per week, and work shift. Shoe type, condition, and gross shoe contamination were visually assessed. Floor coefficient of friction was measured. The logistic generalized estimating equations model was used to compute adjusted odds ratios.

Results: One hundred and twenty-six workers (60% female, mean age 30) participated. Multivariable logistic regression showed that higher restaurant mean coefficient of friction (COF) was significantly associated with a decreased risk of self-reported slipping in the prior 4 weeks (Odds Ratio 0.59, 95% CI 0.42-0.82). From the highest to the lowest COF restaurant, the odds of self-reported slipping increased more than seven times. Younger age, male gender, lower weekly work hours and the presence of gross contamination on worker's shoe sole were also positively associated with slipping.

Conclusion: This study demonstrated that the prevalence of slipping among limited service restaurant workers was sufficiently frequent to allow the application of epidemiologic methods to assess the relative contributions of the observed exposures. Using self-reported slipping as an upstream measure of outcome may make assessment of risk factors and potential interventions for STF-related injuries more feasible.

D2.2
Title: ***Fixed and Transient Risk Factors for Slipping in U.S. Limited-service Restaurant Workers***
Authors: Verma KS, Chang WR, Courtney TK, Lombardi DA, Huang Y-H, Brennan MJ, Mittleman MA, Ware JH, Perry MJ
Presenter: Santosh K. Verma, Sc.D., M.D., M.P.H.

Objectives: Only a few studies have systematically examined risk factors of slips and falls, a leading cause of injury, outside of the laboratory environment. This study examined the associations between fixed factors (floor surface characteristics, slip-resistant shoes, floor cleaning frequency) and transient factors (rushing, distraction, contaminated floor), and the rate of slipping in limited-service restaurant workers.

Methods: 475 workers from 36 limited-service restaurants from three major chains in six states in the U.S. participated in a prospective cohort study of workplace slipping with a nested case-crossover arm. At baseline, kitchen floor surface roughness and coefficient of friction (COF) were measured in eight areas and then averaged within each restaurant. lip-resistant status of the shoes was determined by noting the presence of a 'slip-resistant' marking on the sole. Restaurant managers reported the frequency of daily kitchen floor cleaning. Information about usual frequency of transient exposure was also obtained at the baseline. Participants reported their slip experience, whether exposed to transient exposures at the time of slip, and work hours weekly for up to 12 weeks. A negative binomial generalized estimating equation model and Mantel-Haenszel estimator for person-time data were used to calculate rate ratios.

Results: After adjusting for age, gender, BMI, education, primary language, job tenure, and restaurant-chain, slip-resistant shoe use was associated with a 54% reduction in the reported rate of slipping (95% CI 37%-64%) and the rate of slipping decreased by 21% (95% CI 5%-34%) for each 0.1 increase in the mean COF. The rate of slipping was significantly increased by rushing, distraction and walking on a contaminated floor. Use of slip-resistant shoes decreased the effects of rushing and walking on a contaminated floor.

Conclusion: These results provide support for the use of slip-resistant shoes and measures to increase COF as preventive interventions to reduce slips, falls, and injuries.

D2.3
Title: ***Slips, Trips, and Falls in Healthcare Workers***
Authors: Courtney T, Lombardi D, Verma S, Brennan M, Marucci-Wellman H, Sorock G, Chang W-R, Bell J, Collins J, Gronqvist R, Wolf L, DeMaster E, Matz M
Presenter: Theodore Courtney, M.S., C.S.P.

Objectives: In 2009, occupational slips, trips and falls accounted for over 25% of injuries with days away from work in hospitals. A case follow-back study was conducted to better describe the circumstances experienced by health care workers who had slipped, tripped and/or fallen (STF).

Methods: One hundred fifty-three health care workers, who reported a STF to the occupational health department in one of four private and three public U.S. hospitals, were recruited and interviewed about their injury event using a structured telephone questionnaire.

Results: Participants were predominantly female (86%) with a mean age (range) of 46 (19-67). One hundred and thirty-six workers (89%) fell: 55% after slipping, 32% after tripping. Liquid contaminants (e.g., water) were involved in 35% of events. Fifty-eight percent of STF occurred at transitional areas, of these: 34% were dry/wet transitions, 18% one floor type to another (e.g., carpet to tile), 14% uneven surfaces. Forty-five percent of workers fell forward, 29% fell to the side, and 23% fell backward. While the wrists/hands, knees, and buttocks were most often the points of impact, the knees, back, ankles/feet were most frequently injured. Slipping versus tripping resulted in different predominant directions of fall and body parts impacted. For injured workers (93%), strains/sprains (28%), contusions (28%), and non-specific pain and soreness (24%) were typical. Fifty-nine percent of workers who experienced STF were in direct patient care occupations (e.g., nursing, therapy). Forty-two percent of worker STF occurred in public areas inside the facility, 25% in public areas outside the facility, and 18% in direct patient care areas (intensive care, operating rooms, and patient rooms).

Conclusion: The results indicate the importance of managing surface contamination and assessing risks related to other surface transitions in hospital settings and have been used to inform hospital-based interventions which also have implications for patient and visitor safety.

D2.4
Title: ***An Investigation of Stochastic Distribution of the Required Coefficient of Friction for Level Walking***
Authors: Chang WR, Matz S, Chang CC
Presenter: Wen-Ruey Chang, Ph.D.

Introduction: The stochastic distribution of the required coefficient of friction (RCOF) is used in a statistical model to compare with the available coefficient of friction in order to estimate the probability of slip incidents. The stochastic distribution of the RCOF for level walking was investigated.

Methods: Fifty participants walked on a straight walkway under four walking conditions. The Kolmogorov-Smirnov two-sample test was used to determine if the RCOF from both feet of the same participant under the same walking condition were different. The Kolmogorov-Smirnov goodness-of-fit test was used to compare the distribution of the RCOF with the normal, log-normal and Weibull distributions.

Results: The results of the Kolmogorov-Smirnov two-sample test indicated that 76% of the RCOF data showed a difference in distribution between two feet for the same participant under each walking condition. The results of the Kolmogorov-Smirnov goodness-of-fit test indicated that the distribution of the RCOF appears to have a good match with the normal (85.5%), log-normal (84.5%) and Weibull distributions (81.5%) in most of the cases. However, approximately 7.75% of the cases did not have a match with any of these distributions.

Conclusion: It is reasonable to use the normal distribution for representation of the distribution of the RCOF due to its simplicity and familiarity, but distributions from both feet were different in 76% of cases.

Session: D3.0
Title: **Ergonomics/MSDs**
Moderator: Cammie Chaumont Menéndez, Ph.D., M.P.H.

D3.1
Title: ***Injury Data Analysis to Evaluate the Effectiveness of Ergonomic Interventions***
Authors: Fordyce T, Kelsh M
Presenter: Tiffani Fordyce, M.P.H.

Objectives: This presentation describes a pilot analysis of one electric utility using injury surveillance data to evaluate trends and impacts potentially related to ergonomic intervention programs.

Methods: Injury, claims, and personnel data were collected, processed, and analyzed for the period 1999–2009 for all utility employees. Information on ergonomic programs was provided by safety consultants within three areas: direct buried cable; manhole, vault, and conduit; and overhead distribution. Safety staff also provided input on the occupations that were likely to be affected by each ergonomic intervention, as well as a list of the types of injuries that were expected to be reduced, and a list of injuries to body parts most likely to be affected by the intervention. Overall, there were 33 ergonomic interventions with specific information on start date and were reported as actively used by field staff. Injury rates before and after the initiation of the intervention were calculated for specific interventions and occupational groups to assess potential injury impacts of the newly implemented ergonomic interventions.

Results: The following major findings were determined. A large number of ergonomic interventions implemented in 2002, were associated with: an overall statistically significant decrease in injuries; a statistically significant decrease in overall injuries to plant and equipment operators, line workers, mechanics, and maintenance workers and; a statistically significant decrease in injuries to the back/trunk, neck/shoulder, and hand/finger for plant and equipment operators, line workers, and mechanics. When ergonomic interventions for specific program areas were examined, we did not see a consistent change in injury rates, although there were some statistically significant decreases.

Conclusion: As interventions were introduced in multiple years it is difficult to assess pre and post intervention impacts on injury rates, and we found that it was not possible to determine the effects of specific programs as so many programs affecting same

occupational groups were implemented in the same time frame. In essence, we evaluated the global effects of all of the interventions combined. Additionally, the small number of injury events and small workforce size limit the interpretation of these injury data used to evaluate ergonomic program impact. The results of this pilot analysis suggest that for epidemiologic analysis, using injury surveillance data to evaluate trends and impacts potentially related to ergonomic intervention programs may be more appropriate and useful across a group of utilities so the analyses have improved statistical power. Other ergonomic indicators should also be considered.

D3.2
Title: ***Task-based Measurements to Evaluate Effectiveness of Interventions in Participatory Ergonomic Programs***
Authors: Dale AM, Jaegers L, Johnson M, Buchholz B, Welch LS, Evanoff B
Presenter: Ann Marie Dale, Ph.D., O.T.R./L

Objective: Construction workers suffer from high rates of musculoskeletal disorders. Ergonomic solutions for specific tasks exist but are not widely incorporated. We will present preliminary data from participatory ergonomic programs in construction workers aimed at reducing physical exposures and worker symptoms by altering tools and methods used in high exposure tasks.

Methods: Baseline physical exposures in floor laying work tasks will be measured using one or more methods (worker report, observed-ratings and direct measurement) and self-reported symptoms by survey. Ergonomic training will target the high risk tasks with proposed solutions. Process evaluation will determine the effectiveness of program delivery including observations of the frequency and consistency of performing proposed work methods and tool use solutions and worker surveys to evaluate worker's willingness to change work behaviors, work organization, and safety culture. Reassessment of physical exposures and symptoms will follow implementation of training.

Results: Preliminary results from one group (n=4) showed low back and knee discomfort for three of the workers. Floor laying tasks showed high exposure levels for hand repetition to lay tile (HAL rating 6/10), prolonged flexed low back and kneeling postures (6-7 hours daily), material handling of heavy items (Borg average rating 4.5/10), and gripping of hand trowel (Borg rating 2.5/10). Suggested solutions from training included breaking up loads during packing, use of hydraulic pallet mover, alternating hands for repetitive work tasks, using a body support device for sustained kneeling, using a long-handled device to spread glue, and pacing of work tasks. We will deliver results of worker adoption of interventions and follow-up assessments of physical exposures and symptoms.

Conclusions: Self-reported discomforts in floor layers correspond to high exposure work tasks. Adoption of interventions should show reduction in exposure levels and worker symptoms and process evaluation will describe the extent to which the program was effective.

D3.3
Title: ***Using Pictograms and Training to Reduce MSD Hazard Behaviors in Kitchen Prep Workers: Lessons Learned in Doing Research in Hard-to-Reach Workers***
Authors: King T, Amick, III B, Grant K
Presenter: Benjamin Amick, III, Ph.D.

Objective: We report on a pilot evaluation on the effectiveness of sector specific (kitchen prep areas) pictograms and a corresponding training.

Methods: Four high-risk hazards in kitchen prep areas were identified: chopping, handling large containers of food to be prepped, moving prepped food to the cooking area, and reaching for stored materials. 59 pictograms variants were developed and tested among 44 kitchen prep employees and supervisors. The pilot field evaluation used a pre-post control group design. Sites were non-randomly assigned to intervention or control to balance numbers (control group n=33, intervention group n=29). An MSD pictogram knowledge check was administered immediately before and after training. A daily symptom survey (DSS) was administered at the beginning and end of each shift. Surveys were administered for 3 days at each data collection time point. Direct observations of pictogram related behaviors were conducted over 30 minutes for 3 days at each data collection time point. DSSs and direct observations were conducted one month prior to intervention and then one and two months post intervention.

Results: A number of barriers emerged. Employees were reluctant to sign consent forms. Some reported poor trust in management and did not believe the observations were strictly for research. Others reported not wanting the additional burden. Once observations began, some expressed interest in participating indicating they did not fully understand the project's purpose or the consent form when it was first presented to them. Low literacy rates were a barrier to successful completion of the knowledge test and the DSS. Low manager/supervisor support and loss-to-follow up based on schedule or job changes among participants

were the most damaging elements to completing a high-quality evaluation. Quantitative data are currently being analyzed and will be presented at the conference.

Conclusions: This research raises questions about how to conduct injury prevention research in vulnerable populations.

D3.4
Title: ***Recent Findings from the NIOSH Upper Extremity Musculoskeletal Disorder Consortium Studies***
Authors: Evanoff B, Eisen E, Gerr F, Burt S, Hegmann K, Silverstein B, Garg A, Dale AM, Bao S, Harris C, Kapellusch J, Merlino L, Theise M, Rempel D
Presenter: Bradley Evanoff, M.D., M.P.H.

Objective: Between 2000 and 2004 NIOSH funded seven research groups from around the country to perform large, prospective epidemiologic studies examining associations between workplace physical risk factors and upper limb musculoskeletal disorders. The Upper Extremity MSD Consortium Group includes the University of Utah, University of Wisconsin, Washington State Department of Labor & Industries, NIOSH, University of California San Francisco, Washington University in St. Louis, and University of Iowa.

Methods: A total of 2909 workers at 57 employers/ plants were followed for up to six years. Detailed workplace exposure and health data, including nerve conduction measures, were collected from each participant. Most of the participants were primarily manufacturing and production workers who performed hand intensive tasks. Trained ergonomists measured occupational hand forces and estimated repetition rates and postures. The tasks of each participant were videotaped and were analyzed for repetition rates, duty cycles for grip, grip force, and wrist postures. Periodic structured physical examinations and nerve conduction studies were performed for the diagnosis of common upper extremity disorders, including epicondylitis, deQuervain's tenosynovitis, and carpal tunnel syndrome. Those performing the physical examinations and the video analyses were blinded to exposure and medical condition, respectively.

Results: The Consortium is now pooling its data to examine the effects of individual and workplace factors on the development of carpal tunnel syndrome in what will be the largest study of its kind. Some of the sites have completed analyses of their data and those early study findings will be presented. The early findings indicate that the magnitude and duration of hand pinch and grip forces are a greater contributor to risk than repetition rates.

Conclusions: Ultimately, the study findings can be used to improve workplace ergonomics programs to better prevent musculoskeletal disorders.

Session: D4.0
Title: **Hazardous Work Environments**
Moderator: Timothy J. Pizatella, M.S.

D4.1
Title: ***An Analysis of Workplace Fatalities in USW-represented Workplaces (2008–2010*)**
Author: Fendley A
Presenter: Anna Fendley, M.P.H.

Objectives: The United Steelworkers (USW) is the largest industrial union in North America and has 850,000 members in the U.S., Canada, and the Caribbean. It represents workers employed in a variety of industries including metals, rubber, chemicals, paper, oil refining, atomic energy and the service sector. Between 2008 and 2010 there were 147 fatalities reported in USW-represented workplaces. The USW Health, Safety & Environment Department responded to each fatality to assist our local union with the investigation and report on the details of the injury. This analysis was to provide an overview of trends in industries and causes of workplace fatalities.

Methods: A records review of the 147 USW fatality reports was performed to assess trends. The review included annual summary reports and individual accident reports for the incidents. All of the reported deaths happened while workers were at the workplace; therefore this data primarily represents occupational injury deaths and not deaths related to occupational disease.

Results: Preliminary results indicated that the three USW-represented industries with the highest number of deaths were steel, paper and oil. Trends in causes of workplace fatalities are still being assessed.

Conclusion: This presentation will provide an overview of USW fatality data related to industry and cause of the workplace fatality for 2008-2010. Based on these results, it will describe target topics and industry groups for prevention and outline additional needs related to collection of fatality data by the USW.

D4.2
Title: ***Fire and Explosion Deaths in Construction, 1992–2007***
Author: McCann M
Presenter: Michael McCann, Ph.D., CIH

Objectives: This paper discusses fire and explosion deaths in construction.

Methods: Fires and explosions are a significant hazard in construction. Construction fatality data involving fire and explosion-related deaths from the Bureau of Labor Statistics, Census of Fatal Occupational Injuries (CFOI) were analyzed for the years 1992-2007.

Results: A total of 600 fire and explosion deaths in 505 incidents were identified, an average of 38 deaths per year. Fifty-five multiple death incidents caused 95 of the deaths. Major causes of death were chemical explosions (41%), fires (36%), explosions of pressurized containers (14%), and arc flashes/blasts (9%).

Conclusion: Prevention of fires and explosions would be more effective than prevention of most other causes of death because almost one quarter of fires and explosions in construction are multiple death incidents. Recommendations include: 1) adequate training of contract workers in industrial plants; 2) institution of a hot work permit system for welding; 3) checking for sources of ignition before undertaking activities involving use of solvents and fuels; 4) checking pipes, pipeline or other pressurized containers before cutting, drilling, welding or other activities; 5) maintaining rim wheel tires according to OSHA 1910.177 (Servicing multi-piece and single piece rim wheels); 6) de-energizing live equipment or isolating or insulating live parts; and 7) institution of a live-work permit and following NFPA 70E Standard for Electrical Safety in the Workplace.

D4.3
Title: ***Development of a Severe Injury Surveillance System for Hazard Identification and Guiding Technological Interventions***
Authors: Poplin G, Miller H, Sottile J, Hill JRM, Hu C, Burgess J
Presenter: Gerald Poplin, M.S.

Objectives: The focus of this research is to develop a Severe Injury Surveillance System using Mine Safety and Health Administration (MSHA) data in an effort to better identify risk factors for severe injuries and fatalities within the United States coal mining sector and to identify hazardous work processes amenable to technological interventions. This report evaluates the feasibility of focusing surveillance efforts on the management of high degree (or severe) injuries as a proxy for fatal events.

Methods: Injuries occurring at bituminous coal mines during the years 1996-2006 were analyzed and classified by the degree of severity according to the Abbreviated Injury Scale (AIS). Two mining health and safety experts reviewed all high degree injuries in order to identify technological interventions for prevention and/or mitigation of these incidents.

Results: Using multivariate discrete and logistic models (via generalized estimating equations) and adjusting for number of employees and underground v. surface status, high degree (AIS $\geq$ 3) injuries in the prior year were associated with an increased risk (OR 2.02, 95% CI 1.17 to 3.46) of fatalities within the same mine. Interventions identified included development of technologies and strategies focused on (1) roof and rib fall forecasting, (2) proximity warning & avoidance systems, (3) smart highwall and slope monitoring systems, (4) personal protective equipment, (5) improved perception and visual warning systems, and (6) education and training.

Conclusions: The results of this study support the study hypothesis that mining conditions resulting in high degree injuries can also result in fatalities. Technological interventions identified to prevent and/or mitigate high degree injuries are in areas currently recognized as high priorities by the mining industry and government agencies.

D4.4
Title: ***Making the Business Case for Using Inherently Safer Technology at the Drill Head in Oil Extraction***
Authors: Myers M, Pana-Cryan R, Hill R, Burton J
Presenter: Melvin Myers, M.P.A.

Objectives: In 2008, 120 fatalities occurred in the U.S. oil extraction industry; 30 of these deaths were associated with contact with objects, of which 22 involved being struck by tongs. Work with tongs in oil rigs involves coupling (makeup) and uncoupling pipes used for drilling. An alternative but costly technology that could eliminate the risk of injury associated with tongs is Power Makeup Equipment (PME), with which the coupling can be performed without the use of tongs. The objective of this study was to conduct a cost-effectiveness analysis of using PME versus tongs from the rig owner's perspective, which includes only the costs and benefits associated with the intervention that are incurred by the owner.

Method: We used published data and cost-effectiveness methods to estimate injuries averted and the net cost of implementing the use of PME as compared to the use of tongs. The net cost includes the cost of using the PME minus the cost of using tongs and the cost of injuries averted as a result of using the PME. We calculated the cost per injury averted from the rig owner's perspective.

Results: Given our assumptions and taking into account injuries associated with the PME, preliminary results suggest that replacing the tongs with PME would reduce fatal injuries by 90% and lost-time injuries by 80%, at a cost of $6,150 per (any) injury averted.

Conclusion: We are refining our assumptions and data and performing sensitivity analyses. We will expand our analysis by developing the societal perspective, which includes all costs and benefits associated with the intervention, in order to identify potential additional opportunities for prevention.

Session: **D5.0**
Title: **Motor Vehicle II**
Moderator: CAPT James Collins, Ph.D., M.S.M.E.

D5.1
Title: ***Trends in Work-related Motor Vehicle Fatalities among U.S. Law Enforcement Personnel***
Authors: Tiesman H, Konda S, Hendricks S, Pratt S
Presenter: Hope Tiesman, Ph.D., M.S.P.H.

Purpose: Motor vehicle related incidents have been the leading cause of occupational death among U.S. law enforcement officers (LEOs) for the past thirteen years. This study compares trends in motor vehicle fatality rates between U.S. LEOs and all other U.S. workers.

Methods: Data from the U.S. Census of Fatal Occupational Injuries (CFOI) were used to enumerate motor vehicle fatalities between 2003 and 2008. The Occupational Injury and Illness Classification System (OIICS) event codes were used to define motor vehicle fatalities (‘41', ‘42', and ‘43' series). Occupations were grouped according to the 2002 Bureau of Census Occupation Codes. Fatality rates were calculated with denominators derived from the Current Population Survey (CPS). Trends in rates were analyzed employing a Poisson regression assuming a linear trend across the study period.

Results: Between 2003 and 2008, there were 418 work-related motor vehicle fatalities among LEOs for an overall rate of 7.6 per 100,000 workers. Rates were over five times higher among LEOs than other U.S. workers (1.4 per 100,000). Fatality rates were highest for male LEOs (8.5 per 100,000), Caucasian LEOs (8.2), and LEOs aged less than 24 years of age (11.9). LEOs had the third highest occupational motor vehicle fatality rate behind those in Transportation & Material Moving occupations (10.3 per 100,000) and those in Farming, Fishing, & Forestry occupations (8.8). Motor vehicle related fatality rates significantly decreased an average of 3% among all U.S. workers during this time period (RR=0.97, 95%CI=0.96-0.98). While motor vehicle related fatality rates among LEOs also decreased, this decrease was smaller in magnitude and not significant (RR=0.98, 95%CI=0.93-1.04).

Conclusions: Those in law enforcement continue to be at an increased risk for motor vehicle fatalities while on the job. Further investigation into the causes of these fatalities and possible prevention strategies in this occupation is warranted.

D5.2
Title: ***Impact of In-vehicle Assist Systems on Rural Intersection Crossing Performance in Simulated Driving***
Authors: Drucker C, Becic E, Manser M, Donath M
Presenter: Christopher Drucker, M.S.

Background: Intersections in general, and rural stop-controlled intersections in particular, represent areas of increased driving risk with disproportionately high rates of crashes, as well as fatalities. A cooperative intersection collision avoidance system (CICAS) for such rural intersections already exists, as a roadside-based system.

Objective: The increasing complexity of technology and integration of various assist systems within a vehicle prompted the focus of the current study; to exam the feasibility of an in-vehicle based CICAS.

Methods: Three different designs of an in-vehicle CICAS were examined in terms of their impact on driving performance and applicability to varying age groups and visibility conditions. These designs differed in terms of their complexity, that is, the amount of information that drivers received about the intersection traffic. Older (60-85 years of age) and younger (18-28 years of age) participants, divided into three CICAS groups, completed several intersection crossings under different visibility (clear, foggy) and treatment conditions (system present, absent).

Results: Overall, the presence of the in-vehicle CICAS improved intersection crossing performance, as exhibited by longer average accepted gap and by decreased probability of accepting a potentially dangerous gap. The impact of the CICAS was especially beneficial under conditions of low visibility when drivers' perceptual faculties were strained and determining an appropriate crossing gap became a more demanding task. While all three designs of the CICAS exhibited evidence of its efficacy, the least complex design was also shown to be the least effective in influencing drivers' intersection crossing performance. Older drivers exhibited a more pronounced defensive driving behavior, such as waiting longer to cross an intersection; however they did not benefit from the presence of the CICAS to the same extent as the younger drivers.

Conclusion: These data suggest that in-vehicle based CICASs can be beneficial when crossing rural intersections, especially under conditions of limited visibility.

D5.3
Title: ***Policies for Work-related Road Safety in the United Kingdom, France, and Sweden: Lessons for the United States***
Author: Pratt S
Presenter: Stephanie Pratt, Ph.D.

Motor vehicle crashes (MVCs) are the leading cause of occupational fatalities in most high-income countries. This research examined policies for occupational road safety (ORS) in three European Union (EU) states (the United Kingdom (U.K.), France, and Sweden), finding that progression of the issue, placement of relevant government agencies, interest groups with formal and informal access to policymakers, and events and belief systems in the larger society all influenced the types of policies implemented. Results from the EU cases were applied to the U.S. policy environment.

The U.S. regime for ORS is similar to the U.K. Both countries have histories of regulating economic and safety aspects of trucking operations, leaving safety of lighter occupational vehicles to voluntary business-led initiatives. Neither country has fully integrated occupational road safety into transport policy or occupational safety and health (OSH) policy. Numerous interest groups compete for access to policymakers, with no formalized role for labor and industry in formulating government policies for ORS.

French and Swedish policies reflect a history of corporatism (formal engagement of labor and industry in developing legislation that affects them), and collective bargaining for transport workers. Compared to the U.S. and U.K., both have integrated ORS more fully into both transport and OSH policy, and emphasize social-welfare goals over economic goals.

In the U.S., the Federal Motor Carrier Safety Administration focuses on trucking safety, but the safety of lighter work vehicles lacks an institutional "home." Better coordination across the government agencies with a stake in ORS will promote more unified policy. As in the U.K., businesses that operate lighter vehicles have implemented prevention programs based on "best practices." Following the U.K. example, the U.S. should expand public-private partnerships and research for ORS, working within the prevailing business-centered approach.

D5.4
Title: ***Identifying Potential Safety Technology to Prevent Military Vehicle Crashes***
Authors: Pollack K, Canham-Chervak M, Yee N, Rossen L, Bachynski K, Baker S
Presenter: Keshia Pollack, Ph.D., M.P.H.

Objective: Motor vehicle crashes are the second leading cause of serious injury and the leading cause of fatalities among military populations. The objective of this research is to identify potential technology that may prevent the leading crash circumstances associated with military vehicle crashes.

Methods: A narrative text analysis using data from the Army Safety Management Information System, which is maintained by the U.S. Army Combat Readiness/ Safety Center. Narrative text fields for all military vehicle crashes that occurred between 2001 and 2006 were reviewed. An electronic data collection system was developed and multiple reviewers read the narratives and abstracted key variables related to the crash, environment, vehicle conditions, and driver. A literature review was conducted to assemble information on the effectiveness of various existing technologies. Based on crash circumstances reviewers also determined whether the crash could have been prevented with existing technology.

Results: A total of 3,944 narratives were reviewed. Approximately 63% of the crashes occurred in the U.S. and 24% in Iraq. Nearly 98% of the crashes were nonfatal. Among crash events where the direction of the crash was recorded 32% were to the front of the vehicle, and another 16% involved a vehicle being rear-ended. Rollovers were mentioned in roughly 30% of the crashes. Technology was determined to have the potential to prevent at least 26% of the crashes that

occurred. Based on the leading circumstances, the technologies with the most potential to prevent a military vehicle crash were the forward collision warning system, emergency brake assistance, rear end collision avoidance, and rollover stability control system.

Conclusions: Technology has the potential to prevent the leading circumstances associated with military crashes. Based on these data, future efforts should explore the implementation, and evaluation, of identified technology on new and legacy military vehicles, in both domestic and combat settings.

Session: E1.0
Title: **Underreporting of Injuries II**
Moderator: Eric Sygnatur, M.A.

E1.1
Title: ***Evaluation of Two Outcomes in a Case Matched Dataset: Amputations and Carpal Tunnel Syndrome***
Author: Wuellner S
Presenter: Sara Wuellner, M.P.H.

Objectives: The BLS Survey of Occupational Injuries and Illnesses (SOII) and state-based workers' compensation (WC) data are two major data systems used to estimate the burden of occupational injuries and illnesses. Given the different data sources, data collection methods, and timelines, case capture may differ by system. To explore differences in case ascertainment between WC and SOII, we evaluated work-related amputations and carpal tunnel syndrome (CTS) cases in a matched WC-SOII data set.

Methods: Washington SOII cases from survey years 2006 – 2008 were matched to Washington WC claims based on worker and employer data elements available in both datasets. Amputations and CTS cases were identified in SOII data through injury and illness classification codes and key words in injury narratives and in WC data through injury and illness classification codes, narratives, and diagnosis and procedure codes in medical and hospital billing data.

Results: One hundred sixty-eight (168) SOII cases (unweighted) met our amputation identification criteria. Ninety-four percent of SOII amputations were matched to a WC claim, 63% of which were also identified as an amputation based on WC data. Of all amputations identified in the matched dataset, 34% were identified solely through WC data. There were 573 CTS cases in the SOII data (unweighted); 87% of which matched to a WC claim. Of the total CTS cases identified in the matched data, 16% were identified solely in SOII data and 44% solely in WC data. Among WA State Fund compensable claims, time loss payments occurred in the year of injury for 89% of amputations, compared to 51% of CTS cases. Claims without time loss in the year of injury are unlikely to be recorded as a SOII case.

Conclusions: Case capture differs between the two data sources in part due to differences in injury classification and data development.

E1.2
Title: ***Undercounting of Work-related Amputations and Carpal Tunnel Syndrome in California: Evaluation of Multiple Data Sources***
Authors: Roisman R, Beckman S, Joe L, Beckman J, Frederick M, Jones M, Harrison R
Presenter: Rachel Roisman, M.D.

Objectives: Recent studies suggest that the U.S. Bureau of Labor Statistics (BLS) Survey of Occupational Injuries and Illnesses System (SOII) undercounts work-related (WR) injuries and illnesses and that using additional data sources may improve surveillance. In collaboration with the BLS, the California Department of Public Health conducted multi-source surveillance of WR amputations and carpal tunnel syndrome (CTS) in California in order to enumerate the total number of cases and estimate relative underreporting in each dataset.

Methods: For January 1, 2007, through December 31, 2008, individuals with WR-amputations were identified in the SOII, the California Department of Industrial Relations' Workers' Compensation Information System (WCIS), and health care facility data (OSHPD) including hospital discharges, emergency room visits, and ambulatory surgery. Individuals with WR-CTS were identified in the SOII, WCIS, OSHPD, and by Doctor's First Reports of Occupational Injury or Illness (DFR). After enumerating the total number of cases for the selected conditions in each dataset, record linkage was performed to assess overlap between and underreporting within datasets.

Results: In each dataset, we identified amputations (1,390 SOII, 4,713 WCIS, 4,976 OSHPD) and CTS cases (3,270 SOII, 29,816 WCIS, 17,927 OSHPD, 4,066 DFRs). Final record linkage results are anticipated in the second quarter of 2011. Preliminary results suggest there are fewer than expected amputation and CTS cases in the SOII compared to these other datasets and that linkage of multiple data sources significantly improves detection of WR amputations and CTS.

Conclusions: The study provides an estimate of the number of WR amputations and CTS in California and the extent to which the SOII underestimates these counts. The challenges of, and advantages to, using multi-source surveillance will be discussed and used to determine the feasibility of using state-based data sources to supplement the SOII for national surveillance of occupational injuries and illnesses.

E1.3
Title: ***Use of Multiple Data Sources to Enumerate Work-related Amputations in Massachusetts: Preliminary Results***
Authors: Davis L, Grattan K, Bullock L, Boden L
Presenter: Letitia Davis, Sc.D., Ed.M.

Background: Accurate information about the extent, nature and causes of work-related injuries and illnesses is essential to prioritize and evaluate prevention efforts. No single data source captures all cases and innovative approaches combining information from multiple sources are needed. Massachusetts is one of three states funded by the Bureau of Labor Statistics to pilot multisource surveillance of work-related amputations.

Methods: Massachusetts collaborated with other funded states to establish a surveillance case definition, and, as feasible, similar protocols. An amputation is defined as loss of a distal body part with bone loss or uncertain bone loss status. Eligible cases include those with injury event dates during 2007 and 2008 and the event occurred while working. Four administrative data sources in addition to the Massachusetts SOII sample are being used for case ascertainment: workers' compensation records (WC) of lost time cases and three statewide hospital data sets, collectively referred to as Case Mix (CM) data: inpatient discharge, out-patient observation, and emergency department data. Medical records for potential CM cases are being collected to obtain personal and employer identifiers needed to match with other data sets and assess work-relatedness.

Results: Injury code and narrative text selection criteria identified 448 probable/ possible WR amputations in the WC data base. Approximately 2,800 potential WR amputations were identified using diagnostic, procedure and payment codes in the CM file. Medical record review is underway. Anonymous linkage of potential CM and probable/possible WC cases based on injury and admission dates, birth date, gender and residence zip code identified few matched cases necessitating collection of medical records for more CM cases than anticipated. Findings based on linkages of the five data sets using personal and employer identifiers will be presented.

Conclusion: Preliminary findings suggest that use of multiple data sources will identify substantially more cases than any single source, and more than the 210 cases estimated by the SOII for 2007-08. Multisource methods of surveillance improve our ability to characterize the problem but also pose many challenges. Completion of approvals for this study were time consuming but could be institutionalized for ongoing surveillance. Some additional challenges include: differences in scope of the data source (e.g. population covered, injury severity), data timeliness, variation in coding systems used across data sets, and multi-employer establishments. Medical record collection and review is very resource intensive and added value of collecting these records for all potential CM cases remains to be seen.

E1.4
Title: ***Comprehensive System to Identify Occupational Burns***
Authors: Kica J, Chester D, Rosenman K
Presenter: Joanna Kica, M.P.A.

Objectives: Occupational burns are serious but potentially preventable injuries; in 2009, the BLS Survey of Occupational Injuries and Illnesses (SOII) estimated there were 24,500 burns in the U.S.

Methods: Medical records from Michigan's hospitals/emergency departments (EDs), Workers' Compensation Bureau (WC), Michigan's sole Poison Control Center (PCC) and work-related fatality surveillance were used to identify occupational burns in 2009. Duplicates identified in more than one system were eliminated. In addition, work-related burn fatalities from 2001 to 2010 were compared with non-fatal occupational burns in 2009.

Results: In 2009, there were 110 occupational burns from the PCC, 280 from WC, 1,186 from hospitals/EDs and 2 fatalities; 24 from both PCC and hospital/ED records, and 64 from both WC and hospital/ED records. There were 26 burn fatalities from 2001-2010. One of the 134 hospitals has yet to report and we estimate receiving another 50 occupational burns. The demographics were: men (59.0%); age range 15-68; Caucasian (87.9%), African American (6.4%) and Hispanic (4.7%); thermal (67.4%), chemical (25.0%), electrical (4.2%), radiation (1.9%), and other (1.5%); first degree (40.8%), second degree (54.6%), third degree (4.4%), and fourth degree (0.2%); wrist(s) and hand(s) (35.3%)%), upper limb (22.8%) and head, face, and neck (12.2%); Accommodation and Food Services

(NAICS 72) (38%), Health Care and Social Assistance (NAICS 62) (16.3%), Metal Manufacturing (NAICS 33) (7.2%), Retail Trade (NAICS 44) (5.6%); ED visits (90.2%), outpatient visits (5.9%) and hospitalizations (3.9%). Of the top five NAICS codes from fatal burns only one (Metal Manufacturing) (15.4%) overlapped with the non-fatal burns top five NAICS codes.

Conclusion: We identified 1,490 work-related burns in 2009 in Michigan from the PCC, Worker's Compensation, hospital/ED, and fatalities data in comparison to the 450 burns in the BLS SOII system. The Michigan multidata source surveillance system identified 3.3 more burns than in the BLS employer based system.

Session: **E2.0**
Title: **Falls from Roofs and Ladders**
Moderator: Peter Simeonov, Ph.D.

E2.1
Title: ***Work-related Falls from Ladders: A Follow-back Study of U.S. Emergency Department Cases***
Authors: Lombardi DA, Smith GS, Courtney TK, Brennan MJ, Kim JY, Perry MJ
Presenter: David Lombardi, Ph.D.

Objectives: Ladder falls comprise 16% of all U.S. workplace fall-related fatalities, and ladder use may be particularly hazardous among older workers. This follow-back study of injured workers from a nationally representative sample of U.S. emergency departments focused on factors related to ladder falls in three domains of the work environment: work equipment, work practices, and worker-related factors. Risk factors for fractures, the most frequent and severe outcome, were also evaluated.

Methods: Workers injured from a ladder fall, treated in one of the 65 participating emergency departments in the occupational National Electronic Injury Surveillance System (NEISS) were asked to participate. The questionnaire contained 167 items (branching) including worker demographics, injury characteristics, ladder and work equipment characteristics, work tasks and activities, and work environment attributes. Multivariate logistic-regression models estimated odds ratios and the associated 95% confidence intervals (CIs) of a work-related fracture.

Results: Three-hundred and six workers experiencing a ladder fall injury were interviewed primarily from construction, installation, maintenance, and repair and had fallen from a step, extension, or straight ladder from an average of 7.5 feet. Injuries were most frequently to the arm, elbow or shoulder, head, neck or face with diagnoses were primarily fracture, strain, sprain, contusion or abrasion. Workers were most frequently standing or sitting on the ladder while installing, hanging an item, or performing a repair when they fell. Ladder movement was the mechanism in 40% of falls. Environmental conditions played a role in <10% of cases. There was a significant association between fracture risk and fall height while working on the ladder that was also influenced by older work age.

Conclusions: This study advances knowledge of falls from ladders to inform decisions by those that specify means and methods, select equipment to carry them out, and plan, supervise, or manage performance of employees that work at heights.

E2.2
Title: ***Fatal Falls from Roofs in Construction, 1992–2009***
Authors: Dong S, Wang X, Daw C
Presenter: Sue Dong, Dr.P.H.

Objectives: To examine work-related deaths caused by falls-from-roof (FFR) in the construction industry to provide insight into fall preventions.

Methods: Deaths caused by FFR among construction workers were identified from 1992-2009 Census of Fatal Occupational Injuries (CFOI; 2009 data is preliminary). The CFOI data in 2003-2009 were pooled together for the stratified analyses by major demographics and employment categories. Risk was measured by the number of FFRs per 100,000 full-time equivalents (FTEs). FTEs were estimated based on the self-reported number of hours worked in the Current Population Survey.

Results: Deaths caused by FFR accounted for about one-third of all fatal falls in construction (2,165 of 6,585) from 1992 to 2009. Although half of the decedents were between ages of 35 and 54, the risk of FFR for younger (<20) and older (55+) groups was about double the risk of the entire construction industry. From 2003 to 2009, one-third of FFR deaths were of Hispanic origin in which 83% were foreign-born. Nearly 35% of FFR decedents were roofers which translates to a death rate of 20.7 per 100,000 FTEs, 17 times higher than all construction workers combined (1.2 per 100,000 FTEs). Other occupations at a higher risk of FFR include ironworkers, construction laborers, sheet metal workers, welders, and helpers. In terms of FFR types, 45.4% were falls from roof edges; 13.2%

were falls through skylights; 9.4% were falls through existing roof openings; and 8.4% were falls through roof surfaces. In addition, 66% of FFR deaths occurred in small establishments with 1-10 employees, 34% in residential construction, and nearly half in the South.

Conclusion: FFR continues to be a leading cause of work-related fatalities in construction despite current prevention strategies and interventions. Fall prevention enforcement is desperately needed for high-riskoccupations, Hispanic workers, and workers in small construction establishments.

E2.3
Title: ***Anchoring System for Guardrails on Flat Roofs for Roofers***
Authors: Lan A, Daigle R
Presenter: André Lan, P.Eng.

Objectives: Roofers have one of the most dangerous occupations with falls causing 75% of fatal events. For flat roofs, guardrails are the most appropriate means of collective fall protection. They allow mobility and they dispense the worker from wearing a harness and avoid the installation of 16 to 18 kN anchors. During their tasks, roofers move a lot and arrive rapidly near the open edge without being aware of it, and in the absence of fall protection, they are exposed to serious risks of falls. Presently, roofers use prefabricated metallic guardrails installed on-site on the perimeter of flat roofs. According to the Association of Master Roofers of Québec (AMRQ), these guardrails are very handy and are suitable for flat roofs, but they have never been tested to verify if they are safe and meet the requirements of the Québec Safety Code for the construction industry (S-2.1, r.6). Following a request of the AMRQ, this study was carried out to verify by design and tests, if the three most widely used models of prefabricated metallic guardrails by roofers are safe and meet the requirements of S-2.1, r.6.

Methods: The three models of guardrails were observed to collect data on their installation on the roof's parapet. Their geometrical and mechanical characteristics were compiled following meetings with the manufacturers. Since structural analysis is not the best method to verify the guardrails, laboratory tests of guardrails on a reconstructed flat roof and parapet using the same on-site building techniques were carried out.

Results: Results show that the three guardrails are safe and they meet the requirements of S-2.1, r.6.

Conclusions: On site, the strength of the guardrail/parapet assembly will be governed by the strength of the parapet. This study is based on a process integrating on-site observation of guardrails, laboratory test methods and a test protocol. It can be easily adapted to test guardrails to other standards and codes.

E2.4
Title: ***Development and Evaluation of the NIOSH Multifunctional Guardrail System***
Authors: Bobick T, Fullen M, McKenzie T, Takacs B
Presenter: Thomas Bobick, Ph.D.

Objective: Data from the Bureau of Labor Statistics verify that the leading cause of fatalities in the construction industry is workers falling to a lower level. To address this recurring problem, NIOSH, Division of Safety Research, developed a multifunctional guardrail system for use in residential, commercial, and industrial construction for fall-prevention purposes.

Methods: Iterative laboratory investigations were used to develop a unique design for use on residential roofs. The patented design (U.S. Patent No. 7,509,702) is adjustable from moderate-slopes (27°) to steep-slopes (63°, or A-frame). Additional laboratory testing has resulted in five new component designs: two additional ones for use on roofs, two for vertical surfaces, and one for flat surfaces. An extended field evaluation of these various components is scheduled for summer 2011. Two northern West Virginia contractors have agreed to incorporate the guardrail system into their safety procedures to evaluate its usability and effectiveness, and determine whether the fall-prevention system improves the workers' postures and stability.

Results: The laboratory tests verified that all components of this guardrail system will meet the OSHA requirement to support a 200-pound dynamic load on the top rail. Data from the field evaluations will include the time to initially install the system compared to the time to install the system after four months of usage. Group discussions will be used to collect feedback from crew members and management regarding possible modifications to improve the system's functionality.

Conclusions: Falls to a lower level are the primary cause of fatalities in the U.S. construction industry. NIOSH's multifunctional guardrail system can be used on various unprotected workplaces to prevent workers from falling. The system can provide fall protection for stairs that need temporary handrails, or balconies, decks, roof holes, and floor holes that need temporary protection.

Once commercially available, this system should assist in preventing injuries and fatalities.

Session: E3.0
Title: **Safety Climate II**
Moderator: Ted Scharf, Ph.D.

E3.1
Title: ***Analysis of Needlestick Injuries among Healthcare Workers in a Tertiary Hospital of China***
Authors: Zhang X, Cheng K, Tu Z
Presenter: Xujun Zhang, Ph.D.

Objectives: Health care workers are exposed to the serious risk of contracting bloodborne diseases from needlestick and sharps injuries. This study is to identify who sustains such injuries, under what circumstances and what actions are taken to minimize the risk of needlestick and sharps injuries.

Methods: A review of accident reports in a tertiary hospital was employed to determine the injury rate, causation, and epidemiological distribution of needlestick and sharps injuries. Descriptive statistics, prevalence, and Fisher's exact test were used to analyze the data.

Results: From January 2008 to December 2010, there were a total of 33 reported cases of needlestick and sharps injuries (27 needlestick injuries and 6 sharps injuries). The annual prevalence of needlestick and sharps injuries in three years from 2008 to 2010 ranged from 0.34 to 1.16 cases while the incidence rate was one new case per 100 health care workers per year. The majority of needlestick injuries (n=24, 88.89%) were from contaminated needles. Procedures involved in the needlestick injuries were giving injection (n=11, 40.74%), stitching up the wound (n=5, 18.52%), collecting blood specimen (n=4, 14.81%), inserting angiocatheter (n=3, 11.11%), removal of intravenous infusion (n=3, 11.11%) and checking blood glucose using glucometer (n=1, 3.70%). Surgical instruments (n=4; 66.67%) accounted for the highest percentage of sharps injuries.

Conclusions: Health care workers are at high risk of occupational exposure to bloodborne pathogens because of needlestick and sharps injuries. An engineering, administrative and personal behavioral activity is recommended to reduce the occurrence of needlestick and sharps injuries among health care workers.

E3.2
Title: ***Unintentional Needlestick Injuries in Livestock Production: A Case Series and Review***
Authors: Jennissen C, Wallace J, Donham K, Rendell D, Brumby S
Presenter: Charles Jennissen, M.D.

Background: Livestock producers and their employees sometimes experience unintentional needlestick injury (NSI) while vaccinating or injecting medications into animals. There is little published regarding the medical complications that can develop from this occupational exposure.

Objectives: The objectives of this study were to: (1) Perform a retrospective review of animal-related NSIs treated at a tertiary medical center of a rural state; and (2) Review the risks of NSI and measures to decrease their occurrence.

Methods: Medical records of patients with NSI related to animal injection were identified from the University of Iowa Hospitals and Clinics database from 2002-2008 and reviewed.

Results: Nine patients received medical care for NSI which occurred while vaccinating farm animals. Most common NSI site was the non-dominant hand and most occurred while attempting to inject the animal. Soft tissue infection was common and all nine received oral and/or intravenous antibiotics. Two-thirds required hospital admission. Three required surgery and one had a bedside incision and drainage procedure. One patient had a serious inflammatory reaction with necrosis in their leg due to the oil adjuvant in the animal vaccine. Another case had a probable mycetoma with osteomyelitis and soft tissue infection due to the bacteria Streptomyces which is a NSI complication not previously reported.

Conclusions: Although medical complications from farm-related NSIs do not appear to be common, this case series illustrates how these injuries can be debilitating, costly, and lead to loss of work time and productivity. Producers and employees who inject livestock need to be aware of the risks and utilize measures to decrease unintentional NSI.

E3.3
Title: ***Changes in Sharps Injuries among Healthcare Workers: The Effect of HR 5178 (National Needlestick Safety and Prevention Act)***
Authors: Phillips EK, Conaway M, Parker G, Perry J, Jagger J
Presenter: Elayne Kornblatt Phillips, Ph.D, M.P.H.

Objectives: Occupational infection from contaminated sharp device injuries is the deadliest risk for healthcare workers. 1991 OSHA standards required engineering and work practice controls to minimize risk of bloodborne pathogen transmission. The 2000 Needlestick Safety and Prevention Act, H.R.5178, strengthened and specified the standards requiring employers to identify evaluate and implement safety-engineered medical devices. Did it make a difference in worker injury experience? Was there a differential impact regarding job category, department of the hospital, when or how the injury occurred? This study systematically examines the impact of the law on hospital worker sharps injuries.

Methods: Using EPINet hospital surveillance data, which tracks sharps injuries among hospital workers in an 85 hospital research network, we designed a historic prospective study to identify changes in injuries from 1995-2005. AHA data were used to generate hospital-specific denominators (FTE, ADC, Beds) and calculate annual injury rates across the period prior to and following the legislation.

Results: Comparing the injury rates before the legislation and after, there was a significant (P<.001) decrease beginning in the year 2001, regardless of which denominator is used. The drop varies between 40-50%, depending on the denominator. Not only was there a significant discontinuity in the pre- and post-slopes, but the rates continued to decrease in the post-legislation period. The proportion of injuries attributed to nurses decreased in the post-legislation period, and the proportion of injuries among physicians increased. Proportion of injuries occurring before and after device use decreased. Proportion of injuries occurring in the OR increased.

Conclusions: These findings strongly support the conclusion that, even in the presence of OSHA regulations that pre-date the legislation, and even with a market of safety engineered devices available prior to the legislation, the legislation had an independent and powerful impact on the sharps injury experience of hospital workers in the U.S.

E3.4
Title: ***Using Occupational Culture to Create Effective Safety Training***
Author: Cullen, E
Presenter: Elaine Cullen, Ph.D.

Developing effective training for high-risk industries is challenging. These workers generally accept risk as part of the job and may even self-select into high-risk industries because they have a high tolerance for risk and enjoy the sense of danger it entails. This case-study involves development of effective safety training in the Oil and Gas Extraction industry.

Objective: Develop effective training for oil and gas extraction and production workers that will contribute to a decline in work-related injuries.

Methods:

- Complete an occupational ethnography to determine controlling cultural norms
- Gather information on training gaps that, if filled, could decrease injuries among rig workers
- Identify formal and informal leaders who have earned the respect and credibility of workers
- Create safety training materials using credible insiders

Results: Nearly 50 land-based drilling and service rigs were visited, and extensive information on cultural norms, values, and practices has been gathered. Formal and informal interviews have been conducted, with 32 of these captured on video-tape. Nearly 25 hours of additional footage illustrate drilling and servicing operations on the rigs, as well as three separate rig moves. Rig moves, identified as the most dangerous process, were chosen as the first topic for training development. The video entitled "Move It! Rig Move Safety for Roughnecks" has been released, and a companion video for the trucking companies that move the rigs is in production. Nearly 2000 copies of the video have been distributed.

Conclusion: Because the video has been available for only two months, it is too early to evaluate its effectiveness. Responses from trainers and safety professionals, however, have been very positive, and numerous companies have expressed their willingness to partner with us on creating additional training. NIOSH was an unknown when the project began, so this is considered to be an extremely positive change.

Session: **E4.0**
Title: **Training, Drug Testing**
Moderator: Suzanne Marsh, M.P.A.

E4.1
Title: ***A Systematic Review of the Effectiveness of Occupational Health and Safety Training***
Authors: Robson L, Stephenson C, Schulte P, Amick III B, Irvin E, Eggerth D, et al.
Presenter: Lynda Robson, Ph.D.

Objective: The primary objective of the literature review was to answer whether occupational health and safety (OHS) training has a beneficial effect on workers and firms.

Methods: Systematic review methods were used. Ten electronic databases were searched for articles meeting relevance criteria. Key criteria were that the study design be a randomized trial with pre- and post-intervention measures. Criteria allowed the inclusion of a wide range of OHS training and education intervention studies directed toward primary prevention of occupational illness and injury. The methodological quality of all relevant articles was assessed using a standardized form focused on internal validity. Information on the effectiveness of education & training interventions was extracted with respect to four broad outcome categories: Knowledge, Attitudes & Beliefs, Behaviours (including behaviourally-influenced hazards), and Health (i.e. injuries, illnesses, symptoms). Effects were also expressed as standardized mean differences to facilitate the synthesis of evidence. Evidence was synthesized qualitatively using the Centers for Disease Control and Prevention's Guide to Community Preventive Services' algorithm, which considers the quantity of evidence (number of studies), methodological quality, consistency of effect, and effect size.

Results: Twenty-two studies, involving 36 training interventions met the relevance criteria. Intervention exposures were usually modest, consisting of one or two sessions, which were most often two hours or less each. A variety of methods were used to deliver training (i.e. lecture, printed materials, hands-on practice, etc.). The OHS hazards addressed by the interventions included all five possible types, but ergonomic was the most frequent. Effects were most often measured between 1 and 6 months post-intervention. Twelve of the 22 studies addressed the two research questions and were of Fair/Good methodological quality. These were used in the final evidence syntheses.

Conclusions: Based on the studies reviewed, there is insufficient evidence that training as a lone intervention impacts health (i.e. injuries, illnesses, symptoms), because effects have been inconsistent in direction and too small. The research team nevertheless recommends that workplaces continue to conduct training programs because strong evidence has been found for training impacting targeted Behaviours (work practices) on the job.

E4.2
Title: ***A Multi-year Program Evaluation of the Impacts and Outcomes of OSHA Education Center Training on Worker Safety, Safety Program Development, and Implementation***
Authors: Fullen M, Takacs B, Lundstrom W
Presenter: Mark Fullen. Ed.D., C.S.P.

Objectives: The OSHA Training Institute Education Center Program was created in 1992 when OSHA partnered with training and educational institutions to conduct OSHA Training Institute courses. From four OTI Education Centers in 1992, the Program realized continued growth, expanding to include at least one in each OSHA region for a total of 26. The annual number of students trained by the OTI Education Centers has steadily increased, with 32,881 trained in FY 2010. Beyond the numbers of students trained and instructor and class evaluations there has never been an evaluation of the impact of the training on those that attend the class and on the organizations or companies that they represent. The objective of this project was to collect data from OSHA Education Center students to measure the impact of the training on workplace safety and hazard reduction.

Methods: WVU Safety and Health Extension (WVUS&HE) has been an OSHA Education Center partner organization as part of the National Resource Center since 1992. Beginning in 2004, WVUS&HE began collecting annual survey data from all students that attended the WVUS&HE courses within that calendar year.

Survey data collected between 2004 and 2009 includes demographic data, evaluation of instructors and courses, recommendations for improvement, and most importantly outcomes based data including programmatic, administrative, training and work practice changes in the workplace as a result of the information gained from the OSHA courses.

Results: The data collected includes detailed examples of actions taken by the students as a direct result of the training. The descriptive examples have been

categorized into major areas including but not limited to conducting OSHA 10 and 30 hour training courses, improved training technique, the advancement and the revision of existing safety programs, increase in knowledge, development of better training programs, work practice changes, and workplace condition improvements.

Conclusions: The results of this multi year study show that those that take WVUS&HE OSHA Education Center classes utilize the information in practical applications at the worksite to improve their, to conduct and to reduce hazards and improve workplace safety.

E4.3
Title: ***Integrated Injury Prevention in Small Metal Industry Enterprises***
Authors: Kines P, Andersen D, Andersen LP
Presenter: Pete Kines, Ph.D.

Objectives: Theoretical studies point to the need for combining leader-based (top-down) and worker-based (bottom-up) approaches to attain a greater and sustaining effect in occupational injury prevention. Meta analyses have shown that the two most effective approaches are the behavior-based approach and thorough safety culture initiatives. The objective of this study is to operationalize and test the integration of these two approaches in small iron and metal manufacturing enterprises, where injury risks are high and safety is less formalized.

Methods: The study involves a randomized case-control design with 14 small (10-20 employees) iron and metal enterprises over a 26 week period, with 6 case enterprises and 8 controls. The intervention involves four dialogue-based (‘coaching') safety meetings with owners/managers facilitated by the research team members, and two owner/manager lead dialogue meetings with the workers. Effect measures include a nine-scale safety culture questionnaire and interviews at baseline and follow-up.

Results: Coaching sessions with owners/managers result in 46 safety sub-goals/task, of which 40 are reached/solved, e.g. focus on personal protective equipment, ergonomics, safety dialogue between owner/manager and workers and to clarify the health and safety representative's role. The safety culture questionnaire data reveal that the six cases and eight controls differ significantly on only one scale at baseline, in which the cases have higher mean scores on ‘Workplace satisfaction' (involvement), and are thus more enthusiastic about their workplace than controls. At follow-up cases have significant increases on six of the nine scales: Safety knowledge, safety commitment, safety participation, safety leadership as well as trust and the role of the safety representative. In addition, a borderline significant result is found on a seventh scale - ‘safety attitude.' Controls show significant increase from baseline to follow-up on only one scale - ‘safety participation.' Interview data validate the safety culture questionnaire and in particular reveal that daily communication on safety increases between owners/managers and workers and between workers. This in turn has a positive effect on the level of safety in the enterprises.

Conclusions: Implementing the integrated injury prevention approach is challenging in small enterprises, and needs to be adapted to their more informal (safety) culture compared to larger enterprises. Proactive measures for measuring safety in small enterprises are required, as injuries are too infrequent to use as effect measures. A seven-item safety observation method is proposed as one alternative to a positive and proactive safety measure and tool for use in small iron and metal enterprises.

E4.4
Title: ***Effect of Drug Testing Programs on Injury Rate and Severity in Small- and Medium-sized Construction Companies***
Authors: Schofield K, Alexander B, Gerberich S, Ryan A
Presenter: Katherine Schofield, M.E.H.A.

Objectives: Construction work is hazardous and workers consistently rank in the top of all occupations and industries for illicit drug and heavy alcohol use. We evaluated workers' compensation claims data covering 1,360 construction companies from 2004-2009 to determine associations between active company drug testing programs, injury rate, and severity.

Methods: Presence of a testing program was obtained from the compensation carrier. Drug testing programs included: pre-employment; post-accident; random; and reasonable suspicion. Hours at-risk, estimated from payroll, and injury claims were used to determine injury rates. Rate ratios (RR) and 95% confidence intervals (CI) were estimated as a function of injury rate using a Poisson regression model and accounting for time dependent factors. Generalized estimating equations are used to account for correlated observations within companies over time. Models include confounding covariates of company size, union status, and trade.

Results: Drug testing programs were classified as pre-employment/post-accident only or all four testing types

combined. Compared to no testing, results for these categories respectively were RR=0.85 (CI=0.72-1.0) and RR=0.97 (CI=0.86-1.10) for overall injuries, and RR=0.78 (CI=0.60-1.03) and RR=1.01 (CI=0.86-1.19) for lost-time injuries. Analysis by specific trades revealed significant reductions, as great as 60%, in overall and lost-time injuries for some trades. The trade category of supervisor, however, showed an increased injury rate with testing programs. Union companies had overall RR=0.86 (CI=0.72-1.02) and lost time RR=0.80 (CI=0.63-1.01) injury reduction with the four testing type combination. Non-union companies, however, only showed a noticeable decrease in overall injury RR=0.83 (CI=0.69-1.03) with the pre-employment/post-accident only testing program.

Conclusions: Our results indicate drug testing programs can reduce injury rates in this population; however effects vary based by trade, union status, and type of program. These programs are a potential solution to reducing injury burden to workers in a high risk population.

Session: **F.0**
Title: **Underreporting of Injuries III**
Moderator: Letitia Davis, Sc.D., Ed.M.

F1.1
Title: ***Overview of NIOSH Research on Occupational Injury and Illness Underreporting***
Author: Jackson L
Presenter: Larry Jackson, Ph.D.

To address concerns about occupational injury and illness underreporting, NIOSH is conducting several multi-faceted studies. These studies address case-capture, incentives and disincentives to injury reporting, and estimates for self-employed workers who are excluded in some reporting systems. This presentation will provide an overview of our current major research activities.

NIOSH conducts surveillance of occupational injuries/illnesses treated in emergency departments (EDs) through the National Electronic Injury Surveillance System-Occupational Supplement (NEISS-Work). We are evaluating NEISS-Work case capture through retrospective review of NEISS non-work cases collected for other agencies and onsite hospital record audits. In addition, we are conducting two telephone surveys of workers who were treated in an ED. Congress requested that we conduct one survey on underreporting of worker injuries and illnesses with a focus on the self-employed population. We are conducting a second survey funded by NIOSH's National Occupational Research Agenda (NORA) program. In this survey of employed individuals treated in an ED for work- and non-work-related injuries, we are focusing on identifying the workers' perceived incentives and disincentives to reporting an injury as work-related to the ED and to their employer.

Preliminary data from our retrospective review of NEISS non-work cases suggests that there is little evidence that hospital abstractors misclassify work-related cases as non-work-related. The hospital audits, which are currently underway, will help confirm this and indicate the proportion of missed cases in addition to those misclassified. We developed the two worker surveys with extensive external input that included cognitive testing with workers identified through NEISS-Work and NEISS. These surveys are currently awaiting formal approval to implement.

This presentation will serve as an introduction to more in depth presentations being given at this symposium in conjunction with this Special Session on Occupational Injury Underreporting.

F1.2
Title: ***If You are Injured at Work, Would You Report It and Why? A Questionnaire to Assess Worker Incentives and Disincentives to Reporting Occupational Injuries***
Authors: Reichard A, Marsh S, Heinke D, Dye C, Jackson L
Presenter: Audrey Reichard, M.P.H., O.T.R.

Background: To better understand workers' perspectives on occupational injury reporting, we developed a pilot project that uses telephone interviews to collect information on worker reporting beliefs, attitudes, and behaviors. This presentation will describe questionnaire content and the challenges of designing a valid and reliable questionnaire.

Study design: This pilot project will capture data from about 600 employed persons who were recently treated in an emergency department. Two distinct worker groups will be sampled-those treated for a work-related injury and those treated for a non-work-related injury. Respondents will be identified from the National Electronic Injury Surveillance System occupational supplement (NEISS-Work) and the NEISS-All Injury Program.

Questionnaire development: With the assistance of an expert panel and an extensive literature review, we identified the highest priority topic areas and drafted a

worker questionnaire assessing occupational injury reporting. The questionnaire underwent extensive review, pilot testing, and cognitive testing. The structured 30-minute questionnaire addresses: (1) worker and employment characteristics; (2) injury details; (3) injury reporting behaviors; and (4) process, incentives, and disincentives for reporting an injury to an employer. The Theory of Planned Behavior was used to design questions that assess intent to report a future work-related injury. This allows comparable assessments of beliefs, attitudes, and probable behaviors related to occupational injury reporting among those whose injury was not work-related.

Conclusions: Questionnaire design challenges included developing questions that were appropriate and relevant for workers from all industries and using terminology that could be easily understood by all workers. We also created a means to assess and compare workplace injury reporting beliefs and intent between those treated for an occupational injury and those who were not. Study results will be used to improve occupational injury surveillance activities and determine if a larger study, using the same or a similar questionnaire, is feasible and useful.

F1.3
Title: ***Did You Have a Work-related Injury or Illness? A Questionnaire to Assess Injured Workers' Employment Characteristics, Reporting Behavior, and Chronic Conditions***
Authors: Marsh S, Reichard A, Dye C, Derk S, Estes C, Jackson L
Presenter: Suzanne Marsh, M.P.A.

Introduction: A 2008 Congressional report suggested that non-fatal occupational injuries and illnesses in the U.S. are underreported. Based in part on this report, Congress allocated funds in 2009 for the National Institute for Occupational Safety and Health to collect information on occupational injury, illness, and exposure reporting with a focus on populations not captured through other surveys (e.g., self-employed and farm workers) and on chronic aspects of occupational injuries and illnesses for all workers. This presentation will review our study design and the questionnaire that will be used for data collection.

Study Design: The study will collect retrospective data through follow-back telephone interviews of individuals who were recently treated in the emergency department (ED) for work-related injuries, illnesses, or exposures as identified through the occupational supplement to the National Electronic Injury Surveillance System (NEISS-Work). Pending funding availability, approximately 1,500-3,000 respondents will be selected based on a stratified-random sample.

Questionnaire Development: Working with Westat and the Research Triangle Institute, we designed a 30-minute telephone interview to capture data from the respondents. We revised the questionnaire based on results of expert review, pilot testing, and cognitive testing. The questionnaire will cover topics such as worker and incident characteristics, whether the worker reported the injury to their employer, medical payer, and underlying chronic conditions.

Conclusions: The information gathered through the questionnaire will provide 1) national estimates of the number of ED-treated injuries, illnesses, and exposures by workers' employment characteristics; 2) an assessment of the reporting behaviors of injured or ill workers; 3) clarification of the underlying chronic aspects of each ED-treated condition; and 4) the prevalence of self-identified work-related chronic injuries and illnesses among these ED-treated workers. Ultimately, the knowledge gained will be used to improve surveillance of occupational injuries and illnesses.

F1.4
Title: ***Identification of Work-related Injuries in the Washington State Trauma Registry***
Authors: Sears J, Silverstein B
Presenter: Jeanne Sears, Ph.D., R.N.

Objectives: Many state trauma registries contain work-related information but are underutilized for occupational injury research. We assess approaches for identifying work-related injuries in the Washington State Trauma Registry (WTR), with an eye toward exploring the WTR as a source of work-related injuries not elsewhere reported.

Methods: The WTR contains severe injury reports from state-designated acute trauma facilities. Reports for 16+ year-olds injured during 1998-2008 were linked to workers' compensation (WC) claims using deterministic/ probabilistic protocols. Three methods of identifying work-related injuries using WTR data were assessed: (1) work-related indicator, (2) payer, and (3) ICD-9-CM E-codes (Alamgir et al., 2006). Linkage to an accepted WC claim was the gold standard for sensitivity calculations.

Results: The WTR contained 125,627 unduplicated injury reports, of which 6% linked to a claim. Sixty-three percent (63%) of those indicated as work-related were linked (sensitivity=87%, varying significantly by injury mechanism/location). Using E-codes in addition

to the work-related indicator increased the number of identified work-related injuries by 12% (sensitivity=90%). Forty-one percent (41%) of those additional injuries occurred on non-residential farm premises, compared with 7% when the two methods coincided. Those injuries were plausibly but not demonstrably work-related. Using payer in addition to the work-related indicator increased the number by 16% (sensitivity=95%). However, the number identified solely by payer was roughly similar to the number of crime victim claims involving trauma-related hospitalizations (Washington's Department of Labor and Industries pays both; they are indistinguishable using WTR payer fields). Thirty-five percent (35%) of those additional claims were in the homicide/assault category, compared with just 1% when the two methods coincided.

Conclusion: The work-related indicator is highly sensitive and may also identify injuries that occur in the course of exempt employment, are not reported to WC, and/or are work-related using definitions that go beyond WC coverage. Use of E-codes may add value, depending on the desired definition of work-relatedness.

Session: **F2.0**
Title: **Violence Among Educators**
Moderator: Cammie Chaumont Menéndez, Ph.D., M.P.H.

F2.1
Title: ***Work-related Violence against Educators in Minnesota: Rates and Risks Based on Hours Exposed***
Authors: Wei C, Gerberich S, Nachreiner N, Alexander B, Ryan A, Mongin S
Presenter: Chia Wei, M.S.

Objectives: Violence is a major occupational problem; yet, the population of educators has been neglected. The objective was to identify their potential risks for physical assault (PA) and nonphysical violence (NPV), based on hours exposed.

Methods: From a random sample of 26,000 licensed kindergartens through grade 12 Minnesota educators, 6,469 eligible educators were included. Data were collected, using specially designed mailed questionnaires (12-month recall). Calculated PA and NPV rates, per 100,000 working hours, used generalized linear models with Poisson distribution. Directed acyclic graphs identified confounders for multivariable analysis, adjusted for non-response and unknown eligibility.

Results: NPV rates (per 100,000 working hours) were higher than PA rates (26.37 and 5.31). Subcategory NPV rates were: Threat (34.82); sexual harassment (7.58); verbal abuse (55.48); bullying (19.62). Multivariate analyses for respective PA and NPV models revealed increased rate ratios (95% CIs) for those: not married (1.28[1.00,1.64]; 1.20[1.07,1.34]) versus married; worked in public alternative (1.73[1.11,2.68], 1.93[1.59,2.34]), versus public schools; worked in special education (4.39[3.13,6.16], 1.45[1.23,1.72]) and multiple activities (4.01[2.42,6.63], 1.41[1.09,1.83]), versus classroom teaching; worked with class sizes <10 (2.71[1.92,3.82], 1.43[1.20,1.71]), versus 10 to <25 students. Decreased risks for respective PA and NPV models were identified for: males (0.73[0.56,0.94], 0.85[0.76,0.94]), versus females; those working as educators for 20-29 (0.66[0.45,0.95], 0.66[0.56,0.78]), and more than 30 years (0.55[0.35,0.86]; 0.60[0.49,0.73]), versus <10 years; and worked in their current school for >20 (0.39[0.21,0.73], 0.80[0.63,1.01]) versus < five years.

Conclusion: Results provide information about factors associated with violence against educators and a basis for further investigation and interventions to reduce violence in the school environment.

F2.2
Title: ***Occupational Physical Violence Against Educators: A Case-control Study***
Authors: Gerberich S, Nachreiner N, Ryan A, Church T, Mongin S, McGovern P, Geisser M, Feda D, Sage S
Presenter: Susan Gerberich, Ph.D., M.S.P.H.

Objectives: Teachers/educators are known to be at increased risk of violence; yet, relevant research has focused primarily on students. The purpose of this two-phase mailed survey study (78% response, each phase) was to identify the magnitude of the problem and risk factors for assaults against kindergarten-grade 12 educators randomly selected (n=26,000 with 6,469 eligible) from the Minnesota license database.

Methods: Phase-1 (12-month recall) identified cases (n=290) and controls (n=867). Cases reported at least one work-related physical assault in the past 12 months; controls did not. In the Phase-2 case-control study, cases reported exposures for the month prior to assault, while controls reported exposures for a randomly selected month. Directed acyclic graphs identified confounders for multivariable analyses that were adjusted for non-response and unknown eligibility.

Only cases involving students as primary perpetrators (97%) were included in the analyses.

Results: Risks (ORs; 95% CIs) increased for those working in: Special Education (6.1, 4.2-8.8) or Social Work (7.3, 2.8-19.2) versus traditional classroom teaching; public magnet (versus public) schools (3.4, 1.1-10.7); schools with <50 (4.3, 1.7-11.1) and 50-200 (1.9, 1.01-3.5) versus 501-1000 students; schools with inadequate resources (always/frequently versus sometimes: 1.9, 1.2-2.9); inadequate building safety (always/frequently versus sometimes: 2.9, 1.6-5.5); soft versus brightly lit areas (1.4, 1.0-2.0), and with physical barriers (1.5, 1.1-2.1). In school environments where educators reported witnessing students engaged in physical assault, threats, sexual harassment, verbal abuse and bullying, risks for physical assault against educators increased incrementally for observations of 1-3, 4-10, and 10+ times in a month (OR range, 1.0 - 16.0). Risks decreased for those working in schools: conducting routine locker searches (0.5, 0.3-0.9); with sizes 1000+ versus 500-1000 students (0.5, 0.3-0.8); with easily accessible exits (0.4, 0.2-0.7); and never/infrequently (versus sometimes) inadequate building safety (0.7, 0.4-1.0).

Conclusions: These factors provide targets for potential interventions and additional research.

F2.3
Title: ***Risk Factors for Workplace Violence among Pennsylvania Education Workers: Differences among Occupations***
Authors: Tiesman H, Hendricks S, Konda S, Amandus H
Presenter: Hope Tiesman, Ph.D., M.S.P.H.

Background: There is little data on the prevalence of non-fatal assaults and non-physical workplace violence (WPV) in the education field. Moreover, collecting data on the wide variety of workers employed in education is difficult because of the lack of appropriate data sources for some occupations. The purpose of this study was to measure the prevalence, characteristics, and impact of WPV in a state-based cohort of educational professionals and support staff.

Methods: A state-wide sample of 6,450 workers was drawn using de-identified union membership lists provided by Pennsylvania's education unions. The sample was stratified on gender, occupation, and school location. Occupational groups included special education teachers, non-special education teachers, professionals (nurses, counselors, psychologists), support staff (cafeteria workers, janitorial staff, bus drivers), and teaching aides. A cross-sectional survey was mailed to participants. Analyses were performed using Proc SURVEY in SAS.

Results: An estimated 13,481 (95%CI = 12,352-14,610) education workers were physically assaulted and 49,318 (95%CI = 47,122 - 51,514) experienced a non-physical WPV event during the prior school year. Special education teachers had the highest proportion of workers experiencing a physical assault (21.9%), followed by professionals (11.6%), and teaching aides (9.7%). Professionals were more likely to be alone during a physical assault (p=0.05) and more likely to be assaulted outside of the classroom (p=0.005). Special education teachers (42.4%), professionals (31.8%), and non-special education teachers (30.4%) had the highest proportion of workers experiencing a non-physical WPV event. Verbal abuse was the most frequent type of non-physical WPV event (N=41,522) and the most common perpetrator was a current or former student (72.1%).

Conclusions: Special education teachers and those in professional occupations were at the highest risk for both physical and non-physical WPV. Interventions should not focus solely on teachers, as others in the education field are also at high risk for WPV.

F2.4
Title: ***Electronic Workplace Aggression among Pennsylvania Teachers and Education Support Staff***
Authors: Konda S, Tiesman H, Hertz M, Ferdon C, Hendricks S, Amandus H
Presenter: Srinivas Konda, M.P.H.

Introduction: Electronic aggression (using media technology, such as email, a chat room, a website, or instant or text messaging to harass or bully) has been identified as an emerging problem among youth; however, the victimization among those who work in a school-setting is relatively unknown. The purpose of this study was to measure the magnitude of physical, non-physical, and electronic workplace violence (WPV) in a state-based cohort of teachers and educational support staff using de-identified union membership lists. This analysis focuses on electronic WPV.

Methods: Using three large union member databases in the Pennsylvania, a population-based sample of 6,450 workers, stratified on gender, occupation, and school location was selected. Participants were mailed a cross-sectional survey on demographics, work history, frequency of WPV, and characteristics of WPV events. Estimates, prevalence proportions, and standard errors were calculated using Proc SURVEY methods in SAS.

Results: Two-thousand five-hundred and eighteen surveys were returned, for an unadjusted response rate of 39%. Unadjusted analyses indicated that approximately 4% (95% CI = 2.5% - 4.8%) of education workers were electronically victimized in the prior year (n=87). Seventy percent of the events were single incidents and 30% were on-going in nature. A higher proportion of females reported an electronic aggression event (females=4.1%, males=2.3%). More than two thirds of electronic workplace aggression events were experienced among Teachers (76.5%). Email (70.3%), social network sites (16.7%), and calls to personal cell phones (11.8%) were the leading mechanisms used for electronic workplace aggression. The most frequent type of electronic aggression event was a lie or rumor (47.3%), an aggressive or threatening comment (34%), and teasing (18.7%). Most electronic aggression events were perpetrated by co-workers (54%) and students (26%). Forty-eight percent of those who experienced electronic aggression reported that the event was 'very distressing'. Those who reported that their school or school districts had policies addressing teacher/staff electronic victimization were less likely to have experienced an electronic workplace aggression event in the prior year ($p \leq 0.001$).

Conclusions: This study provides knowledge on the frequency and characteristics of electronic workplace aggression among unionized education workers. Teachers were at the highest risk for electronic workplace aggression through email and social network sites from co-workers and students. Appropriate guidelines and policies should be implemented to reduce electronic workplace aggression directed at education workers.

Session: **F3.0**
Title: **Fall Prevention**
Moderator: Ted Courtney, M.S., C.S.P.

F3.1
Title: ***Factors Associated With Use of Slip-resistant Shoes in U.S. Limited-service Restaurant Workers***
Authors: Verma S, Courtney T, Corns H, Huang Y-H, Lombardi D, Chang W, Brennan M, Perry M
Presenter: Santosh Verma, Sc.D., M.D., M.P.H.

Objectives: A number of studies have indicated that slip-resistant shoes can reduce the risk of slips and falls, a leading cause of injury, at work. Few studies, however, have systematically examined factors associated with slip-resistant shoe use. This study examined the individual and workplace factors associated with slip-resistant shoe use in limited-service restaurants.

Methods: Four hundred seventy-five workers from 36 limited-service restaurants from three major chains in the U.S. participated in a study of workplace slipping. Demographic and job characteristic information about each participant was collected including, age, gender, ethnicity, education, job tenure, and hours worked per week. Restaurant managers provided the information on whether slip-resistant shoes were provided and paid for by the employer, and whether any guidance was given regarding slip-resistant shoe use when they were not provided. Kitchen floor coefficient of friction (COF) was measured. Slip-resistant status of the shoes was determined by noting the presence of a 'slip-resistant' marking on the sole. Poisson regression with robust standard error was used to calculate prevalence ratios.

Results: The mean age of the participants was 31 years, and 24% were 19 years old or younger. A total of 320 participants wore slip-resistant shoes (67%). In the multivariate analysis, the prevalence of slip-resistant shoe use was the lowest in 15-19 year age group. Women were 18% more likely to wear slip-resistant shoes. Use of slip-resistant shoes was 50% higher when they were provided by the employer as compared to when no guidance was given (95% CI 1.27 - 1.82). Education level, job tenure, and mean COF had no significant effects on the use of slip resistant shoes.

Conclusion: Findings suggest that provision of slip-resistant shoes was the strongest predictor of their use. Given their effectiveness and low cost, employers may consider providing slip-resistant shoes to reduce slips and falls at work.

F3.2
Title: ***Perceptions of Slipperiness as a Function of Visual Cues and Available Coefficient of Friction***
Authors: Lesch M, Chang W-R, Chang C-C
Presenter: Mary Lesch, Ph.D.

Objectives: Research suggests that people rely on visual cues to judge slipperiness of surfaces. However, it is unclear the extent to which visually-based perceptions of slipperiness are valid and reliable indicators of actual slipperiness (i.e., as measured by the coefficient of friction) and how they are integrated with proprioceptive cues obtained while walking on a surface. This study assessed perceptions of floor slipperiness before and after walking on different surfaces varying in terms of

their visual cues to slipperiness and available coefficient of friction (ACOF).

Methods: Walkways constructed from five different floor materials were presented in each of three surface conditions (dry, water, and 45%-glycerol). Participants wore a harness and were asked to walk repeatedly on each floor-surface condition as quickly as possible without slipping. Before and after each walk, participants rated perceived slipperiness of the walkway on a continuous scale from 0 (not at all) to 100 (extremely). Participants also provided visually-based ratings of reflectiveness, texture, and traction prior to walking on the surfaces. ACOF was measured by a PIAST slipmeter.

Results: A mixed model analysis of variance of the difference scores (pre-walk - post-walk slipperiness ratings) indicated significant main effects of Floor and Condition and a significant Floor X Condition interaction. While, overall, participants provided higher ratings of perceived slipperiness prior to walking on the surfaces (Mean Difference = 11.8, SE = 1), the magnitude and direction of the change in perception varied by floor condition. A generalized estimating equation regression analysis indicated that the relative contributions of ACOF and visual cues, to the perception of slipperiness, changed from pre-walk to post-walk.

Conclusion: While walkers may initially base their perceptions of slipperiness on visual cues, perceptions are further refined by proprioceptive feedback (as a function of differences in ACOF) received while walking across a surface.

F3.3
Title: ***Hazard Recognition Training to Prevent Falls among Ironworkers***
Authors: Scharf T, Hunt, III J, Repmann R, McCann M
Presenter: Ted Scharf, Ph.D.

Objectives: From 2008-2010, NIOSH collaborated with the International Association of Bridge, Structural, Ornamental and Reinforcing Iron Workers to evaluate a hazard recognition training curriculum to prevent falls in construction. Hazards are ubiquitous on a construction site; this training strives to help participants become more alert to and aware of the constantly changing hazards around them.

Methods: The hazard recognition training curriculum is structured around a title slide that establishes the construction job site and thirteen additional stereo images that are presented on a Viewmaster® viewer. (The images may also be projected via a computer and LCD.) The fourteen images derive from the construction of the Paul Brown Stadium in Cincinnati, Ohio, in February 2000.

Typically, trainees first approach the images thinking only, "where's the (OSHA) violation?" However, after four or five images, they begin to understand that the purpose of the training is not so much about what they see in the images. Rather, the training asks participants to think about what is missing from the images, and, more importantly, how the particular job could be completed more safely.

Training Evaluation: Trainees were asked to evaluate an image (not included in the training) 30 days prior to the training, and a second image just prior to the class. Following the training, a third image was evaluated, as well as two additional images at three- and six-months post-training. An evaluation of the training class was also solicited. Trainers assessed the curriculum qualitatively for its effectiveness with apprentices.

Results & Conclusion: Three hundred thirty apprentices and thirty-three journeymen ironworkers participated in at least some portion of the seven-month hazard recognition training evaluation. Data entry is currently underway. Findings from the evaluation of the hazard recognition training will be presented. A summary of the trainers' qualitative evaluations will also be presented.

F3.4
Title: ***Field Evaluation of a Hands-on Training Program for the NIOSH-designed Guardrail System***
Authors: Fullen M, Takacs B, Bobick T
Presenter: Mark Fullen, Ed.D., C.S.P.

Objectives: A current NIOSH project has developed a guardrail system. West Virginia University Safety & Health Extension (WVU) has developed a training program, in conjunction with NIOSH that focuses on OSHA Fall Protection training requirements and on the installation and use of the NIOSH guardrail system. The objective of this research is to evaluate the impact of the training on the reduction of fall hazards and on the proper installation and use of the guardrail system.

Methods: Two residential construction contractors have agreed to use the guardrail system to evaluate its effectiveness and usability in a field study. WVU has conducted baseline field evaluations of residential construction work underway prior to having access to or being trained on the guardrail system. The field evaluation collects data on events where workers are exposed to fall hazards. The baseline field data

collection includes residential fall hazards of installing floors, erecting walls, setting trusses, and installing roofing. Once the hands-on training is complete, multiple field evaluations will be conducted to measure the change in fall hazards and use of controls from the baseline.

Results: WVU has completed baseline field evaluations of both contractors. The baseline results have shown that with the exception of an occasional window opening 2x4 guardrail installation, no fall protection is being used by either contractor during any phase of construction. The training program is complete and will be delivered in April 2011. The post training field evaluations will be conducted between April and June 2011 and a focus group will be conducted in July 2011. The focus group will determine the effectiveness and impact of the hands-on training on the proper installation and use of the guardrail system, as well as determining any reduction of fall hazards.

Conclusions: The baseline field data that has been collected, which shows virtually no fall protection being used, reinforces the need for effective training programs on fall protection for the residential construction industry, as well as the need for fall protection products that meet the needs of the residential construction worker. The final results of this project will be analyzed in July and August 2011 and will be complete to present in October 2011.

Session: **F4.0**
Title: **Mining**
Moderator: Jeffrey Welsh, B.A.

F4.1
Title: ***Profitability and Occupational Injuries in U.S. Underground Coal Mines***
Authors: Getahun AA, Mark C, Pana-Cryan R
Presenter: Christopher Mark, Ph.D.

Background: The coal mining industry plays a crucial role in the U.S. economy. However, coal mining continues to be one of the most dangerous occupations in the country. Not only is the overall injury rate high in the industry, there also are significant variations in the incidence of occupational injuries across mines.

Objective: The major objective of this study was to examine the association between profitability and the incidence of occupational injuries in U.S. underground coal mines between 1992 and 2008.

Data and Method: We used the employment and accidents/injury database of the Mine Safety and Health Administration (MSHA) and individual mine revenue data provided by the U.S. Energy Information Administration. A negative binomial random effect regression model was used. Injuries were measured by the incidence rates of all reported injuries, including fatal injuries; injuries with days lost; and serious injuries, including fatal injuries. Profitability was approximated by revenue per hour worked. Our model included control variables such as mine age, union status, long-wall mining, and region. The total number of hours worked in each mine during each year examined was used as an exposure variable.

Results: After controlling for the other factors we included in the model, a 10 percent increase in the real total revenue per hour was associated with 0.8, 0.11, and 1.4 percent decrease the incidence rates of all reported injuries, injuries with days lost, and serious injuries, respectively.

Conclusion: The association we observed between profitability and safety might have been due to larger investments in safety by highly profitable mines. It could also have been due to less tangible variables that affect both profitability and safety, such as management or engineering practices. An important finding of this study was that mines that are already financially stressed cannot afford to forgo investing in worker safety.

F4.2
Title: ***Need for an Intelligent Proximity Detection System in Underground Coal Mining***
Author: Carr J
Presenter: Jacob Carr, M.S.

Proximity detection technology is emerging as an effective means to protect workers from striking and pinning hazards around machinery. The underground mining industry is deploying electromagnetic proximity detection systems on a trial basis, and regulators are considering mandating the use of such systems. These systems use machine-mounted and wearable devices to create a magnetic marker field around a machine - if the system detects a person within this marker field it disables machine motion. While this technology provides a certain level of protection, there are limitations. NIOSH has conducted extensive research related to the use of proximity detection systems and on the acceptance of these systems by the mining industry. This research has included interviews conducted with machine operators to determine where they position themselves around the machinery and what visual attention locations they need to see. In addition,

researchers collected interview data to determine what pre-conceived notions miners hold about this technology. This data is extremely valuable in assessing the potential for widespread adoption of the technology. Based on the findings of this prior effort, researchers concluded that a more intelligent technology is necessary to provide optimal protection. The intelligent Proximity Detection (iPD) system, developed by NIOSH, provides more advanced protection by monitoring the position and posture of the miners in real-time and assessing their safety status relative to the specific machine motions being commanded by the machine operator. With this intelligent protection, the miners can position themselves to perform their jobs most effectively and best avoid other hazards present in the mine, such as other equipment and unsupported roof. The adoption of this concept in the mining and other industries could significantly improve the safety of workers and could accelerate the widespread adoption of proximity detection technology.

F4.3
Title: ***Avoiding Collisions in Underground Mines***
Author: Burgess-Limerick R
Presenter: Robin Burgess-Limerick, Ph.D., C.P.E.

Collisions between vehicles or equipment, and between people and equipment, are a high risk in underground mines. The probability of collisions is relatively high because of the restricted working environment, restricted visibility from vehicles, and in some situations by the use of mining methods which involve close interactions between pedestrians and equipment. The consequences include serious injury and fatalities.

The prevention of collisions has recently been a focus of attention by regulators in both Australia and the USA; and particularly the promotion of technological solutions for alerting equipment operators to the proximity of other vehicles, equipment or people. While the application of proximity detection technology is potentially beneficial, this paper takes a broader view of the problem and provides a review of the human factors and ergonomics issues related to the prevention of collisions in underground mines.

Case studies are presented which illustrate: The potential for equipment design changes to improve visibility; augmenting perception through the use of video cameras; the potential for proximity detection technology to reduce underground collisions; the role of vehicle control design in reducing collision risks; and the potential role of mine design.

Human factors issues associated with the introduction of remote control and automation are canvassed, as is the role of human factors in the training of operators of underground equipment.

F4.4
Title: ***Internalizing Occupational Health Effects in the South African Coal Mining Sector***
Authors: Thopil G, Pouris A
Presenter: George Thopil

Coal mining is an integral part of South Africa's mining sector. The majority of the electricity industry is dependent on coal as the primary fuel source, hence the condition of coal workers who extract coal from the mines cannot be undermined. Coal is also the largest commodity mined in South Africa in absolute quantity thereby employing the largest mining workforce amongst all other sectors.

This paper attempts to make a breakdown of the type of occupational health injuries both fatal and non fatal and also of the health effects the workers in coal mining sector encounter. Breaking down the fatalities and health effects enables providing occupational compensation a less tedious task. A cumulative statistical analysis is made to analyze the total monetary value involved while providing compensation for the health aspects involved in the coal mining industry. This monetary value is further expressed in terms of the total electricity produced. The aim of this paper is to provide the local coal mining sector a holistic awareness of the occupational hazards involved and to express the throughput electricity generated in terms of the total monetary compensation.

Session: **G1.0**
Title: **Patient Lifting**
Moderator: CAPT James Collins, Ph.D., M.S.M.E.

G1.1
Title: ***"Time" as a Barrier to the Use of Patient Lift Equipment: More Complex than "Minutes to Complete the Task"***
Authors: Myers D, Schoenfisch A, Lipscomb H
Presenter: Douglas Myers, Sc.D.

Objectives: "Time" is often mentioned as a barrier to use of patient lift equipment. The meaning of "time," however, may be more complex than has been reported in the literature. As part of an evaluation of a Minimal Manual Lift Environment policy, qualitative methods were used to explore what healthcare workers meant by

"time" as a constraint and the conditions under which "time" was a barrier to lift equipment use.

Methods: Focus groups (n = 12) were conducted among healthcare workers (nurses, aides, PT/OT, radiology technicians, transporters) in a large academic hospital and an affiliated community hospital in the southern U.S. as part of the larger intervention effectiveness evaluation. Focus group participants were asked about barriers to adoption of patient lift equipment. When "time" was mentioned, participants were asked to elaborate on the meaning of "time" and to illustrate conditions/contexts in which time was seen as a barrier. Data were analyzed using text analysis software (ATLAS.ti v6.2).

Results: Focus group participants regularly cited "time" as a barrier. However, the text data revealed that what was meant by "time" was often not simply "minutes to complete a task." "Time" was connected to efficiency and task duration, but also to equipment availability, staffing, relations with other hospital staff, patient needs, competence and comfort with the equipment and other factors.

Conclusions: "Time" as a barrier to adoption of safety measures must be understood as dependent on workplace contexts. Aspects of "time" beyond individuals' time expenditures, such as the time required of the organization to train workers in efficient use of patient lift equipment to ensure and maintain competence, must also be considered. Overcoming "time" as a barrier to the adoption of safety measures may depend in part on understanding the social contexts and cultural interpretations of time at both individual and organizational levels.

G1.2
Title: ***Evaluating the Effect of an Intervention to Prevent Patient-handling Injuries among Hospital Workers: Support of the Collection of Intermediate Measures of Intervention Adoption and the Integration of Quantitative and Qualitative Methods****
Authors: Schoenfisch A, Lipscomb HJ, Myers D, Pompeii L, Dement JM, James T
Presenter: Ashley Schoenfisch, M.S.P.H.

Background: An understanding of the effectiveness of interventions to prevent patient-handling injuries to staff in the acute care hospital setting is needed, but evaluations are challenging. They must be flexible to accommodate the complexity of the healthcare setting but rigorous enough to provide a sound evaluation. This study evaluated the effectiveness of institution-wide placement of mechanical patient lift equipment in preventing musculoskeletal (MS) patient-handling injuries among patient caregivers in a large medical center and affiliated community hospital.

Methods: Various sources of quantitative and qualitative data were used to evaluate the intervention's implementation, adoption and effect on injuries and injury-related outcomes (e.g. days away, restricted days, costs): a surveillance system, surveys, focus groups, unit-level assessments and equipment supply purchase data. To address delayed impact of the intervention effect, analyses of injuries and related outcomes compared rates pre- versus post-intervention, applying lagging at 6-month intervals following the intervention.

Results: Lift equipment adoption was gradual, variable and limited. Several factors influenced adoption: time, knowledge/ability, staffing, patient characteristics, organizational factors, and cultural aspects of work. At the medical center, no change was observed in the rate of MS patient-handling injuries following the intervention with no lagging; a 44% decrease was observed at the community hospital. A non-significant protective effect of the intervention was observed in lagged analyses. At both hospitals, the rate of days away declined substantially and immediately, patterns which most likely reflect parallel institutional-level changes.

Conclusions: Data on intervention adoption and the context in which an intervention takes place can be important to guiding a researcher's analytical approach and interpretation of quantitative findings. Each piece of this work had a significant level of research rigor and unique strengths, yet the overall strength of this evaluation lies in the comprehensive picture provided of the context, intervention implementation, adoption, and effect on patient-handling injuries.

*Intervention Evaluation Contest - Winning Paper

G1.3
Title: ***Safe Patient Handling: Implementing a National Program***
Authors: Hodgson M, Matz M, Nelson A
Presenter: Michael Hodgson, M.D., M.P.H.

Background and Objectives: The Veterans Health Administration (VHA) consists of approximately 150 hospitals, 800 outpatient clinics, 40 nursing homes, and residential rehabilitation facilities.

Methods: VHA developed a national role-based injury management system to support national safety programs in 2002 and 2001. A patient manual handling injury program was developed and pilot-tested, from 2001 to

2003, generating business case estimates. A national survey, in 2006, identified the estimated proportion on partially and fully dependent patients and established a likely needed density of ceiling lifts and other technology. This supported the development of a formal budget proposal for national implementation. A roll-out plan included both ongoing operational evaluation and a formal translational research endeavor.

Results: Patient manual handling injuries represent 12% of the adverse events among the over 260,000 health care personnel and 45% of injuries among nursing personnel. Rates rose continuously through 2006 reaching 400 injuries / 10,000 person years, driven by increasing awareness, increased patient acuity, and increased patient body mass. VHA's nation-wide safe patient handling program, a joint patient and employee safety program, consists of an ergonomics assessment, implementation of technology [ceiling lifts], changes to the patient care process[assessment algorithms, training], unit peer leaders as change agents, safety huddles to examine adverse events, and infrastructure maintenance. A demonstration project in one regional business unit showed an internal rate of return of between 19 and 37%. A budget proposal for approximately $200,000,000 led to implementation beginning in June 2008, with completion anticipated by the end of 2011. Crucial to implementation was a designated program manager at each facility. The absence of protected time to implement the program was associated with slower injury rate declines. By June 2010 approximately 50% of equipment was on-site though some not yet installed. Patient handling injury rates among nursing personnel declined by over 45% from the peak of 2006 to early 2011. Implementation of program elements, including measures of management commitment and buy-in, unit-peer leader program development, front-line worker training, and infrastructure development, was not associated with injury rate declines.

Conclusion: Large scale safety program implementation requires careful business case development, a collaborative implementation approach, multiple levels of evaluation, and both careful oversight and local flexibility.

G1.4
Title: ***VHA Evaluation of Safe Patient Handling Initiative***
Authors: Powell-Cope G, Rugs D, Patel N
Presenter: Gail Powell-Cope, Ph.D., R.N., F.A.A.N.

Objectives: In 2007 the Veterans Health Administration (VHA) launched a system-wide initiative to implement an evidence-based Safe Patient Handling Initiative (SPHI) across all VHA Medical Centers. The purpose of the initiative was to reduce injuries among nursing professionals in VA Medical Centers. The James A Haley VA, Patient Safety Center of Inquiry was tasked with the program evaluation of the National VA Safe Patient Handling Initiative (SPHI). The objectives were to: (1) Evaluate program results associated with implementation of the SPHI across sites and over time; (2) Identify factors associated with implementation over time; (3) Identify program components associated with injuries over time.

Methods: This three-year longitudinal study used a mixed-methods (quantitative and qualitative) approach. Process and outcome variables were collected at baseline and 6-month intervals. For the evaluation, a three-tiered plan was implemented. Level I data was collected from 153 VA Medical Centers. Program implementation, milestones and selected outcome measures were tracked with surveys. Data on injury rates was gathered from VA extant databases. Level 2 data came from a sample of 18 VA Medical Centers that collected anonymous staff and peer leader surveys. Level 3 data was gathered from qualitative interviews, focus groups and unit walk-arounds of a subset of 6 VA Medical Centers.

Results: Since the VA National rollout of the Safe Patient Handling Initiative:

- Patient lifting and repositioning injuries have decreased among nursing professions in the VA. Program implementation has steadily increased.
- Characteristics of facility championship were associated with implementation in multiple areas.
- Program Elements and Facility Readiness were not associated with injuries; however, amount of equipment installed was associated with injuries.
- Although facility championship status was not significantly related to injuries, a trend was identified; the less turnover in the facility champion position the greater reduction in injuries.
- Other analyses to be presented will include staff outcomes (turnover, severity of injuries, job satisfaction), patient outcomes, and program costs of the program.

Conclusions: The evidence shows increasing implementation of the SPH program over time. Facility champions positively influence implementation in multiple areas. Degree of implementation (only equipment) is positively related to patient handling injuries.

Session: **G2.0**
Title: **Vulnerable Populations**
Moderator: Thomas Bobick, Ph.D.

G2.1
Title: ***Temporal Patterns in Fatality Rates of Selected Retail Industries in the United States, 2003–2008***
Authors: Chaumont Menéndez C, Amandus H, Konda S
Presenter: Cammie Chaumont Menéndez, Ph.D., M.P.H.

Background: Convenience store, gas station, and liquor store workers have historically experienced a disproportionately high occupational fatality burden due to workplace violence. I n the United States cashiers and managers of food-serving and lodging establishments experienced high homicide rates from 1996 through 2000. The objective was to describe temporal patterns in fatalities due to violent acts by another person among selected retail industries using a national active surveillance system for fatal work-related injuries.

Methods: An analysis of fatality rates among selected retail industries in the U.S. occurring from 2003 through 2008 was conducted using the Census of Fatal Occupational Injuries. Homicide rates were differentiated between all workers, retail industry workers, and foreign-born retail industry workers and evaluated for temporal patterns over the 6-year time span.

Results: The overall fatality rate due to violent acts in 2008 was 0.03 per 10,000 workers (95% CI +/- 0.00009) compared with 0.04 (95% CI +/- 0.0001) in 2003. For selected retail industries the fatality rate due to violent acts by another person averaged 0.15 per 10,000 workers (95% CI too small to report). Among foreign-born workers the rate decreased from 0.43 in 2003 to 0.25 in 2008 (95% CI too small to report).

Conclusions: Fatality rates due to violent acts by another person in selected retail industries remain high. Although fatality rates have decreased substantially among foreign-born workers, they remain double those of all retail workers. Foreign-born workers are an important focus for workplace violence prevention efforts, particularly in retail industries.

G2.2
Title: ***Cut-laceration Injuries and Related Career Groups in New Jersey Career and Technical Education***
Authors: Mizan S, Marshall E, Shendell D, Campbell J, Kelly S
Presenter: Derek Shendell, D.Env., M.P.H.

Objectives: We identified factors leading to cut-laceration injuries among adolescent students in New Jersey (NJ) career and technical education courses.

Methods: Of 1772 injury incidents reported by NJ public secondary schools 12/1/1998-9/10/2010, 777 (44%) were cuts and lacerations; we focused on 224 reported since fall 2005. Records of behavior incidents (n=9) were excluded. We focused on three major career groups-- Food, Hospitality & Tourism (FH&T) (n=71), Manufacturing & Construction (M&C) (n=84), Automotive & Transportation (A&T) (n=27); final sample size was 182. We analyzed injury type, tools involved, and body part injured, by career group, age and gender.

Results: Most common cause (n=93, 51%) of cuts and lacerations was being "struck by" a tool or hard surface; 68 were caused by knives (n=62 in FH&T). Metal cutting tools caused most cuts and lacerations (n=83). In M&C, most cuts and lacerations were caused by hand-held tools (n=18), especially saws, and being "struck against/by" or "caught between hard surfaces" (pinch points) (n=19), particularly metal objects and equipment. In A&T, contact with machinery was most common (n=9). Overall, males had more cuts and lacerations (n=176) than females (n=48). Cuts and lacerations occurred most commonly among 11th graders (n=54) and 16-17 year-olds (n=79). Fingers were body part (n=131) most often injured, usually by a cutting tool (n=80), and most frequently a knife (n=66 of 80) in FH&T (n=59 of 66). The second most frequent body area injured was upper extremity; for M&C (n=19), the reason was not a specific tool but being struck against/by or caught between hard surfaces, particularly metal objects and equipment.

Conclusion: Further appropriate training, supervision, and equipment are needed to prevent cuts caused by knives in FH&T. Proper training on hand held tools and further assessment of struck by and pinch point hazards may prevent injuries in M&C and A&T.

G2.3
Title: ***Systematic Review of Intervention Practices for Depression in the Workplace***
Authors: Furlan A, Gnam W, Carnide N, Irvin E, Amick B, DeRango K, McMaster R, Cullen K, Slack T. Brouwer S, Bultmann U
Presenter: Andrea Furlan, M.D., Ph.D.

Objective: Depression is a common psychiatric illness with personal and economic consequences: While at work. A systematic review was conducted to determine which workplace intervention approaches to manage depression have been successful and yielded value for employers in developed economies.

Methods: We searched MEDLINE, EMBASE, CINAHL, Central, PsycINFO and Business Source Premier (BSP) up to June 2010 using search terms in four broad areas: work setting, depression, intervention, and work outcomes. Two independent reviewers selected potential articles for inclusion using the PICO framework. Population: working age individuals with depression diagnosis. Interventions that were workplace-based or that could be implemented and/or facilitated by the workplace. Comparison: Any study with a comparator group and studies with before-and-after comparisons within the same group. Outcomes: prevention, management and recurrences of work disability or sickness absence, work functioning, economic outcomes, depression severity and remission, psychosocial work outcomes and workplace incidents. From 5,416 titles and abstracts identified, we retrieved 293 for full-text screening, and 12 met inclusion criteria. Two independent reviewers extracted data. The evidence was then aggregated and graded on six domains: Study design, risk of bias, consistency, generalizability, data precision, and economic benefit. Following GRADE guidelines the final grade for quality of evidence was categorized as: High, Moderate, Low or Very Low.

Results: We included ten randomized trials and two non-randomized studies from various countries and jurisdictions that evaluated a wide range of intervention practices. The evidence was graded as "very low" in all cases. Consequently, there is no single intervention that we recommended as effective. At best, we have identified the following interventions as recommended for future research: Enhanced Primary Care, Enhanced Psychiatric Care, Enhanced Role for the Occupational Physician, Psychological Interventions, Worksite Stress Reduction and Systems Integration and Care Management.

Conclusions: More research is needed in North America.

G2.4
Title: ***Preventing Injuries among Hispanic Construction Workers in the United States***
Authors: Forst L, Ahonen E, Zanoni J, Tendick F
Presenter: Linda Forst, M.D., M.P.H.

Objectives: To foster development of an occupational health and safety agenda within the Worker Center movement; reduce construction injuries among Hispanic workers.

Methods: We identified worker leaders among worker centers that serve low wage and street corner, Hispanic construction workers in seven cities to become trainers of an OSHA 10-hour, popular education course in construction health and safety. They recruited peers from street corners and jobs and trained them in 14 sessions.

Results: In year 3 of the project, 16 worker leaders trained over 350 Hispanic construction workers. Three-month post-training interviews indicate the ways in which workers implemented the training content in their workplace, including confronting their supervisors for personal protective equipment, organizing co-workers to walk off unsafe jobs, contacting OSHA and bringing their own PPE to work.

Conclusions: Popular education, worker-led training positively impacts worker behavior and should ultimately lead to injury prevention among Hispanic construction workers.

Session: **G3.0**
Title: **Work Schedules, Sleep, and Fatigue**
Moderator: David Lombardi, Ph.D.

G3.1
Title: ***Hours of Work in the United States: Results from Three Waves of the General Social Survey***
Authors: Grosch J, Caruso C
Presenter: James Grosch, Ph.D.

Objectives: Despite a growing body of research on the safety and health effects of long working hours, there are relatively few studies that have examined this issue using nationally representative data collected over time. The goal of this study was to analyze data from the General Social Survey (GSS) to better understand recent changes in the U.S. regarding hours worked per

week and type of shift, as well as possible associations between hours worked and several safety and health measures.

Methods: Data came from three waves of the GSS (2002, 2006, and 2010), which is conducted as a face-to-face cross-sectional interview by the National Opinion Research Center. The GSS yields a representative sample of the civilian, non-institutionalized, U.S. adult population. For all three waves, a 76-item quality of worklife module (QWL) developed by NIOSH was included. Topics covered in the QWL module included: work arrangements (e.g., hours worked during previous week, type of work schedule), job tasks, psychosocial working conditions, and several measures of worker health and well-being. Sample size for the QWL module was 1,744 in 2002, 1,669 in 2006, and 1,132 in 2010---for a total 4,545 respondents. Response rate was approximately 70%. Analyses were conducted focusing on changes in hours worked and type of work schedule across the three waves, as well as associations between hours worked and safety/health measures in the three waves combined.

Results: Across the three waves, the average number of hours worked in the past week increased slightly from 2002 (41.8 hrs) to 2006 (42.1 hrs), and then declined slightly in 2010 (41.4 hrs.). The percentage of workers in non-traditional work schedules also changed slightly, with the greatest declines reported for night and rotating shifts. Mandatory overtime increased from 26.2% in 2002 to 28.3% in 2010. For the combined GSS data, adverse health associations were present for workplace injuries, back pain, and general health when the number of hours worked was 60 or greater, although this relationship was moderated by occupation/industry, whether or not overtime was mandatory, and psychosocial working conditions (e.g., autonomy, fairness).

Conclusions: Results of this analysis indicated slight changes in number of hours worked and type of work schedule in the U.S. between 2002 and 2010. In addition, several significant associations emerged between long hours of work and measures of health and well-being. Possible reasons for these findings, as well as limitations of the GSS data, will be discussed.

G3.2

Title: ***Patterns of Sleep, Sleepiness, Fatigue, and Neurobehavioral Performance in Registered Nurses Working Successive 12-hour Shifts***

Authors: Geiger Brown J, Rogers V, Trinkoff A, Kane R, Scharf S
Presenter: Jeanne Geiger Brown, Ph.D., R.N.

Objective: Nurses working 12-hour shifts complain of fatigue and insufficient/poor quality sleep. Objectively measured sleep times have not been described. This study described patterns of achieved sleep, sleepiness, occupational fatigue, and neurobehavioral performance over three consecutive 12-hour shifts (day and night) for hospital registered nurses.

Methods: We examined sleep (actigraphy), performance (PVT), sleepiness (Karolinska) prospectively in 80 R.N.s over three successive 12-hour shifts. Occupational fatigue was assessed at baseline.

Results: Nurses had short sleep (mean 5.5 hours) between shifts, were sleepier on the third day, had more lapses in vigilance on the second day. Fatigue was high in one third of nurses, with intershift fatigue being most common. Lapsing was trait like with rare, occasional and frequent lapsers.

Conclusions: Nurses accrue a considerable sleep debt while working successive 12-hour shifts, this seems to be related to sleep opportunity rather than sleep ability.

G3.3

Title: ***The Impact of Nurses Work Schedules on Patient Mortality***

Authors: Trinkoff A, Storr C, Johantgen M, Liang Y, Han K
Presenter: Alison Trinkoff, Sc.D., M.P.H., R.N., F.A.A.N.

Objectives: Nurses work schedule characteristics, including long work hours and shift rotation, have been previously related to nurse illness, injury, fatigue and sleep deprivation. The impact of nurse schedules on patient mortality has been little studied, and could be an important addition to the evidence base that supports healthier work schedules for nurses. We therefore sought to examine the impact of nurses work schedules on patient mortality.

Methods: We conducted a secondary data analysis using administrative data from 71 hospitals, linked to survey data from 633 nurses working within these hospitals. Nurse survey data were collected in 2004, as part of the Nurses Worklife and Health Study 3, which focused on neck, shoulder and back MSD and needlestick injuries in relation to extended work schedules. Principal

components analysis was conducted on 12 work schedule items to create 8 independent components reflecting work schedule characteristics. Generalized estimating equations were used to test the hypothesis that hospitals with higher patient mortality rates would be those where nurses reported adverse work schedule characteristics. Mortality was measured using Agency for Healthcare Research and Quality (AHRQ) Inpatient Quality Indicators. Control variables included nurse staffing (nursing hours per patient day), skill mix (proportion of registered nurses), and other hospital descriptors.

Results: Pneumonia deaths were significantly more likely in hospitals where nurses reported schedules with long work hours (odds ratio [OR] = 1.42, 95% confidence interval [CI] =1.17-1.73, $p < .01$) and lack of time away from the workplace (OR =1.24, 95% CI = 1.03-1.50, $p < .05$). Findings regarding other work schedule components that were significantly related to patient mortality will also be presented.

Conclusion: Nurses' work schedules were significantly related to patient mortality. Our finding that work schedules adversely affected patients provides another incentive for stakeholders to implement healthier schedules for nurses.

G3.4
Title: ***Improving Computer Break Schedules: The NIOSH Rest Break e-Toolbox***
Authors: Streit J, Pierson K, Strominger J, Ripley T, Galinsky T
Presenter: Jessica Streit

Today, over half of all U.S. workers use computers daily (BLS, 2007). Despite the safe use threshold of 25 weekly hours, the average user spends 37 weekly working hours on a computer. These intense users experience adverse health effects ranging from fatigue and short term discomfort in the muscles and eyes to long-term chronic conditions like carpal tunnel syndrome, blurred vision, and chronic headaches (Matias et al., 1998; Nainzadeh et al., 1999; University of Toronto, 2000). Recent studies have even linked intense computer use to increased risk of developing obesity, heart disease, high blood pressure, and diabetes (Yeager, 2009).

Engaging in regular rest periods lasting 5 minutes during each hour of computer use have been deemed the most effective health protection intervention available for this worker population (Galinsky et al., 2000; Galinsky et al., 2007; Van Erd, et al., 2006). This recommendation highlights the inadequacy of the standard rest schedule (two 15-minute breaks and one 30-minute meal period) in providing recovery time for computer users.

NIOSH has partnered with social research evaluation and integrative business solutions firms to develop a rest break e-toolbox. This toolbox educates stakeholders on the importance of rest breaks and aids with their transitions to revised break schedules.

This presentation will share a beta version of the e-toolbox with the audience and describe the upcoming field studies to test the behavior changing properties of the e-toolbox and the effectiveness of a supplemented rest break schedule for computer users. This presentation is meant to be a true give-and-take between presenter and audience: the audience will receive a demonstration with the beta version of the rest break toolbox while concurrently providing the presenters with constructive commentary e-toolbox and planned data collection efforts.

Session: **G4.0**
Title: **Agriculture II**
Moderator: David Hard, Ph.D.

G4.1
Title: ***Injuries to Hired Crop Workers in the United States***
Authors: Myers J, Wang S, Layne L
Presenter: John Myers, M.S.

Objective: Little empirical data are available examining the injury experience of hired crop workers in the United States (U.S.). To fill this gap, this study analyzed farm work-related injury data from a national survey of hired U.S. crop workers.

Methods: Data were collected through the U.S. Department of Labor (USDOL), National Agricultural Workers Survey (NAWS) for the federal fiscal years 1999, 2002, 2003 and 2004. Multi-year survey weights were used to provide adjusted estimates for the number of crop workers interviewed, injuries, and injury rates from the NAWS. Full time equivalent estimates for crop workers were developed using the number of weeks of farm work reported by the crop workers for the 12 month period prior to interview, and is denoted as FTE_{WB}.

Results: The multi-year weighted number of crop workers for the study was 9,970, of which 262 reported a farm work-related injury. The farm work injury rate was 4.3 injuries per 100 FTE_{WB}. The majority of the injuries occurred to male (84%) and Mexican born 72%)

workers. Workers reporting one or more health problems and workers reporting one or more complaints of musculoskeletal pain had statistically significant higher injury rates compared to workers with no health or musculoskeletal pain complaints respectively. The most common injury events were overexertion from lifting (20%), being struck by hand held objects (13%), and falls to a lower level (10%). Injuries due to falls to a lower level accounted for the highest average number of restricted workdays (45 days).

Conclusions: Lifting, hand tool use, and falling to a lower level were significant causes of injury among hired crop workers. Hired crop workers with existing health or musculoskeletal complaints also had increased injury risk. These results are useful for targeting injury prevention efforts and future research needs for this unique worker population.

G4.2
Title: ***Research to Action Promotes a Healthier Workplace on the Farm***
Authors: Wyckoff S, May J, Simcox N, Cherniak M, Gonzales M
Presenter: Sherry Wyckoff, B.S.

Background and Objective: Northeast Center for Agricultural Health researchers and the University of Connecticut Health Center used community-based participatory research (CBPR) to identify/address an occupational health priority for employers and workers producing shade tobacco in Connecticut. Field sanitation conditions concerned workers. Hygiene issues concerned employers. Perceptions relating to the availability of water /soap / towels differed substantially between employees and employers.

Methods: We provided: 1) hygiene trainings for workers; 2) encouragement regarding OSHA field sanitation requirements for employers. The CBPR work team incentivized attendance at bi-lingual hygiene trainings. We worked with employers to devise new economical solutions to the problems encountered meeting OSHA wash station requirements. To sustain this project, we are currently developing a health and safety promoter program to continue to provide trainings to farmworkers by farmworkers.

Results: To date, 1500 workers have received safety trainings. We educated growers in individual meetings and with presentations at a spring regional meeting. The team's consistent presence over four years built trust. A major producer in the region redesigned wash stations to increase access for hand washing and permitted worker trainings during work. Wash station enhancements continue to be developed and will be presented. Interview data with farmworkers show impact of the trainings. Field surveys of wash stations document high compliance with OSHA standards.

Conclusion: The CBPR approach and years invested created trust between the farming community, health agencies and researchers. This allowed access to farms and workers for testing, implementation and evaluation of interventions. Employers were provided with a cost-effective method of complying with field sanitation requirements. Farmworkers experienced improved environmental health and safety through enhanced hygiene practices.

G4.3
Title: ***A Campus-community Partnership for Tomato Workers' Health***
Authors: Hoffman K, Andino A, Manock S, Manz N, McNabb R, Keen P, Reining C, Silver K, Liebman A, Loury S, Florence J
Presenter: Ken Silver, S.M., D.Sc.

Objective: Migrant farm workers are continuously exposed to ergonomic and chemical hazards in Tennessee which is among the top five tomato producing states. Marshaling greater resources to address these job-related health concerns in rural areas requires innovative partnerships among primary care providers, occupational health professionals, and farmworker advocates.

Methods: In the spring of 2008 an interdisciplinary team of students and faculty catalyzed a partnership with a regional clinic for migrant laborers and a national clinical network for healthcare professionals caring for the mobile underserved. Based on clinical observations and an earlier survey, musculoskeletal disorders were identified as a priority issue.

Results: Six assessment and intervention activities are underway in a framework of community-based participatory research. First, video footage of harvesting and sorting was analyzed using the Rapid Entire Body Assessment method, revealing movements and postures likely to be injurious. Second, an ergonomic intervention in packing house workers was conducted. Third, diagrams and photos of alternative technologies for hoisting 35 pound buckets of tomatoes were assembled for evaluative discussions with tomato workers and farm owners, with an eye toward field trials. Fourth, the intake questionnaire used at summer health screenings has been progressively modified to capture more information about job-related exposures, injuries and illnesses. Fifth, continuing education seminars on occupational health for primary care clinicians were

presented by the national network, with students and faculty evaluating outcomes. Sixth, a case-based training module on occupational health has been developed for residents in family medicine and third year medical students.

Conclusions: Ergonomic hazards require a multi-pronged effort to redress longstanding practices. Factory-like operations in the packing house are readily amenable to ergonomic solutions. Ergonomic interventions for field harvesting are more challenging, due to work organization issues.

G4.4
Title: ***Occupational Fatalities in Alaska: Two Decades, 1990–1999 and 2000–2009***
Authors: Lincoln JM, Somervell P, Hull-Jilly D
Presenter: Jennifer M. Lincoln, Ph.D.

Objectives: In 1991, NIOSH established the Alaska Field Station in collaboration with the Alaska Department of Health and Social Services, Section of Epidemiology, to prevent work related deaths. Working through partnerships and by applying the public health model, Alaska experienced a 49% decline in work related deaths from 1990-1999. Additional prevention efforts have continued since 2000.

Methods: The Alaska Occupational Injury Surveillance System (AOISS) was used to identify all fatal occupational traumatic injuries that occur in Alaska. Data are available on age, gender, occupation, industry, weather and circumstances of death. Data were analyzed in SAS.

Results: During 2000–2009 there were 379 occupational fatalities in Alaska. This is a decrease of 41.5% from the previous decade. The occupations accounting for the highest number of fatalities continued to be commercial fishermen (111, 29%) and pilots (47, 12%). The most common events or exposures leading to fatalities also remained the same. They were related to vessels such as sinkings or falls overboard (128, 34%), aircraft crashes (87, 23%), contact with objects (46, 12%), vehicle crashes (35, 9%) and assaults (29, 8%).

Conclusions: Although the occupations with the most fatalities and the events/exposures leading to traumatic deaths have not changed from the decade of the 1990s to the 2000-2009 decade, there continues to be a substantial decline in the number of work related fatalities in Alaska. NIOSH has reported that fatality rates among crab fishermen have declined by 60% since 1999. Additionally, the aviation crash rate has declined by 34% since 2000. Interventions that have been developed in Alaska since 2000 include stability checks for the Bering Sea crab fleet, and the Capstone Program to improve aviation aeronautics. Progress has been made, but there remains a need for continued safety interventions to combat the unique work hazards found in Alaska.

DAY THREE: WEDNESDAY, OCTOBER 20, 2011

Session: **H.0**
Title: **EMS /Fire Services**
Moderator: Tim Merinar, M.S.

H1.1
Title: ***The Nature of Injuries in the Fire Service***
Authors: Poplin G, Harris R, Pollack K, Peate W, Nied E, Gulotta J, Burgess J
Presenter: Gerald Poplin, M.S.

Objectives: Firefighting and emergency medical services combined has one of the highest occupational incident rates for injury and fatalities, however, few studies have sought to identify the causes of injury in the fire service beyond the fireground. The present study describes the variation and associative factors of injuries within an occupational fire service cohort, in effort to better understand the circumstances in which injury events occur.

Methods: Injury reports from 2004 to 2009 were analyzed among a retrospective cohort of career fire service employees in a medium-sized metropolitan fire department. Information pertaining to injury events included the nature of injury, agent, mechanism, body location, environment, and abbreviated injury scale (AIS).

Results: Incidence rates averaged 17.9 injuries per 100 employees, compared to the 2006 national rate of 7.3 injuries per 100. The 902 injuries reported were sustained among 409 individuals. Sprains and strains accounted for 67.1% of all injuries, primarily to upper and lower extremity joints as well as the lumbar portion of the back. One-third of all injuries (32.9%) were the result of physical exercise activities, while 16.9% and 10.2% occurred during patient transport and fireground operation processes, respectively. Thirty percent of injuries were involved lost time from work. Of all injuries, 29 (3.22%) were scored as moderate (AIS = 2), including fractures, dislocations, inhalation and electrical injuries. All others were scored as minor in severity.

Conclusions: Contrary to expectations, the most frequent activity associated with injuries in the fire service was physical exercise, followed by patient transport and fireground operations. Furthermore, despite an injury rate higher than the national average, the severity of injuries was overwhelmingly minor when assessed using a trauma-based injury scale. Improved health surveillance and standardized reporting will enable fire departments to tailor intervention strategies to their individual risk profile to prevent or mitigate future injuries.

H1.2
Title: ***Partnering to Develop Ambulance Safety Standards***
Authors: Green J, Moore P, Hess J
Presenter: James Green, B.S.M.E., M.B.A.

Objectives: Ambulances, like most large vehicles licensed in the United States, are required to meet very limited crash safety standards. NIOSH, working collaboratively with the ambulance industry and other government agencies, is moving aggressively to update the pertinent ambulance standards to bring them in line with many of the standards applicable to civilian passenger vehicles.

Methods: NIOSH researchers and industry partners at the Ambulance Manufacturers Division (AMD) of the National Truck Equipment Association have developed a program to move the patient compartment of an ambulance toward crash safety standards equivalent to those required for passenger vehicles in the U.S. As a part of this effort NIOSH has conducted or will conduct full scale vehicle crash testing and individual component (seat and cot) testing to assess performance in a 30 mph impact. To ensure consistency with accepted automotive safety standards and testing practices, the team has sought independent review from the National Highway Traffic Safety Administration, three ISO certified independent crash test facilities and manufacturers Ford and GM.

Results: To date, NIOSH and the AMD have published one standard and drafted three others which now await final validation tests. Additionally, the team has provided frontal and side impact test data to the Society of Automotive Engineers which has been published as two unique SAE Recommended Practices for testing components installed in an ambulance.

Conclusions: Working collaboratively, NIOSH, industry, and other government partners have developed a series of safety standards which will dramatically improve worker and patient safety when traveling in an ambulance. This effort would not have been possible without the sharing of resources and expertise provided by each organization.

H1.3
Title: ***The Incident Command System as a Fire Fighting or Emergency Response Risk Management Tool***
Author: Loflin M
Presenter: Murrey Loflin, A.A.S., M.S.

Objectives: Development of the Incident Command System (ICS) was driven by the need for new risk management approaches for rapidly moving wildfires in the 1970s. The ICS addresses problems related to establishing effective command and control and has been extensively field tested. The ICS structure can expand and contract as needed to meet the changing conditions of the incident. The ICS uses principles of span of control, unity of command, and resource accountability to ensure the safety of emergency responders while working at all incident types including structure fires, traffic incidents, wildfires, and technical rescues. This presentation will show how the proper use of ICS can improve fire fighter safety.

Methods: The NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP), investigates fire fighter line of duty deaths (LODD) and significant injuries to identify contributory factors and formulate prevention strategies. The FFFIPP evaluates circumstances related to the victim, working environment, and injury source during the pre-event, event, and post-event phases of an incident. Determining the use or non-use of ICS and its impact on responder safety is a routine component of these investigations

Results: In 2009 and 2010 the FFFIPP investigated 20 incidents of LODD and injury involving residential and commercial structure fires, wildland fires, and technical rescues. In 11 of these incidents, involving 15 LODD and 18 injuries, failure to utilize or fully implement the ICS during the response contributed to the death or injury.

Conclusions: While the ICS provides for effective command and control of any size incident response, ensuring the safety of emergency responders, FFFIPP investigation results show that non-use of ICS continues to contribute to fire fighter death and injury.

H1.4
Title: ***Assessing the Cost-effectiveness of the Wellness-fitness Initiative (WFI)***
Authors: Asfaw A, Pana-Cryan R, Myers M
Presenter: Regina Pana-Cryan, Ph.D.

Objectives: Fire fighting is one of the most dangerous occupations in the U.S. This results in fire fighters experiencing a heavy burden of occupational injury and illness such as cardiovascular disease and fatal and nonfatal injuries. The WFI was implemented as a comprehensive program aimed to improve fire fighters' quality of life. Our objective was to conduct an economic evaluation of the WFI as it is implemented by a fire department.

Methods: We build on a previous evaluation of the WFI that included data from four participating and four control fire departments in the U.S. and Canada for 7 years before (1991-1997) and after (1998-2004) implementation of the program. We examine the returns to the department on its investment in safety and health as well as the cost of implementing the program from a fire department's perspective, which includes only the costs and benefits incurred by the department. We are working to better understand the effectiveness of WFI in preventing specific conditions such as cardiovascular disease and musculoskeletal disorders.

Results: We will report on the cost-effectiveness of implementing WTI to avert fire fighter injuries and illnesses from a fire department's perspective.

Conclusion: We will develop the societal perspective, which includes all costs and benefits associated with an intervention, in order to identify additional opportunities for prevention. Based on our findings, we will also use this study to facilitate partnering with one of the fire departments that currently implement WFI and develop guidance on lessons they have learned that can help others who are considering implementation of WFI or similar programs.

Session: **H2.0**
Title: **Violence in Healthcare**
Moderator: CDR Marilyn Ridenour, M.P.H.

H2.1
Title: ***Developing a Comprehensive Hospital Violence Surveillance System: Findings from a Baseline Needs Assessment***
Authors: Pompeii L, Dement J, Smith C, Schoenfisch A, Lipscomb H, Hansen A, Jimenez M
Presenter: Lisa Pompeii, Ph.D.

Objectives: Under-reporting of Type II workplace violent events experienced by hospital workers is a significant barrier to developing evidence-based prevention strategies. Additionally, OSHA Log and workers' compensation (WC) systems limits the inclusion of violent events not resulting in serious physical injury or lost time from work, and often do not collect data needed to develop prevention strategies. We conducted a baseline needs assessment as an initial part of a NIOSH-funded study to engage hospital stakeholders with developing a surveillance system, and accompanying workplace policy, to foster the capture and reporting of violent events experienced by their workers.

Methods: This study includes all workers from five hospitals in Texas and North Carolina including two tertiary care medical centers and three community hospitals. The needs assessment involved a systematic literature review, assessment of current surveillance systems within each hospital, and examination of data captured by these systems. These data and collaboration with hospital stakeholders were used to develop survey tools to ascertain the 12-month prevalence of workplace violence experienced by workers, event circumstances, perpetrator characteristics, patterns of reporting, and reasons for not reporting.

Results: Data from more than 60 research articles pertaining to hospital violence from 1980 through 2010 were reviewed to identify issues influencing reporting. Participating study hospitals utilize several reporting systems, including First Report of Injury, WC, OSHA Log, and Patient Safety Systems. More than 600 reports were filed through the various systems from 2004 through 2009. No system was comprehensive in capturing violence events. In fact, the Patient Safety System, which is not a mechanism intended for work-related injury reports, captured events not reported through the occupational injury systems.

Conclusions: These findings highlight the need for a centralized reporting system that captures all workplace violence events, as well as details necessary for developing targeted prevention strategies.

H2.2
Title: ***Patient-related Violence Experienced by Workers in a Large Hospital System***
Authors: Dement J, Schoenfisch A, Pompeii L, Lipscomb H, Smith C, Hansen A, Jimenez M
Presenter: John Dement, Ph.D., C.I.H.

Objectives: Hospital workers are at risk of being assaulted or threatened by patients, family members and other visitors. Many of these events go unreported. As part of a study to develop and evaluate a comprehensive workplace violence reporting system, we explored Type II violent events reported through three existing data systems in a large hospital system comprised of a large teaching hospital and two smaller community hospitals.

Methods: Text descriptions from workers' compensation (WC) claims, incident reports in a Safety Reporting System (SRS), and OSHA logs were flagged and manually reviewed if they contained a keyword(s) suggestive of a violent event. The violence events from these systems were concatenated, and duplicates were removed. All words in the event text descriptions were ranked based on their frequency of occurrence and manually assigned to injury event categories, including patient characteristics, staff actions toward the patient and actions taken by the patient against the staff member.

Results: A total of 515 patient-perpetrated violence events were identified from 2004 through 2009. Only 46 (8.9%) events were reported in more than one data system and 388 (75.3%) were reported only in the WC file. Most victims were inpatient nurses (47%), nurses' aides (24%) or police/security workers (9%). Common patient actions toward staff were hitting (28%), scratching (24%), grabbing (15%), kicking (13%), biting (13%), pushing (5%) and spitting (4%). More than one of these actions was described in 13% of the injuries. In 5% of the injuries, staff described restraining or struggling with a patient. Common characteristics of patients perpetrating violence events included combative/aggressive/violent/hostile (17%) and confused/disoriented (3%).

Conclusions: Hospital workers providing direct patient care are most at risk for patient-perpetrated violent events, followed by security. These analyses suggest the need for a comprehensive violence reporting system that captures data necessary to develop prevention programs.

H2.3
Title: ***Assaults in Healthcare: From Enumeration and Counting to Threat Assessment and Management***
Authors: Drummond D, Bell M, Hodgson M
Presenter: Michael Hodgson, M.D., M.P.H.

Background and Objectives: Almost 60% of workplace assaults in the U.S. occur in the health care industry, although it represents only 15% of the U.S. Gross National Product. Injury classification has evolved from simple enumeration of events through classification by perpetrator to, now, characterization by intent. Distinguishing predatory from affective violence, for both coworker and customer events, is critical to managing events and preventing recurrence. Beginning in 2005, each hospital in the Veterans Health Administration established a Disruptive Behavior Committee (DBC), under senior clinical leadership reporting to the Chief of Staff (COS), and created a formal training program, including a one-week, on-site mini residency, a monthly supporting conference call, and a consultation service. A parallel critical element was the creation of an electronic flag [Category I Behavioral Flag] visible to all who opened the fully electronic medical record, beginning with scheduling clerks. The recommendations of the DBC are captured in a chart note visible behind the electronic flag. Many facilities have additional committees in place to manage disruptive and noncompliant patients. This survey describes current practices in managing seriously disruptive, threatening, violent, and seriously non-compliant patient behavior, explores satisfaction with the committee performance, and summarizes the relationships between perceptions of effectiveness and independently measured outcome rates.

Methods: The authors developed a series of questions, pilot-tested them, and implemented a web-based survey through the Chief Operating Office.

Results: Results were received from all facilities. Overall, 128 of 138 [93%] integrated facilities imposed at least one Category I flag. Facilities evaluated a median of 36 and an average of 47 assaultive patients in 2010, with a range of 36 to284. In general, the higher the facility complexity, the more likely COS were to perceive the committee as highly effective. For non-compliant patients, 62% of facilities used health care agreements as an enforcement tool. The hospital complexity metric, by itself, does not include the

presence or absence of closed mental health units, so analyses continue.

Conclusion: Threat assessment with warnings and feedback to employees at risk represents an important element of violence prevention programs.

H2.4
Title: ***Employee Assistance Program Use for Intimate Partner Violence and its Impact on Work Performance***
Authors: Pollack K, Cummiskey C, Krotki K, Grisso JA
Presenter: Keshia Pollack, Ph.D., M.P.H.

Objectives: Employee Assistance Programs (EAPs) are a workplace resource that offers assistance for many issues, including intimate partner violence (IPV). The objectives of this research are to: (1) Identify determinants of EAP use among women impacted by IPV; and (2) determine the impact of EAP use on work performance among women who contacted the EAP for IPV assistance.

Methods: Participants were identified from the Harris Poll Online Panel. Eligible respondents were employed women, aged 18+, living in the U.S., who experienced IPV and had access to an EAP. Data were weighted by age, race, education, income and region to reflect the national composition of employed adult women. Propensity score weighting was also used to adjust for respondents' tendency to be online.

Results: A multi-stage sampling approach yielded 1,765 women who completed the survey, of which 10% had access to an EAP and contacted them for IPV assistance. Compared to women who did not contact their EAP, women who contacted the EAP were significantly more likely to have experienced IPV daily, had an employer that effectively explained the benefits and services of the EAP, and reported that IPV negatively impacted their work performance. Women described several negative impacts of IPV on work, including decreased ability to concentrate (75%), decreased productivity (54%), and decreased ability to get to work on time or remain at work (37%). The vast majority of EAP users (89%) used the help they received and 71% reported that their work performance improved after contacting the EAP.

Conclusions: EAPs are one resource used by women impacted by IPV, which they reported resulted in improvements in their work performance. These results are a strong indicator of the potential benefit that EAPs can have for workers, and provides support for employers to offer this benefit to their employees.

Session: **H3.0**
Title: **Work Hours and Sleep**
Moderator: David Lombardi, Ph.D.

H3.1
Title: ***Serious Police Injuries: The Association With Shift Work***
Authors: Violanti J, Fekedulegn D, Andrew M, Charles L, Hartley T, Burchfiel C
Presenter: John Violanti, Ph.D.

Objectives: Law enforcement is a worldwide occupation with over 699,000 police officers in the United States alone. Police officers are often fatigued because of shift work, erratic work hours, and insufficient sleep increasing the risk of job-related accidents and injuries. Work injuries may be serious and require extended time off leading to personnel shortages and increased health costs. The objective of this study was to assess the seriousness of injury in police officers based on their dominant shift. We hypothesized that officers working midnight or afternoon shifts would have a higher incidence of serious injury than those working day shifts.

Methods: The association between shift work and incidence of serious injury was examined among police officers from the Buffalo Cardio-Metabolic Occupational Police Stress Study (1994-2009; n=419 with complete data). Objective day-to-day payroll work history data from 1994-2010 (e.g. start time of work, shift worked, hours worked, reason for time off work, etc.), were collected to determine the officers' dominant shift, injury status and duration of first injury. If the duration of first injury was greater than three months, the injury was considered serious. Poisson regression models were used to compute incidence rates and incidence rate ratios of first serious injury.

Results: After adjusting for age differences, the incidence rate ratio (IRR) of first serious injury for officers working midnight shifts was 2.6 times larger than those working day shifts (IRR=2.56, 95% CI: 1.15, 5.67) and 2.2 times larger than those working afternoon shifts (IRR=2.24, 95% CI: 1.06, 4.72).

Conclusions: Results suggest a strong association between shift work and serious injury among police officers. Police organizations should create a culture in which officers receive adequate information about the importance of good sleep habits, the hazards associated with fatigue and shift work, and strategies for managing them.

H3.2
Title: ***Sleep Duration, Body Mass, and the Risk of a Work-related Injury: Results from the U.S. National Health Interview Survey (2004–2009)***
Authors: Lombardi DA, Wirtz A, Willetts JL, Folkard S
Presenter: David Lombardi, Ph.D.

Objectives: Fatigue has been linked to adverse safety outcomes and poor quality or decreased sleep has been associated with obesity (higher body mass index BMI). Using the U.S. National Health Interview Survey (NHIS), we examined the risk of a work-related injury as a function of total daily sleep time across categories of weekly work hours and BMI.

Methods: The NHIS is an in-person household survey using a multistage, stratified, clustered sample design representing the U.S. civilian population. During the survey period 2004-2009, 83,472 adults, reported their total work hours during the prior week, usual daily sleep hours, and height and weight (for BMI), and whether they had a work-related injury in the past 12 months. Weighted annualized work-related injury rates were estimated across a priori defined categories of daily sleep, stratified by BMI categories: healthy weight (BMI: <24.99), overweight (BMI: 25 - 29.99), and obese (BMI: >30). To account for the complex sampling design, weighted multiple logistic regression was used to estimate the risk of a work-related injury as a function of usual daily hours of sleep controlling for body mass, weekly work hours, age, sex, race/ethnicity, education, pay type, and occupation.

Results: There were an estimated 129,723,086 workers annually at risk with an overall injury rate of 2.71/100 workers. Comparing obese to healthy workers across categories of daily sleep duration, the estimated annualized injury rates (per 100 workers) were: 6.41 vs. 4.75 (<6 hours sleep), 4.76 vs. 3.35 (6-6.9 hours), 2.79 vs. 1.60 (7-7.9 hours), 3.50 vs. 2.04 (8-8.9 hours), and 3.02 vs. 3.65 (9+ hours). In the weighted logistic regression model, significant increases in risk per decrease in sleep hour category were observed after controlling for categories of weekly work hours ($p < 0.04$) and BMI ($p < 0.005$) and the aforementioned covariates. Using 7-7.9 hours of sleep as the referent period, the adjusted injury risk (odds-ratio) for a worker sleeping a total of <6 hours per day was OR = 1.92 (95% CI: 1.39-2.65), and for 6-6.9 hours was OR=1.54 (95% CI: 1.21 - 1.95). No other sleep hour categories were significantly different than the referent.

Conclusion: These results from a large representative sample of U.S. workers suggest an increase in injury risk for decreasing total daily sleep hours adjusting for body mass, weekly working hours, gender, age, ethnicity, education, pay type, industry, and occupation.

H3.3
Title: ***Long Working Hours and Sleep as Direct and Indirect Risk Factors for Work-related Injury–A Structural Equation Modeling Approach***
Authors: Wirtz A, Lombardi DA, Willetts JL, Folkard S, Christiani DC
Presenter: Anna Wirtz, Ph.D

Objectives: Working long hours can increase occupational injury risk by increasing worker's fatigue and limiting sleep duration. Structural equation modeling (SEM) techniques were evaluated as a novel approach to examine these direct and indirect risk factors for work-related injury in a representative sample of the U.S. workforce using data from the National Health Interview Survey (NHIS).

Methods: The NHIS is a multistage clustered, stratified cross-sectional sample representative of the U.S. population, collected every year. Pooled data from 2004-2009 (n=83,472) were used that contained information about individual and workplace characteristics, and self-reported work-related injuries. SEM was used to estimate the direct and indirect effects of self-reported weekly work hours (categorized in intervals of 10h) and usual sleep duration (in intervals of 1h) on injuries. Simultaneously, several potential confounding and mediating variables were accounted for in the model that included gender, age, race/ethnicity, occupation, industry, type of pay, body mass index (BMI), and psychological distress.

Results: Six-hundred and thirty six (0.8%) individuals reported a work-related injury, while working on average 40 h/week and sleeping 7 h/day. The results of the SEM indicated a statistically significant increase in injury risk with increasing h/week (OR 1.12; 95% CI 1.05 - 1.21), and with shorter sleep h/day (OR 1.10; 95% CI 1.02 - 1.19). Additionally, long work hours decreased sleep duration, thus affecting injury risk both directly and indirectly. Additional factors increasing injury risk directly were being male, being paid hourly, high BMI, and occupation, whereas high psychological distress increased injury risk both directly and indirectly via sleep duration.

Conclusion: The findings indicate that complex modeling such as SEM may be a useful and powerful approach to examine the relationship among temporal factors and occupational injury risk factors, accounting for complex sample design and mediating effects, thus offering advantages over traditional statistical methods.

H3.4
Title: ***The Organization of Crop and Horse Breeding Work in Central Kentucky and its Relationship with Occupational Illness/Injury for Latino Farmworkers***
Authors: Swanberg J, Miller J
Presenter: Jennifer Swanberg, Ph.D.

Objectives: Agricultural work ranks among the most hazardous in the U.S. for fatalities, injuries, and illnesses and employs significant numbers of Latino workers, a vulnerable population. Research on health outcomes associated with job-related physical and psychological stressors for Latino farmworkers is scarce. This pilot study describes the organization of work in crop and horse production; identifies the job-related health issues among Latino farmworkers employed in these industries; and determines which aspects of work organization correlate with illness/injury for these workers.

Methods: Data was collected using a community-based, purposive sample of 103 Latino crop (n=49) and horse (n=54) production workers in Central Kentucky. The interview-assisted, cross-sectional survey included questions about work organization (physical and psychological stressors), physical health status, and illness/injury. Interviews were conducted in Spanish and included standardized measures tested with Latino farmworkers.

Univariate and bivariate statistics (cross-tabulation, chi-squares and t-tests) assessed frequencies, means, and standard deviations in order to describe the individual, job and workplace characteristics, as well as worker health. Analysis of Variance (ANOVA) calculations assessed differences in illness/injury outcomes relative to occupational exposures. Logistical regression will be employed to identify which job and workplace factors are associated with incidence of illness/injury.

Results: Descriptive statistics indicated that the majority of workers were male, Mexican-born and in their mid-thirties. Two-thirds of workers had low English-speaking proficiency. Horse workers were significantly more likely to be married, though two-thirds of both groups had children under 18. On average, both groups worked six days a week, though crop workers spent significantly more time at work each day (11.3 vs. 9.3 hours, respectively). Nearly half of horse workers had worked at their current employer one to three years, whereas 75% crop workers had been employed less than one year. Crop workers experienced greater physical, psychological and environmental demands and reported higher incidence of illness and missed work due to work-related illness/injury. About 25% of both groups reported a work-related injury in the past year. Physical demands were associated with increased illness, but psychological stressors and retaliatory-abusive supervisory practices were correlated with increased illness, injury and missed work. After controlling for demographic factors, similar factors may be associated with illness/injury.

Conclusions: Findings indicate that Latino farmworkers endure poor working conditions which appear to be associated with incidence of illness/injury. Further surveillance of occupational illness is needed to better understand how supervisory practices and psychosocial aspects of work organization impact workers' health.

Session: **H4.0**
Title: **Hazard ID and Management**
Moderator: Jennifer Bell, Ph.D.

H4.1
Title: ***Proposal for Defining "Hazard" in the Context of Occupational Safety and Health***
Author: Jensen R
Presenter: Roger Jensen, J.D., Ph.D.

Objectives: The field of occupational safety and health is built on the concept that hazards can be anticipated, recognized, evaluated, and controlled, yet defining the word "hazard" has proved elusive. Although dozens of definitions are stated in books, voluntary standards, and journal articles, none reflect a widely shared definition. This investigation was undertaken to compare and contrast several representative definitions and propose a recommended definition.

Methods: Representative definitions from diverse sources were identified, broken down into elements, and compared. The element-to-element comparisons facilitated identifying strengths and weaknesses. A new definition was developed in the form of a simple basic definition followed by specific definitions of the words and phrases.

Results: Most attempts at defining "hazard" reflect an intention to keep it simple and easily quotable. Most contain three elements, starting with words about a source, followed by a causation phrase, and ending with words describing the undesired outcomes. An example is: A condition, set of circumstances or inherent property • that can cause • injury, illness, or death (ANSI/AIHA Z10-2005). The end product of this investigation is the set of definitions below.

A hazard is a source with potential for causing harmful consequences.

A source can be a condition, form of energy, weather or geologic event, chemical substance, biologic agent, musculoskeletal stressor, or human behavior.

Potential for causing means the source is sufficient to bring about at least one harmful consequence.

Harmful consequences is an organization-specific enumeration of whatever is to be avoided.

Conclusions: A challenge with the first element--being neither too inclusive nor too exclusive--was achieved by separately defining source. The middle phrase was the least challenging. The challenge of the third element was to accommodate inter-organizational differences in the harmful consequence they seek to avoid.

H4.2
Title: ***Comparison of an Observational Hazard Assessment Tool with Traditional Approaches***
Authors: Neitzel R, Crollard A, Cohen M, Dominguez C, Seixas N
Presenter: Richard Neitzel, Ph.D., C.I.H.

Objectives: As part of a comprehensive safety and health evaluation for a scrap metal recycling facility, we developed an observational hazard assessment tool (HAT) and compared its performance with two traditional hazard assessment techniques, self-reported questionnaires and industrial hygiene measurements.

Methods: We made HAT observations, rating intensity of exposures, personal protective equipment (PPE) use, and presence of controls, for twelve different hazards. Observations were made repeatedly at fixed points along an established walkthrough route. Each observation documented exposures to all twelve hazards experienced by a single worker at one point in time. Six researchers made 686 HAT observations over two months. The observed HAT exposures were compared with those reported during interviews with all workers at the facility (n=46) and with full-shift quantitative measurements of dust/fume (n=69) and noise (n=60).

Results: Inter-rater agreement of exposure scores among researchers during simultaneous side-by-side observations ranged from moderate (weighted kappa 0.56) to substantial (0.86) across all twelve hazards. Major hazards observed at the worksite included noise, lacerations, walking and working surfaces, and repetitive motions; more than 20% of observations for each of these hazards were rated as "high" exposures, and PPEs/controls were typically absent. Observations of "high" noise agreed well with full-shift noise measurement data and with worker self-reports. Conversely, observed "high" dust levels agreed with worker self reports, but were not supported by measured full-shift dust levels, which indicated minimal exposures.

Conclusions: Our results demonstrate the strengths and weaknesses of different hazard assessment methods. Our observational 'HAT' tool can be effective for assessment of hazards which are readily detected by observers. Quantitative measurements are appropriate for exposures such as dusts and gases that are both measurable and not easily detected by observers. Finally, self-reports can capture aspects of exposure which cannot be evaluated through observations or measurements, such as those rare events.

H4.3
Title: ***Something Might be Missing from Your OHS Audit: Findings from a Content Validity Analysis of Five Audit Instruments***
Authors: Robson L, Macdonald S, Van Eerd D, Gray G, Bigelow P
Presenter: Lynda Robson, Ph.D.

Objective: The objective of this project was to examine the content validity of OHS management audit methods. This was part of a broader objective to address the gap in the research literature regarding the measurement properties (e.g. reliability and validity) of OHS management audit instruments. We had previously established the existence of this gap through a systematic search of the research literature.

Methods: Evaluating content validity requires a definitional standard against which concepts or items can be compared. The definitional standard for this study was the OHS management standard developed by the Canadian Standards Association, CSA Z1000. The Technical Committee that developed the standard made reference to other well known OHS management standards: OHSAS 18001, the ILO Guidelines and a draft version of ANSI/AIHA Z10. There are five major elements in CSA Z1000 (Commitment, Leadership, and Participation; Planning; Implementation; Evaluation and Corrective Action; Management Review and Continual Improvement) and these were subdivided into 163 content units for the purpose of the analysis. Using the documentation for an audit instrument, two independent raters determined, for each content unit, whether the instrument, when used in the field, assesses the concept described by the unit (fully, partially, or not at all). Results for the major and minor elements of CSA Z1000

were derived by aggregating the results for the constituent content units. This analysis was carried out for five of the more comprehensive OHS management audit instruments used by public and not-for-profit OHS organizations when auditing workplaces in Ontario.

Results: A relatively high proportion of CSA Z1000's content (74%) was partially or fully represented on average in the audit methods. However, six minor management elements were found to be were found to be less completely represented (i.e. 35% of content units not represented at all) in three or more of the methods: General [OHSMS] (i.e. integration with other management systems), Objectives and Targets, Documentation, Internal Audits, Management Review Input, and Management Review Output. The most extreme example is the Internal Audits element whose content was completely missing for three of the audit methods.

Conclusion: Some OHS management audit instruments in current use are incomplete relative to a recent OHS management standard. It may be that some instruments warrant revision in order to better reflect current expert consensus.

H4.4

Title: ***The Psychometric Properties of the OSHA Audit Tool for Assessing an Organization's Safety and Health Management System***

Authors: Gimeno Ruiz de Porras D, Amick B, Read T
Presenter: David Gimeno Ruiz de Porras, Ph.D.

Objective: The Occupational Health and Safety Administration under the auspices of its State Consultation Program have developed an audit tool to assess an organizations safety and health management system (SHMS) called the Form 33. The audit is designed to assess: Hazard anticipation and detection, Hazard prevention and control, Planning and evaluation, Administration and supervision, Safety and health training, Management leadership, and Employee participation. These 7 dimensions are considered to tap, operational, managerial and cultural elements of a SHMS.

Methods: We have been provided the unique opportunity to examine 5 years of State Consultation data (2005-2010) for employers (about 7,500) who have participated in at least 2 audits during this period (sample over 15,000 observations). We are currently examining:

- The validity of hypothesized 7 SHMS concepts measured in the OSHA Form 33, the internal consistency reliability of the measures and their responsiveness to change
- Examine the predictive validity of the SHMS measures by examining their relationship to occupational hazards and injury and illness rates
- Examine the performance of the SHMS measures for businesses of different sizes, in different sectors, by union status
- Examine whether the SHMS measures can be captured with a reduced set of items thereby reducing respondent burden

Results: We will report on the outcomes of these analyses and the overall psychometric quality of OSHA's SHMS Audit tool.

Conclusion: There is little scientific evidence on OSHA's Form 33 and no evidence on its predictive validity. This research will provide important evidence as OSHA continues to develop an Injury and Illness Prevention Program standard of which the SHMS is a core component.

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Abstracts
Wednesday, October 19, 2011
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Grand Exhibit Hall, Salon B

LIST OF FEATURED POSTERS

Surveillance

P01
Title: ***Toxicology Testing in Fatally Injured Workers: A Review of Five Years of Iowa FACE Program Cases***
Authors: Sullivan R, Ramirez M, Kraemer J, Peek-Asa C, Gergely R
Presenter: Ryan Sullivan, M.P.H.

Objectives: An estimated 4,300 fatal workplace related injuries occurred in the United States in 2009. The state of Iowa alone experiences an average of 80 cases of occupational fatalities annually. While much is known about the risk factors for occupational injury, little is known about the prevalence of substance use surrounding these fatal events. To address this gap, we examined the prevalence of positive toxicology testing in fatal occupational injuries occurring in the state of Iowa.

Methods: We conducted a retrospective study of the Fatality Assessment Control and Evaluation (FACE) reports of workplace related fatalities in Iowa from 2005 to 2009. Reviewed documents included medical examiner reports, autopsy and pathology reports, police and department of transportation reports, and toxicology laboratory reports. In Iowa, workplace fatalities require a medical examiner's examination, frequently including toxicology analysis. Positive tests were determined to be those that detected any substance on either a Drugs of Abuse screen or Comprehensive Drug Panel. Exclusions included cases with caffeine only or with incomplete/missing records.

Results: A total of 429 cases were examined from 2005 to 2009. Of these, 42 cases were excluded due to incomplete or missing records. Of the remaining 387 cases, 77 or 19.9% were found to have positive toxicology testing. Commonly identified drug classes included Cannabinoids (19 cases), Alcohols (15 cases), Amphetamines (8 cases), among others. Further analysis will include descriptive statistics and models predicting which occupations and industries have the highest prevalence of positively tested drugs involved in traumatic deaths.

Conclusions: A substantial portion of fatally injured workers in the state of Iowa were found to be positive on toxicology testing. These results highlight the significant role that substance use plays as a potential contributor to fatal occupational injuries. These results identify an area in need of further research efforts and a potential target for injury prevention strategies.

Emergency Responder Safety

P02
Title: ***Work-related Injuries among Firefighters***
Authors: Hong OS, Chin DL, Vogel S, Feld J
Presenter: Oi-Saeng Hong, Ph.D., R.N.

Background: Firefighters (FFs) are exposed to various occupational hazards that may result in injuries, illnesses and diseases while at work. Little is known about factors associated multiple (more than two) injuries among firefighters. The purpose of the present study was to assess the type of occupational injuries as well as demographic and work-related characteristics that may affect multiple injuries among firefighters.

Methods: The study included a total of 305 FFs from California, Illinois, and Indiana, who completed the pretest survey as a part of ongoing hearing protection and cardiovascular disease prevention interventions. The data were collected through internet-based self-administered survey since November 2009.

Results: The participants were predominantly middle aged Caucasian males (mean age = 44.5 years, Caucasian or White = 84.7%, male = 92.7%) with an average of 17 years of work in fire services. About 65% (197/305) of the participants had experienced work-related injuries and about 47% (143/305) reported multiple (more than two) injuries. The most common type of injury was muscle strain/sprain (75.6%). Most frequent reported injuries were upper or lower extremity injury (59.4%), back injury (56.9%), burns (24.4%) and hazardous chemicals exposure (14.2%). Significant numbers of firefighters reported that they had been on no-duty (56.3%) or

modified duty (47.7%) due to a work-related injury. The logistic regression revealed that job title, ethnicity, and years in fire service were significantly associated with firefighters' multiple injuries. Firefighter engineers (OR=0.37; 95%CI: 0.15-0.88) and chief officer (OR=0.25; 95%CI: 0.07-0.90) were less likely to have multiple injuries, compared to firefighters. Whites were less likely to experience multiple injuries, compared to non-Whites (OR=0.42; 95%CI: 0.19-0.91). Firefighters with longer years in fire service were more likely to have multiple injuries (OR=1.09; 95%CI: 1.05-1.13).

Conclusion: Firefighters experienced multiple occupational injuries and several factors were associated with their injuries. It is important to develop and implement interventions to reduce occupational injuries in firefighters.

P03
Title: ***NIOSH Fire Fighter Fatality Investigation and Prevention Program***
Author: Timothy R. Merinar
Presenter: Timothy R. Merinar, M.S.

Objectives: The United States currently depends on approximately 1.15 million career and volunteer fire fighters to protect its citizens and property from losses caused by fire. On average, 100 fire fighters die each year in the line of duty. In 1998, Congress recognized the need to address this continuing occupational problem and directed NIOSH to implement a fire fighter safety initiative.

Methods: The NIOSH Fire Fighter Fatality Investigation and Prevention Program uses the Fatality Assessment and Control Evaluation (FACE) model to conduct investigations of fireground and non-fireground fatal injuries resulting from a number causes such as cardiovascular and other medical events, motor vehicle incidents, burns, falls, structure collapse, training incidents, diving and electrocutions. The Fire Fighter Program may also investigate selected non-fatal injuries where the circumstances indicate the possibility of equipment failures or new or emerging hazards could adversely impact the health and safety of fire fighters.

Results: Since the NIOSH Fire Fighter Fatality Investigation and Prevention Program was initiated in 1998, the U.S. Fire Administration has reported 1,343 fatalities*. During this time period, NIOSH has investigated 548 of these fatalities or approximately 41%. These include 315 trauma fatalities and 233 medical fatalities. Heart attacks continue to be the leading cause of fire fighter fatalities and result in over 50% of the line-of-duty deaths each year.
*As of August 5, 2011.

Conclusions: Based upon a review of the completed investigations over the first 8 years of the program, the leading recommendations for preventing medical fatalities included better medical screenings and that fire departments should require wellness/fitness programs. The leading recommendations for preventing trauma fatalities included need for standard operating procedures, improved fireground communications, and improved incident command.

P04
Title: ***Injuries Sustained by Responders Involved in Acute Hazardous Substance Releases, 2001–2009***
Authors: Anderson AR, Orr M
Presenter: Ayana R. Anderson, M.P.H.

Introduction: Every year thousands of hazardous substance releases occur which result in injuries and fatalities. To prevent morbidity and mortality from such events, the Agency for Toxic Substances and Disease Registry (ATSDR) established the Hazardous Substances Emergency Events Surveillance (HSEES) system.

Methods: Data from 18 states participating in the Agency for Toxic Substances and Disease Registry's (ATSDR's) Hazardous Substances Emergency Events Surveillance (HSEES) system were used to describe injuries sustained by responders involved in acute hazardous substance releases.

Results: Of the 18,469 injured persons reported from 2001-2009, 9.6% were responders. The most commonly reported categories of injured responders were police officers (43.9%) and career firefighters (23.1%). Almost half of the responders (49.4%) were treated at the hospital but not admitted. The most frequently reported injures/symptoms sustained by responders were respiratory irritation and headaches. Personal protective equipment (PPE) status was reported for 1,601 responders. Of these, 47.8% reported wearing some form of PPE. Injured responders were reported in 805 events. These events involved the release of 2,613 chemicals. Ammonia, hydrochloric acid, and methamphetamine chemicals (NOS [not otherwise specified]) were the most frequently released chemicals. Police officers were exposed to almost half (48.1%) of the hazardous chemicals that were released. Responders were most frequently injured in general service oriented, which includes auto repair, civic and social organization, death care services, dry cleaning and laundry, private households, and religious organizations. Of these, a majority of the injuries occurred in private households.

Conclusion: Responders should be aware of these events and properly prepare for incidents involving chemical releases. Proper hazardous materials training and education can help reduce the morbidity and mortality responders experience during such events.

P05
Title: ***Critical Mass: Comparing Nuclear Exposure Injury Compensation Programs***
Author: Winters G
Presenter: Gregory Winters

Objectives: To identify U.S. nuclear exposure injury compensation programs and compare program inequities, assumptions and requirements.

Methods: Case studies and examinations of case law and Federal statutes were compared to identify commonalities and differences between exposed claimants. Government statistics highlight stark differences in claimant classes, compensation amounts and probabilities of success. Congressional testimony and personal interviews of individual claimants revealed unique program problems. A test case of an injured worker is used to highlight program inequities and evidentiary burdens, as well as epidemiological assumptions under each program.

Results: Victims of nuclear exposure, whether disease is present or not, have vastly different experiences under each program. Identical exposures at identical sites result in significantly unequal treatment and starkly disparate compensation amounts dependent upon available radiological monitoring and employment status. Caps on program allowable attorney's fees severely limit the participation of technical assistance, leading to further claimant frustration and lower success rates.

Conclusion: Non-tort administrative programs compensate victims of nuclear exposure using sets of assumptions and criteria codified in Federal law. While tort remedies may increase claimant compensation amounts, the perceived simplicity and claimant-friendly assumptions of these programs provide a faster path to compensation. The gross inequities of victim experiences dependent on employment status, location, date of exposure and other factors results in a patchwork of programs with varying success rates for identical exposures. Technical assumptions regarding health physics, epidemiology, environmental monitoring and industrial hygiene are left to Congress and Federal agencies in the absence of supportable data for many of these sites. Without aggressive legislative revision, future explorations of emerging-technologies with little understood risks may model compensation programs on outdated nuclear exposure compensation schema that may have already failed generations of victims.

P06
Title: ***Ten Years Later–Still Learning About World Trade Center Responder Injuries and Illnesses***
Authors: Perritt K, Herbert R, Levin S, Moline J
Presenter: Kara Perritt, M.S.

In 2002, the Mount Sinai Center for Occupational and Environmental Medicine, with support from the National Institute for Occupational Safety and Health, began coordinating the World Trade Center (WTC) Worker and Volunteer Medical Screening Program (MSP) to monitor the health of qualified WTC responders. Enrolled participants were offered a clinical examination; interviewed to collect medical, mental health, and exposure information; and asked to complete a self-administered medical questionnaire.

The objective of this retrospective study was to analyze select data from the MSP self-administered medical questionnaire to better understand work-related injuries and illnesses sustained on-site by WTC responders. Data collected between July 2002 and April 2004 from MSP participants enrolled at the Mount Sinai clinic were analyzed using univariate statistical techniques.

Records from 7,810 participants were analyzed, with approximately a third (n= 2,486; 32%) reporting at least one injury or illness sustained during WTC work/ volunteer activities. Of the total 4,768 injuries/illnesses reported by these participants, respiratory complaints were most common (n=1,350; 28%); followed by traumatic injuries, excluding eye injuries (n=961; 20%) and eye injuries/ conditions (n=709; 15%). These results were quite comparable to findings from previous WTC studies where data were collected in real-time. New findings included information on treatment location. Participants reported that 36% of injuries/illnesses were treated off-site and 29% were treated on-site, with the remaining not specifying treatment location. Off-site treatment was prevalent for respiratory complaints, psychological stress, and chest pain. On-site treatment was predominate for eye injuries/conditions and traumatic injuries, excluding eye injuries/conditions.

Study results underscore the need for rapid deployment of personal protective equipment for disaster responders and medical care stations mobilized near disaster worksites. Additionally, the results indicate that a screening program such as the MSP may be effective in retrospectively

providing general information on disaster responder demographics and work-related injuries and illnesses.

P07
Title: ***Dying While Saving Lives and Protecting Property: A Comparison of Four Systems that Collect Traumatic Firefighter Fatalities***
Authors: Estes C, Marsh S, Castillo D
Presenter: Suzanne Marsh, M.P.A.

Introduction: Surveillance data serve as the foundation for understanding characteristics of traumatic occupational fatalities. These data identify situations that contribute to high numbers or rates of fatalities, and guide prevention efforts. Because firefighters regularly respond to hazardous situations that put them at risk for fatal occupational injuries, they are a sub-population of U.S. workers on which fatal injury surveillance efforts are focused. Currently, surveillance of U.S. firefighter fatalities is conducted through four systems. We examined these systems for their utility in characterizing firefighter fatalities and potential for informing prevention measures.

Methods: We examined three population-based systems (the Bureau of Labor Statistics' Census of Fatal Occupational Injuries (CFOI) and systems maintained by the United States Fire Administration and the National Fire Protection Association) and one case-based system (data collected through the National Institute for Occupational Safety and Health Fire Fighter Fatality Investigation and Prevention Program). From each system, we selected traumatic fatalities among firefighters for 2003-2006. We compared case definitions, methods for case ascertainment, variables collected, and rate calculation methods.

Results: The overall magnitude of fatalities differed among systems, with CFOI identifying fewer cases. The population-based systems were effective in characterizing the circumstances of traumatic firefighter fatalities. The case-based surveillance system was effective in formulating detailed prevention recommendations, which could not be made based on the population-based data alone. Methods for estimating risk were disparate and made inter-system comparisons impossible.

Conclusions: The systems examined in this study each include valuable data to describe firefighter fatalities. Areas of improvement for these systems should continue to be identified as they are used to direct research and prevention efforts.

P08
Title: ***Saving Lives at the Risk of the Provider: Fatal and Nonfatal Injuries among EMTs and Paramedics, 2003–2009***
Authors: Reichard A, Marsh S, Moore P
Presenter: Audrey Reichard, M.P.H., O.T.R.

Background: Emergency medical technicians (EMTs) and paramedics serve as primary providers of urgent medical care and are integral components in disaster response. These activities often put them at risk for fatal and nonfatal injuries. Although the EMT and paramedic workforce is projected to grow in the number of needed workers, retention of these workers may be negatively impacted by the effects of injuries and illnesses. To identify the most prevalent injury issues being faced by this workforce, this study provides data on fatal and nonfatal injuries occurring to EMTs and paramedics.

Methods: We analyzed data from the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI) and the occupational supplement to the National Electronic Injury Surveillance System (NEISS-Work). Data analyses for 2003-2007 have been completed. At the time of presentation, data from 2003-2009 will be described.

Results: From 2003-2007, a total of 65 fatal injuries and approximately 99,400 (95% confidence interval [CI] = ± 27,700) nonfatal emergency department (ED) treated injuries occurred among EMTs and paramedics. Most fatalities were related to motor vehicle incidents (45%) and aircraft crashes (31%). Among compensated EMTs and paramedics, the rate of fatal injuries was 6.3 per 100,000 full-time equivalents. Nonfatal injuries primarily resulted from stress on some part of the body from motion or overexertion (33%). Among all nonfatal injuries, the most common diagnosis was sprains and strains (38%).

Conclusions: EMTs and paramedics have higher fatal injury rates when compared to all workers. To reduce fatalities, targeted efforts should be made to prevent ground and air transportation incidents. Reducing nonfatal injuries may be accomplished by developing and evaluating interventions to prevent bodily stress and overexertion injuries.

Emergency Department Injury Surveillance and Underreporting

P09

Title: ***Developing Questionnaires on Underreporting of Occupational Injuries and Illnesses–A Journey into the Abyss***

Authors: Reichard A, Marsh S, Dye C, Peterson K, Flicker L, Jackson L
Presenter: Audrey Reichard, M.P.H., O.T.R.

Background and Objectives: This presentation will discuss the results of the expert feedback and formative testing of two telephone interview questionnaires designed to assess occupational injury and illness underreporting among injured and ill workers treated in U.S. emergency departments. Questionnaire development included expert review, pilot testing, and cognitive testing. The results indicate difficulties one may encounter when undertaking similar studies.

Methods: Initial questionnaire drafts were reviewed by private sector workers from various industries and subject matter experts. The survey designers pilot tested the questionnaire with NIOSH employees who developed hypothetical work injury scenarios. Survey methodologists conducted cognitive interviews with subjects identified from the occupational supplement to the National Electronic Injury Surveillance System (NEISS-Work) and the NEISS All Injury Program (NEISS-AIP). These subjects were employed individuals treated for either work-related or non-work related injuries. Nine interviews were completed for each questionnaire. Methodologists conducted telephone interviews using "think aloud" and concurrent probing techniques.

Results: Expert reviews and pilot tests assessed questionnaire flow and content. As a result questionnaire revisions included elimination of questions that were deemed inconsequential, rewording of questions to improve understanding, and changes to the order of questions. Cognitive tests identified issues related to participants' ability to respond to questions about their health status, their comprehension of hypothetical scenarios, their understanding of medical billing, and their recall of interactions with emergency room staff.

Conclusion: The results have important implications for designing questionnaires to assess the reporting of work-related injuries and illnesses. Cognitive tests highlighted the difficulties of asking workers about their expected behavior in hypothetical scenarios or vignettes. Addressing issues identified during review and testing prior to initializing data collection enabled us to improve the questionnaire validity and reliability. Ultimately, data from these surveys will provide valuable insight into understanding worker underreporting issues and improving occupational injury and illness surveillance.

P10

Title: ***Characteristics of Occupational Injuries Resulting in Hospitalization***

Authors: Miller K, Jackson L
Presenter: Larry Jackson, Ph.D.

Objectives: To characterize non-fatal occupational injuries resulting in hospitalization by using the National Institute for Occupational Safety and Health's emergency department (ED) surveillance and the National Hospital Discharge Survey (NHDS).

Methods: For 2007, we analyzed work-related injuries and illnesses treated in U.S. hospital EDs by using the National Electronic Injury Surveillance System occupational supplement (NEISS-Work). Occupational cases are identified through NEISS-Work based on details in the medical record. Hospitalized cases were identified as having an ED disposition of "hospitalized within the same institution" or "transferred to another hospital." We analyzed public-use microdata files from NHDS to characterize work-related hospitalizations based on expected payer being workers' compensation. NHDS cases include multiple sources of admission and were not restricted to cases admitted through an ED.

Results: In 2007, NEISS-Work estimated 3.4 million (95% Confidence Interval (CI) =±0.9 million) injuries and illnesses for workers ≥15 years old seen at U.S. EDs. Approximately 94,000 (CI=±27,100) of these injuries resulted in hospitalization. In the same year, NHDS reported 170,000 (CI=±34,000) work-related hospitalizations, 36% (60,000 CI±12,200) of which were admitted through an ED. Workers 40-59 years old accounted for 48% of NEISS-Work hospitalizations and 53% of NHDS hospitalizations. Thirty-one percent of NEISS-Work hospitalizations involved fractures, whereas 30% of NHDS ED-admitted cases and 7% of non-ED admitted cases involved fractures. The leading injury events involved contact with objects and equipment or falls among NEISS-Work (58%) and NHDS cases (14%). Injuries to the trunk and upper extremities accounted for 51% of hospitalized NEISS-Work cases and 15% of hospitalized NHDS cases.

Conclusion: Occupational injuries resulting in hospitalization share many of the same characteristics whether identified through NEISS-Work or NHDS.

P11
Title: ***NEISS–Work Surveillance System Evaluation Part 1: Retrospective Review of NEISS Non-work Injury Narratives for Misclassification of Occupational Injuries***
Authors: Heuscher ZJ, Derk SJ, Jackson LL
Presenter: Susan Derk, M.A.

Objectives: The National Institute for Occupational Safety and Health conducts surveillance of nonfatal occupational injuries and illnesses treated in U.S. hospital emergency departments (EDs) through the National Electronic Injury Surveillance System work-related supplement (NEISS-Work). Multiple agencies use the NEISS program and other supplements to capture various outcomes including all non-work-related injuries. To assess the extent hospital-based medical record abstracters misclassify occupational injuries, we conducted a retrospective review of NEISS non-work cases.

Methods: We used semi-automated search strategies to identify cases with the greatest potential for being misclassified among all non-work cases captured in 2009 by NEISS programs using a 67 hospital sample. Strategies included reviewing cases that occurred at specific locations (e.g., farms); involved selected products (e.g., construction tools); and contained selected keywords within the narrative description (e.g., "work"). We manually reviewed all identified cases for likely misclassified cases and characterized them as "probable-work" and "possible-work." Analysts reviewed and adjudicated all identified cases.

Results: In 2009, NEISS-Work captured ~41,000 cases through its hospital sample representing a national estimate of 2,640,400 (95% confidence interval (CI) = ±604,400) occupational injuries and illnesses treated in EDs. The search strategies identified ~38,000 (7%) of 544,000 non-work cases for manual review. Of these cases, we classified about 300 probable- and 300 possible-work-related cases; representing about 1.6% of NEISS-Work cases. Revised national estimates suggest that there were "probably" at least 2,661,000 (CI = ±604,200) and "possibly" as many as 2,684,000 (CI = ±605,000) occupational injuries treated in U.S. EDs.

Conclusion: This retrospective review suggested that the hospital-based medical records abstracters are not substantially misclassifying work-related cases. However, we only reviewed the limited narrative fields provided by the abstractors and other categorical variables. We are conducting onsite hospital record audits to further evaluate the potential for missing or misclassification of occupational cases by the medical record abstracters.

P12
Title: ***Occupational Injuries among U.S. Workers Missed by Employer-based Reporting***
Authors: Dye C, Derk S, Jackson L
Presenter: Claire Dye, M.S.P.H.

Objectives: Surveillance systems are frequently restricted in scope for various regulatory, data access, and practical reasons. For example, the Bureau of Labor Statistics' (BLS) Survey of Occupational Injuries and Illnesses (SOII) excludes federal government workers, self-employed, private household workers, workers on farms with fewer than 11 employees, and volunteers. This study estimates the percentage of the U.S. workforce excluded by SOII and assesses the number of emergency department (ED) work injuries and illnesses for SOII-excluded workers.

Methods: We used the BLS Current Population Survey and Current Employment Statistics to estimate the number of workers in SOII-excluded worker groups except volunteers. We used preliminary data from the National Electronic Injury Surveillance System occupational supplement (NEISS-Work) to estimate the number of ED-treated occupational injuries and illnesses for SOII-excluded workers.

Results: In 2010, an annual average of 140 million civilian non-institutionalized workers aged 16 and older were employed in the U.S. An average of 2.2 million workers were in agriculture, of which 40% were owner-operators or unpaid family members. An average of 8.9 million Americans were self-employed in non-agricultural industries, while an additional 750,000 were employed as private household or non-agricultural unpaid family workers. The federal government employed 3 million workers in 2010. Overall, 10% of the documented U.S. average annual workforce was excluded from the BLS SOII.

Preliminary NEISS-Work data for 2010 indicate there were an estimated 2.7 million occupational injuries and illnesses treated in EDs. Of these, 7% (186,400 [95% confidence interval = ±46,700]) were to workers excluded by SOII, including volunteers.

Conclusions: These results suggest that while the BLS SOII excludes 10% of the U.S. workforce, injury and

illness information for a majority of these workers can still be obtained through other means. Additional work is needed to understand occupational injuries and illnesses not captured by either SOII or NEISS-Work.

Agriculture Safety

P13
Title: ***ROPS Attribute Identification by Channel Intermediaries***
Authors: Keane P, Sorensen J
Presenter: Paul Keane, M.B.A.

Objectives: The purpose of this research was to determine preference for characteristics of the provisioning process, or the item of safety equipment, on the part of channel intermediaries. In this study, tractor parts dealers that supply rollover protective structures (ROPS) constitute the channel intermediaries, and occupy a central position in the supply chain between manufacturers and consumers. Members of the Northeast Equipment Dealers Association (NEDA), an organization of tractor parts dealers active in 12 Northeastern and Mid-Atlantic States, were selected as representatives of the channel intermediaries. The New York Center for Agricultural Medicine and Health (NYCAMH) was a partner in this study.

Methods: This is a mixed-methods research project to determine preference for: a. Qualitative attributes of the provisioning process and the item itself, and b. Dominance or importance of attributes, as based on self-reported utility preference. The method followed is that of multinomial logit, specifically, "best-worst" choice, or maximum-difference scaling, in which respondents choose the best and worst alternatives among a randomized combination set of attributes. Utility scores are summed to establish dominance. The software application is the industry standard, MaxDiff. Subsequent latent-class (LC) analysis will be used to differentiate responses for differing sectors of respondents. Latent Gold Choice will be used to perform an analysis of sectors revealed by data analysis and independent variables.

Results: The tractor-parts dealers selected the following attributes as the most significant in the decision of intermediaries to distribute ROPS to end users: Price, avoidance of exposure to lawsuits, fold-ability of ROPS structures, preservation of profile and information effects (don't know where to get ROPS). Quantitative assessment of utility scores is ongoing.

Conclusions: Parts dealers felt that a limited number of characteristics described their choice set.

P14
Title: ***Work-related Pesticide Poisoning Analysis among Farmers in Jiangsu***
Authors: Xujun Z, Zhibin T
Presenter: Tu Zhibin

Objective: Pesticide poisoning is an important occupational health problem among Chinese farm workers, but there is a relative paucity of pesticide poisoning data from China. Aims of this study were to use a case-control study to estimate the risk factors of work-related acute pesticide poisoning among Chinese farmers who applied pesticides.

Methods: A stratified sampling of 910 pesticide applicators from two villages in southern China participated in face-to-face interviews. Respondents, who self-reported having two or more of a list of sixty-six symptoms 24 hours after pesticide application, were categorized as having suffered acute pesticide poisoning. During the process obtaining subjects included 87 patients of the productive pesticide poisoning as case group and by using 1:2 pairing case control study searching 174 controls matched on gender , simple age (≤3 old years), residence (the south or north of Jiangsu province).

Results: The results were based on statistical analysis. Firstly, possible risk factors of work-related acute pesticide poisoning in the production process of rural residents were analyzed by single-factor logistic regression, then for the result of single-factor logistic regression analysis were made multi-conditional logistic regression analysis. The results show that the lack of safely guidance (OR=2.517, 95% CI: 1.452-4.362), no reading the label (OR=1.539, 95% CI: 0.925-2.562), continuing to work when workers were sick (OR=0.453, 95% CI: 0.243-0.844) and their bodies contaminated (OR=0.575 , 95%CI：0.340-0.972) showed positive correlation with acute pesticide poisoning in rural residents.

Conclusion: The results of the study show that the productive pesticide poisoning of rural residents was related to many complicated influencing factors during process of using pesticide.

P15
Title: ***Depression, Perceived Stress, and Nervios Associated with Injury in a California Farm Worker Population***
Authors: Xiao H, Stoecklin-Marois M, McCurdy S, Schenker M
Presenter: Hong Xiao, Ph.D.

Introduction: While many studies report on the risks of agricultural injury, few studies have examined psychosocial factors associated with injury among the Latino farm workers. We examine psychological factors, including depression, perceived stress, low-level of social support and nervios that may be associated with an increased risk of injury.

Methods: MICASA is a population-based study. An interviewer-administered questionnaire collected data on 759 (420 male and 339 female) Latino farm workers, 18-55 years old, engaged in farm work and residing in Mendota, CA. The questionnaire assessed self-reported psychosocial factors and the risk of injury. A qualifying injury was defined by need for medical care, or going to medical settings, or loss of consciousness, or ½ day lost work time or restricted from normal activities.

Results: Mean age was 37.9 years. 64.7% were born in Mexico and 27.6% were from El Salvador. 53% of participants had worked in agriculture for more than 11 years. The prevalence of injury was 9%. A higher prevalence of injury was observed among participants were older than 40 years (55.5% vs.37%), current smokers (15.9% vs.8.3%), worked in agriculture for more than 11 years (67.7% vs. 52%), and those who had resided in the U.S. more than 21 years (60.3% vs.42.5%). After adjusted for age, years of living in the U.S., years of working in agriculture and current smoking, depression (OR=5.52, 95% CI: 3.07-9.93) and nervios (OR=2.4, 95% CI: 1.37-4.23) were associated with injury.

Conclusions: Psychosocial variables were strongly associated with injury. Mental health therapy and education of economic impact of injury may prevent psychosocial-related injury but need more studies to prove the effect in cohort.

P16
Title: ***The Protective Mental Health Effects of Farm Work among Aging Farmers***
Author: Reed D
Presenter: Deborah Reed, Ph.D.

Objective: Much has been written about the physical risks of agricultural work. This report highlights the lesser examined impact of the mental aspects of farmwork among aging farmers discovered from a NIOSH funded study that examined work, work organization, health and injury, and future plans of farmers ages 50 and over.

Methods: Five wave survey study conducted 2002-2006 with a panel of farmers (n=1,423), primarily married couples, in Kentucky and South Carolina. Focus groups (19) that included 127 participants who had completed the surveys were embedded within the study to illuminate dimensions not conducive to survey methods.

Results: Mean age of participants was 65, with 51% male, and 78% White. Participants were engaged in farming and 40% defined health as "the ability to work." Injury rate for males: 14.4/100 farmers; women: 4.4. Using the 20 item CES-D measure, only 12% of the participants scored above the cut-off (>16) for possible depression. White males scored significantly less than White females or Blacks of either gender. The 12 item John Henry Self-efficacy score was higher for Black males than for Black females or Whites of either gender, and was high for the overall group (40.8, SD=4.6; possible range 12-60). Scores were significantly higher in the oldest 2 age groups. Focus group results confirmed the positive influence of farmwork on mental health and frank agreement that depression would occur if they could not contribute to farmwork. Many could not fathom what they would do if farmwork was not an option. Some even suggested suicide.

Conclusions: Although injury fatality rates for older farmers are higher than for younger farmers, it is important to consider the psychological benefits of farmwork for aging farmers. Results from this study illustrate the need to develop safety strategies for continued work as farmer's age.

P17
Title: ***Utilization of Cost-effective Rollover Protective Structures in NYCAMH Retrofit Program***
Authors: McKenzie EA, Jr., Hard DL, and Cantis DM
Presenter: Eugene A. McKenzie, Jr., Ph.D.

Background: There are approximately 4.2 million tractors on farms and ranches across the United States, with an average age of over 25 years. Older tractors are less safe than newer tractors, and many older tractors are operated by populations at greatest risk of becoming injured or killed by the tractor. A key tractor safety device, a rollover protective structure (ROPS) is missing from most tractors manufactured before 1985. NIOSH has developed a cost-effective rollover protective structure (CROPS) for older tractors that shows promise to offer rollover protection to older non-ROPS tractors.

Objective: Two agricultural organizations worked collaboratively to increase the use of CROPS on older tractor models by facilitating ROPS retrofit activities, the New York Center for Agricultural Medicine and Health (NYCAMH) and the Virginia Farm Bureau.

Methods: To increase the number of retrofits on older non-ROPS tractors, NIOSH is currently conducting two projects to supply CROPS to farmers in the states of New York, Virginia, Vermont, and Pennsylvania. One project is a direct supply activity where the participating farmer agrees to install the CROPS and then have it inspected by a NIOSH engineer. The other project is a demonstration activity where the farmer agrees to install the CROPS on their tractor while other local tractor owners observe the installation to determine if this has an impact on the observers deciding to retrofit their tractor with a CROPS. Data were collected before and after the installation to gain insight to potential barriers towards the CROPS retrofit.

Results: During the past two years, 69 CROPS have been installed (19 in the direct supply project and 50 in the demonstration). This poster shows the tractor types and locations of the CROPS installations and identifies installation challenges and solutions.

Conclusion: This project demonstrated the viability of utilizing the NIOSH developed CROPS to increase rollover protection for operators of older non-ROPS tractors in the U.S.

Construction Safety

P18
Title: ***NIOSH Development of a Multi-functional Guardrail System***
Authors: McKenzie EA, Jr., Bobick TG, Cantis DM, Fullen MD, Takacs BC
Presenter: Eugene McKenzie, Jr., Ph.D.

Background: Injuries sustained due to falls to lower levels from unprotected roof edges or through unguarded holes and skylights are an ongoing problem for residential construction workers. During the period of 2004-2008, a yearly average of 153 workers were killed and 3,374 suffered serious injuries in all U.S. industries. The proper use of safety interventions, in combination with proper OSHA training, is a necessary step in reducing these incidents.

Objective: This research developed a multi-functional guardrail system that could reduce the risk of falls-to-lower level.

Methods: The Division of Safety Research of NIOSH conducted laboratory research which: (a) has produced a multi-functional safety intervention for residential construction, and (b) is in the process of developing a safety training program. The three-part research effort: (1) developed and laboratory tested (to appropriate OSHA regulations) an adjustable fall-prevention guardrail system with a walking-working surface for use in residential construction; (2) is currently testing a stair and edge perimeter guardrail system that utilizes several features of the initial roof system; and (3) is developing a training program with the WVU Safety & Health Extension Office which blends the requirements of the OSHA regulations (§1926.503 Subpart M – Fall Protection – Training requirements) with the utilization of the NIOSH-developed guardrail intervention. The laboratory testing results confirmed that the safety system met and exceeded the OSHA §1926.500 Subpart M – Fall Protection requirements.

Results: A NIOSH-Designed Roof Bracket-Safety Rail Assembly was developed, tested, and patented (U.S. 7,509,702). This system has been exclusively licensed to a company based in Kansas City, MO to be marketed to residential roofing contractors in the U.S.

Conclusion: The acceptance of the guardrail system and the corresponding training program should result in the reduction of injuries and fatalities in the residential construction industry.

P19
Title: ***Labor/NIOSH Construction Research Partnerships***
Authors: McCann M, Hunt III J
Presenter: Michael McCann, Ph.D., C.I.H.

Objective: This presentation discusses productive Labor/NIOSH research partnerships in construction.

Methods & Results: Partnerships with Labor support the NIOSH mission in construction in several ways: 1) Labor can identify serious safety problems on construction sites and request NIOSH assistance in developing ways to solve these problems; 2) Labor can participate in the actual research; 3) Labor can assist in finding construction sites to test interventions; 4) Labor can play a major role in having construction sites evaluate and adopt effective interventions (R2P); and 5) Labor can establish research hypotheses and plans using NIOSH researchers to implement the methodology (P2R). This paper will give examples of such Labor/NIOSH partnerships.

The recently concluded study, "Hazard recognition: preventing falls and close calls," was begun when the first author introduced NIOSH hazard recognition materials to the Safety Director of the Ironworkers International. The Ironworkers created a detailed training curriculum from NIOSH stereo slides.

A series of focus groups sponsored by NIOSH identified the numerous and inter-connected barriers to reporting injuries on the construction site. When journeymen apprentice trainers were asked how they might address these barriers, they proposed that an anonymous survey of their apprentices would be able to collect injury and exposure data by insuring anonymity within each local and by aggregating the results across all participating locals.

An on-going study of the safety of aerial lifts began when the first author and others approached NIOSH with concerns about tipovers and fall protection. NIOSH has been conducting experimental research using manikins and developing a computer simulation model.

This presentation will report some of the lessons learned from these collaborations.

Conclusion: Labor/NIOSH partnerships can assist in the identifying, solving and spreading solutions to construction safety hazards.

P20
Title: ***Evaluation of Maximum Impact Forces and Postural Instability During Various Methods of Exiting and Entering Scissor Lifts at Elevations***
Authors: Chiou S, Pan C, Powers J, Wimer B, Cantis D, Newbraugh B, Weaver D
Presenter: Sharon Chiou, Ph.D.

Objectives: The use of scissor lifts in the construction industry has increased tremendously over the past decade. This growing popularity makes scissor lift safety an important issue. Previous NIOSH studies identified an increasing trend for fatalities associated with falls from scissor lifts. An emerging issue is that of extreme extensibility height and its effect on platform and worker stability. According to the recent version of ANSI A10.29, workers may enter and exit scissor lifts at heights greater than 6 feet when the work platform surface is adjacent to the elevated surface. The objective of this study was to evaluate the impact forces and postural instability during various methods of exiting and entering scissor lifts at elevations.

Methods: This study investigated impact forces and postural instability of twenty-two (37.6±11.4 years) construction workers while entering and exiting a scissor lift set at 10-foot height. Two three-dimensional force plates were used to determine the impact forces and postural instability in each of the experimental conditions. The vertical distance between the scissor lift and the adjacent surface was level, 8 inches lower, or 8 inches higher than the landing surface to which the worker was exiting. Also, the landing surface was either flat or sloped at 26 degrees.

Results: The repeated measure ANOVA revealed that entering the scissor lift from a sloped surface resulted in impact forces as high as 2.3 times the subject's body weight. Greater lateral forces, anterior-posterior forces and postural instability were found to be significantly associated with the sloped surfaces ($p<0.05$). Significant increases in impact forces were identified when the lift was positioned higher than the landing surface ($p<0.05$).

Conclusion: This study demonstrated that impact forces and postural stability were significantly affected by various entering and exiting methods. Findings from this study will be used to recommend safer work practices to prevent fall injuries from elevations for the use of scissor lifts.

P21
Title: ***Preventing Worker Fatalities Due to Backing Road Construction Vehicles and Equipment– Lessons from the NIOSH Fatality Assessment and Control Evaluation (FACE) Program***
Authors: Romano N, Casini V
Presenter: Nancy Romano, M.S.

Introduction: According to a Bureau of Labor Statistics review of the 639 fatal workplace injuries at road construction sites from 2003 to 2007, 305 were due to a worker being struck by a vehicle or mobile equipment. Workers were fatally struck 101 times by a vehicle or mobile equipment that was backing up. In 60 of these cases, the worker was fatally struck by a dump truck that was backing up.

Methods: The FACE program conducted field investigations of workers fatally injured at roadway construction work sites to identify risks and interventions. 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: Between 1992 and 2009, the FACE program investigated 32 deaths of workers killed by backing construction vehicles or mobile equipment on roadway construction work sites. Hazards identified included backing vehicles or equipment without spotters, equipment operators being unaware of the location of workers on foot, and lack of coordination between the movement of workers on foot and vehicle and equipment operators.

Conclusions: FACE investigations identified several prevention measures that may reduce these deaths. Some examples of preventive recommendations arising from these investigations are: 1) employers, contractors, and sub-contractors develop, implement, and enforce standard operating procedures that address worker safety and minimize work to be performed near vehicles and equipment, 2) workers wear high-visibility apparel, 3) use and maintain contact with a spotter when backing any vehicle and equipment and, 4) vehicle and equipment manufacturers incorporate video cameras and proximity warning technology to help monitor the presence of workers in blind areas.

Mining Safety

P22
Title: ***Influence of Different Kneepads and Location of Work on Knee Stresses***
Authors: Jampala SH, Merryweather A, Kallakanti MK
Presenter: Sree Harsha Jampala, M.S.

Background: Several studies have shown evidence relating kneeling work to knee joint disorders. Relatively few studies have been conducted to estimate the effect of kneepads on knee stresses.

Objectives: One purpose of this study was to quantify the stresses on the knees during kneeling both with and without kneepads, and the effect of the location of work in a kneeling reach envelope on knee stresses.

Methods: Ten male participants simulated a tile setting job. Custom sensors were fabricated using FlexiForce™ Sensors and were placed on both knees over anatomically defined landmarks on patella and tibial tubercle. Data were analyzed to compare the relative difference between the actual resultant force, and the measured force between the knee and the kneepad.

Results/Discussion: A significant reduction in force as a function of kneepad was found. The measured force distribution and location of work in the kneeling work envelope was significantly correlated. Measured force was correlated with self-reported knee discomfort. A gel cushioned kneepad was identified as the best kneepad tested, showing a significant reduction in measured force compared to other kneepads in the study ($p<0.05$).

Conclusions: The type and style of a kneepad significantly influences the distribution of forces on the knee while kneeling. Kneepad selection may be an effective control to reduce stresses on the knee during kneeling work. Kneeling stresses significantly increase as the location of work approaches the extremes of the kneeling reach envelope. Future studies investigating the dose-response relationship between kneeling work and development of knee disorders are warranted. These studies could help establish better work practices and provide guidelines related to the duration and frequency of kneeling, and subsequent risk of developing knee disorders. Understanding the effect of kneepad design and material may provide additional data to influence future kneepad designs that reduce exposure to elevated joint stresses while kneeling.

P23
Title: ***Machine Maintenance and Repair Injuries in Mining Mills and Preparation Plants***
Authors: Heberger J, Pollard J
Presenter: John Heberger, M.A.

Objectives: Maintenance and repair work is non-routine and is associated with risks due to restricted workspaces, environmental influences, electrical hazards, chemical hazards, and materials handling exposures. In the mining community, minerals processing (mills) and coal preparation plants (prep plants) make up a large portion of the plants where raw earth materials are processed for use. In these plants, maintenance and repair work contributes to hundreds of injuries each year.

Methods: In this study, researchers examined injury reported to the Mine Safety and Health Administration (MSHA) between 2005 and 2009. Injuries from machine maintenance and repair activities at mine mills and prep plants were isolated, yielding 3,655 incidents. Nonfatal injuries with days lost made up 2,261 of the incidents. Analyses were performed to ascertain which activities contributed to the most injuries. Information gathered from the incident reports included:

1. Body part(s) affected (ex: back, shoulder, multiple parts)
2. Types of equipment involved (ex: crushers, conveyors, mills)
3. Nature of injury (ex: sprain/strain, laceration, fracture)

Results: Results showed finger lacerations (13%) and fractures (7.5%) were predominant followed by back (9.5%) strains, eye chemical burns (3.5%), and hand lacerations (2%).

Conclusion: Improved materials handling and personal protective equipment may alleviate the stresses and thereby reduce the injuries associated with maintenance and repair work in mine mills and prep plant.

P24
Title: ***Comparison of Noise Reductions of Cap Mount Muffs Fitted on a Traditional and a Newly Designed Mining Helmet***
Authors: Takacs B, Guffey S, Wu M
Presenter: Brandon Takacs, M.S.

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. At present exposure limits, one in four workers will develop a permanent hearing loss as a result of mining coal. Virtually all mines have hearing conservation programs and virtually all miners are issued and told to wear Hearing Protector Devices, either ear muffs or ear plugs. Nevertheless, miners still have a high rate of NIHL. Many mines require mining helmets to be fitted with cap mount hearing protector devices (HPDs), commonly referred to as "cap mount muffs." This study compares the noise reduction of various cap mount muffs fitted on a traditional mining helmet and a newly designed mining helmet. In previous mining noise studies conducted by West Virginia University, the mining helmet was identified as a factor in the proper fit of the cap mount muff and consequently the overall performance of the HPD (hearing protector device). Currently, WVU has begun laboratory data collection and will conduct a field assessment using the traditional and newly designed mining helmet. WVU will determine the primary parameters for proper selection and fit of cap mount muffs and whether they are being properly utilized in the mines.

Methods: This study uses the Real Ear Attenuation at Threshold (REAT) and the Microphone in Real Ear (MIRE) approach for laboratory and field testing of the cap mount muffs. The REAT and MIRE are 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 noise reduction achieved during fit tests of the various mining helmet and cap mount muff configurations. 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.

P25
Title: ***Physiological Evaluation of Air-fed Ensembles during Exercise***
Authors: Turner N, Powell J, Novak D, Sinkule E, Shepherd A
Presenter: Nina Turner, Ph.D.

The plan for NIOSH certification of air-fed ensembles has been proposed; however, research on the physiologic burden of wearing air-fed ensembles is scarce.

Objective: The goal of this study was to evaluate the respiratory and metabolic stresses of air-fed ensemble use in wearers during rest, low-, and moderate-intensity treadmill exercise.

Methods: Fourteen male subjects completed baseline testing to determine the speed and grade required to elicit oxygen consumption levels of 1.0 (LOW) and 2.0 L/min (MOD). Subjects then wore two different air-fed ensembles (A and B) and one two-piece supplied-air suit (C) at rest and while walking for six minutes at each treadmill setting. Inhaled O_2, CO_2, pressure and temperature were measured continuously breath-by-breath, and tests were to be terminated if maximum inhaled O_2 fell below 19% or minimum inhaled CO_2 rose above 2%.

Results: During rest, maximum inhaled O_2 concentrations were 20.4%, 20.2%, and 20.4%; minimum inhaled CO_2 concentrations were 0.2%, 0.4%, and 0.1%; average inhalation pressures were 1.2 cmH_2O, 0.4 cmH_2O, and 0.1 cmH_2O; and inhalation temperatures were 25.2°C, 25.1°C, and 23.0°C for ensemble A, B, and C, respectively. During LOW, maximum inhaled O_2 concentrations were 20.0%, 19.4%, and 20.4%; minimum inhaled CO_2 concentrations were 0.4%, 0.9%, and 0.2%; average inhalation pressures were 1.0 cmH_2O, 0.2 cmH_2O, and 0.1 cmH_2O; and inhalation temperatures were 26.4°C, 26.2°C, and 23.0°C for ensemble A, B, and C, respectively. During MOD, maximum inhaled O_2 concentrations were 19.9%, 19.0%, and 20.3%; minimum inhaled CO_2 concentrations were 0.6%, 1.4%, and 0.3%; average inhalation pressures were 0.8 cmH_2O, 0.4 cmH_2O, and -0.1 cmH_2O; and inhalation temperatures were 26.7°C, 26.4°C, and 23.4°C for ensemble A, B, and C, respectively.

Conclusions: Preliminary results show that inhaled O_2 is deceased and inhaled CO_2 is elevated in air-fed ensembles during low- and moderate-intensity treadmill walking.

P26
Title: ***A Case Study of Gold Fields Exploration's Effort in Establishing Zero Harm Safety Culture Within Its Corporate Safety Culture in Africa 2010/2011***
Authors: Aggrey-Odoom J, Crankson M
Presenter: Jacob Aggrey-Odoom

I have conducted a research and one of the findings indicate that the beliefs of some Corporate Entity's on Zero Harm Safety Culture is not achievable, but it must be stated emphatically that it is doable and achievable and should be given the needed support for its vivid awareness and implementation.

Objectives:

- To gain alignment behind a single Corporate Entity's vision for a Zero Harm Safety Culture strategy for Health & Safety
- To highlight priority programmes that will support Zero Harm Outcome

Aim:

"The primary aim is to create a proactive safety culture in which all corporate entity employees believe that all injuries and occupational illness are foreseeable and preventable and act in a manner that demonstrates their personal commitment to this aim."

Methods:

Creating a Zero Harm Safety Culture means:

- Corporate Entity's vision is Zero Injuries, Zero Fatalities, Zero Harm.
- Being obsessively committed to preventing every single injury
- When an injury occurs the rank and file of the corporate entity are ruthlessly focused on ensuring the person is supported in treatment and return to work, they understand the root cause and know it is a responsibility to share learnings across board
- Always recognized the benefits of safe behaviors and celebrate corporate safety success

Results:

- By measuring, understanding and actively developing the prevailing safety culture at our various corporate

entities, one will foster on a set of shared values enabling a step change in safety performance.

- Corporate entity's strategy will influence every employee's beliefs attitudes and values so that they are fully engaged in safety and are obsessed with preventing harm, thereby achieving the Zero Harm Safety Culture.

Conclusion: Zero harm culture is a key element of each corporate entity to ensuring the protection of their people and to build a reputation.

Healthcare Safety

P27
Title: ***A Comprehensive Safe Lifting Program Influences Caregiver Injury Outcomes and Resident Quality Indicators***
Authors: Gucer P, Restrepo T, Shuford H, Oliver M, Gaitens J, Shmid F, Shyong C, McDiarmid M
Presenter: Patricia Gucer, Ph.D.

Objective: To determine the association between a comprehensive safe lift program, including powered mechanical lifts, in long-term care (LTC) facilities and a) caregiver injury experience and b) resident quality of care indicators.

Methods: Data on Powered Mechanical Lift availability and safe lifting policies and procedures were obtained from a survey of 271 LTC Directors of Nursing (DONs) in late 2007 and early 2008. We used facility level data of mobility-related resident outcomes from the Minimum Data Set (MDS) Quality Indicators, and workers compensation data provided by the National Council on Compensation Insurance.

Results: Facilities increased their inventories of PMLs over the three years studied (2005 - 2007). As inventories of sit-stand lifts increased, some measures of resident quality indicators improved. Associations were modest, but the more sit-stand lifts facilities had relative to their census the less likely were residents to have pressure ulcers or to be bedfast. In facilities with low availability of sit-stand lifts, 16% of residents had pressure ulcers and 4% were bedfast. In facilities with high availability of sit-stand PMLs only 10% had pressure ulcers and 2% were bedfast (probabilities <.006). Resident falls were fewer in facilities with better safe lift procedures. Fractures were slightly higher among facilities with more sit stand lifts. Physical restraints and use of antipsychotic drugs in the absence of psychosis declined between 2005 and 2007. Safe lift policies and procedures were associated with lower workers compensation claims and costs.

Conclusion: The increasing availability of sit-stand lifts is associated with resident benefits related to mobility and also some mobility-related risks, which can be mitigated by safe lift policies and procedures. Safe lifting policies and procedures are also associated with lower workers compensation claims and costs.

P28
Title: ***Practioner's Risk Exposure to Client Violence: A Test of Gender Sensitive to Case Assignment Practices***
Author: Lowe T
Presenter: Tony Lowe, Ph.D.

Objectives: Gender has emerged as a risk factor for male social workers exposed to client-related assaults in the workplace. This explanatory study examined the hypothesis that male social workers are more likely to be assigned adult mental health clients with histories of violence than female colleagues.

Methods: This experimental case vignette study solicited a national random sample of National Association of Social Workers members (N=181) who identified mental health as their primary service setting and supervision as their primary practice function. This investigation used gender role theory as a conceptual framework. A mixed-model repeated measure analysis of variance was employed to test the hypotheses.

Results: The findings suggest that management practices can contribute to disparate assignment of male exposure of gender disparities of client-related violence among social workers.

Conclusion: Implications for practice, management and policy are discussed.

P29
Title: ***Psychiatric Nursing Staff's Emotional Response in Relation to Severity of Patient Aggression***
Authors: Ridenour M, Lanza M, Hendricks S, Rierdan J, Zeiss R,
Presenter: CDR Marilyn Ridenour, M.P.H.

Objective: Psychiatric nursing staff typically reports the highest levels of exposure to patient aggression among all nursing specialties. Because studies of nursing staff response to violence exposure are typically retrospective, the emotional impact of patient aggression on nursing staff is not yet clear.

Methods: For 21 weeks, nursing staff (registered nurses, licensed practical nurses and certified nursing assistants) of six in-patient locked psychiatric units affiliated with the Veterans Health Administration recorded instances of patient aggression. Nursing staff rated verbal and physical aggression according to the Modified Overt Aggression Scale on a daily incident log at the end of each day's shift.

Results: Incidents characterized by physical aggression only (against property and/or persons) were associated with greater distress for nursing staff than incidents characterized by verbal aggression only (proportional odds ratio 1.52 [95% CI 1.14, 2.02]). Incidents which involved both physical and verbal aggression were associated with the highest distress (proportional odds ratio 1.99 [95% CI 1.55, 2.56]). Examining the relationship between distress and severity of aggression within the domains of verbal and/or physical aggression, a significant relationship was found for Verbal Aggression ($p < .0001$); the greater the severity of verbal aggression, the greater nursing staff distress. In contrast, the relationship between severity of physical aggression (whether against persons or property) and distress was not found ($p = 0.5924$ and $p=0.8941$, respectively).

Conclusion: Both verbal and physical aggression by psychiatric patients is associated with emotional distress on the part of nursing staff that care for them. Although distress was higher for exposure to physical aggression than to verbal aggression by patients, it was higher still when the two were combined in single incidents. For physical aggression, the critical variable seemed to be whether it occurred at all (or not); for verbal aggression, distress varied depending on severity of the verbal aggression.

Workplace Violence

P30
Title: ***Causes of Non-robbery Related Homicides among Retail Workers, 2003–2008***
Authors: Konda S, Amandus H, Tiesman H, Hendricks S, Gurka K
Presenter: Srinivas Konda, M.P.H.

Background: Prevention of workplace violence (WPV) among retail workers has focused primarily on robbery and robbery-related events because the majority of homicides among retail workers have been during a robbery event. However, little has been published concerning events associated with non-robbery related homicides. The purpose of this study was to assess the causes of non-robbery related homicides and to determine possible recommendations for prevention.

Methods: Workplace homicides among retail businesses workers from 2003 through 2008 were examined using the Census of Fatal Occupational Injuries (CFOI). 2002 North American Industry Classification System (NAICS) was used to define retail business industry as the retail industry (NAICS 44 or 45) or food service and drinking places (NAICS 722). Workplace homicides were identified using the Occupational Injury and Illness Classification System (OIICS). Codes '6000' (assaults and violent acts, unspecified), '6100' (assaults and violent acts by person, unspecified), '6120' (hitting, kicking, beating), '6130' (shooting), '6150' (stabbing), and '6190' (assaults and violent acts by persons, n.e.c) were included. Further, a taxonomy for the types and circumstances of events was developed using the narrative text information. Additionally, codes for the circumstances of robbery and non-robbery events were developed and characteristics were compared.

Results: A preliminary review of the data indicates that the majority of non-robbery related homicides are due to arguments. Arguments are primarily between the victim and a co-worker or supervisor, victim and a customer and domestic-related which plays out in the orkplace. Results of the tabulations of the recoded CFOI data will be presented.

Conclusions: Conclusions will be provided concerning the primary causes of non-robbery related homicides. Recommendations for prevention will be discussed.

Safety Program Effectiveness

P31
Title: ***Evaluation of the California Injury and Illness Prevention Program***
Authors: Mendeloff J, Haviland A, Gray W, Main R
Presenter: John Mendeloff, Ph.D.

Objectives: Federal OSHA's top standard-setting priority is the adoption of an Injury and Illness Prevention program, which would require firms to implement a safety program involving worker training, hazard surveys, accident investigations and more. This initiative has been endorsed by the ASSE and AIHA along with other organizations.

Several states already have similar requirements, with California's IIPP, adopted in 1991, perhaps the best known. This paper presents an evaluation of the IIPP's impact on injuries in California in order to help us understand what the impact of these programs is and what might be achieved by broadening the requirement.

Methods: The study examines several different bodies of data—from the OSHA Data Initiative, the California Workers' Compensation Information System, and the California Workers' Compensation Insurance Rating Board. It also looks at fatality data from CFOI, NTOF, and OSHA accident investigations.

The study relies on two major tests: 1) Did workplaces cited for violations of the IIPP have relatively bad injury rates once we control for other factors? If so, we might infer that non-compliance plays a role in causing higher rates. 2) Did workplaces cited for IIPP violations experience improvements in their rates in subsequent years, controlling for other factors? Was there a difference depending on whether the workplace was found to be compliant or non-compliant in a subsequent inspection?

Because of concerns about biased reporting of non-fatal injuries, we also examine fatality data, both at the workplace level and in the aggregate.

Results: We anticipate that the study will be completed in April, 2011. Therefore, we cannot report results at this time.

Conclusion: See above.

P32
Title: ***Are There Unusually Effective Health and Safety Inspectors?***
Authors: Haviland A, Mendeloff J, Gray W, Main R
Presenter: Amelia Haviland, Ph.D.

Objectives: In many fields, there are searches to identify unusually effective practitioners and their characteristics. Teaching is a prominent example. This study is one of the first to ask whether there are unusually effective occupational safety and health inspectors. We define effectiveness in terms of reducing injury rates. Other studies have shown that OSHA inspections have led to reductions in injury rates at certain subgroups of establishments when penalties were levied. This study builds on those studies, adding variables about both the identity of the inspector and the characteristics of the inspectior's "style." Knowledge from this study could assist in selecting and training safety and health inspectors.

Methods: Our inspection data come from OSHA inspection files. We were given access to the inspector ID variable in order to link the inspections that each inspector carried out. We linked the inspection data with multiple sources of data on injury rates from the OSHA Data Initiative, the California Workers' Compensation Information System, and the California Employment Development Department.

We examined two separate but related issues. The first was to find out (using a random effects model) whether injury rates were more likely to decline after an inspection when it was conducted by an inspector with certain characteristics. These included years of experience, the propensity to involve workers in the inspection, a health vs. safety background, a tendency to cite only a limited set of standards and others. The second approach uses a fixed effects model to see whether, holding all of the preceding factors constant, some inspectors still achieved higher levels of injury reduction. In both cases, we control for exogenous factors like the size of the workplace, the industry, and the scope and type of inspection.

Results: This study is expected to be completed later in April, 2011. Therefore, results cannot be presented at this time.

Conclusions: See above.

P33
Title: ***Synthesis of Risk Reduction Methods for Occupational Safety and Health***
Author: Jensen R
Presenter: Roger Jensen, J.D., Ph.D.

Objective: During the past forty year, improvements in professionalism have kept pace with the expansion of occupational safety and health (OSH) jobs. But along with this improvement there has been a trend toward silo building tied to professional societies, educational program accreditation, conferences, and literature. Different silos exist for ergonomists, industrial hygienists, safety engineers, occupational healthcare providers, and allied professions. In an effort to strengthen bonds among the various OSH professions, an extended project was undertaken to identify and clarify basic principles, definitions, and methods suited for sharing among all the specialties.

Methods: Using research literature, handbooks, textbooks, and personal experiences, the author synthesized great ideas from leading thinkers in traditional OSH, public

health injury control, system safety, and ergonomics. The end product of the project required a book-length manuscript, with highlights consolidated for this presentation.

Results: The project resulted in an integrated whole with four main outcomes. First, numerous definitions of fundamental terms were examined, compared, and analyzed. This resulted in clarification of definitions for the word hazard, the concepts of risk, and the phrases hazard control and risk reduction. Second, a taxonomy of hazard sources was developed and used to add specificity to the definition of hazard. Seven source groups form the first tier of a taxonomy of hazard sources, with each having sub-groups. Third, proactive methods for anticipating and addressing diverse occupational hazards were identified. These methods are job hazard analysis, risk assessment, fault trees, and incident investigation. The fourth outcome of the project was modification of the ten strategies proposed by Dr. William Haddon. The modified taxonomy consists of nine risk reduction strategies, with each having subcategories.

Conclusions: The hope for the outcomes of this project is to provide scientific foundations for shifting the silo building tendency into a trend toward a more integrated field.

Safety Program Effectiveness in Vulnerable Populations

P34
Title: ***What Makes Safety Training Effective in Preventing Injury among Young Workers?***
Authors: Zierold K, Welsh E, McGeeney T
Presenter: Kristina Zierold, Ph.D.

Objectives: With more than 70% of teenagers working for pay before graduating high school, work-related injuries are a major public health concern. Young workers have twice the risk of injury compared with adult workers and many of those injuries are severe, resulting in workers' compensation claims and emergency department visits. Safety training has been suggested as a preventive measure of injury, but little information exists on the nature and effectiveness of training that working teens receive. The objective of this study was to characterize safety training and its association with injury among working teens. Focus was specifically on methods of safety training, amount of safety training, and teen's perceptions of the effectiveness of safety training.

Methods: This study utilizes mix-methods techniques. techniques. Initially teenagers aged 15-19 were recruited from two large public high schools in Jefferson County, KY during spring 2010 to participate in focus groups and interviews. In total, five focus groups and seven interviews were conducted, involving 42 teenagers. Following the qualitative part of the study, a questionnaire was administered to over 2,700 students within the high schools.

Results: Among the working teens, 38% reported being injured. Teens that received safety training were less likely to be injured compared with teens who did not report receiving safety training (33% vs. 59%). Furthermore, time spent on training was negatively correlated with injury prevalence. Among teens that received less than 30 minutes of training, 41% were injured; while among those teens who received more than one hour of training 25% were injured. While many teens felt that other teens needed safety training (80%); one-third of teens felt that they personally did not need safety training (37%).

Conclusion: Limited information exists on the methods, the quantity, and effectiveness of safety training that teen workers receive. This study assesses numerous aspects of safety training and its role in prevention of workplace injury among teens. Additional analysis of this recently collected data will provide a clearer picture of the needs of teen workers and the relationship between safety training and injury at their jobs.

P35
Title: ***The Role of Supervisors in Preventing Injury among Working Teens***
Authors: Zierold K, McGeeney T, Welsh E
Presenter: Kristina Zierold, Ph.D.

Objectives: Work-related injury among teen workers is an enduring problem. NIOSH estimates that approximately 200,000 teens are injured each year at work. The Bureau of Labor Statistics reports that in 2007 there were 38 deaths of U.S. teens < 18 years old; of which eighteen deaths occurred to teens < 16 years old. Prevention of injury in teen workers depends on proper safety training as well as on-the-job supervision; however, no information exists about the role of supervision in teen's work experiences and injury occurrences. The objective of this study was to characterize the association between supervision and injury among working teens. Specific focus was on the quality of the relationship between teen and supervisor, teen's perception of their supervision, and amount of time spent in contact with supervisor.

Methods: This study utilizes mixed-methods techniques. Initially teenagers aged 15-19 were recruited from two large public high schools in Jefferson County, KY during spring 2010 to participate in focus groups and interviews. Both schools combined traditional education with career magnet programs. The schools were racially diverse. In total, five focus groups and seven interviews were conducted, involving 42 teenagers. Following the qualitative part of the study, a questionnaire was administered to over 2,700 students within the high schools.

Results: Among the teens employed, 38% were injured at work. Overall 86% thought that they received enough supervision at work. Fifty-one percent of teens talked with their supervisor every day while 8% never talked with their supervisor. Teens that talked with their supervisors every day were less likely to be injured compared with teens who never met with their supervisor (38% vs. 0%). Furthermore, teens who felt that their supervisor was concerned about workplace safety were less likely to be injured compared to teens who felt that their supervisors did not care about workplace safety (34% vs. 71%).

Conclusion: Supervision may play a key role in preventing workplace injury among teens. Results from our study indicate that both quality and quantity of supervision is important in preventing work-related injury, as is the relationship between supervisor and teen worker. Additional analysis of recently collected data will help to elucidate how intricacies of the relationship dynamic between supervisor and teen worker can help prevent work-related injury.

P36
Title: ***Adapt and Validate Spanish Ergonomic Job Exposure Tools***
Authors: Pierson K, Streit J, Flynn M, Vossenas P, Orta-Anes L, Bailey C
Presenter: Kellie Pierson

The Bureau of Labor Statistics estimates that nearly 20 million Latino workers are currently employed in the United States, more than half of whom are foreign born (BLS, 2009). In 2010 nearly 2 million of these workers were employed in cleaning and maintenance jobs, including hotel housekeeping positions. Seminal studies on hotel housekeeping staff demonstrate that MSDs-in particular, back injuries-are a significant problem for these workers (Buchanan et al., 2010; Krause et al., 2005; Lee and Krause, 2002). Along with reporting MSD prevalence rates, these studies also consistently cite the need for culturally- and linguistically-appropriate tools for obtaining accurate injury data from the Latino workforce.

The purpose of this project is to provide the scientific community with empirically-validated, ergonomic assessment tools that are culturally- and linguistically-appropriate for application with Spanish speaking workers in the United States. Specifically, this project seeks to create a battery of novel research instruments assessing work-related musculoskeletal disorders in Spanish-literate Latino hotel housekeepers. The adaptation will be accomplished by creating English-version instruments under the guidance of subject matter experts (SMEs), then translating those instruments into Spanish and establishing their conceptual equivalencies and content validities with workers in the hotel industry.

This presentation will describe the plans for this effort, slated to run from FY10 to FY13. In particular, this presentation will explain the translation process that was used to translate the instruments and establish their technical and cross-cultural equivalencies to their English source versions. It will also describe the analysis plan for assessing the quality, interpretability, face validity, and content validity of the new Spanish instruments. Finally, it will expound upon plans for a future large-scale data collection effort, which will employ the instruments in conjunction with an ergonomic intervention for Latino hotel housekeepers to further assess their reliability and validity.

Economics of Injury

P37
Title: ***The Economic Burden of Occupational Fatal Injuries in the United States by Industry Sector, 2003–2006***
Author: Biddle, E
Presenter: Elyce Biddle, Ph.D.

Introduction: Since the implementation of the OSH Act, the safety and health environment has seen marked improvement in the magnitude of the problem. Although these improvements are laudable, workplace hazards continue to plague the American worker. Understanding the economic burden of fatalities by industry sector 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 each industry sector from 2003–2006.

Methods: This study uses occupational fatal injury data from the Bureau of Labor Statistics Census of Fatal Occupational Injuries for the period 2003 through 2006. This system compiles data using multiple data sources for decedents of any age as long as the death was a work-related fatal injury. The cost to society of workplace fatalities was estimated using the cost-of-illness approach, which combines direct and indirect costs to yield an overall impact of an occupational fatal injury on the Gross Domestic Product (GDP).

Results: During the 4-year study period, over 22,000 occupational fatal injuries occurred in the U.S. accounting for a total cost of over $21billion and a mean of nearly $1million. While the toll is substantial, it is not evenly distributed among industry sectors. Construction accounts for 22% of fatalities but 24% of the total burden on GDP. Conversely, Agriculture constitutes 12% of fatalities, but only 10% of the total costs. Furthermore mean costs are not consistent as Mining is almost 1-1/2 times greater than the industry sector with the lowest mean value.

Conclusions: Cost estimates from this study confirm that research to prevent fatal occupational injuries should be conducted within each industry sector independently.

P38
Title: ***Improving the Strategy for Demonstrating the Value of Occupational Safety and Health Activities***
Authors: Shroff R, Biddle E
Presenter: Reepa Shroff, M.S.

Introduction: In today's economic environment firms are faced with challenges of increasing global competition, expectations of stellar sustainability practices, and maintaining production levels or market share while often experiencing decreased resource availability. It is critical that a strong value proposition is made to support occupational safety and health (OSH) programs and activities to compete successfully for limited resources. The American Industrial Hygiene Association, partnering with the American Board of Industrial Hygiene engaged Mercer ORC Networks to develop a comprehensive process called "Strategy" that provides the basis for OSH professionals to demonstrate that value proposition. While "Strategy" aligns risk management with business objectives and value, it remains complex to initiate and interpret the results. Mercer ORC Networks and NIOSH initiated this project as the first step in developing a tool designed for users to walk step-by-step through the "Strategy" process, helping them to finalize a comprehensive and accurate value analysis.

Methods: Using original "Strategy" data collection instruments, the team used a network analysis approach to examine relationships among programs, activities, resources, and timelines associated with employing the "Strategy" process. Structured analysis techniques provided baseline information required for programming a new Value Analysis Tool. Logic flow diagrams were created to ascertain specific steps that allow the user to identify the direction and content of the analysis.

Results: The finalized logic flow contains a step by step thought process to help the user make informed decisions and evaluate all potential areas of value within their OSH programs or activities. Additional assistance was provided to the user through definitions of terms and "help screens" at key decision points within the logic flow.

Conclusions: This structured analysis and design approach provided the team with additional means to identify areas of value that users normally would not consider when applying the original "Strategy" approach—decreasing complexity simultaneously.

Motor Vehicle Safety

P39
Title: ***Selecting Male and Female Multivariate Anthropometric Models for the Design of Truck Cab Workspace***
Authors: Guan J, Hsiao H, Reed MR, and Amendola AA
Presenter: Jinhua Guan, Ph.D.

Objectives: This research proposed a method to mathematically recombine male and female boundary models after they had been derived separately by principal component analysis (PCA). PCA is commonly used to develop small sets of male or female boundary manikins that capture a desired level of anthropometric variability in a population. However, some of the manikins are redundant because they lie within the space spanned by the manikins of the other gender. The new method rigorously identifies those redundant manikins that can safely be excluded from analyses.

Methods: The PCA was conducted on the male sample (n=1778) and female sample (n=168) separately, resulting in a set of three orthogonal principal components for each sample. These three components formed an ellipsoid in

distribution. Based on a 95% enclosure criterion, 14 male and 14 female boundary models were selected on the surface of the ellipsoid. To recombine male and female models, the models of each gender were put into the other gender's 95% enclosure space, and those who were identified to be within the enclosure space of the opposite gender were considered redundant and discarded. Otherwise, they were retained for the joint male and female model space.

Results: When the 14 male and 14 female boundary models were projected into each other's 95% enclosure space, four males and four females were found to coincide with the enclosure space of the opposite gender. These eight models were excluded from the final set of recombined male and female body models. The final male and female model space consisted of the remaining 10 males and 10 females.

Conclusions: A mathematically rigorous methodology is proposed for removing redundancy from male and female boundary manikin families generated using principal component analysis under the multivariate normality assumption. The method has general applicability to boundary manikin development.

P40
Title: ***System Design of a Portable Exposure Assessment Device for Package Truck Drivers***
Authors: Zeng S, Pan CS, Wimer BM, Lin W
Presenter: Shengke Zeng, Ph.D.

Background: The courier industry injury/illness incident rate was 8.7 per 100 workers in 2008. An estimated 35,600 total recordable injuries/illnesses occurred in the courier industry, of which 12,940 involved days-away-from-work in 2008. The injury and illness incident rate for days-away-from-work was 3.3 per 100 workers, 3 times greater than the private sector.

Objectives: The objective of this project is to develop a portable exposure assessment system (PEAS) to conduct evaluations of integrated assessment methods leading to effective interventions and real-time monitoring of MSD and STF injuries. The PEAS is a noninvasive instrument-based device that acquires and analyzes exposure data from the sensors, triggers proximal and remote alarms and saves data for more extensive assessment.

Methods: The PEAS is composed of several credit-card sized exposure-assessment modules, a data-logger and a smart-phone. The gyroscope-modules monitor a worker's spine-angle change and hand positions. An accelerometer-module measures body vibration RMS magnitudes. The resistive pressure-sensor-modules monitor foot-pressure distribution. The modules transmit exposure data to the data-logger via 915-MHz wireless links. As the data-logger determines abnormal data exceeding safety thresholds, it sets off an alarm and commands the smart-phone via Bluetooth wireless link to automatically send out a text message containing the abnormal data, GPS-location and time.

Results: The hardware and software of the prototype modules have been designed, fabricated, and programmed. Some modules have been preliminarily characterized. The angular drift of the low-cost compact gyroscope modules is within 5 degrees in 2 minutes, and the 90-degree rotation measuring error is within 3 degrees. The RMS gravity measuring error of the accelerometer module is less than 3%. The transmission distance of the 915-MHz wireless links is more than 40 meters.

Conclusion: The preliminary module characterization results show that it is feasible to use this system design to provide real-time monitoring of package truck drivers' biomechanical exposures within acceptable error ranges.

NIOSH Safety Research Labs

P41
Title: ***NIOSH Safety Research Labs and Research Activities for Traumatic Injury Control***
Authors: Hsiao H, Weaver D, Powers J, Amendola A
Presenter: Darlene Weaver, M.O.H.S.

Background: The Division of Safety Research (DSR) is the focal point for the NIOSH occupational traumatic injury prevention and safety program, and the Protective Technology Branch (PTB) is the research arm for injury prevention and control.

Objectives: This poster provides a brief summary of the NIOSH DSR/PTB laboratory facilities and the lab's research activities for traumatic occupational injury control and prevention.

Methods: Three key factors (mission relevance, state-of-the-art status, and integration capacity) were considered to develop the NIOSH DSR lab facility and three primary drivers (injury database, stakeholder input, and staff capacity) were used to define the DSR research focus to maximize relevance and impact of the NIOSH traumatic injury prevention research program.

Results: Six laboratories were developed: Anthropometry Research Lab, Virtual Reality Lab, Human Factors Lab, High Bay Lab, Safety Engineering Lab, and System Safety and Digital Modeling Lab. Program activities and research impacts within each lab are presented with a focus on prevention of the four leading causes of workplace injury and death in the U.S.: motor vehicle incidents, falls, workplace violence, and machine and industrial vehicle incidents.

Conclusions: This poster showcases six NIOSH traumatic injury control research labs and selected priority activities and impacts of the NIOSH injury prevention program. The NIOSH contribution to the overall decrease in fatalities and injuries is reinforced by the concentrated efforts DSR has made. There are also many outcomes that are on a direct path to preventing injuries, such as new safety regulations and standards, safer technology and products, and improved worker safety training. The outcomes serve as an excellent foundation to stimulate further research and industrial partnership to address workplace injury problems.

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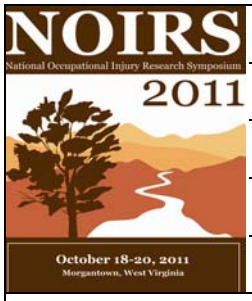
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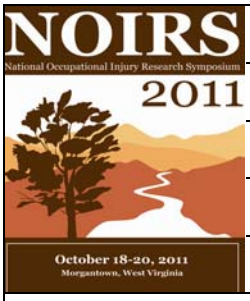
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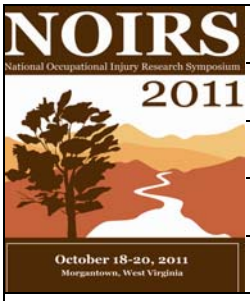
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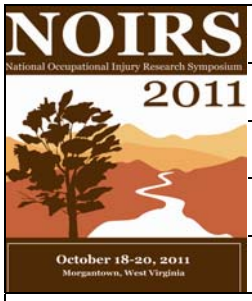
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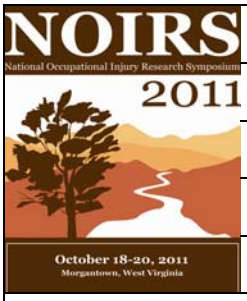
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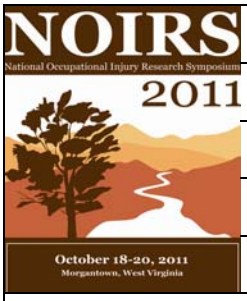
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