

Appendix 2: Traumatic Injury Intramural and Extramural Projects

Intramural

More information is available for selected listed intramural projects. Follow the links to access additional detail on the goals, activities, outputs and outcomes of these studies.

Acute Back Injury

9278000	Evaluation of Best Practices Back Injury Prevention Program
9278435	Effectiveness of Training and Controls in Nursing Homes
9278879	Evaluation of the Efficacy of Back Belts in Material Handling Workers
9278943	Psychosocial Risk Factors for Injury in Retail Material Handling Workers
9278823	Laboratory Evaluation of Back Support Belts
VLD8890	Evaluation of Muscle Strength for Handling Lg-Size Materials
VLE824	Nursing Home Back Intervention Study
VLE8944	Evaluation of Retail Material Handlers Communication Intervention

Emergency Responders

927002N	Communication Materials for 1st Responders
927008F	Ambulance Crash Survivability Improvement Project
92700BK	Biomechanical and Physiological Study of Firefighter Boots
9277136	Evaluation of Emergency Services Occupant Safety
9277136D	Evaluation of Emergency Services Occupant Safety
9278861	Fire Fighter Fatality Investigation and Prevention Program
927AT13	World Trade Center Surveillance Study
927AT15	Disaster Recommendations for Emergency Worker Safety & Health

Falls from Elevation

9270025	Fall Prevention for Aerial Lifts in the Construction Industry
9277110	Preventing Injuries in Telecommunication Tower Construction
9277271	Occupational Hazards of Roofers
9278426	Harness Design and Sizing Effectiveness
9278884	Dynamic Scaffold Modeling for Fall Protection
9278955	Influence of Visual Cues Work at Heights
59278104B	Suspension Tolerance in Men/Women Wearing Safety Harnesses
927000A	Lab Testing of Adjustable Safety Rail-Roof Bracket Assembly
927006Q	Sensory-Enhanced Balance Control at Elevated Workplaces
9278066	Footwear for Improved Balance Control in Construction Work

Machines

9277051	Prevention of Vehicle and Mobile Equipment-Related Injury
9277085	Lockout/Tagout, Jammed and Moving Machinery Controls
9277241	Safety System to Protect Workers from Caught-In Injury
9278061	Evaluation of a New Method for Machinery Risk Reduction
9278818	Development of Automatic ROPS
9278885	Development of Automatic ROPS Overturn Sensor
927006T	Commercialization of a Cost-Effective ROPS (CROPS) Design
9277178	New Technology to Increase ROPS Use on Tractors
9277178D	New Technology to Increase ROPS Use on Tractors

927P148 Lockout/Tagout, Jammed and Moving Machinery Controls
VAJ882 Hazard Control Evaluation of Cardboard Paper Baler Safety Device Tech

Motor Vehicles

9277051 Prevention of Vehicle and Mobile Equipment-Related Injury
9278810 Developing a CIB on Occupational Motor Vehicle Deaths
927008D Motor Vehicle Safety and Health Research Coordination
927008E Risk Factors for Vehicle Crashes among Public Employees
927008X Evaluation of Safety Training for Spanish Speaking Roadway Workers
92700B9 Occupational Motor Vehicle Safety & Health Research Center
9278107 Effectiveness of Collision Warning System in Large Trucks
927P151 Evaluating Roadway Construction Work Zone Interventions
927S163 Evaluating Roadway Construction Work Zone Interventions
VLB808 Motor Vehicle Safety and Injury Prevention

Workers in Alaska

9277041 Aviation Safety in Alaska
9277173 Surveillance of Non-Fatal Work-Related Injuries in Alaska
9277394 Injury Prevention in the Commercial Fishing Industry
9278893 Occupational Injury Prevention in Alaska
92700BL Deck Safety for Commercial Fishing Vessels

Workplace Violence

9277120 Evaluation of State-Based Workplace Violence Prevention
9277166 Intervention Strategies for Taxi Cab Drivers
9278109 Prevention of Violence Against Nurses: Feasibility Study
9278313 Workplace Violence Initiative: Research and Implementation
9277327D Work-Related Violence Against Women
9278180R Evaluation of Workplace Violence Prevention in VA Hospitals
Q Workplace Violence: Research for Prevention
VLE843 Homicide in Convenience Stores: An Evaluation of Prevention Strategies

Youth

9277059 Young Worker Regional Health Education Center
9277269 Injuries and Illnesses Among Farm Youth in the U.S.
9277407 NIOSH Internet Page/Site for Adolescents
9278953 Childhood Agricultural Injury Surveillance
9278954 Child Ag. Injury Prevention
927006N OS&H Assistance to Vocational/Technical Schools
927008W Evaluation of OSH Training of Young Workers
9277187R Young Worker Safety
VIE8088 OS&H Training for Voc. Ed.
VLB8806 Surveillance of Occupational Injuries Among Children and Adolescents

PROJECT ID: 9278435 - Effectiveness of Training and Controls in Nursing Homes

PROJECT OFFICER: Robert Park

END OUTCOMES: An estimation of what effects various intervention programs in nursing homes have had on reducing workers compensation claims and costs.

INTERMEDIATE OUTCOMES (IO): provide knowledge that will lead directly to intervention programs for reducing injuries in nursing home workers.

FINAL CUSTOMERS: Bureau of Workers Compensation (BWC).

INTERMEDIATE OUTPUTS:

INTERMEDIATE CUSTOMERS:

TRANSFER ACTIVITIES:

OUTPUTS:

ACTIVITIES:

INPUTS: Using workers compensation records for the period 1995-2001, we have performed preliminary analyses of intervention effectiveness in Ohio nursing homes focusing on programs offered by Ohio Bureau of Workers Compensation (BWC).

PROJECT ID: VLE8944, 9278879, 9278943

Project name: Evaluation of Retail Material Handlers Communication Intervention

PROJECT ID: 9278879

Project name: Evaluation of the Efficacy of Back Belts in Material Handling Workers

PROJECT ID: 9278943

Project name: Psychosocial risk factors for injury in retail material handling workers

END OUTCOMES:

The expected or potential end outcomes of the evaluation of back belts (that concludes that there is no reduction in back injuries or back pain) is to redirect efforts and attention toward other measures (e.g. engineering controls) that could reduce the burden of back injury and back pain among material handlers. Data from the Department of Labor, Bureau of Labor Statistics indicates that the number of lost time injuries has steadily decreased. Following the publication of the research results in 2000, there was a 10% decline the first year (255,774 overexertion back injuries reported involving lost work days in 2000, to 230,523 in 2001) and 8% decline in 2002 (212,229 injuries reported) followed by a 13% decline in 2003 (184,850 injuries reported). Other external factors may be responsible for the reduction in injuries, but specific causes have not been definitively identified.

INTERMEDIATE OUTCOMES (IO):

Although not well quantified, some intermediate outcomes have been noted. Anecdotally, there has been a shift in the type of safety products advertised in safety trade journals. The emphasis on back belts before the publication of the research results has shifted to other safety products and there has been a reduction in the number of advertisements for back belts. Annual sales figures for back belts are not available.

FINAL CUSTOMERS:

The final customers for this research include material handling workers, their employers, safety managers, unions and manufacturers of safety equipment. The result of this research is intended to change the emphasis on back belts for back injury and back pain prevention. Alternative practices and behaviors toward different measures to reduce back injuries and back pain should be considered, instead of back belts.

INTERMEDIATE OUTPUTS:

Anecdotally, it was noticed that there was a shift in the type of safety products advertised in safety trade journals. The emphasis on back belts before the publication of the research results has shifted to other safety products and there has been a reduction in the number of advertisements for back belts. Annual sales figures for back belts are not available.

INTERMEDIATE CUSTOMERS:

Intermediate customers consist of the extensive press coverage through an Associated Press article that appeared in about 400 newspapers nationally and a video news release. CBS Evening News' covered the back belt study on Dec. 5,2000 including an interview with Acting NIOSH Director, Dr. Larry Fine.

TRANSFER ACTIVITIES:

Partners: A number of partners were involved in this project including:

- Wal*Mart corporation. Provided employees time to participate in the telephone surveys.
- Battelle Corporation. Conducted the telephone surveys and data management under contract.
- University of Massachusetts, Lowell. Dr. Laura Punnett conducted a direct observation task analysis in a limited number of workplaces.
- University of Pittsburgh. Dr. Roslyn Stone, consultant on design and analysis.
- Dr. David Kleinbaum, informal consultation.
- Manuscript reviewers: Thomas Hodous, Harvey Checkoway, Barbara Silverstein, Ellen Eisen, and Laura Punnett.

Scientific Publications:

1. Johnston JM, Landsittel DP, Nelson NA, Gardner LI, Wassell JT [2003]. Stressful psychosocial work environment increases risk for back pain among retail material handlers, *Am J Ind Med* 43(2):179-187.
2. Wassell JT [2003]. Studies on Back Belts in the Workplace, *Salud (i) (SIIC) (i)Ciencia-Voice of the Sociedad Iberoamericana de Informacion Cientifica (SIIC)*, March 3, 2003.
3. Bobick TG, Belard J-L, Hsiao H, Wassell JT [2001]. Physiological effects of back belt wearing during asymmetric lifting, *Applied Ergonomics* 32(2001):541-547.
4. Giorcelli RJ, Hughes RE, Wassell JT, Hsiao H [2001]. The effect of wearing a back belt on spine kinematics during asymmetric lifting of large and small boxes, *Spine* 26(16):1794-1798.
5. Wassell JT, Gardner LI, Landsittel DP [2001]. A Study of Back Belts to Prevent Back Pain and Injury, *Injury Insights Newsletter*, June 2001 (June):1-2.
6. Wassell JT, Gardner LI, Landsittel [2001]. Does back belt use prevent on-the-job back pain and injury? *Injury Insights* 2001(June/July):1.
7. Wassell JT, Landsittel DP, Gardner LI, Johnston JM [2001]. Do Back Belts Prevent Back Injury? In reply to letters to the editor. *JAMA* 285(9):1152.
8. Wassell JT, Gardner LI, Landsittel DP, Johnston JJ, Johnston JM [2000]. A prospective study of back belts for prevention of back pain and injury, *Journal of the American Medical Association* 284(21):2727-2732.
9. Gardner LI, Landsittel DP, Nelson NA [1999]. Risk factors for back injury in 31,076 retail merchandise store workers, *Am J Epidemiol* 150(8):825-833.

10. Landsittel DP, Gardner LI, Arena VC [1998]. Identifying populations at high risk for occupational back injury with neural networks, *Human and Ecological Risk Assessment* 4(6):1337-1352.
11. Gardner LI, Collins JW, Johnston JJ, Wassell JT [1997]. Efficacy of back belts for prevention of back injuries in material handling workers. Presented and published in the proceedings of the 4th Annual Conference for Managing Ergonomics in the 1990's: A Discussion of Science and Policy Issues, Cincinnati, OH, June 17-20, 1997.

ACTIVITIES

This effort consisted of three projects. The main project was a prospective evaluation of the efficacy of back belts to prevent back injury and back pain in material handling workers.

The aim of this study was to evaluate stretchable industrial-type back supporting belts in preventing initial and recurrent low back injuries in retail store employees. The study was conducted in workers with the highest lifting exposures from 160 Wal-Mart stores distributed across 30 different which ranged geographically from New Hampshire to Michigan in the north and from Florida to Texas in the south. Between April 1996 and April 1998, 50 new stores and 110 newly expanded stores (combination supermarket and merchandise) were enrolled in the study on the day they first opened for customer sales. A prospective cohort study was conducted following sequential assignment (according to store opening date) of groups of store to either the usual belt wearing policy or voluntary belt use. In this study, 89 stores required back belt use and 71 stores had voluntary belt use.

Limitations of previous epidemiologic studies were addressed through longitudinal data collection, assessment of physical work exposures, data collection of adequate sample sizes, and assessment of psychosocial factors using validated scales. A survey contractor conducted telephone interviews using trained interviewers. Baseline and follow-up interviews (approximately 6 months later) consisted of questions covering work history, lifestyle habits, medical history, job activities, psychosocial factors, belt wearing habits and demographic information.

Study results made significant contributions to the literature by providing higher quality information on the value of back belts in preventing workplace injuries, and thus provided a more definitive, scientific basis for future recommendations to industry and the public. The study found no statistically significant differences in back injury rate or the percentage reporting back pain comparing workers who often used back belts and those whose self-reported back belt use was infrequent or never.

A second project was undertaken to develop and implement a comprehensive communication strategy to increase worker and management understanding of, and participation in, the NIOSH back belt study. This study increased awareness of the study and facilitated the telephone interview process through enhanced public relations between the employees, their managers and the contract interview staff.

A third project focused on the psychosocial factors (such as job satisfaction, job demands, and worker control). The interview data for approximately 8,000 workers in 160 retail stores was

analyzed to determine if psychosocial factors are causally related to low-back injuries. Previously, these factors had not been definitely established as causes of injury, therefore this study addressed the issue that psychosocial factors are risk factors for back strain injuries and falls. The study involved baseline data and data over a 26-month period in 160 Wal-Mart Stores. This research generated new information about the etiology of injury and its relationship to both individual and larger organizational influences. The results provided information to prioritize and guide future organizational-level intervention strategies. The results were published in the scientific peer review literature.

In this study, WalMart Corporation contributed thousands of employee hours, as interviews were conducted during regular work hours, in a separate area. Battelle developed the interview instrument and conducted the extensive telephone interviews consisting of 151 items. There were 9,377 completed baseline interviews and 6,311 completed follow-up interviews. AFEB staff developed the research protocol, secured Human Subjects Research Board approval, Office of Management and Budget approval and had general oversight of the study. AFEB received data from Battelle and conducted the full statistical analysis of the data. PTB participated in the direct observation task analysis in a small number of selected stores. PTB also conducted laboratory evaluations of the back belts effects on human physiology and biomechanics parameters which were published in separate peer reviewed papers.

INPUTS

Study Management structure:

AFEB staff developed the research protocol, secured Human Subjects Research Board approval, Office of Management and Budget approval and had general oversight of the study. AFEB received data from Battelle and conducted the full statistical analysis of the data. WalMart Corporation contributed thousands of employee hours, as interviews were conducted during regular work hours, in a separate area. Battelle developed the interview instrument and conducted the extensive telephone interviews consisting of 151 items. There were 9,377 completed baseline interviews and 6,311 completed follow-up interviews. PTB participated in the direct observation task analysis in a small number of selected stores. PTB also conducted laboratory evaluations of the back belts effects on human physiology and biomechanics parameters which were published in separate peer reviewed papers.

Summary of stakeholder input:

WalMart Corporation developed an interest in the effectiveness of back belts in response to questions from employees and a recognition by their management that NIOSH guidelines and some published studies were equivocal in the assessment of the value of back belts. Prompted by employees' questions, WalMart agreed to partner with NIOSH to determine the efficacy of back belts.

PROJECT ID: Evaluation of Muscle Strength Capability for Handling Large-Size Materials

END OUTCOMES: None to report at this time.

INTERMEDIATE OUTCOMES (IO): None to report at this time.

FINAL CUSTOMERS: The final customers are construction contractors and sub-contractors who are involved with scaffolding work, either in original construction or maintenance and repair activities. This will include health and safety practitioners who are responsible for keeping these workers safe.

INTERMEDIATE OUTPUTS: None to report at this time.

INTERMEDIATE CUSTOMERS: Scaffold manufacturers, scaffold renting companies; labor associations; safety and health professionals; and other fall-prevention researchers.

TRANSFER ACTIVITIES: This project provided practical recommendations for scaffold workers to mitigate the likelihood of postural imbalance while allowing for the generation of sufficient isometric force to handle the weight of a scaffold end frame. A hand separation of 46 cm at between the elbow and chest heights is suggested as an optimal hand location for a conceptual assistive lifting device (e.g., a light-weight clip bar) for scaffold disassembly job. At least 95% of the construction population would have isometric forces in excess of the weight of scaffold end frame and also be able to mitigate the likelihood of postural imbalance. An alternative method without an assistive device would be a hand location slightly higher than the elbow height with a hand separation of 116.8 cm. This is a compromised situation that yields 2.4 times isometric strength of the scaffold weight with a little risk of postural imbalance. The research results also suggested that scaffold erectors adopt the symmetric side-carrying method as the primary technique for handling the current scaffold end-frames and that a light-weight end frame (e.g., use of reinforced light-weight materials) has the potential to reduce injury risk among scaffold handlers during their scaffold erection and dismantling jobs, based on the study results on worker stepping response, postural stability, and perceived task difficulty. All the recommendations were published in peer-reviewed journals and were presented in both scientific and trade association conferences.

OUTPUTS:

Hsiao H., Hause M., Powers J., Kau T., Hendricks C., Simeonov P., Effect of Scaffold-End-Frame Carrying Strategies on Worker Stepping Response, Postural Stability, and Perceived Task Difficulty (Submitted to Human Factors, 2006)

Cutlip R., Hsiao H*, Becker E., Garcia R., and Mayeux, B., Optimal Hand Locations for Safe Scaffold-End-Frame Disassembly, Applied Ergonomics, 33(4): 349-355, 2002

Hsiao H., Guan J., Mayeux B., and Cutlip R. Identifying Less Stressful Work Methods: Computer-aided Simulation vs. Human Subject Study, Society of Automotive Engineers Technical Paper #2000-01-2163, 2000.

Cutlip R., Hsiao H. Mayeux B. [2000] Laboratory Evaluation of Isometric Strength Associated with Typical Scaffold End Frame Disassembly Postures, 14th Triennial Congress on the International Ergonomics Association, San Diego, California, July 30 - Aug 4, 2000.

Cutlip R., Hsiao H*, Becker E., Garcia R., and Mayeux B., Comparison of Postures for Scaffold End Frames Disassembly, Applied Ergonomics, 31, pp 507-513, 2000.

Cutlip R., Hsiao H., Becker E., Garcia R., and Myers J. Isometric Strength during Scaffold End Frames Disassembly, Society of Automotive Engineers Technical Paper #1999-01-1907, 1999.

Hsiao, H. [1997] Erection and Dismantling of Frame Scaffolds: Safety and Ergonomics, Proceedings of the 13th Triennial Congress of International Ergonomics Association, Finland, June 29 - July 4, 1997.

Hsiao H. and Stanevich R., Biomechanical Evaluation of Frame Scaffolding Tasks, International Journal of Industrial Ergonomics, 18, pp407-415, 1996.

ACTIVITIES:

Four experiments were conducted to address the overexertion and fall injury hazards associated with scaffold end-frame disassembly. The first experiment involved with 12 construction sites and 29 workers to identify commonly used scaffold disassembly techniques; computer simulations were also performed to determine the biomechanical stress induced on workers for each disassembly technique. The second experiment identified the most favorable scaffold end-frame disassembly techniques by measuring whole-body isometric strength capability of 46 participants for each disassembly posture. The third experiment determined the optimal hand location for a conceptual assistive lifting device to mitigate potential postural imbalance while reducing overexertion hazards during scaffold disassembly. The whole-body maximum isometric strength of 54 construction workers was measured in nine postures; these postures were selected based on the results from the second experiment. The last experiment evaluated the effect of scaffold end-frame carrying methods on worker performance, under various work conditions, to determine the most favorable strategy to carry scaffold end frames for minimizing the risk of being struck by an object, falls, and overexertion injuries. Three carrying methods, four types of work surfaces, two weight levels of scaffold frames, and three directions of stepping movement were tested in a laboratory with eighteen healthy construction workers, using a repeated-measures design. Stepping-response time, postural instability, and task difficulty rating were appraised.

The first experiment identified six common lifting techniques used by scaffold workers. Computer simulations showed that considerable biomechanical stress occurs to most of the workers at their shoulders, elbows, and hips. The second experiment indicated that symmetric front-lift method with hand locations at knuckle height would be the most favorable posture; at least 93% of the male construction worker population could handle the end frame with minimum overexertion risk. However, adequate postural stability cannot be reached when the workers placed their hands at the knuckle height. The third experiment determined that a hand location between elbow height and chest height with a hand separation distance of 46 cm (a conceptual, light-weight assistive bar) would allow workers to generate sufficient isometric strength (about twice that of the scaffold weight) to disassemble the typical 22 kg scaffolds while concurrently allowing them to mitigate the likelihood of postural imbalance. The last experiment suggested

that scaffold erectors adopt the symmetric side-carrying method as the primary technique for handling the current scaffold end-frames and that a light-weight end frame (e.g., use of reinforced light-weight materials) has the potential to reduce injury risk among scaffold handlers during their scaffold erection and dismantling jobs, based on the study results on worker stepping response, postural stability, and perceived task difficulty.

INPUTS: The primary input for the development of this project was the Bureau of Labor Statistics data and a National Constructors Association report on assessment of carpenter injury risks needing research.

PROJECT ID: 927002N - Communication Materials for 1st Responders

PROJECT OFFICER: Ralph Zumwalde

END OUTCOMES: Update of recommendations posted on the NIOSH web site for emergency responders in the use of eye protection drafted for external review; revisions to interim recommendations for respirator cleaning and sanitation and for traumatic stress was drafted for internal review.

INTERMEDIATE OUTCOMES (IO): Educational materials for emergency responders that address the proper selection and use of personal protective equipment (PPE) as well as other recommendations intended to prevent injury and illness during rescue and recovery operations.

FINAL CUSTOMERS: Emergency responders

INTERMEDIATE OUTPUTS: Subsequent evaluations of the hazardous conditions found at these disaster sites will be used to update existing and develop new recommendations..

INTERMEDIATE CUSTOMERS:

TRANSFER ACTIVITIES: collaborate with other NIOSH research staff and external partners in the development of appropriate communication products to convey recommendations (i.e., PPE, hazard assessment) for protecting emergency responders at disasters involving the structural

OUTPUTS: Updated recommendations for eye safety have been drafted while revisions to recommendations on respirator cleaning and sanitation, and on reducing traumatic stress for responders have been initiated

ACTIVITIES: identify the safety and health risks associated with rescue and recovery operations at a structural collapse of a large building and provide recommendations for protecting emergency responders.

INPUTS:

PROJECT ID: CAN 008F, Ambulance Crash Survivability Improvement Project

END OUTCOMES:

The end outcome for this project has yet to be realized. However, the project expects to significantly reduce the risk of ambulance crash-related injury and death to emergency medical service (EMS) workers by influencing ambulance manufacturers, emergency medical service (EMS) providers, and standards setting bodies to improve ambulance crashworthiness by design revision.

INTERMEDIATE OUTCOMES (IO):

The Winter Park Fire Department has requested NIOSH assistance in evaluating the efficacy of new ambulance designs which they recently placed into service.

NIOSH was invited to collaborate with the National Highway Traffic Safety Administration (NHTSA) and the National Registry of Emergency Medical Technicians (NREMT) in analyzing NREMT survey data characterizing EMS worker ambulance safety.

FINAL CUSTOMERS:

Fire fighters – Currently, 45% of all Emergency Medical Service is fire department based, and 65% of fire department responses are for medical aid.

EMS workers throughout the U.S – Researchers estimate that there are over 800,000 volunteer and professional EMS workers nationwide.

INTERMEDIATE OUTPUTS:

INTERMEDIATE CUSTOMERS:

The International Association of Fire Fighters

GSA Engineering and Commodity Management Division

Ambulance Manufacturers Division (AMD) of the National Truck Equipment Association

Ambulance manufacturers including; Collins Industries, Medtec Ambulance Corporation, Horton Emergency Vehicles Co., AEV Inc./American Emergency Vehicles, Marque Inc.

EMS equipment manufacturers including EVS Ltd. and Ferno-Washington Inc.

The National Association of State EMS Directors

National Registry of Emergency Medical Technicians (NREMT)

The National Highway Traffic Safety Institute (NHTSA) Office of Emergency Medical Services.

Occupant restraint manufacturers including Allied Services Systems and Schroth Safety Products

TRANSFER ACTIVITIES:

Project staff routinely present at EMS conferences and meetings

OUTPUTS:

Presentations:

"Selection of Dependent Variables to Evaluate EMS Worker Activities in Ambulance Patient Compartments" Bobick, TG, Lucien Brouha Work Physiology Symposium, Keystone, Colorado. September 1-2, 2004.

"National Institute for Occupational Safety and Health Research to Improve Ambulance Safety" Moore PH, Bobick TG, Current RS, EMS Expo 2006 Las Vegas, Nevada, September 28, 2006.

ACTIVITIES:

This project builds upon research results and cooperative relationships stemming from a previous project, the Evaluation of Emergency Service Vehicle Occupant Safety.

The project staff are currently conducting a human factors evaluation aimed to identify obstacles to occupant restraint use in ambulance patient compartments. Three systems are being evaluated, the lap belts that are currently equipping U.S. ambulances, and two mobile occupant restraints that incorporate harnesses and retractor-mounted tethers. Evaluation of the crash performance of the mobile restraints by the previous project indicated that they offered a significant improvement over lap belts in preventing harmful contact with patient compartment cabinets and bulkheads. The human factors evaluation is exploring the impact that using the restraints may have on the ability of EMS workers to perform their work. As of September 18, 2006, heart rate and task-completion time data for 8 subjects have been collected in a pilot testing phase of the study. The data is collected while the subjects perform simulated patient care tasks in a moving ambulance patient compartment using an EMS training manikin. The pilot data will support refinement of the test methodology in preparation for a more extensive test of 30 or more subjects in the early spring of 2007.

NIOSH has contracted with ARCCA Inc. to identify typical mounting techniques for EMS equipment normally carried in the patient compartment. This equipment, if not adequately mounted to the vehicle, may become injury causing projectiles during a crash. Under NIOSH direction, ARCCA Inc. has begun engineering studies of the equipment and mounts. This study is expected to result in recommendations for standards and testing methods to eliminate the danger of crash-induced projectile injury.

NIOSH, through an inter-agency agreement with the Naval Air Warfare Center Aircraft Division (NAVAIR), is supporting head impact studies of the performance of energy absorbing foams. These foams may be strategically placed within the patient compartment to prevent transfer of

injury causing energy during crash-induced occupant head impacts with cabinets and bulkheads. NAVAIR is conducting computer simulations and impact tests at 17 mph using 50th and 95th percentile manikins that will identify the material specifications and recommendations to support the proper selection of foam for padding. In addition, NIOSH has contracted with CALSPAN Corporation to conduct supplemental impact tests at 3 different temperatures and speeds of 23 and 30 mph. Results of these tests will be used to expand and refine recommendations resulting from the NAVAIR study.

Project staff are assisting the Winter Park Florida Fire Department in evaluating the department's new ambulances. The patient compartments of these vehicles use a non-typical layout that is intended to reduce the need for EMTs to move about the compartment during patient transport. The department is administering a user survey using methodology suggested by project staff. Winter Park FD is supplying engineering drawings of the layout to NIOSH that will be used to construct a computer model. NIOSH will use the model along with anthropometry data to evaluate the layout ergonomics. Using the same techniques and a NIOSH owned ambulance, the project is evaluating the ergonomics of the GSA KKK-1822E Specifications for the Star-of-Life ambulance. These efforts are expected to support recommended changes to the specifications that will result in safer and more efficient patient compartments.

NIOSH is working with AMR, the NREMT and NHTSA's Office of Emergency Medical Services to characterize the scope of non-fatal injuries to EMS workers in patient compartments. Previous NIOSH work identified an injury surveillance gap for non-fatal ambulance crash-related injury. Contrary to national level crash-related fatality data, similar data for non-fatal injury does not exist at a national level. What data exists, resides in the custody of private sector entities and is not generally available to public sector researchers. NIOSH, at NHTSA's invitation, conducted joint analysis with NREMT of their 2004 membership survey of ambulance safety. This work resulted in a draft article that has been submitted for publication to the Journal of Emergency Medical Services. The draft is currently undergoing journal review. Through a letter of agreement, AMR has provided NIOSH access to their employee injury and compensation database. AMR has over 4000 employees in 34 states, and this joint effort has potential to provide a more comprehensive picture of the non-fatal ambulance crash injury situation than previously available to government researchers.

INPUTS:

Preliminary results from the NIOSH project, "Evaluation of Emergency Service Vehicle Occupant Safety."

PROJECT ID: Biomechanical and Physiological Study of Firefighter Boots

PROJECT OFFICER: Sharon Chiou, Ph.D.

PROJECT START DATE: 01/01/05

PROJECT END DATE: 09/30/07

END OUTCOMES:

No outcomes have been achieved.

This project is still in the phase of data collection. The project is scheduled for completion in FY07. The end outcome of this project is expected to a reduction of biomechanical and physiological stresses upon firefighters caused by the weight of firefighter boots if results are incorporated into new consensus standards about boot selection.

INTERMEDIATE OUTCOMES (IO):

No intermediate outcomes have been achieved, other than completion of annual research milestone targets. The intermediate outputs for this study include (1) NFPA 1971 standard update and revisions regarding how firefighter boot weight and design affect firefighters' physiological and biomechanical stress; (2) boot selection guidelines for firefighters and fire departments; (3) boot performance guidelines (rubber vs. leather; light vs. heavy) for boot manufacturers.

FINAL CUSTOMERS:

The customer for this research includes 1.1 million firefighters (who are 95% male, 5% female, 3% black, & 2% Hispanic), as well as federal and industrial firefighters, and 670,00 emergency medical service workers who are employed in over 28,579 municipal fire departments and 6,000 EMS departments.

INTERMEDIATE OUTPUTS:

No intermediate outcomes have been achieved, other than completion of annual research milestone targets. The primary intermediate output will be the establishment of a new boot performance and selection guideline created by the NFPA or adopted by local fire departments.

INTERMEDIATE CUSTOMERS:

The intermediate customers include (1) The National Fire Protection Association (NFPA) 1971 Standards Committee – Protective Ensemble for Structural Fire Fighting; (2) US and Canadian Certified Firefighter Boot Manufacturers; (3) International Safety Equipment Association (ISEA); (4) Canadian Safety Organization (CSO); and (5) International Standards Organization (ISO).

TRANSFER ACTIVITIES:

Findings from this study will be disseminated through firefighter conferences, the NFPA, journal publications, trade magazines, and stakeholder meetings. Results from this study will be delivered to the NFPA technical committee and recommendations will be incorporated into their guidelines and standards to improve firefighter boot performance standards. Furthermore, findings from this project will be translated to the workplace through collaborative efforts between NIOSH and certified firefighter boot manufacturers.

OUTPUTS:

The outputs of this project will include conference presentations, peer-review journal articles (External Publication Sub-Category), and meetings with stakeholders -- NFPA 1971 standards committee in FY08 (Dissemination).

ACTIVITIES:

This project is a laboratory study which will be conducted over a two-and-one-half-year period. Twenty-five female and 25 male career or volunteer firefighters will be recruited and tested for physiological and biomechanical responses while performing several simulated firefighting tasks (e.g., climbing a ladder, carrying a hose pack, and dragging a 145-lb dummy) in the laboratory. Subjects' physiological responses will be determined by metabolic and respiratory variables including energy expenditure, minute ventilation, and peak flow. Standard anthropometric measurements will be recorded of the lower extremity and foot for both genders. Subjects' biomechanical responses in performing simulated fire fighting tasks will be determined by examining their whole-body center-of-mass movements as well as joint loadings (e.g., joint forces and moments).

This laboratory-based study will provide important outcomes which are expected to impact emergency response and fire department workers, emergency response and firefighter boot manufacturers, and the US national standards setting body responsible for oversight of structural fire fighting policy (NFPA). The long-term outcome goal is to provide much needed biomechanical and physiological data to the NFPA 1971 standards committee to revise and update their standards for protective ensembles for structural fire fighting.

INPUTS:

The National Fire Protection Association (NFPA) Standard 1971 technical committee is in the process of revising its Structural Fire Fighting standard. The committee is very interested in including recent, objective data on the physiological and biomechanical effects of firefighter boot weight and design for men and women in future standard revisions and has specifically requested the assistance of NIOSH, DSR, Protective Technology Branch, in conducting and interpreting this research.

PROJECT ID: CAN 7136, Evaluation of Emergency Services Vehicle Occupant Safety

END OUTCOMES:

To date, the end outcome has not been accomplished. However the project expects to significantly reduce the risk of ambulance crash-related injury and death to emergency medical service (EMS) workers by influencing revision of the General Service Administration KKK1822 Specifications for the Star-of-Life Ambulance; by disseminating information regarding crash injury mitigating tactics to emergency EMS service providers and workers; and by introducing manufacturers of occupant restraints to the EMS vehicle and equipment market.

INTERMEDIATE OUTCOMES (IO):

This project has identified an untapped market for manufacturers of vehicle occupant restraints. In implementing the project, NIOSH worked collaboratively with four private sector restraint system manufacturers. As a result, Schroth Safety Products, with over 40 years of experience designing products and applications for a wide range of international vehicle users and manufacturers (including amateur and professional automobile racers, military and civilian aviation, and military ground vehicles), is actively marketing restraints to ambulance manufacturers and has developed collaborations with several ambulance manufacturers, and a seat manufacturer to incorporate Schroth restraints into new ambulances.

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

EMS Ltd, a manufacturer of seats for use in ambulance patient compartments, has developed first generation seats that replace the standard 3-point lap and shoulder belt with mobile occupant restraints manufactured by Schroth Safety Products, or Allied Services Systems. EVS is currently working to refine their seat design to better utilize the capabilities of the restraints.

The Winter Park Fire Department's newly purchased ambulances incorporate design changes based on NIOSH sled and crash test results. The Winter Park Fire Department in cooperation with Med Tec Industries, an ambulance manufacturer, has developed two new ambulances that incorporate redesigned patient compartments. These compartments are designed to minimize the need for emergency medical technicians (EMTs) to move around the patient compartment. Of note, the Winter Park Fire Department eliminated the CPR seat location and adjacent equipment cabinet based on information contained in NIOSH crash test videos. The new ambulances also incorporate an improved 5-point occupant restraint manufactured by Schroth Safety Products. Use of the Schroth 5-point restraint resulted from Schroth's marketing campaign to ambulance manufacturers.

The General Services Administration (GSA) and the Ambulance Manufacturers Division (AMD) of the National Truck Equipment Association have used NIOSH project results and NIOSH

supplied anthropometric data to support development of revision E to the KKK 1822 Specification for the Star-of-Life Ambulance. This specification, which has been adopted by 34 state Emergency Medical Services (EMS) departments, is the principal driver of U.S. ambulance design and is maintained by GSA, in cooperation with AMD. Virtually every U.S. ambulance and EMS equipment manufacturer is a member of AMD. KKK 1822E is currently undergoing industry and public comment and includes specifications for increased head clearance above seats, based in part on NIOSH project results. Revision E is scheduled for full implementation during the 3rd quarter of FY2007.

FINAL CUSTOMERS:

Fire fighters – Currently, 45% of all Emergency Medical Service is fire department based, and 65% of fire department responses are for medical aid.

EMS workers throughout the U.S – Researchers estimate that there are over 800,000 volunteer and professional EMS workers nationwide.

INTERMEDIATE OUTPUTS:

NIOSH ambulance crash test videos were incorporated into an emergency vehicle operators training DVD and course curriculum developed by the International Association of Fire Fighters (IAFF) for its membership. As well, numerous professional and volunteer EMS services and fire departments have requested NIOSH crash test footage to support their local training programs.

INTERMEDIATE CUSTOMERS:

The International Association of Fire Fighters

GSA Engineering and Commodity Management Division

Ambulance Manufacturers Division of the National Truck Equipment Association

Ambulance manufacturers including; Collins Industries, Medtec Ambulance Corporation, Horton Emergency Vehicles Co., AEV Inc./American Emergency Vehicles, Marque Inc.

EMS equipment manufacturers including EVS Ltd. and Ferno-Washington Inc.

The National Association of State EMS Directors

National Registry of Emergency Medical Technicians

The National Highway Traffic Safety Institute (NHTSA) Office of Emergency Medical Services.

U.S. Fire Administration

The Phoenix Arizona Fire Department

The Ontario Ministry of Health and Long Term Care, Ontario Canada

United States Army Tank-Automotive Research and Development Center

The Canadian Forces Health Services Group

TRANSFER ACTIVITIES:

Because the project was implemented in cooperation with private sector partners, data from sled and crash testing has been to four restraint system manufacturers and one cot manufacturer. Schroth Safety Products, H. Koch & Sons Co, Pacific Scientific, and Allied Services Systems have received test data packages that can be used to support design refinements that will improve the crash performance of their restraint systems. Ferno Washington has received a data package that can be used to improve the crashworthiness of patient cots and cot mounting systems.

Public sector project partners include: The Phoenix Arizona Fire Department; the Ontario Canada Ministry of Health and Long Term Care, the United States Army Tank-Automotive Research and Development Center, and the Canadian Forces Health Services Group. Each of these entities received a complete data package containing sled and crash test results that can be used to support improvement of EMS transport safety and vehicle safety in general.

From 2002 to 2006, members of the project staff have disseminated preliminary data results at EMS and firefighter conferences.

Crash test data, including vehicle acceleration pulses, was disseminated through a presentation before the February 2002 AMD meeting.

Members of the project staff have disseminated preliminary project results in face-to-face meetings with ambulance manufacturers including; Collins Industries, Med Tec Ambulance, Horton Emergency Vehicles, and AEV Inc./American Emergency Vehicles.

DVDs containing NIOSH and NHTSA ambulance crash investigation reports have been sent to numerous EMS and Fire Departments.

NIOSH staff are in regular communication with GSA, and have provided GSA with data to inform revisions to the KKK 1822E standard.

The final report for the sled and crash tests will be widely disseminated to the EMS community, and associated peer-review journal articles will be published.

OUTPUTS:

Crash Investigation Reports:

National Highway Traffic Administration crash reconstruction reports funded by NIOSH documenting environmental and vehicular circumstances and the injury mechanisms for patient compartment occupants present during an ambulance crash:

NHTSA CA02-028, 1999 Ford E-350 Super Duty Van Chassis W/Wheeled Coach Type III Ambulance Body, New Jersey, July 2002

NHTSA CA02-009, 2000 Ford E-350 Type III Ambulance, Kentucky, March 2002

NHTSA CA02-033, 1995 Ford E-350 Type III Ambulance, Minnesota, July 2002

NHTSA CA03-004, 1997 Ford E-350 Type III Ambulance, Kentucky, January 2003

NHTSA DS02-003, Wheeled Coach Moduvan Ambulance on a 1997 Ford E-350 Series Chassis, Washington, February 2002

Three NIOSH investigation reports documenting the circumstances present during fatal ambulance crash incidents.

F2003-33, Career Fire Fighter/Emergency Medical Technician Dies and Paramedic is Injured in a Three-Vehicle Collision – Nebraska

FACE 2001-11, 26 Year-Old Emergency Medical Technician Dies in Multiple Fatality Ambulance Crash – Kentucky

FACE 2001-12, Emergency Medical Technician Dies in Ambulance Crash – New York

Papers:

Proudfoot, SL, Romano, NT, Bobick, TG, Moore, PH, “*Ambulance Crash-Related Injuries Among Emergency Medical Services Workers -- United States, 1991 - 2002*” Morbidity and Mortality Weekly Report, February 28, 2003/Vol. 52/No. 8.

Proudfoot, SL, “*Ambulance Crashes: Fatality Factors for EMS Workers,*” published in Emergency Medical Services, Volume 34, Number 6, June 2005.

Green JD, Moore PH, Current RS, Yannaccone J, Day D, Proudfoot SL, Bobick TG, Romano NT, “*Reducing Vehicle Crash-Related EMS Worker Injuries Through Improvements in Restraint Systems*” Conference proceedings XVIIth World Safety Congress, Orlando FL, September 20, 2005.

Presentations:

Ambulance Crash-Related Injuries Among EMS Workers, Bobick TG, Current RS, Romano NT, Green JD, Moore PH, presented at NOIRS 2003, October 22-30. NOIRS 2003, October 29, 2003.

“*A Review of NIOSH Research to Support Ambulance Worker Safety,*” Current RS, the National Truck Equipment Association’s (NTEA), Ambulance Manufacturers Division (AMD) winter business meeting February 2004, Tampa, FL.

“Evaluation of Emergency Service Vehicle Occupant Safety” Green JD, presented at the National Association of State EMS Directors meeting, October 8, 2004

“Ambulance Crash Injuries Among EMS Workers,” Moore, PH, presented at International Association of Fire Chiefs, Fire-Rescue Med 2005, April 20-22.

“Ambulance Safety in the Fire Service,” Proudfoot SL, presented at 2005 NFPA World Safety Conference and Exposition, June 6-10.

“Reducing Vehicle Crash-Related EMS Worker Injuries Through Improvements in Restraint Systems,” Green JD, poster presentation at Safety 2005, the American Society of Safety Engineers Annual Conference and Exposition, June 12-15.

“Ambulance Safety in the Fire Service,” Proudfoot SL, Fire Department Safety Officers Apparatus Symposium 2006, Las Vegas NV, January 2006.

“Evaluation of Emergency Service Occupant Safety,” Moore PH, Current RS, Green JD, Proudfoot SL, Bobick TG, Romano NT, Yannaconne J, Day D, Whitman G, NORA 2006, poster presentation, Washington, DC, May 9 and 10, 2006.

“Evaluation of Emergency Service Occupant Safety,” Moore PH, EMS Care 2006, Linthicum Maryland, April 30, 2006.

“Evaluation of Emergency Service Occupant Safety,” Moore PH, Green JD, EMS Safety Net 2006, Atlanta Georgia, June 9, 2006.

“Ambulance Safety in the Fire Service, an Update,” Proudfoot SL, Moore PH, NFPA World Safety Conference & Exposition, Orlando Florida, June 4-8 2006.

ACTIVITIES:

This project used the public health model to identify the risk and engineering interventions for vehicle crash-related injury for EMS workers in ambulance patient compartments. The project was implemented through a series of cooperative and contractual partnerships, and shared funding and staff resources from public and private sector organizations.

The NIOSH project staff conducted analysis of NHTSA’s Fatality Analysis Reporting System (FARS) to identify and describe the scope of the problem.

NIOSH conducted fatality investigations to identify incident circumstances and injury risks for patient compartment occupants during ambulance crashes. Through an Interagency Agreement, NIOSH funded NHTSA’s Center for Statistics and Analysis Crash Investigation Division NRD-32 to conduct crash reconstructions of ambulance crashes. These reconstructions identified environmental and vehicular circumstances and the injury mechanisms for patient compartment occupants during ambulance crashes. The NIOSH and NHTSA investigations identified contact with patient compartment interior surfaces as the primary injury source, and that EMS workers rarely used the lap belt restraints equipping current ambulances because they precluded patient access.

NIOSH and its engineering services contractor, ARCCA Inc., partnered with the U.S. Army Tank-Automotive Research, Development, and Engineering Center (TARDEC) to identify crash injury interventions. Through a FedBiz Ops announcement, 9 restraint systems that allowed EMT mobility within the patient compartment while providing crash protection were identified. Four mobile-type occupant restraint systems that addressed the injury risks and circumstances identified through the crash investigations were selected for further engineering evaluation. ARCCA Inc, supported by TARDEC and NIOSH funds, evaluated system performance using computer simulation. Based on the computer simulation, NIOSH invited Schroth Safety Products, H. Koch and Sons Co, Pacific Scientific, and Allied Services Systems to partner in conducting dynamic testing of each manufacturer's restraint system.

A series of 29 dynamic tests using instrumented crash test dummies were conducted on the horizontal accelerator (HyGe sled) at Defence Research and Development Canada (DRDC), Toronto, Ontario. Development of the test plan was led by ARCCA Inc. with oversight from NIOSH and significant contribution by DRDC, and Canadian Forces Health Services Group (CFHSG) staff. Testing materials were supplied by the four restraint manufacturers and the Phoenix Fire Department. Logistics and test facility fees were supported by funding resources contributed by NIOSH, CFHSG, and U.S. Army TARDEC. Based on the results of the HyGe sled tests, two restraint systems were selected for further evaluation though full scale vehicle crash tests.

Full scale crash testing was conducted at PMG Technologies in Blainville, Quebec. A series of 4 crash tests were conducted: 3 frontal barrier crash tests at 30 mph using Type III ambulances, and 1 vehicle to vehicle side crash using a Type I ambulance and a small truck. Each test used instrumented crash test dummies to evaluate the 2 mobile-type restraint systems as well as the currently used lap belt system. The test plan was developed jointly by ARCCA Inc, NIOSH, and CFHSG. NIOSH, CFHSG, MOH, TARDEC, Allied Services Systems, and Schroth Safety Products shared funding resources to support facility fees, material costs, and engineering support.

Primary responsibility for test data analysis resided with ARCCA Inc. whose services were supported by shared resources from NIOSH, TARDEC, CFHSG, and the U. S. Fire Administration. Analysis is still ongoing. However, preliminary results have been disseminated by NIOSH staff at various EMS conferences and meetings with ambulance manufacturers and EMS industry leaders.

INPUTS:

A March 2001 seminar by Dr. Nadine Levick and Brian Maguire presented at the NIOSH Morgantown, West Virginia facility. This seminar focused on the gaps in injury surveillance for EMS workers and the lack of engineering interventions for ambulance crash-related injuries.

Discussions with staff from the NHTSA Office of EMS during the spring of 2001 encouraged NIOSH to pursue further research.

Meetings with David Tenenbaum, U.S. Army TARDEC and Gary Whitman, ARCCA Inc. during May 2001.

Discussions and meetings with staff from GSA's Engineering and Commodity Management Division, in particular Mr. Mel Globerman, since retired. These discussions, beginning in June 2001, indicated support for NIOSH research into ambulance safety and resulted in a regular and continuing dialogue with Mr. Globerman's replacement John McDonald.

PROJECT ID: CAN 8861, Fire Fighter Fatality Investigation and Prevention Program

END OUTCOMES:

None to report.

INTERMEDIATE OUTCOMES (IO):

- Voluntary consensus standards issued by the National Fire Protection Association (NFPA) incorporate findings and recommendations from the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP). In 2001, NFPA issued a new standard, NFPA 1710 *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*. This standard recommends staffing based on the types of emergency response fire departments are likely to encounter. Mr. Richard Duffy, the Secretary of the Technical Committee that developed this standard, reported that NIOSH fatality investigation reports were used extensively in development of this standard. Many provisions of this standard are also included in a counterpart for volunteer departments, NFPA 1720. Additionally, NIOSH findings and recommendations were referenced in 2002 revisions to NFPA 1500 *Standard on Fire Department Occupational Safety and Health Program*, and NFPA 1561 *Standard on Emergency Services Incident Management System*. These standards cover minimum requirements for a fire service related occupational safety and health program (NFPA 1500), and minimum requirements for an incident management system (NFPA 1561). The following statements are included at the beginning of the NFPA 1561, “*It is interesting to note that their [NIOSH] recommendations listed the use of an incident management system and its associated areas as key components to reducing fire fighter fatalities. NFPA 1561 provides the template on how this can be accomplished; it is imperative that fire departments look at how they operate on a daily basis and use an incident management system. Only then can the technical committee begin to address those other areas that kill over 100 fire fighters a year.*”
- In July 2003, New York State Governor Pataki signed a law that makes it illegal to use people in the role of victims during live-burn fire fighting training exercises. A civil penalty of up to \$1,000 can be imposed for violations of the law, which is referred to as Bradley's Law. In late 2001, a volunteer fire fighter died from smoke inhalation and another fire fighter was severely burned during a live training drill. After investigating the death, NIOSH recommended that fire departments prohibit anyone from playing the role of victim during live-burn training, along with other recommendations to improve safety during live-burn training. NIOSH's findings and recommendations were instrumental in leading to the enactment of the New York law.
- In July 1998, the International Association of Fire Fighters requested that NIOSH investigate the circumstances surrounding a series of incidents involving fire fighters who were injured when portable oxygen resuscitators spontaneously ignited and burned. NIOSH worked with the Food and Drug Administration (FDA) that regulates these devices and the National Aeronautics and Space Administration (NASA) that has a long history of relevant expertise in oxygen safety. Investigation into this and similar events

revealed that aluminum in the regulator was a contributing factor, and there were a number of safe handling techniques which firefighters and emergency medical technicians could use to reduce the risk of regulator fires. NIOSH and FDA developed a joint public health advisory that was widely distributed to the fire service, and a training video on safe handling of oxygen systems. Most of the reported incidents involved a single manufacturer who voluntarily recalled all regulators of the same model and offered its customers trade-ins to replace the aluminum regulator with a brass regulator. NIOSH is not aware of any subsequent injuries associated with explosions and fires in aluminum oxygen regulators.

- As a result of NIOSH and FDA investigation of oxygen regulator fires, NASA, in collaboration with NIOSH, developed methods to assure that oxygen regulators did not have a propensity to flash or explode from particle impact. The new test method, “Standard Test Method for Evaluating the Ignition Sensitivity and Fault Tolerance of Oxygen Regulators Used for Medical and Emergency Applications” is more reliable than prior test methods and was adopted in 2006 as an active standard by the American Society for Testing and Materials standard (ASTM) (G175-03). Information on this new standard is available at http://www.astm.org/cgi-bin/SoftCart.exe/DATABASE.CART/REDLINE_PAGES/G175.htm?L+mystore+xoqp4502+1158875864).
- In a letter dated April 20, 2005, to the National Fire Protection Association (NFPA), NIOSH raised the issue of probable performance problems associated with Personal Alert Safety Systems (PASS) identified in NIOSH investigations. PASS systems are used by fire and emergency services personnel during emergency operations and emit a signal to summon aid in the event the user becomes incapacitated or needs emergency rescue assistance. NFPA proposed new test methods for the 1982 standard (e.g. Heat Immersion/Leakage Resistance Test and the High Temperature Functionality Test) which were distributed for public comment in December 2005, and will become effective in February 2007.
- A December 5, 2005 article in the Worcester Telegram & Gazette, *5 Years Later: Worcester Warehouse Fire: Lessons Learned Taken to Heart* documented that the fire department which lost 6 fire fighters in a single incident adopted 12 of 13 NIOSH recommendations, including ensuring full implementation of an Incident Command system and using guide ropes to help guide fire fighters out of buildings.
- In February 2006, NIOSH released the fire fighter fatality report F2004-17, “[Career Battalion Chief and Career Master Fire Fighter Die and Twenty-Nine Career Fire Fighters are Injured during a Five Alarm Church Fire – Pennsylvania.](#)” The Wilkes Barre Times-Leader published an article on March 22, 2006, which included the following statements from the Fire Chief who was hired one year after the fire, “This incident shows the need for how the collapse zone has to be maintained;” “I agree with the recommendations and we’re going to try to implement them to the best of our ability.” As of September 2006, the Fire Chief has verbally reported implementing 8 of the 10 recommendations made by NIOSH.

FINAL CUSTOMERS:

- Fire Fighters
- Fire Chiefs
- Incident Commanders
- Safety Officers

INTERMEDIATE OUTPUTS:

- Based on preliminary findings from a national sample survey of fire chiefs conducted for NIOSH by RTI international, NIOSH recommendations have been used by some 11,000 fire departments to update the content of their training programs on personal protective equipment, self-contained breathing apparatus, Personal Alert Safety System (PASS) devices, Incident Command System, traffic hazards, radio communications, and other topics. [RTI. Fire Fighter Fatality Investigation and Prevention Program Evaluation: Volume 1: Draft Final Report, August 2006]
- NIOSH has received feedback on a variety of ways in which the fire service, public safety departments, and universities are using fatality investigation reports from the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) to improve fire fighter safety. State fire training academies, including those in Pennsylvania, West Virginia and Tennessee, consider findings and recommendations when reviewing and developing new curriculum. As an example, in Pennsylvania, the training academy instructed 1,200 local instructors to incorporate training on “accountability” into their classes based on a series of NIOSH investigations making recommendations for improving accountability on the fire scene. State agencies involved with transportation safety have also reported using fatality investigation reports in their safety training, including the Pennsylvania Motor Vehicle Training Division and the North Carolina State Highway Patrol. NIOSH is also aware of reports used in university fire safety curriculum, including courses at West Virginia University and Northern Virginia Community College.
- The Pennsylvania State Fire Marshal’s office has instituted the use of NIOSH’s fire fighter fatality reports in the curriculum of their State-wide fire fighter training. The reports are used to point out facts about Pennsylvania line-of-duty deaths. The Fire Marshal’s office is also continuing to work on a CD that will be handed out at each training session. The CD will include all of the NIOSH reports that have been completed in Pennsylvania and will also include other NIOSH reports that cover a variety of line-of-duty deaths. Dissemination of the CD will include an introductory letter that indicates the CD contains NIOSH reports and thanks NIOSH for their help. Note: There have been 19 fire fighter fatality investigations conducted in Pennsylvania.
- A Deputy Fire Marshal provided the following input via email: *“I used the Firefighter Fatality reports published by your organization. These are invaluable as case studies to represent to our young rookies the true hazards of their job. These reports bring the aspect of safety into a reality for them. I know they are safe for having reaped the rewards from the hard work your staff puts into the reports. This is a great and invaluable service to my profession.”*

- On April 4th, 2006, the Director/Chief of Safety of the Chicago Fire Department informed the NIOSH FFFIPP that the department uses FFFIPP products in its in-house training of fire fighters, and requested 325 copies of various reports and documents. NIOSH is also aware of routine use of FFFIPP products for training purposes in the following fire departments: Baltimore City, Maryland; Howell Township, New Jersey, and Portland, Oregon.
- In September, 2005, the Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) received written feedback from the training division of a fire department in Ohio regarding the use of the investigative reports in multi-department functions and training exercises for fire fighters. The written feedback stated: “I would also like to express my department’s appreciation in providing the NIOSH Firefighter, Death in the Line of Duty Reports. We recently printed dozens of the reports for the National Stand-down for Firefighter Safety for our firefighters to review. The reports are extremely valuable in addressing the need for training. They also address many issues that exist in our department related to training, equipment, procedures and education. The reports, on many occasions, hit close to home in regards to the similarities to our department. The reports stimulate changing an attitude of "it wouldn't happen here" to an attitude and belief that "it COULD happen here." I thank NIOSH for the countless lives they have saved. I believe the NIOSH reports are preventing deaths and serious injury by opening the eyes of those who are involved in the fire service. The reality is, for the most part we, as a fire service, are not killing firefighters in new ways, they are usually similar circumstances. The NIOSH reports continually address these elements that still need to be addressed by each department. I personally and professionally cannot thank NIOSH enough for all the effort and education that results from the NIOSH Firefighter Fatality Reports for the fire service.” This feedback provides written evidence of similar verbal feedback that the FFFIPP staff receive across the country at conferences and during investigations.
- The Occupational Safety and Health Reporter (OSHR) published a summary of the March 22, 2006 Stakeholders’ meeting [Volume 36 Number 13, March 30, 2006 (ISSN 1522-4082)]. The article concluded that fire service representatives who attended the meeting sent the resounding message that the FFFIPP is successful and should be expanded. The article also documented statements from participants on how their agencies utilize FFFIPP products and recommendations in their efforts to prevent fire fighter deaths. The following are excerpts from representatives at the meeting
 - *“This is a very important program for the International Association of Fire Fighters and we fully support the continuation of this program,”*
 - *“The Program is a consistent reference for safety initiatives and a trusted broker for fire fighter fatality reports” (International Association of Fire Chiefs),*
 - *“Program information is also used by the National Fire Protection Association in the association’s annual fire fighter fatality study, its fire service standards, and outside requests for information,”* and
“Overall the program is well worth it” (National Fallen Firefighter Foundation).
- In July 2005, the Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) received an email from the widow of a fire fighter whose line-of-duty death was

investigated through the FFFIPP. The email expressed her gratitude for the comprehensive and informative report that was written as a result of the investigation. The content of the letter follows:

“On behalf of myself and Steve's entire family, I would like to thank you for writing such a comprehensive and informative report. I would especially like to thank you for placing the conclusion to "ensure that the authority to conduct firing out or burning out operations is clearly defined in the SOP and the IAP" in the first position. It pleases me greatly. Above all, I want for other firefighters to learn from the factors that may have caused my husband's death. In my opinion, the rouge backfiring was the most important one.

I would also like to thank you for the examples of "firing" safety guidelines. In May I wrote to the California Occupational Safety and Health Standards Board about the need for such safety guidelines. My petition file number is 469. I will forward a copy of the NIOSH report to their office immediately. I believe that the deadline for their decision will be November 11, 2005. It is my wish that Federal OSHA will consider and adopt firing safety standards as well.”

- In response to NIOSH notifying the National Fire Protection Association (NFPA) of potential performance issues with PASS devices, NFPA posted a notice on their website, PASS Alarm Signals Can Fail at High Temperatures, <http://www.nfpa.org/itemDetail.asp?categoryID=823&itemID=26606&URL=Codes%20and%20Standards/Code%20development%20process/Technical%20Committees/Special%20> Numerous fire agencies and fire related magazines subsequently ran articles which highlighted the possible problems with PASS devices. The following are a sampling of websites with these articles:

http://firechief.com/news/niosh_pass_12022005/ Fire Chief Magazine

http://fe.pennnet.com/Articles/Article_Display.cfm?ARTICLE_ID=242886&p=25&cat=HLTHS Firehouse Magazine

<http://01e.pentonstage.com/500/GlobalSearch/Article/False/12828/> Homeland Response

http://www.chautcofire.org/pass_alarm_info.htm Oklahoma State Firefighters Association

<http://www.vcos.org/pd-2005/PASSalarm.pdf> New York State Department of State Office of Fire Prevention and Control

<http://www.iaff.org/across/news/Archive2005/113005pass.html> International Association of Fire Fighters

http://www.chautcofire.org/pass_alarm_info.htm Chautauqua County Office of Emergency Services

- In July 2003, William Mora, a Captain with the San Antonio Fire Department in Texas, finalized a report that proposed solutions to fire fighter deaths resulting from disorientation, *U.S. Fire Fighter Disorientation Study*. Captain Mora made extensive use of 12 NIOSH fire fighter fatality investigations in his study: “...the study was facilitated by the detailed information provided by the Firefighter Fatality Investigation Reports of the National Institute for Occupational Safety and Health. The reports allowed for the study of specific incidents in which disorientation was known to occur.” Captain Mora’s

report, which proposed four broad-based solutions (Increasing awareness of the hazard, firefighter training, changing fire fighting tactics, and ensuring proper functioning of fire protection systems such as sprinklers), was highlighted in the annual U.S. Fire Administration’s annual Firefighter Fatality Report.

- The State of Texas Fire Marshal’s office issued an Alert, “Crashes involving fire department water tanker trucks are the leading cause of death in fire service motor vehicle incidents,” in March 2006. The Alert was distributed to all fire departments in the State of Texas. The Alert contained recommendations from the NIOSH Hazard ID “Fire Fighter Deaths from Tanker Truck Rollovers,” and contained a link to the entire publication.
- By request, the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) provided copies of the FFFIPP Investigation Procedures Manual to fire departments in Utah and Ohio. The Procedures Manual will be used by these fire departments to perform internal investigations into injury incidents and near-misses. Feedback from one of the departments stated “The intent of using the program is to coincide our investigations along with NIOSH in the event of an incident involving fatality or serious injury to a firefighter. We also intend to use the investigation model for any instances that we may have related to serious injuries and any close calls.”
- The scenarios and recommendations from five fire fighter fatality investigation reports (F99-34, F2000-07, F2002-04, F2002-24, and F2002-37) were included in a training book regarding fire fighter safety. The book highlights all the recommendations contained in these reports which encompass: fall from ladder, heart attack, protective clothing in wildland fire fighting, vehicular fire, and vehicular crash. The book, *Safe Firefighting, Vol. 1: First Things First* was published by the Carlisle Publishing Services (McGraw-Hill Companies, Inc). The ISBN number is ISBN-13: 978-007-297913-8.
- On Wednesday, June 21, 2006, thousands of fire departments across the United States and Canada conducted a stand down for fire fighter safety. Every fire department—career, volunteer and combination—was urged to participate by suspending all non-emergency activity and instead focusing on fire fighter safety. This year’s Stand Down was focused on emergency vehicle safety, including seatbelt usage and safe driving through intersections. The NIOSH Fire Fighter Fatality Investigation and Prevention Program was a partner with the IAFC and other fire service organizations in this effort. NIOSH reports and recommendations were identified as training tools for the Stand Down, including in a radio announcement. NIOSH also partnered on the first safety Stand Down, held in June 2005.
- The fire fighter fatality report F2002-31 ND (Volunteer Fire Fighter Dies Due to Inadvertent Fireworks Discharge - North Dakota), was reprinted in the Occupational Safety and Health Reporter, Vol. 33, No. 9, pp 193-195.
- “Preventing Deaths and Injuries to Fire Fighters During Live-Fire Training in Acquired Structures” (NIOSH Pub. No. 2005-102) was covered on the Homeland Response website at http://www.homelandresponse.org/full_story.php?WID=12939. Homeland

Response is published by Penton Media, Inc., and is an online resource for the latest personal protection news and products.

- Recommendations for the prevention of struck-by-incidents to fire fighters working along roadways (NIOSH Hazard ID – McFall M., Schmidt E [2001]. *Traffic Hazards to Fire Fighters While Working Along Roadway*, HID 12 - June 2001, Publication No. 2001-143), were published in the American Society of Safety Engineers newsletter *Perspectives* and disseminated nationwide. Arnold, K[2006]. *Perspectives*. American Society of Safety Engineers, Spring 2006, Vol 5, No. 3.
- The Occupational Safety and Health Reporter published the safety hazard warnings developed by FDA/NIOSH regarding the use of plastic crush gaskets on oxygen regulators, and disseminated the information nationwide. BNA [2006]. *FDA, NIOSH Warn of Oxygen Regulator Fires*. Occupational Safety and Health Reporter, Volume 36 Number 18, May 2006.
- Bureau of National Affairs [2006]. “FDA, NIOSH Warns of Oxygen Regulator Fires.” Occupational Safety and Health Reporter, Volume 36 Number 18, May 2006. Note: This is a reprint of the joint FDA/NIOSH PHN appearing on the FDA web site.
- *The Occupational Safety and Health Reporter* reprinted several fire fighter fatality investigation reports.

INTERMEDIATE CUSTOMERS:

- International Association of Fire Fighters
- International Association of Fire Chiefs
- National Volunteer Fire Council
- Fire Departments Nationwide (Career, Volunteer, and Combination)
- National Fire Protection Association
- National Wildland Coordinating Group
- State Fire Marshals
- US Fire Administration
- Department of Labor/OSHA
- National Institute of Standards and Technology
- Food and Drug Administration
- Federal Railway Administration
- Equipment manufacturers

TRANSFER ACTIVITIES:

The primary venue for the dissemination of NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) products is the webpage which was specifically designed for the program. The webpage contains links to all fire fighter fatality and injury reports, and publications such as Alerts, Hazard IDs, Workplace Solutions, Bulletins, and Advisories. To encourage routine visits to the webpage for safety and health information, the webpage includes a biweekly quiz requiring users to access NIOSH publications on the webpage to find the correct answer and related information. Also, the webpage provides a section where users can subscribe to the webpage and be automatically notified when a new product is available. The webpage has

been an enormous success, for example, there were around 60,000 visits in 2005. Additionally, the webpage provides links to other fire fighter related organizations and pages, including the International Association of Fire Fighters, International Association of Fire Chiefs, Fire Department Safety Officers Association, National Volunteer Fire Council, National Association of Fire Marshals, National Wildfire Coordinating Group, National Fire Protection Association, Fire Marshals Association of North America, Firehouse, and the U.S. Fire Administration. Also, the previously listed fire related organizations provide links to the NIOSH fire fighter webpage.

NIOSH conducts periodic mass-mailings to all 30,000+ fire departments in the United States. The mass mailings are typically done once per year and may contain a packet of five to six reports addressing a variety of situations in which fire fighters have died in the line-of-duty, or a single report thought to be of particular import for the fire service as a whole. Examples of individual reports that have been distributed to all fire departments in the United States include a warehouse fire in Massachusetts that ended in the deaths of six fire fighters ([Report No. F99-47](#)), and a training incident in California in which an instructor fell to his death demonstrating an escape procedure portrayed on a training video marketed to the fire service ([Report No. F99-25](#)). The escape procedure, which was not recommended by any fire service organization (such as the NFPA, USFA or the International Association of Fire Instructors), involved the potentially dangerous maneuver of exiting a window head first down a ladder.

NIOSH has partnered with fire service magazine editors to reprint summaries of NIOSH fatality reports in their publications and on their websites. These magazines include, *Firehouse*, *Fire Rescue*, *Fire Chief*, *NFPA Journal*, *Responder Safety*, *Responder Magazine*, and *Wildland Fire Journal*. These journals reprinted over 70 fire fatality report summaries through March 2006. The total monthly combined circulation for the 6 magazines is approximately 300,000, reaching a potential audience of over 1,400,000 fire service professionals per month.

In 2005, NIOSH signed a Memorandum of Understanding with the U.S. Fire Administration (USFA) towards encouraging the use of NIOSH Fire Fighter Fatality Investigation Program (FFFIPP) fatality reports and other products in USFA curricula and training. A similar agreement was finalized with the Pennsylvania State Fire Commissioner's office in 2006.

FFFIPP staff participate on the National Fire Protection Association (NFPA) 1500 Committee, *Standard on Fire Department Occupational Safety and Health Program*, and communicate with other NIOSH staff on NFPA committees, such as those addressing equipment. Participation on these committees helps ensure that the committees are aware of findings from the FFFIPP which may warrant revisions to standards.

NIOSH has a representative on the International Association of Fire Chiefs (IAFC), Safety, Health and Survival Section, and works with groups such as the Emergency Responder Safety Institute on safety initiatives.

In the continuing effort to disseminate safety related materials to the fire service, the fire fighter fatality investigation and prevention program has given 44 oral presentations and presented 18 poster sessions. NIOSH routinely has informational booths at major fire service meetings, such as those of the International Association of Fire Fighters and International Association of Fire Chiefs.

OUTPUTS:

Top-Level Category Patent, Print Publication, Web Document, Software, Training, Video, Workshop/Seminar, Database or Information Resource, or Other (w/ narrative description)

- The NIOSH webpage - <http://www.cdc.gov/niosh/fire/> - was designed especially for the fire fighter program.
- FEMA produced a video on the Fire Fighter Fatality Investigation and Prevention Program that was aired on the EEnet broadcast system during the Month of April, 2001. NIOSH staff helped develop the format and content for the video and were featured in the video.
- Video - “Hidden Danger: Oxygen Regulator Fires” Rockville, MD: Food and Drug Administration. Available at <http://www.fda.gov/cdrh/ocer/dcm/html/gallery.html> (NIOSH provided technical and funding support)
- CD-ROM – Fire Fighter Fatality/Injury Reports and Other Related Publications, DHHS (NIOSH) Publication No. 2002-136
- CD-Rom – Fire Fighter Fatality Investigation and Prevention Program, August 2006
- CD-Rom – Fire Fighter Fatality Investigation and Prevention Program, July 2005.

NIOSH Publication Sub-Category: Alert, Criteria Document, Current Intelligence Bulletin, Fact Sheet, Federal Register Notice, Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) report, Fatality Assessment and Control Evaluation (FACE) report, Hazard Control, Hazard ID, Health Hazard Evaluation (HHE) report, Press Release (HHS or CDC press release or NIOSH Update), Workplace Solutions, or Other.

- Fatality and injury reports – Three hundred thirty-two finalized reports can be viewed at the following web page address - <http://www.cdc.gov/niosh/fire/>
- FDA/NIOSH Public Health Advisory: Explosions and Fires in Aluminum Oxygen Regulators. February 1999
- NIOSH Hazard ID - Braddee R., Washenitz F [1999]. *Fire Fighting Hazards During Propane Tank Fires*, Hazard ID 7 - June 1999, Publication No. 99-129.
- NIOSH Alert – Pettit T., Dunn V., and Main G [1999]. *Preventing Injuries and Deaths of Fire Fighters due to Structural Collapse*. August 1999. Publication No. 99-146.
- NIOSH Alert - Merinar T., Braddee R.W., et al. *Preventing Injuries and Deaths of Fire Fighters due to Truss System Failures*. May 2005. Publication No. 2005-132.

- NIOSH Hazard ID – McFall M., Schmidt E [2001]. *Traffic Hazards to Fire Fighters While Working Along Roadway*, HID 12 - June 2001, Publication No. 2001-143.
- NIOSH Hazard ID – Romano N [2001]. *Fire Fighter Death From Tanker Rollovers*. HID 14 – December 2001, Publication No. 2002-111.
- NIOSH Hazard ID – Cortez K., Mezzanotte T [2002]. *Fire Fighters Exposed to Electrical Hazards During Wildland Fire Operations*, HID 15 - January 2002, Publication No. 2002-112.
- NIOSH Workplace Solutions document - Tarley J, Guglielmo C [2004]. Preventing Deaths and Injuries to Fire Fighters during Live-Fire Training in Acquired Structures. NIOSH Pub. No. 2005-102.
- NIOSH Workplace Solutions document *Divers Beware: Training Dives Present Serious Hazards to Fire Fighters*, NIOSH Publication No. 2004-152.
- NIOSH, Federal Railroad Administration, Operation Lifesavers Inc. Your Safety 1st - Railroad Crossing Safety for Emergency Responders, NIOSH Publication No. 2003-121.
- FDA and NIOSH Public Health Notification: Oxygen Regulator Fires Resulting from Incorrect Use of CGA 870 Seals. June 2006.
- Guidelines - Berardinelli S., McFall M, and Romano N [2005]: *Interim Guidelines for Fire Fighting Operations in the Hurricane Katrina Response*, <http://www.cdc.gov/niosh/topics/flood/ff-katrina.html>, September 2005.

External Publication Sub-Category: Book/book chapter; Conference proceedings; final grant report; journal article (peer-reviewed); journal article (non-peer-reviewed); etc.

- Baldwin, T. N. [2001]. *Basement Fires: A Lethal Trap*. American Fire Journal, May 2001, p.p. 12-16.
- McFall M [2001]. *Roadway Assistance*. Fire Chief Magazine, 45(3):62-64.
- Washenitz F, Stolfus J. et. al. [2001]. *Fire Incidents Involving Regulators Used in Portable Oxygen Systems*. Injury Prevention. September 2001. pp 24-37.
- Hodous T, Washenitz F, Newton B [2002]. *Occupational burns from oxygen resuscitator fires: The hazard of aluminum regulators*. Am J Industr Medicine 42(1): 63-69.
- Fabio A, Ta M, Strotmeyer S, Li W, Schmidt E [2002]. *Incident-level risk factors for firefighter injuries at structural fires*. JOEM 44(11):1059-1063.

- Hodous TK, Pizatella TJ, Braddee RW, Castillo DN [2004]. *Fire fighter fatalities 1998-2001: overview with an emphasis on structure related traumatic fatalities*. *Injury Prevention* 2004; 10(4): pp 222-226.

Presentations:

- 1) Braddee RW [1998]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the National Volunteer Fire Council, Warwick, RI, October 9, 1998.
- 2) Washenitz F [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Baltimore Fire Safety Conference, Baltimore, MD, July 11, 1999.
- 3) Cortez K [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Search and Rescue/Disaster Response World Conference and Exposition, Nashville, TN, August 1, 1999.
- 4) Washenitz F [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Safety and Environmental Management (SEM 334) class, West Virginia University, Morgantown, WV, September 9, 1999.
- 5) Braddee RW [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Safety and Environmental Management (SEM 310) class, West Virginia University, Morgantown, West Virginia, September 21, 1999.
- 6) Cortez K [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the National Volunteer Fire Council Meeting, Memphis, TN, October 4, 1999.
- 7) Washenitz F [1999]. How the NIOSH Fire Fighter Investigation Team Conducts Fatality Investigations. Unpublished paper presented at the NFPA Fall Meeting, New Orleans, LA, November, 1999.
- 8) Hodous T [1999]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program, an Overview. Unpublished paper presented at the National Institute for Standards and Technology Conference, Gaithersburg, MD, December, 1999.
- 9) Cortez K [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program and Fire Fighter Fatality Statistics. Unpublished paper presented at the Fire Department Instructors Conference, Indianapolis, IN. February, 2000.
- 10) Washenitz F [2000]. Fire Fighter Fatality Case Presentations. Unpublished paper presented at the Fire Department Instructors Conference, Indianapolis, IN, February, 2000.
- 11) McFall M [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the American Society of Safety Engineers, Pittsburgh, PA, February, 2000.

12) Braddee RW [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Professional Fire Fighters of Massachusetts Annual Meeting, Springfield, MA, June 19, 2000.

13) Washenitz F [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program - Fatality Case Presentation. Unpublished paper presented at the Professional Fire Fighters of Massachusetts Annual Meeting, Springfield, MA, June 19, 2000.

14) Mezzanotte T [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Firehouse Conference and Exposition, Baltimore, MD, July, 2000.

15) Washenitz F [2000]. Safety Hazards with Oxygen Systems. Unpublished paper presented at the Firehouse Conference and Exposition, Baltimore, MD, July, 2000.

16) Romano N [2000]. Motor Vehicle Incidents in the Fire Service. Unpublished paper presented at the International Association of Fire Chiefs Conference, Washington, DC, August, 2000.

17) Cortez K [2000]. Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Journal of Emergency Medicine Society Apparatus Maintenance Workshop, Ft. Worth, TX, August, 2000.

18) Braddee RW [2000]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Unpublished paper presented at the Fire Service Leadership Convention, Fairfax, VA, October, 2000.

19) Washenitz F [2000]. Oxygen Regulator Flash Fires. Unpublished paper presented at the National Occupational Injury Research Symposium 2000, Pittsburgh, PA, October, 2000.

20) Braddee RW [2000]. Overview of the Fire Fighter Fatality Investigation and Prevention Program and Prevention Recommendations. Unpublished paper presented at the National Occupational Injury Research Symposium 2000, Pittsburgh, PA, October, 2000.

21) Myduc Ta, [2000]. Traumatic Occupational Injury Fatalities to Fire Service Personnel, 1992-1998. Presented at the National Occupational Injury Research Symposiums 2000. Pittsburgh, Pennsylvania, October, 2000.

22) McFall M [2001]. Fire Fighter Injury Incident - F2000-43. Presented at the Delaware State Fire Chiefs Association, Newark, Delaware, March 22, 2001.

23) Pizatella T [2001]. Investigating and Preventing Fire Fighter Fatalities. Presented at the program briefing, Atlanta, Georgia, March 23, 2001.

24) Braddee R [2001]. Investigating and Preventing Fire Fighter Fatalities. Presented at the International Association of Fire Chiefs (West), Oklahoma City, Oklahoma, May 6, 2001.

- 25) Cortez K [2001]. NIOSH's Fire Fighter Program and Two Fatality Incidents. Presented at the National Volunteer Fire Council meeting, Wenatchee, Washington, April 20, 2001.
- 26) Romano N [2001]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Presented at Firehouse Expo, Rockville, Maryland, July 2001.
- 27) Braddee R [2001]. Structure Fire Claims the Life of Three Career Fire Fighters and Three Children – Iowa. Presented at 16th Redmond Symposium, Phoenix, Arizona, September 2001.
- 28) Castillo D [2001]. NIOSH's Fire Fighter Fatality Investigation and Prevention Program's Investigation Database. Presented at the 16th Redmond Symposium, Phoenix, Arizona, September 2001.
- 29) McFall M [2001]. Restaurant Fire Claims the Life of Two Career Fire Fighters – Texas. Presented at the 16th Redmond Symposium, Phoenix, Arizona, September 2001.
- 30) Washenitz F [2001]. Restaurant Fire Claims the Life of Two Fire Fighters – Texas. Presented at the FRESH conference, Emmitsburg, Maryland, October 13, 2001.
- 31) Myduc Ta, M Strotmeyer [2001]. Characteristics of fire fighter line-of-duty motor vehicle-related fatal injury, 1992-1998. Presented at the 129th annual meeting of the American Public Health Association, Atlanta, GA, October 21-25, 2001.
- 32) Hodous T, Castillo D, Braddee R, Pizatella T. [2002]. NIOSH Fire Fighter Fatality Investigations 1998-2000: Overview with an Emphasis on Structure-related Fatalities. Presented at 6th World Conference: Injury Prevention and Control, May 14, 2002, Montreal, Canada.
- 33) Merinar T [2003]. Fatality cases involving roof and floor truss failures. Presented at the 17th Redmond Symposium, San Francisco, California, October 2003.
- 34) Tarley T [2003]. Live-fire Training case study. Presented at the 17th Redmond Symposium, San Francisco, California, October 2003.
- 35) Tarley J [2003]. Review of NIOSH Fire fighter Structure Fire Fatality – New York. Presented at the NOIRS conference, Pittsburgh, Pennsylvania, November 2003.
- 36) Powers J [2003]. Visibility: Which Way is Out? Presented at the NORIS conference, Pittsburgh, Pennsylvania, November 2003.
- 37) McFall M, Lutz V [2004]. Case Studies of the NIOSH Fire Fighter Fatality Investigation Program. Presented at the annual conference of the Minnesota State Fire Chief's Association, Minneapolis, MN, October 21, 2004.
- 38) Castillo DN. [2005]. NIOSH Fire Fatality Investigation and Prevention Program. Overview and Experiences Relevant to a Near-miss Reporting System. Invited presentation at *National Fire Fighter Near-Miss Reporting System Task Force Meeting*, Reston, VA, March 7-8, 2005.

- 39) McFall M. [2005]. NIOSH Fire Fighter Fatality Investigation and Prevention Program Overview and Case Studies. Presented at the *West Virginia Fireman's Association's Annual Safety Summit*, Weston, WV, April 2, 2005.
- 40) Koedam R, Farmer A. [2005]. Risk vs. Gain: Considerations for Working Fires in Unoccupied Structures. Presentation at the NFPA World Safety Conference & Exposition, Las Vegas, NV, June 30, 2005.
- 41) Koedam R. [2005]. Risk vs. Gain: Considerations for Working Fires in Unoccupied Structures. Presentation at the Firehouse Expo, Baltimore, MD, July 30, 2005.
- 42) Frederick, L. [2005]. NIOSH Fire Fatality Investigation and Prevention Program. Presentation at the Firehouse Expo, Baltimore, MD, July 30, 2005.
- 43) Tarley J. [2005]. Live-Fire and Motor Vehicle Fatality Case Studies. Invited presentation at the Ohio State Fire Fighter Association Conference, Wilmington, OH, August 19-20, 2005.
- 44) Frederick, L [2005]. Fire Fighter Fatalities due to Carbon Monoxide Poisoning. Presentation at the XVIIth World Congress on Safety and Health at Work, Orlando, Florida, September 18-22, 2005.

Posters:

- 1) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the National State Fire Marshals Convention, 3rd quarter FY99, Las Vegas, Nevada.
- 2) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the Fire Department Instructors Conference, February, 2000, Indianapolis, Indiana.
- 3) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the State Fire Marshals Convention, July, 2000, Lexington, Kentucky.
- 4) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the Firehouse Conference and Exposition, July 2000, Baltimore, Maryland.
- 5) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Fighters Annual Conference, August, 2000, Chicago, Illinois.
- 6) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Chiefs Convention, August, 2000, Dallas, Texas.

- 7) Poster regarding A Potential Univariate Risk Factors for Severe Firefighter line-of-duty injuries. Displayed and presented at the American Public Health Association Annual Meeting, November, 2000, Boston, Massachusetts.
- 8) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the 16th Redmond Symposium, September 2001, Phoenix, Arizona.
- 9) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the Fire Chiefs Conference, August 2001, New Orleans, Louisiana.
- 10) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented Fire-Rescue International Conference, August 2001, New Orleans, Louisiana.
- 11) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the Firehouse Expo Convention, July 2001, Baltimore, Maryland.
- 12) Poster regarding Fire Fighters Deaths From Tanker Truck Rollovers. Displayed and presented at SAFEUSA Leadership Conference, December 2001, Atlanta, Georgia.
- 13) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Fighters Conference, August 2002, Las Vegas, Nevada.
- 14) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Chiefs Conference, August 2002, Kansas City, Missouri.
- 15) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Fighters' Redmond Conference, October 2003, San Francisco, California.
- 16) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the National Safety Congress, October 26-29, 1998, Los Angeles, California.
- 17) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Chiefs, Fire Rescue International Conference, August 11-14, 2005, Denver, Colorado.
- 18) Poster regarding NIOSH's Fire Fighter Fatality Investigation and Prevention Program. Displayed and presented at the International Association of Fire Fighters' Redmond Conference, October 23-27, 2005, Honolulu, Hawaii.

ACTIVITIES:

- Identify work situations at high risk for fatal injury or serious injury
- Conduct fatality and injury investigations
- Formulate prevention strategies for those who can intervene in the workplace
- Write Alerts, Hazard IDs, Workplace Solutions documents, Public Health Advisories, and Journal Articles
- Disseminate materials developed through the project
- Conduct meetings with stakeholders to refine and enhance the project
- Make presentations regarding the program to stakeholders
- Attend stakeholders' conferences and distribute safety related materials and network with stakeholders

INPUTS:

In Fiscal Year 1998, Congress recognized the need for further efforts to address the continuing problem of occupational fire fighter fatalities, and funded NIOSH to undertake this effort. NIOSH was given a \$2.5 million congressional appropriation to "... conduct fatality assessment and control evaluation investigations to gather information on factors that may have contributed to traumatic occupational fatalities, identify causal factors common to fire fighters fatalities, provide recommendations for prevention of similar incidents, formulate strategies for effective intervention, and evaluate the effectiveness of those interventions."

NIOSH held public meetings to seek stakeholder input on the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) in January 1999, and again in March 2006. This input was used to design, refine and enhance the FFFIPP to ensure it meets stakeholders' needs.

PROJECT ID: World Trade Center Surveillance Study (CAN AT13)

END OUTCOMES:

No end outcomes have resulted from this project.

INTERMEDIATE OUTCOMES (IO):

Although no intermediate outcomes have resulted from this project, findings indicate that emergency responders and disaster site workers are likely to utilize on-site medical care providers for treatment of mild illnesses and minor injuries. Information resulting from this project on the specific types of illnesses and injuries treated on the site of the World Trade Center disaster may be used by these providers in preparing for future disasters.

FINAL CUSTOMERS:

- Disaster site rescue and recovery workers and volunteers
- Leaders of rescue and recovery teams and volunteer organizations
- Emergency responders
- Employers of emergency responders

INTERMEDIATE OUTPUTS:

No intermediate outputs have resulted from this project.

INTERMEDIATE CUSTOMERS:

- Federal Emergency Management Agency, oversees deployment of Disaster Medical Assistance Teams that provide on-site medical care
- Mount Sinai School of Medicine, conducting a medical screening and evaluation program for World Trade Center responders
- Emergency preparedness and response planners

TRANSFER ACTIVITIES:

Results from this project have been disseminated through a peer-reviewed journal and a presentation. An external factor that continues to impact the effective transfer of project findings to our intermediate customers is centered on the multiple governmental reorganizations that occurred following the September 11 tragedy. The most significant for this project was the transfer of responsibility for overseeing the deployment of disaster site medical care units, which moved from an office under the Department of Health and Human Services to an agency under the Department of Homeland Security. Staff reassignments and shifting priorities that transpired during this lengthy transition phase have challenged collaborative transfer activities.

OUTPUTS:

Peer-reviewed journal article:

Perritt KR, Boal WL, The Helix Group Inc [2005]. Injuries and illnesses treated at the World Trade Center, 14 September – 20 November 2001. *Prehosp Disast Med* 20(3):177-183.

Presentation:

Perritt KR [2005]. Injuries and illnesses treated at the World Trade Center Sept 14 – Nov 20, 2001. Presented for West Virginia University, Institute of Occupational and Environmental Health, April 19, 2005, Morgantown, West Virginia.

ACTIVITIES:

The objective of this project was to evaluate injuries and illnesses sustained by emergency responders and rescue and recovery workers at the World Trade Center disaster site following the September 11 attacks. Two different pre-existing datasets were to be evaluated. First, data recorded on medical forms completed when patients were treated at the on-site Disaster Medical Assistance Team (DMAT) stations were analyzed. These data were obtained through a Letter of Agreement with the Office of Emergency Preparedness, which at the time oversaw DMAT deployments from within the Department of Health and Human Services. The data analysis results have been disseminated through a journal article publication and a presentation. The second pre-existing dataset was obtained from the Mount Sinai School of Medicine, where a medical screening and evaluation program for World Trade Center responders is ongoing. Prior to the program implementation, NIOSH assisted Mount Sinai in developing an injury and illness questionnaire that was self-administered by program participants. Through this module, detailed information was collected on injuries and illnesses that were experienced at the World Trade Center disaster site during the active rescue and recovery operation period. These data, obtained through a data use agreement with Mount Sinai, are being analyzed by NIOSH and will be published along with other findings from the Mount Sinai evaluation program.

INPUTS:

In the month following the September 11, 2001 tragedy, NIOSH was provided with funds to address the needs of workers responding to the attacks. A portion of the funding was used to support this project with the objective of evaluating injuries and illnesses experienced on-site by World Trade Center responders.

Several factors influenced the methods used to accomplish the project objective. First, in October 2001, NIOSH staff were requested to provide technical support to the New York City Department of Health in efforts to develop a registry of those affected by the World Trade Center disaster. In this supporting role, project staff traveled to New York City, witnessing firsthand the need for information related to the distribution of responder injuries and illnesses. A second influencing factor precipitated in November 2001, when NIOSH was approached by a representative of the Office of Emergency Preparedness regarding the possibility of NIOSH obtaining and analyzing data from DMAT records. The ensuing discussions and resulting collaboration directly led to the development of the project protocol for evaluating on-site

injuries and illnesses. The final influence occurred through NIOSH support of the Mount Sinai School of Medicine program that provides medical screening and evaluation for World Trade Center responders. In June 2002, the collaboration began for including a respondent-administered injury and illness questionnaire in the Mount Sinai program. This collaboration will continue through the analysis, result interpretation, and publication efforts.

PROJECT ID: HCCB7 9270025 – Fall Prevention for Aerial Lifts in the Construction Industry

END OUTCOMES: The outcome of this project will be the immediate use of the outputs by aerial lift companies involved with design and production of equipment — represent a step forward in the r2p process, and involves purposeful collaboration between a leading manufacturing partner and NIOSH. NIOSH partners have indicated that they are willing to be instrumental in the distribution of this information to end users, design engineers, industrial partners, and other stakeholders. External partners have also expressed a willingness to support future NIOSH endeavors in this area and to express public support for NIOSH research endeavors in public and private forums. This project has implications for many types of lift equipment used in construction, building maintenance, warehousing, and other applications. The involvement of NIOSH in addressing advanced engineering aspects of cross-sector safety research is directly extendable to boom trucks, cranes, scaffolds, and other elevating equipment. Additionally, this project has implications for the entire area of fall safety, in that the safe engineering of mechanized lift equipment is significantly related to many aspect of fall safety for workers operating at height.

INTERMEDIATE OUTCOMES (IO): This project solicited and acted on criteria submitted by industry and union partners from the initial stages. As such, the project has focused on practical value to the occupational and industrial community using aerial lifts. Aerial lifts have different configurations; most companies specialize in one type of aerial lift or another, although there is direct competition in most categories. The company we partnered with is the leading manufacturer (i.e., SkyJack Inc.) of a particular kind of aerial lift, a scissor lift, which is a general purpose, widely used lift with applications in construction, maintenance, warehouse operations, and other applications. SkyJack will review the study results and suggest possible alternative designs, including interventions, for further testing and fabricate possible revised designs of the lift. NIOSH and SkyJack will jointly provide interested parties with test progress results and recommendations. SkyJack Inc. has agreed to extend its letter of agreement with NIOSH, and continue its collaboration with NIOSH in FY07 and beyond to develop, transfer, commercialize the product. So far, all demonstrations perform effectively.

FINAL CUSTOMERS: Aerial lift manufacturers and rental/lease agencies are two major customers of the project. Because of the high risk of litigation related to the use of aerial lifts, corporate officers in the manufacturing sector have high awareness of technological issues related to safety.

INTERMEDIATE OUTPUTS: A letter of agreement (LOA) was signed in 2004 and runs through FY 2007 with the leading scissor lift manufacturer — SkyJack Inc. SkyJack will review the study results and suggest possible alternative designs, including interventions, for further testing and fabricate possible revised designs of the lift. NIOSH and SkyJack will jointly provide interested parties with test progress results and recommendations.

INTERMEDIATE CUSTOMERS: Mr. Boehler from the leading manufacturer – SkyJack Inc., serves as a representative of the industry as a whole. He is a committee member of a number of standards committees relating to aerial lifts. These include the American National Standards Institute (ANSI) A92 Aerial Platforms Main Committee and various A92 sub-committees, the US Technical Advisory Group to ISO Technical Committee 214 Elevating Work Platforms, and the Canadian Standards Association (CSA) B354 Elevating Work Platforms

Technical Committee. Mr. Boehler is also a contributing member of various industry associations including the International Powered Access Federation (IPAF) and Aerial Work Platform Training (AWPT). The latter is a North American subsidiary of IPAF and is dedicated to standardizing the training of aerial work platform operators throughout North America. SkyJack is an AWPT training center, and he is a registered AWPT Operator Instructor. Further, he has presented papers regarding safety and standards within the industry at both Aerial Platform Safety Conferences to be held to date. SkyJack and all other manufacturers will transfer the technologies.

TRANSFER ACTIVITIES: The study has established several media channels to disseminate the progresses and update the project status for all interested parties. These include the Bureau of National Affairs (BNA) Inc. (i.e., the Occupational Safety and Health Reporter), the Lift and Access³⁶⁰ (eMagazine), and the newsletter of the Center to Protect Workers' Rights (CPWR). A dissemination strategy for the findings of the project will be developed with the assistance of the American National Standards Institute (ANSI) A92 (Elevating Work Platforms) and A10.29 (Aerial Lifts in the Construction Industry), ISO 16368 (Mobile Elevating Work Platforms), CSA B354 (Elevating Work Platforms) committees. Additionally, the findings and outputs of this project will be disseminated with the collaboration of CPWR, lift manufacturers, and interested parties in the insurance industry.

Also, Aerial Work Platform Training (AWPT) in conjunction with the International Powered Access Federation (IPAF) will examine the findings of the study and potentially adopt useful safety findings of this study for its operator safety training. The Manufacturer's Elevating Work Platforms Council of the Association of Equipment Manufacturers (AEM) will collaborate with the study and disseminate equipment stability findings and operator safety recommendations.

OUTPUTS: Three major outputs for improved equipment design and appropriate safe work practices could be generated. They are outlined as follows:

1. A validated model that could be used to analyze the impact of the following changes on the definition and design of a scissor lift's operational envelope:
 - A. Work practices when on the platform at different heights.
 - B. Weight and size of tools and building materials used on the platform at different heights.
 - C. Existing safety features.
2. An evaluated dynamic effect attributed to the completion of task(s) on a scissor lift platform at different heights (e.g., dynamic curb test and depression test). An evaluated dynamic effect attributed to driving and stopping (jerking) a scissor lift at a range of heights and with a range of loadings on the platform. These measured effects could then be used by future designers as dynamic load amplification factors in standard tip-over analyses.
3. Recommendations for modifications of some design parameters to make the lift safer without significantly increasing its weight, cost, and convenience of use. Some improved designs for safety structures, accompanied with newly-developed intervention techniques, will be proposed, prototyped, and tested in collaboration with lift manufacturers.

Several expected outputs for equipment design and operators' training could be generated. Consensus equipment standards and safe work practices will be proposed through appropriate standards subcommittee(s) (e.g., ANSI A10.29 and/or ANSI A92). Results and recommendations from this study will be disseminated in collaboration with major manufacturers, construction unions, and public service organizations. Further intervention studies and collaborative opportunities can be expected to develop for those workforces operating heavy construction equipment, targeting machinery safety and fall prevention programs.

This study uniquely incorporates a multidisciplinary approach to the engineering design and analysis of a multifactorial safety hazard; the integration of these approaches to develop a comprehensive method for injury prevention represents an opportunity to apply these methods to a range of equipment used in construction, maintenance, telecommunications, and other industries. Engineering designs and analyses that eliminate fall hazards associated with heavy construction equipment are generally accepted as preferred over other methods that attempt to mediate injury outcomes following a fall incident.

Patents, peer-reviewed publications and conference presentations from the project will be produced. A mechanism to develop and commercialize any inventions through the technology transfer process with the collaborating manufacturer (e.g., SkyJack Inc) will be investigated.

ACTIVITIES: In FY03-FY04, the project team reviewed literature and analyzed data to examine injury and fatality databases. The objective of this component was to establish a mechanism to determine research priorities for addressing fall incidents associated with aerial lifts. After completing this data review, a widely used scissor lift model and several key work-tasks were identified for further study. In FY04, a peer review public meeting was completed at the NIOSH Morgantown facility. Manufacturers' representatives, project collaborators, and interested parties proposed constructive comments and possible research directions for consideration for this study at a public meeting. A consensus on the usefulness and research implications of this study for the aerial lift industry and related industries was established.

After the meeting, the objectives of this study were re-examined in light of the peer reviewers' and collaborators' suggestions. The basic project focus was validated as sound, as per suggestions from the interested parties and further study by the Project Officer. The primary focus remained that of developing a comprehensive dynamic computer-simulation model of a 19-foot electric scissor lift, systematically investigating the mechanisms of the tip-over of the lift and the related fall of workers from the lift platform, forming preventive strategies and work practices, and exploring the development of effective safety devices. Additional possible goals include: the examination of the role of pothole guards as an intervention technology and future research directions including the possibility of a feasibility study on the value of instituting a retrofit program for pre-year 2000 scissor lifts without pothole guards, the role of maintenance and bearing wear in older lifts, and the use of aerial lifts as anchorages.

In FY05-FY06, four separate study components have been conducted: (1) A computer simulation model was developed and refined; (2) A workstation to statically measure the center of gravity (CG) of the lift at different heights and to determine horizontal load/stability limits at different heights and workloads was built; (3) Tests to collect interactions and changes in CG and loadings of operator(s) within the platform were conducted; and (4) Dynamic response data for the lift during its horizontal movements were collected. The final model was validated and refined using

collected data which includes the following essential parameters: (a) the gravity centers of the lift when the lift is raised to different heights; (b) the dynamic loadings and changes of CG locations due to human operations and placement of tools and building materials on the platform of the lift; and (c) the accelerations and displacements that could be generated during start and stop movements of the lift.

In FY07, a field validation test and additional engineering data from construction worksites will be collected to provide the model with information, which will be used to refine and expand the model, and more importantly, to demonstrate to the audience of union workers, laborers, manufacturers, and users of aerial lift technology, that NIOSH study results can be validated as safe, beneficial and valuable to them and the industry. This approach represents a substantial commitment to the r2p program developed by the Institute, for the development of products jointly with industry, to address hazards known to exist within industrial sectors, and which represent a human and economic burden to the industry, to the workforce, and to society.

INPUTS: Aerial lifts are complex systems, subject to failure from both mechanical problems and operator error. Manufacturers have typically relied on the failure statistics of individual component manufacturers to generate information on times to failure, and have done limited modeling, such as finite element analysis or solid materials modeling, to estimate the service life of individual components subject to failure. This study was formulated to build a research model which can be employed throughout the aerial lift manufacturing industry. This modeling approach is generally done in a highly restrictive fashion, usually in response to a consensus standard calling for system survivability to a specific environmental exposure, such as encountering a pothole while in motion. This study attempts to build upon the limited modeling being done within the industry by adding research data on the dynamic loading effects and center-of-gravity changes imposed by human subjects, as well as, on the dynamic loads imposed by equipment operation in the vertical and horizontal planes.

The specific objectives of this laboratory study are to develop a comprehensive dynamic model of a scissor lift, to systematically investigate the mechanisms of the tip-over of the lift and the related fall of workers from the lift platform, to form preventive strategies and work practices, and to develop effective safety devices. The ultimate goal is to significantly reduce the fatalities and injuries in the operation of scissor lifts.

These objectives represent a unique application of engineering methods and technologies to an emerging occupational safety hazard, and represent an attempt to apply basic and applied engineering research to develop a systematic approach to the prevention of fall-related injuries from aerial lifts. As such, the engineering and scientific expertise being applied to this problem is drawn from a range of disciplines, and includes mathematical modeling, computerized simulations, sensor-based force-data analysis, computer aided design (CAD), biomechanical analysis, human factors engineering, as well as traditional mechanical engineering.

Based on the results of the modeling and laboratory experiments conducted within two DSR laboratories (i.e., High Bay and Human Factors laboratories), the project team will investigate opportunities to increase the overall stability of the aerial lift and improve work practices to minimize human errors. The effectiveness of improved equipment designs and work practices will be evaluated using dynamics analyses (i.e., computer modeling). After potential equipment

failures and human errors for causing fall incidents are identified, different corresponding solutions will be proposed.

A dissemination strategy for the findings of the project will be developed with the assistance of the ANSI A92 (Elevating Work Platforms) and A10.29 (Aerial Lifts in the Construction Industry) committees. Additionally, the findings and outcomes of this project will be disseminated with the collaboration of CPWR, lift manufacturers, and interested parties in the insurance industry.

PROJECT ID: 9277110 - Preventing Injuries in Telecommunication Tower Construction

PROJECT OFFICER: Thomas Lentz

END OUTCOMES: Safety messages will be communicated using partnerships with OSHA and industry to produce trade journal articles, compliance directives, NIOSH documents and presentations.

INTERMEDIATE OUTCOMES (IO):

FINAL CUSTOMERS: small business, nonunion workers, and OSHA

INTERMEDIATE OUTPUTS: development of strategies to prevent injuries and fatalities in

INTERMEDIATE CUSTOMERS: safety and health of tower construction workers, and involves hazard characterization

TRANSFER ACTIVITIES: produce trade journal articles, compliance directives, NIOSH documents and presentations.

OUTPUTS: Information for OSHA's priority areas of fall hazards and crane and hoist safety; as well as the objective in the Healthy People 2000 Agenda to reduce deaths from work-related injuries to no more than 4 per 100,000 full-time workers.

ACTIVITIES: conduct surveillance of injuries and fatalities during tower construction; identification of hazards and high-risk activities for tower workers; and increased awareness of hazards and safe practices.

INPUTS: National Traumatic Occupational Fatalities (NTOF) data (1980-1994) identified 123 fatalities related to tower work; eight additional fatal falls from towers were investigated by NIOSH within the past year.

PROJECT ID: 9277271 - Occupational Hazards of Roofers

PROJECT OFFICER: Jerry Flesch,

END OUTCOMES: NIOSH policy/technical document containing a comprehensive evaluation of the work-related health and safety risks of roofers and providing appropriate intervention recommendations to remediate the risks.

INTERMEDIATE OUTCOMES (IO) A hazard review or criteria document will be developed to address the hazards and provide recommendations that can be used by OSHA and health and safety professionals.

FINAL CUSTOMERS: Roofers

INTERMEDIATE OUTPUTS: Roofing industry and labor representatives

INTERMEDIATE CUSTOMERS: A hazard review or criteria document will be developed to address the hazards and provide recommendations.

TRANSFER ACTIVITIES: Products will be transferred to be used by OSHA and health and safety professionals.

OUTPUTS:

ACTIVITIES: critically evaluate the health and safety risks associated with roofing work and determine the types of strategies, including training and education that may be required to reduce injuries and exposure to hazardous substances.

INPUTS: BLS data and information from construction industries and labor groups.

PROJECT ID: Harness Design and Sizing Effectiveness

END OUTCOMES: None to report at this time.

INTERMEDIATE OUTCOMES (IO): None to report at this time.

FINAL CUSTOMERS: The final customers are workers, construction contractors and sub-contractors who are involved with roofing work or other jobs that are performed at 6-feet height or above, either in original construction or maintenance and repair activities. This will include health and safety practitioners who are responsible for keeping these workers safe.

INTERMEDIATE OUTPUTS: Research and development efforts at two major US fall-arrest harness manufacturers (MSA Fall Protections Inc. and DBI-SALA Fall Protections Inc.) are currently underway, using NIOSH research results to modify their current harness designs, as well as more extensive efforts to develop the next-generation harness designs and prototypes.

INTERMEDIATE CUSTOMERS: Fall-arrest harness manufacturers, heavy construction equipment renting companies; labor associations; safety and health professionals; and other fall-prevention researchers.

TRANSFER ACTIVITIES:

This project involves significant technology transfer activities with harness manufactures. Letters of agreement have been signed with two harness manufacturers, MSA Fall Protection and DBI-SALA Fall Protection. These agreements provide a framework for conducting research and development activities, as well as subsequent marketing activities, to advance the adoption of this technology by the construction industry and its customers. These two partners have provided design criteria and blueprints for current harness models, as well as consultative services, and continued collaboration on the process of transferring and converting TI findings and intellectual property into harness design. MSA and DBI-SALA are finalizing the adjustment range of each harness component with the NIOSH research team and will complete the prototypes of the new generation harnesses in year 2007 for NIOSH to conduct validation studies to determine the validity and reliability of the newly established sizing system.

American Society of Safety Engineers (ASSE) participation in this process is ongoing, and members have indicated strong support for establishing ASSE/ANSI recommendations for harness design.

OUTPUTS:

NIOSH research has found that thigh strap angle and back D-ring location could be utilized along with current harness static-fit-test criteria to further enhance post-fall harness-fit predictions. The information is useful for construction workers to assure that they select the right size of harness and to don the harness properly. Presentations on this research have been made in national and international trade symposia and have as well been published in leading peer reviewed journals, such as Ergonomics and Human Factors.

Fit-performance-criteria tests revealed that current sizing schemes did not provide adequate fit to as many as 40% of workers due to variations in human body shape, size, and torso composition,

strongly suggesting the need for more robust and sophisticated sizing schemes. Mathematical parameters were established to determine the points of contact between the safety harness and human body in its various shapes to define optimal sizing schema. This finding was pivotal in developing relationships with manufacturers and standards committees for more extensive design-criteria development. Additionally, this finding informed discussions with the harness subcommittee of the American Society of Safety Engineers (ASSE) in establishing the need for modification of harness sizing schema. Upon finalization, this project will have two discrete and significant products: A mathematically sophisticated algorithm for minimizing the number of harness-design configurations while simultaneously maximizing the number of workers accommodated by this scheme; and a set of recommendations for producing this limited set of harnesses. Current recommendations are for 4 sizes of harnesses for men, three sets for women for over-the-head style harnesses and 4 to 7 sizes for the vest style harnesses.

Some project-related publications are listed below, which provide new human-body-size-and-shape-quantification methods for anthropometry researchers to advance human-protective-equipment-fit evaluations and provide practical criteria for equipment designers to advance their designs.

Hsiao H., Whitestone J., and Kau T., Evaluation of Fall-Arrest Harness Sizing Scheme, Human Factors, 48, 2006. [in press]

Hsiao H., Bradtmiller B., Whitestone J., Sizing and Fit of Fall-Protection Harnesses, Ergonomics, Vol. 46, No. 12, 1233-1258, 2003.

Hsiao H., Long D., Snyder K., Anthropometric Differences among Occupational Groups, Ergonomics, 45 (2), pp 136-152, 2002.

Hsiao H., Anthropometric Procedures for Design Decisions: From Flat Map to 3D Scanning, Contemporary Ergonomics 2004: Proceedings of the Ergonomics Society Conference. Boca Raton, FL: CRC Press, 2004, April: 144-148.

Friess M., Rohlf F.J., Hsiao H., Quantitative assessment of human body shape using Fourier analysis, SPIE—The International Society For Optical Engineering conference, January 18-22, 2004, San Jose, California.

Bradtmiller B., Whitestone J., Feldstein J., Hsiao H., and Snyder K., Improving Fall Protection Harness Safety: Contributions of 3-D Scanning, Scanning 2000--Numerisation 3D. 5th ed. Proceedings of the Industrial Congress on 3D Digitizing, Paris, France, May 24-25, 2000. Dinard Cedex, France: Harbour, pp. 117-128.

ACTIVITIES:

The overall goal of this research effort is the establishment of anthropometric guidelines for the design of improved full-body harnesses, and the development of an effective harness sizing schema that will best accommodate the current population of U.S. workers. The Traumatic Injury program was in a unique position to address this issue. The program is at the forefront of emerging technology, having acquired the advanced scanning hardware (Cyberware Whole Body Scanner) and associated analytic software systems to perform whole-body 3D scans of workers in both standing and suspended conditions, the same conditions that workers would encounter during work and following a fall from height. The tools and methods of this research overcame a long-standing problem: Human subjects in suspended conditions could go into distress in as little as 5 minutes, making it too hazardous to conduct human-subjects harness-fit tests with traditional anthropometric tools and methods, which were time-intensive and therefore unacceptable for this purpose.

Mathematical parameters were established to determine the points of contact between the human body in its various shapes and the safety harness and to define optimal sizing schema.

Additionally, the power of the NIOSH studies was increased through the addition of data from an international anthropometric database of 2400 subjects, known as CAESAR (Civilian American and European Surface Anthropometry Resource) project. Along with two harness manufacturers, NIOSH researchers have applied the mathematical parameters that were developed through the NIOSH pilot studies to the CAESAR database to establish the adjustment range of each harness component. This is an important step to transfer the scientific research results into industrial design practice.

Two major harness manufacturers have actively participated in this research and are finalizing the adjustment range of each harness component with the NIOSH research team. In the final phase of this research, researchers will conduct validation studies to determine the validity and reliability of the newly established sizing system when the manufacturers complete the prototypes of the new generation harnesses in year 2007.

INPUTS: The primary input for the development of this project were the Bureau of Labor Statistics data on magnitude and cost of construction-related fall incidents and a request from multiple stakeholders through professional meetings with a goal to advance scientific knowledge on formulating harness-sizing schemes and harness designs for various populations, including women and minorities, to assure the required level of protection, productivity, and comfort of harnesses to workers.. These stakeholders include two harness manufacturers, American Society of Safety Engineers (ASSE), International Safety Equipment Association (ISEA), International Society of Fall Protection (ISFP) and California OSHA.

PROJECT ID: HCCB7 9278955 – Influence of Visual Cues at Heights

END OUTCOMES: none to report at this time

INTERMEDIATE OUTCOMES (IO):

The results from this project established the scientific basis for conducting fall prevention research with application of Virtual Reality simulations, and allowed the development of new projects for evaluation of innovative strategies for improving workers balance at elevation. Two new projects have been developed and one project has already been completed with results having direct practical implications for improving workers' safety at elevation.

FINAL CUSTOMERS:

The final customers for the project results will be the workers involved in work at elevation who are at risk for falls, including workers in the construction industry, service, maintenance, transportation, and firefighters.

INTERMEDIATE OUTPUTS:

The study contributions will be to advance knowledge in the area of virtual reality. Potential applications include research on balance control and fall prevention, with emphasis on sensory interfaces interactions – an area in which active research is ongoing.

INTERMEDIATE CUSTOMERS:

Intermediate customers include the scientific community as well as the safety professionals, trainers, developers of safety training programs and employers who have to make safety-related decisions.

TRANSFER ACTIVITIES:

The results of the project have been reported at scientific meetings attended by many safety professionals, and have been published in leading peer-reviewed journals.

OUTPUTS:

Hsiao H, Simeonov P, Dotson B, Ammons D, Kau T, Chiou S.: Human responses to augmented virtual scaffolding models, *Ergonomics*, 48(10), 1223-42 (2005).

Simeonov P, Hsiao H, Dotson B, Ammons D.: Height effects in real and virtual environments, *Human Factors*, 47(2), 430-438 (2005).

Simeonov P, Hsiao H, Dotson B, Ammons D.: Comparing standing balance at real and virtual elevated environments, *Proceedings of the Human Factors and Ergonomics Society 46th Annual Meeting 2002*, Sep-Oct, 2169-2173 (2002).

Dotson-BW; Hsiao-H: Safe work at elevation through virtual reality simulation. NOIRS 2000-- Abstracts of the National Occupational Injury Research Symposium 2000, Pittsburgh, PA, October 17-19, 200, Pittsburgh, PA: National Institute for Occupational Safety and Health, 2000 Oct; :60-61

ACTIVITIES:

This project involved a complex and extensive effort of a multidisciplinary team of researchers with diverse qualifications and expertise. The activities included the development and validation of an advanced visualization and modeling laboratory (using a surround screen virtual reality system) and the development and completion of experimental studies with human participants.

The studies applied both real and virtual models of elevation and used augmented virtual scaffolding models to evaluate human psycho-physiological and balance control responses during standing and walking activities (static and dynamic tasks).

One study compared human perceptions of height, danger, and anxiety, as well as skin conductance and heart rate responses and postural instability effects, in real and virtual height environments. The participants performed “lean-over-the-railing” and standing tasks on real and comparable virtual balconies, using a surround-screen virtual reality (SSVR) system. The results indicate that the virtual display of elevation provided realistic perceptual experience and induced some physiological responses and postural instability effects comparable to those found in a real environment. It appears that a simulation of elevated work environment in a SSVR system, although with reduced visual fidelity, is a valid tool for safety research. Potential applications of this study include the design of virtual environments that will help in safe evaluation of human performance at elevation, identification of risk factors leading to fall incidents, and assessment of new fall prevention strategies.

A second study investigated the effect of adding real planks, in virtual scaffolding models of elevation, on human performance in a surround-screen virtual reality (SSVR) system. Construction workers performed walking tasks on real and virtual planks at three virtual heights and two scaffolding-platform-width conditions. Gait patterns, walking instability measurements and cardiovascular reactivity were assessed. The results showed differences in human responses to real vs. virtual planks in walking patterns, instability score and heart-rate inter-beat intervals; it appeared that adding real planks in the SSVR virtual scaffolding model enhanced the quality of SSVR as a human – environment interface research tool. The practical implications of this study are in the adoption of augmented virtual models of elevated construction environments for injury prevention research, and the development of program for balance-control training to reduce the risk of falls at elevation before workers enter a construction job.

INPUTS:

The project concept emerged from in-depth analysis of the information available in the scientific knowledge base and the latest technological developments in the Virtual Reality systems, combined with information from previous research studies at DSR.

PROJECT ID: Suspension Tolerance in Men and Women Wearing Safety Harnesses

PROJECT OFFICER: Nina L. Turner, Ph.D.

PROJECT START DATE: 01/01/2004

PROJECT END DATE: 09/30/2005

END OUTCOMES:

The end outcomes will be to reduce the incidence of suspension trauma in workers who fall while wearing full-body safety harnesses.

INTERMEDIATE OUTCOMES (IO):

The intermediate outcomes will be successful commercialization of the NIOSH-developed harness accessory for the prevention of suspension trauma.

FINAL CUSTOMERS:

Final customers include construction workers and other workers required to wear full-body safety harnesses.

INTERMEDIATE OUTPUTS:

The intermediate outputs will include licensing agreements between NIOSH and those who might be interested in producing the harness accessory.

INTERMEDIATE CUSTOMERS:

Intermediate customers are harness manufacturers and those who are interested in producing the harness accessory.

TRANSFER ACTIVITIES:

Findings are being disseminated at an industrial hygiene conference, and a provisional patent application has been filed.

OUTPUTS:

1) Slide presentation at the American Industrial Hygiene Conference and Exposition:

Turner, N., Weaver, D., Whisler, R., Zwiener, J., and Wassell, J. Suspension tolerance in men and women wearing safety harnesses, American Industrial Hygiene Conference and Exposition, Chicago, IL, 2006. (Abstract No. 144)

2) Provisional patent application filed on July 14, 2006 (CDC Ref. No. I-002-06).

3) Draft manuscript to be submitted to the Journal of Occupational and Environmental Hygiene.

ACTIVITIES:

A total of 22 men and 18 women completed front O-ring and back D-ring suspension tests. A total of 14 men and 11 women completed testing of a unique harness accessory designed to delay/prevent suspension trauma. There were no significant gender differences in suspension time. Mean suspension times for all subjects were 24.4 ± 13.5 min (range 4 – 60 min) and 29.2 ± 12.1 min (range 5 – 56 min, $p < 0.05$) for the CHEST and BACK conditions, respectively. Medical symptoms were the cause of suspension termination in 69% of CHEST tests and 81% of BACK tests, while suspensions were voluntarily terminated in 28% of CHEST tests and 19% of BACK tests. One subject completed a 60-min CHEST suspension. Mid-thigh circumference changes were 1.4 and 1.9 cm ($p < 0.05$), and changes in minute ventilation were 1.2 and 1.5 L/min for CHEST and BACK, respectively. Suspension time was 57.9 ± 5.6 min (range 39 – 60 min) for all subjects for the harness accessory test (CAN 8104C). There were no medical symptoms during tests with the accessory, and 85% of accessory wearers completed 60-min suspensions. These data provide information on tolerance time for wearers of full-body harnesses for standards-setting organizations and demonstrate the potential of a harness accessory to delay or prevent suspension trauma.

INPUTS:

There are no additional inputs.

PROJECT ID: Lab Testing of Adjustable Safety Rail-Roof Bracket Assembly

END OUTCOMES: None to report at this time.

INTERMEDIATE OUTCOMES (IO): None to report at this time.

FINAL CUSTOMERS: The final customers will be construction contractors and sub-contractors who are involved with working on roofs, either in original construction or maintenance and repair activities. This will include health and safety practitioners who are responsible for keeping these workers safe.

INTERMEDIATE OUTPUTS: None to report at this time.

INTERMEDIATE CUSTOMERS: Manufacturers of roofing products; Labor associations; safety and health professionals; and other fall-prevention researchers.

TRANSFER ACTIVITIES: This project has just recently gotten started. One presentation was given at NORA 2 Conference in Washington, D.C. in April 2006. This 5-min presentation was accompanied by a Poster that provided background about the development of the adjustable bracket assembly. A reporter from the newsletter, Inside OSHA, attended the NORA 2 Conference and stopped at the Poster for this project and asked numerous questions. The reporter was interested enough to prepare a short highlight piece on the prototype assembly that was published in May 2006.

OUTPUTS:

1. An Abstract, “NIOSH-Designed Adjustable Roof Bracket and Safety Rail Assembly,” was published in the Proceedings of the NORA Symposium 2006, *Research Makes a Difference*, held in Washington, D.C., April 18-19, 2006.
2. A 5-min overview presentation (by the same title) was given at the NORA Symposium 2006.
3. A Poster (by the same name) was prepared and presented at the NORA 2006 Symposium. The Poster provided more detail than the Abstract or the 5-min talk. However, details had to be kept vague since the prototype safety product is going through the patent process. Until the Patent Application is published on the U.S. Patent and Trademarks website, the assembly has to be protected from others acquiring this design and manufacturing it before the prototype can be protected.

ACTIVITIES: Research from a previous project helped to define the need for such an adjustable bracket. The basic design of the prototype assembly was developed and through iterative testing, the design was improved and refined. While the laboratory evaluations were on-going, the patent application was slowly going through the filing process. The Employee Invention Report was submitted during April 2004. The Patent Application was finally filed on October 24, 2005. After the application was filed, an announcement was posted on the Federal Business Opportunities website. A manufacturer of roofing products has been sought to partner with NIOSH to manufacture and market this prototype design. We have had discussions with four companies, but none of them has yet agreed to partner with NIOSH in this manufacturing and marketing venture.

INPUTS: The primary input for the development of this prototype safety product was a previous pilot study that evaluated the effectiveness of different guardrail systems. This project identified the need for a highly adjustable roof bracket that could be used in residential construction. Input from external stakeholders could not really be obtained because of the privacy issue related to the filing of the Patent application. After the application was filed in October 2005, a few external researchers and safety practitioners were asked to comment on the basic design of the bracket assembly.

PROJECT ID: HCCB7 927006Q - Sensory-Enhanced Balance Control at Elevated Workplaces

END OUTCOMES: none to report at this time

INTERMEDIATE OUTCOMES (IO): none to report at this time

FINAL CUSTOMERS: The final customers for the project results will be the workers involved in work at elevation who are at risk for falls, including workers in the construction industry, service, maintenance, transportation, and firefighters.

INTERMEDIATE OUTPUTS: none to report at this time

INTERMEDIATE CUSTOMERS: Intermediate customers include footwear designers and manufacturers, safety professionals and employers who have to make safety-related decisions, as well as the research community in the field of fall prevention.

TRANSFER ACTIVITIES: From the start of the project the research team established collaboration with the inventors of this new technology from the Center of Biodynamics at Boston University, and the developers of sensory-enhancing devices (based on this technology) at Afferent Corporation. At the end of the study, the research findings will be directly transferred to the researchers and the developers of this innovative technology which may facilitate its further development and application in the occupational field.

OUTPUTS: none to report at this time – the study is still ongoing (not completed)

ACTIVITIES:

This project will evaluate the effectiveness of a novel sensory-enhancing technology to improve workers balance at elevation. NIOSH researchers, in collaboration with researchers-inventors from Boston University, built and tested a prototype of randomly-vibrating (smart) shoe inserts. The “smart” shoe inserts increase the pressure-sensitivity under the feet by inducing undetectable mechanical vibrations. The effect of this new device on workers’ postural stability will be evaluated with motion analysis methods, and in simulated construction environments using a surround-screen virtual reality system. Improvements in workers’ balance control will ultimately result in a reduced number of fall incidents in the elevated workplace.

INPUTS:

The project concept emerged from in-depth analysis of the latest information available in the scientific knowledge base, combined with information generated in preliminary research studies at DSR. Stakeholders input (from the inventors from Boston University and the developers from Afferent Corporation) helped to develop a sensory-enhancing device prototype and define the experimental conditions for the study (see transfer activities). Additional input was also received from leading researchers in the field, who served as external reviewers for the project.

PROJECT ID: HCCB7 9278066 - Footwear for Improved Balance Control in Construction Work

END OUTCOMES: none to report at this time

INTERMEDIATE OUTCOMES (IO):

The study triggered a new NORA-related research project, entitled “Sensory-enhanced balance control at elevated workplaces.” The new project will explore the potential effectiveness of an emerging technology “randomly-vibrating shoe inserts,” to improve workers’ balance at height.

FINAL CUSTOMERS: The final customers for the project results will be the workers involved in work at elevation who are at risk for falls, including workers in the construction industry, service, maintenance, transportation, and firefighters.

INTERMEDIATE OUTPUTS:

The study contributions will be to the advancement of knowledge in the area of balance control, and the role of sensory interfaces, i.e., footwear – an area in which active research is ongoing. Specifically, the study results indicate a good potential for developing practice-centered interventions, i.e., the application of procedures for optimal selection and improved design of footwear for work at elevation.

INTERMEDIATE CUSTOMERS:

Intermediate customers include footwear designers and manufacturers, safety professionals and employers who have to make safety-related decisions, as well as the research community.

TRANSFER ACTIVITIES:

From the start of the project the research team established contacts with a leading work-shoe manufacturer (Iron Age Corp.) and the ANSI Accredited Standards Committee Z41 “Performance Requirements for Protective Occupational Footwear,” to pursue the best possible ways for transfer of the research results (the new knowledge for improved footwear selection and design) after the study is completed. Other collaborators included a recognized footwear-biomechanics research laboratory (University of Massachusetts, Amherst), and world leading footwear testing companies (SATRA, Artech Testing), and manufacturers of shoe-testing equipment (Exeter Research). The research results have been reported at two scientific meetings, attended by many safety professionals from the US and internationally, and have been summarized in a research paper and submitted for publication in a leading peer-reviewed journal.

OUTPUTS:

Simeonov P, Hsiao H , Powers J, Ammons D, Amendola A, Kau T, Cantis D. (2005). Footwear effects on walking balance at elevation. (submitted to the journal *Ergonomics*)

Simeonov P, Hsiao H , Amendola A, Powers J, Ammons D, Kau T, Cantis D. (2005) Evaluation of footwear for improved balance at height using virtual reality technology. Presentation at the *XVIIth World Congress on Safety and Health at Work, Orlando, FL.*

Simeonov P, Hsiao H , Amendola A, Powers J, Ammons D, Kau T, Cantis D. (2005) Footwear effects on workers’ instability in a virtual roof workplace. Abstract, in *Proceedings of the American Industrial Hygiene Conference and Expo 2005*, May 21-26, Anaheim, CA, pp. 49-50.

ACTIVITIES:

This laboratory study used virtual reality technology to evaluate footwear style effects on workers' instability at elevation. Construction workers performed standing and walking tasks with three athletic and three work shoe styles on 10"- and 6"-wide planks on a virtual roof. Trunk and foot kinematics and workers' perceptions were collected. Dependent variables included angular velocity of the trunk and the rear foot, and perceived instability and comfort. The study demonstrated that workers' balance on elevated and narrow surfaces was significantly improved with footwear styles which provide good motion control, and shoes with high upper, i.e., boot style. Overall, the study indicated that proper shoe selection and improvements in the design of specialized work footwear would enhance workers' stability at height, and can be an effective intervention strategy to reduce the risk of falling.

INPUTS:

Falls are the leading cause of work-related death in the US construction industry, which employs 9.6 million workers. Each year, on average 367 construction workers die and 22,000 are seriously injured in falls from elevation. The consequences of fall injuries are extremely severe, and result in substantial medical cost - \$4.4 billion (Liberty Mutual, 2004). Losing balance has been determined as a triggering event for fall incidents in construction. Field observations indicate that in work at heights i.e., roof construction, workers use various footwear types, some of which may be a contributing factor for loss of balance and fall initiation.

The project concept emerged from in-depth analysis of information available in the scientific knowledge base which was combined with information from field observations of roof construction work. Stakeholders input (from footwear industry and footwear testing experts) further helped to define the experimental conditions for the study (see transfer activities).

PROJECT ID: 7085 – Lockout/Tagout, Jammed and Moving Machinery Controls

END OUTCOMES:

None to report.

INTERMEDIATE OUTCOMES (IO):

Findings from this research have been used by the standards committee that completed a revision of ANSI Z245.5 “Baling Equipment Safety”. The latest program information on baler hazards was provided to the committee. The committee is composed of safety experts from baler manufacturers, municipal waste authorities, and waste handling companies.

This project has produced an engineering control for balers referred to as the “JamAlert” System. The project has also entered into a Cooperative Research and Development Agreement (CRADA) with HJA International, a baler controls manufacturer. The CRADA will allow for further development of the “JamAlert” system with the final goal being commercialization of the device.

FINAL CUSTOMERS:

Baler Owners, Baler Manufacturers

INTERMEDIATE OUTPUTS:

None to report.

INTERMEDIATE CUSTOMERS:

Baler Controls Manufacturers

TRANSFER ACTIVITIES:

None to report.

OUTPUTS:

Peered Reviewed Articles:

Mick, T., Means, K., Etherton, J., Powers, J., McKenzie, E.A., “Design Recommendations For Controlling The Jam-Clearing Hazard On Recycling Industry Balers”, In the Proceedings of the 2005 American Society of Mechanical Engineers Congress and Exposition, Orlando, FL, November 5-11, 2005.

ACTIVITIES:

This project developed a new safety system for baling equipment that warns the operator of a jam condition. The “JamAlert” System that was developed, is a microprocessor controlled, captured key, system that is integrated with the baler control system and main power. The system monitors the readings from a strain gauge mounted to the shear bar of the baler. If these readings indicate an unsafe condition (baler jammed) the “JamAlert” system will shut down the baler and warn the operator that a jammed condition exists. The operator must then follow a set procedure to lock out the main power, clear the jam, and then reset the system to allow normal operation to continue. A used baler was purchased to perform testing of the “JamAlert” System.

To test the “JamAlert” System, a used horizontal baler was purchased and setup at our local recycling center. Testing was done utilizing various test blocks of cardboard, newspaper, and magazines. To verify the operation of the strain gauge specifically, tests were conducted at West Virginia University utilizing a shear bar mounted to Baldwin testing machine. Test blocks consisting of cardboard, newspaper, and magazines were used. Identical test blocks were used on the research baler and the results of both tests were compared. These results were presented at the 2005 ASME International Mechanical Engineering Congress and Exposition.

This project was also fortunate to create a partnership with HJA International. HJA International was the successful responder to a Sources Sought announcement in Fed Biz Ops for a “JamAlert” commercialization partner. HJA and NIOSH entered into a Cooperative Research and Development Agreement (CRADA) to continue to modify and refine the “JamAlert” System. The goal of the CRADA is to commercialize the “JamAlert” System so that it can be offered on new balers as well as on existing balers.

INPUTS:

None to report.

PROJECT ID: HCCB7 9278061 - Evaluation of a New Method for Machinery Risk Reduction

END OUTCOMES:

This project will contribute to wider use of machine risk assessment methods throughout US industry. NIOSH needs to maintain focus on this project area to measure the rate of adoption of machine risk assessment in the US. Use of risk assessment will contribute to the self-improvement of machine safety by companies rather than waiting for OSHA leverage to improve safety. Machine-related injury rates should decline as a result. Again NIOSH needs to make it a priority to register machine-related injury. The NIOSH project activities have been communicated to the ANSI B11 Machine Tool Safety Accredited Standards Committee and they are taking NIOSH's results into account as they begin to assimilate the ISO 14121 standard on machine risk assessment for application in the US. The ANSI B11 machine risk assessment standard (to replace the current TR3 guideline) is expected to be completed by 2008.

INTERMEDIATE OUTCOMES (IO):

The sites that participated in the evaluation made changes to their machine systems and experienced the benefit of safer operation.

FINAL CUSTOMERS:

The final customers will be machine systems manufacturers, the management in industries using machine systems and the employees operating the machine systems.

INTERMEDIATE OUTPUTS:

The intermediate outputs are the pilot studies at industrial locations, the “train the trainer” workshops that were given to the program teams and the reconfiguring of the safety systems associated with the machine systems at the pilot sites.

INTERMEDIATE CUSTOMERS:

The intermediate customers were the teams that were trained at the Machine Risk Reduction Workshops in the TR3 methodology (based on “Risk assessment and risk reduction – A guide to estimate, evaluate and reduce risks associated with machine tools”, ANSI B11-TR3, New York, 2000) who directed the changes to be made to machine systems and evaluated the changes that occurred due to those changes.

TRANSFER ACTIVITIES:

As part of the transfer activities two Machine Risk Reduction Workshops were held in 2002 and 2004.

OUTPUTS:

Results of the pilot study will be published in the Risk Analysis Journal (Etherton J, Main B, Cloutier D, and Christensen W, *Industrial Machine Systems Risk Assessment: A Critical Review of Concepts and Methods*, in press, Risk Analysis Journal. and Etherton J, Main B, Cloutier D, and Christensen W, *Reducing Risk on Machinery: A Field Evaluation Pilot Study of Risk Assessment*, being peer reviewed, Risk Analysis Journal).

An article, Machinery Risk Assessment for Risk Reduction was published in *Human and Ecological Risk Assessment* in 2001. A paper entitled, “Related Machinery Controls for Maintenance Risk Reduction” appeared in the Proceedings of American Society of Safety Engineers Professional Development Conference in 2002 and another, “Empowering Effective Teamwork for Machine Risk Reduction in the Workplace” is in the 2003 proceedings of the American Society of Mechanical Engineers, Congress and Exposition. Two presentations on current NIOSH research on machine safeguarding were given to the ANSI B-11 Committee in 1997 and 1998. Another presentation was made to that group in 2001 concerning machinery risk reduction evaluation. “Risk Reduction with Mechanical Guards” was presented at the 2000 American Society of Safety Engineers Annual Meeting. A presentation, “Empowering Effective Teamwork for Machine Risk Reduction in the Workplace” was made at the 2004 American Society of Mechanical Engineers, Congress and Exposition. The presentation, “We Can Live with Risk: The New ANSI Machine Risk Assessment Guidelines”, was presented at the Ohio Safety Congress, and the United Steel Workers/PACE Safety School in 2005. A NIOSH Update: NIOSH, Partners Enter Third Phase of Project to Evaluate ANSI Machine Safety Guideline, was released in 2004. A poster, “A NIOSH Machine Risk Reduction Workshop”, was presented at the NORA Annual Meeting in 2003 and a technical session “New Directions in Machinery Risk Assessment” was organized for the 2000 NIOSH Occupational Injury Research Symposium (NOIRS) in 2000.

ACTIVITIES:

In 1995, a US safety standards consensus subcommittee (TR3) was formed under the auspices of the ANSI B11 Machine Tool Safety Standards Committee. NIOSH provided voting member expertise to this group that also includes labor, machine builder, and machine user experts. The ANSI B11 TR3 “Machine Risk Assessment” guideline became available for application in the US in November 2000. The International Standards Organization decided in 2002 to consider implementing the new US machine risk assessment practice into International standard ISO 14121 “Safety of Machinery: Risk Assessment”. NIOSH was a member of the US experts ISO team that included automotive industry, packaging industry, and general machine risk reduction experts. Other countries on this ISO committee include Great Britain, England, France, Canada, and Denmark. In 2004, the ISO committee, with NIOSH represented, began work on a final draft of the revised standard. Both the ANSI guideline and the ISO standard provide a process that is being followed in workplaces to ensure that safety measures are appropriate to the risks in machine operation and servicing tasks.

NIOSH and diverse business, labor, and insurance industry partners participated in an extensive three-part study to evaluate the effectiveness of an American National Standards Institute (ANSI) voluntary guideline for preventing occupational injuries from industrial machines.

The NIOSH-led study compares operations involving two similar machines within several companies. In one setting, the ANSI TR3 process was adopted. The matched operation continues to follow traditional safety practices.

In the first phase, completed in 2002, NIOSH led a process to train representatives from the participating companies in the understanding of the TR3 process and the computer software used to put the process into place.

In the second phase, completed in 2003, the representatives in turn formed and trained risk-reduction teams in their companies. The teams were composed of engineering, maintenance, and operating personnel. The teams conducted TR3-based risk assessments using the computer software provided by NIOSH, identified protective measures that would reduce risks, and implemented or tried to implement those measures.

In the third phase, the sites that adopted the TR3 assessment process used the protective measures that they identified through the assessment. This phase took one year. Then NIOSH and its partners reassessed occupational injury data and other safety indicators in the workplaces, to determine whether there were any differences between the operations that adopted the TR3 process, and those that followed traditional safety practices (importantly, whether indicators suggest that the TR3 process enhanced workplace safety). The results of the assessments will soon be published and made widely available to employers, employees, safety professionals, and other partners.

INPUTS:

NIOSH had a representative on the ANSI B11-TR3 committee who provided input to the creation of the risk assessment/risk reduction framework. This approach to machine safety formed the basis for the evaluation and will aid in validating the approach. Inputs of support for the project resulted from NIOSH press releases. Public response to the information in the releases added partners to the project.

PROJECT ID: HCCB7 9278818 - Development of Automatic ROPS

END OUTCOMES: None given

INTERMEDIATE OUTCOMES (IO): Project developed a prototype AutoROPS. This supported a new NIOSH project to develop a marketable versions of the AutoROPS (7178D-New ROPS Technology to Increase Use), which has resulted in a partnership with SCAG Power Equipment, a zero turn mower manufacturer, to pursue an AutoROPS design for a zero turn mowers.

FINAL CUSTOMERS: None given

INTERMEDIATE OUTPUTS: None given

INTERMEDIATE CUSTOMERS: None given

TRANSFER ACTIVITIES: None given

OUTPUTS:

Peer Reviewed Articles:

Etherton JR, McKenzie Jr EA, Lutz TJ, Cantis DM, Kau TY. [2004]. An Initial Farmer Evaluation of a NIOSH AutoROPS Prototype. *International Journal of Industrial Ergonomics* 34:155-165

Etherton JR, Cutlip RG, Harris JR, Ronaghi M, Means KH, Howard S. [2002]. Dynamic performance of the mechanism of an automatically deployable ROPS. *Journal of Agricultural Safety and Health* 8(1):113-118.

Etherton JR, Cutlip RG, Harris JR, Ronaghi M, Means KH, Gillispie A. [2002]. Static load test performance of a telescoping structure for an automatically deployable ROPS. *Journal of Agricultural Safety and Health* 8(1):119-126.

Powers JR, Harris JR, Etherton JR, Snyder KA, Ronaghi M, Newbraugh BH. [2001]. Performance of an automatically deploying ROPS on ASAE Tests. *Journal of Agricultural Safety and Health* 7(1):51-61.

Powers JR, Harris JR, Etherton JR, Ronaghi M, Snyder KA, Lutz TJ, Newbraugh BH. [2001]. Preventing tractor rollover fatalities: performance of the NIOSH AutoROPS. *Injury Prevention* 7(Suppl. D):54-58.

Harris JR, Ronaghi M, Snyder KA. [1998]. Analyzing tractor rollovers using finite element modeling. *Analysis Solutions* 2(4):24-25.

Conference Papers

Powers J.R., Harris J.R., Snyder K.A., Ronaghi M., Etherton J.R., Newbraugh B.H.,
APerformance of the NIOSH AutoROPS@, National Occupational Injury Research Symposium
(NOIRS) 2000, Pittsburgh, Pennsylvania, October 17-19, 2000, Abstract, p.12.

Ronaghi M., Harris J.R. , Powers J.R., Snyder K.A., ADynamic Nonlinear Analysis of Tractor
Rollovers@, In the Proceedings of the 9th International ANSYS Conference and Exhibition,
Pittsburgh, Pennsylvania, August 28-30, 2000.

Powers J.R., Harris J.R., Etherton J.R., Snyder K.A., Ronaghi M., Newbraugh B.H.,
APerformance of a New ROPS on ASAE Tests@, In the Proceedings of the 93rd Annual
International Meeting of ASAE, Paper No. 007005, Milwaukee, Wisconsin, July 9-12, 2000.

Harris J.R., Mucino V., Etherton J.R., Snyder K.A., Means K.H., “Computer simulation of
ROPS testing in ASAE S519”, National Occupational Injury Research Symposium (NOIRS)
1997, Morgantown, West Virginia, October 15-17, 1997, Abstract, p.46.

INTERMEDIATE OUTCOMES:

Project developed a prototype AutoROPS. This supported a new NIOSH project to develop a marketable versions of the AutoROPS (7178D-New ROPS Technology to Increase Use), which has resulted in a partnership with SCAG Power Equipment, a zero turn mower manufacturer, to pursue an AutoROPS design for a zero turn mowers.

ACTIVITIES:

A spring-action, telescoping ROPS structure and mechanism have been designed by NIOSH and will be combined with a sensor that detects tractor rollover parameters. The single-post auto-deploying ROPS prototype has been fabricated. The functional components of the single-post of the prototype are being tested in the lab for proof-of-concept for concurrent release, time of deployment, reliable latching, ASAE S519/SAE J2194 static load test satisfaction, and ease of hydraulically resetting the structure after a deployment. During FY99 the laboratory testing of the two-post structure will be completed. The prototype will be field tested where its performance with the overturn sensor will be evaluated. When this device is made available on new tractors, fewer new tractor owners should remove their ROPS and the tractor rollover fatality rate will decrease more rapidly. A review of similar patents was conducted for the patent application on this concept. Further research on the concept is needed to justify a patent. Other project activities have included the acquisition and calibration of a hydraulic testing platform for mechanical test and simulation with full-scale ROPS. A commercially available fixed-post ROPS was tested to ASAE S519 requirements.

INPUTS: None given

PROJECT ID: 8885 – Development of Automatic ROPS Overturn Sensor

END OUTCOMES:

None to report.

INTERMEDIATE OUTCOMES (IO):

Project developed the sensors needed to trigger a prototype AutoROPS. This supported a new NIOSH project to develop a marketable versions of the AutoROPS (7178D-New ROPS Technology to Increase Use), which has resulted in a partnership with SCAG Power Equipment, a zero turn mower manufacturer, to pursue an AutoROPS design for a zero turn mower.

FINAL CUSTOMERS:

Farmers, Tractor Owners

INTERMEDIATE OUTPUTS:

None to report.

INTERMEDIATE CUSTOMERS:

ROPS Manufacturers, Tractor Manufacturers, Mower Manufacturers

TRANSFER ACTIVITIES:

None to report.

OUTPUTS:

Peered Reviewed Articles:

Powers J.R., Harris J.R., Etherton J.R., Snyder K.A., Ronaghi M., Newbraugh B.H., “Performance of an Automatically Deploying ROPS on ASAE Tests”, *Journal of Agricultural Safety and Health*, 2001, 7(1):51-61.

Powers J.R., Harris J.R., Etherton J.R., Ronaghi M., Snyder K.A., Lutz T.J., Newbraugh B.H., “Preventing Tractor Rollover Fatalities: Performance of the NIOSH AutoROPS”, *Injury Prevention*, 2001, 7(Suppl I):i54-58.

Conference Papers

Ronaghi M., Harris J.R. , Powers J.R., Snyder K.A., “Dynamic Nonlinear Analysis of Tractor Rollovers”, In the Proceedings of the 9th International ANSYS Conference and Exhibition, Pittsburgh, Pennsylvania, August 28-30, 2000.

Etherton J.R., Snyder K.A., Ronaghi M., Newbraugh B.H., “Performance of a New ROPS on ASAE Tests”, In the Proceedings of the 93rd Annual International Meeting of ASAE, Paper No. 007005, Milwaukee, Wisconsin, July 9-12, 2000.

ACTIVITIES:

This project, in conjunction with CAN 8818, Development of an Automatically Deployed Roll-Over Protective Structure, developed a prototype ROPS that extends automatically if an overturn, in any direction, is imminent. CAN 8818 developed the roll bar, or ROPS structure. This project developed a sensor that will initiate the extension of the ROPS structure. Under normal operating conditions the roll bar will normally be stored out of the way, but will extend to its full dimensions to protect the operator if an overturn occurs. The sensor will be evaluated through laboratory testing and actual field overturns with an instrumented, unmanned tractor, according to the test sequence prescribed in ASAE Standard S519. An automatically-extending ROPS should reduce the risk of injuries from not raising a manually-raised ROPS and from not using a ROPS in a low clearance situation. A spring-action, telescoping ROPS structure and mechanism have been designed by NIOSH and will be combined with a sensor that detects tractor rollover parameters. The single-post auto-deploying ROPS prototype has been fabricated. The functional components of the single-post of the prototype were tested in the lab for proof-of-concept for concurrent release, time of deployment, reliable latching, ASAE S519/SAE J2194 static load test satisfaction, and ease of hydraulically resetting the structure after a deployment. The field testing demonstrated that the sensor and AutoROPS system could detect an overturn and be deployed in sufficient time to protect the operator. The static testing demonstrated that the structure would pass the current testing criteria for ROPS structures. By the completion of the project, there potential improvements to the design had been identified. When this device is made available on new tractors, fewer new tractor owners should remove their ROPS and the tractor rollover fatality rate will decrease more rapidly. A review of similar patents was conducted for the patent application on this concept.

INPUTS:

None to report.

PROJECT ID: HCCB7 927006T - Commercialization of a Cost-Effective ROPS (CROPS) Design

END OUTCOMES: None given

INTERMEDIATE OUTCOMES (IO):

CROPS designs were developed for the Farmall-M, Farmall-H, Ford-3000, Ford-4000, and Ford-8N. These designs were delivered to FEMCO, Inc. and included all engineering assembly drawings necessary for CROPS fabrication. NIOSH researchers located these tractors in the field or at dealerships to collect relevant tractor dimensions for development of CROPS designs. CROPS prototypes for the Ford-3000 and Ford-4000 successfully passed load testing specified in SAE J2194. FEMCO plans to evaluate performance of the remaining three prototypes.

FINAL CUSTOMERS: None given

INTERMEDIATE OUTPUTS: None given

INTERMEDIATE CUSTOMERS: None given

TRANSFER ACTIVITIES: None given

OUTPUTS:

Harris J.R., McKenzie, Jr., E.A., Etherton J.R., Cantis D.M., “Designing Cost-effective Rollover Protective Structures (CROPS) at NIOSH”, In the Proceedings of the National Institute for Farm Safety (NIFS) Annual Conference, Ponte Vedra, Florida, June 23-27, 2002.

ACTIVITIES:

In previous work, a cost-effective ROPS (CROPS) with no welds was developed. During the current project, NIOSH researchers collaborated with a ROPS manufacturer to develop and test CROPS designs for five common non-ROPS tractor models.

Comprehensive tractor data from both 1993 and 2001 were used to identify the most popular non-ROPS tractors. “Non-ROPS” does not imply that a ROPS was not available for the tractor, but means that the tractor did not have a ROPS installed when surveyed. NIOSH researchers worked with a ROPS manufacturer, FEMCO, Inc., by Letter of Agreement, to identify popular non-ROPS tractors for investigation. The five tractor models chosen for CROPS development either did not have a retrofit ROPS kit available or had a retrofit ROPS kit available that was relatively expensive. The estimated cost for a CROPS was \$290 (shipping and installation not included). The five tractor models selected for this study were the Farmall-M, Farmall-H, Ford-3000, Ford-4000, and Ford-8N. CROPS designs were developed for each of these models, and engineering assembly drawings were delivered to FEMCO, Inc.

CROPS designs were developed for the Farmall-M, Farmall-H, Ford-3000, Ford-4000, and Ford-8N. These designs were delivered to FEMCO, Inc. and included all engineering assembly drawings necessary for CROPS fabrication. NIOSH researchers located these tractors in the field or at dealerships to collect relevant tractor dimensions for development of CROPS designs. Tractor owners and dealers provided important information regarding typical attachments or implements used with the various tractor models. NIOSH researchers incorporated this input in

CROPS designs so that typical tractor function would not be hindered by the CROPS. CROPS prototypes for the Ford-3000 and Ford-4000 successfully passed load testing specified in SAE J2194. FEMCO plans to evaluate performance of the remaining three prototypes. In addition to being cost effective, NIOSH researchers observed that CROPS typically can be installed by one person without special lift-assist equipment.

INPUTS: None given

PROJECT ID: HCCB7 9277178 - New Technology to Increase ROPS Use on Tractors

END OUTCOMES: None given

INTERMEDIATE OUTCOMES (IO):

NIOSH, through a partnership with SCAG Power Equipment, a zero turn mower manufacturer, obtained support for the Office of Technology Transfer and Commercialization (OTTC) to develop an AutoROPS design for a zero turn mower. OTTC is a private, nongovernmental office with the mission of promoting the transition of new technologies to the marketplace. As part of this process, OTTC conducted a marketing study for NIOSH for this technology.

With the help of industry, NIOSH successfully introduced a new American Society of Agricultural and Biological Engineers (ASABE) standard for the NIOSH AutoROPS. The new standard, ASABE-X599, Standardized Deployment Performance of an Automatic Telescoping ROPS for Agricultural Equipment, is in draft form and has undergone its first review. This standard, once issued, will give the manufacturers criteria to build, test, and sell AutoROPS to consumers.

FINAL CUSTOMERS: None given

INTERMEDIATE OUTPUTS: None given

INTERMEDIATE CUSTOMERS: None given

TRANSFER ACTIVITIES: None given

OUTPUTS:

Outputs of the project include:

Exhibit Material:

- NIOSH AutoROPS display booth at the State Fair of Ohio (August 2005), State Fair of Virginia (September 2005) and The International Lawn, Garden & Power Equipment Exposition (October 2005)/

Conference Proceedings:

- McKenzie, Jr., E.A., Etherton, J.R., Harris, J.R., Cantis, D.M and Lutz, T.J [2005] “NIOSH AutoROPS Research to Practice: Zero Turn Commercial Mowers” (IMECE2005-81575) Proceedings of 2005 American Society of Mechanical Engineers, Congress and Exposition, {November 11, 2005}: Orlando, FL
- Lutz, T.J. and McKenzie, Jr., E.A.,[2005] “Remote Control on a Zero-turn Commercial Lawn Mower To Conduct SAE J2194 Rollover Test” Proceedings of the 2005 ASAE AutoROPS .Annual International Meeting (#055004), {July 17-20 2005} Tampa, FL
- Etherton JR, McKenzie, Jr., E.A., Powers JR, [2004]. “Commercializing An Automatically Deployable Rollover Protective Structure (AutoROPS) For A Zero-Turn Riding Mower: Initial Product Safety Assessment Criteria” Proceedings of 2004 American Society of Mechanical Engineers, Congress and Exposition IMECE2004-59570 {November 13-20}: Anaheim, California
- McKenzie, Jr., E.A., Etherton JR, Harris JR, Cantis DM, Lutz TJ [2003]. “NIOSH AutoROPS 3rd Generation Static Testing and Human Interaction Element” Proceedings

Article published, professional:

- Etherton JR, McKenzie, Jr., E.A., Lutz TJ, Cantis DM, Kau TY, [2004]. “An Initial Farmer Evaluation of a NIOSH AutoROPS Prototype”, International Journal of Industrial Ergonomics 34:155-165

ACTIVITIES: This was a safety engineering project that was designed to organize similar technical skills, equipment and instrumentation to work on a common problem: too many tractors do not have Rollover Protective Structures (ROPS). Two aspects of ROPS engineering were considered: 1) industry technology transfer of the structure for an automatically deployable ROPS that could provide passive protection for work that includes low overhead clearances; 2) industry technology transfer of a rollover sensor that initiates deployment of a low profile ROPS. This combination of activities was intended to provide an efficient use of personnel and resources to resolve shortcomings in ROPS engineering that lead to ROPS not being used. Field and laboratory testing of prototype structures developed jointly with industrial partners are important elements of this project.

This project was cancelled in fiscal year 2006. However, during the implementation of the project we were contacted by domestic and foreign stakeholders (approximately 25 contacts) regarding design progress. In addition, one new industry standard was being created with (ASABE) titled X599

INPUTS: None given

PROJECT ID: VAJ882 – Hazard Control Evaluation of Cardboard Paper Baler Safety Device Technology

END OUTCOMES:

None to report.

INTERMEDIATE OUTCOMES (IO):

This project investigated current control systems on cardboard baling equipment. The project also investigated the use of strain gauges mounted to the baler to determine how they were affected by normal baling operations. This work ultimately supported a later NIOSH project to develop a new control system for balers that would make the job of clearing a jam safer.

FINAL CUSTOMERS:

Baler Operators, Recycling Centers, Baler Owners

INTERMEDIATE OUTPUTS:

None to report.

INTERMEDIATE CUSTOMERS:

Baler Manufacturers, Baler Control System Manufacturers

TRANSFER ACTIVITIES:

None to report.

OUTPUTS:

Peered Reviewed Articles:

Etherton J.R., Moore P., Harris J.R., Zeng S., “Safety Factors Relating to Monitored Compactor Operating Parameters”, *Safety Engineering and Risk Analysis*, 1998, Vol. 8: 49-56.

Conference Papers

Etherton J.R., Moore P., Harris J.R., Zeng S., “Factors Limiting the Use of Frame Deflection Monitoring to Predict Material Jams in Baling Equipment”, National Occupational Injury Research Symposium (NOIRS), Morgantown, West Virginia, October 15 – 17, 1997, Abstract, p.60.

ACTIVITIES:

This project investigated the use of strain gauges mounted to an integral horizontal compactor container. Readings were taken once a day under normal compactor operations. The goal of this

part of the project was to observe the effects of gauge site, gauge length, compactor fill, and gauge orientation. The study concluded that readily available strain gauges produced measurable responses to stresses in a normally filled compactor container that did not jam. Changing conditions inside the container resulted in substantial changes in strain responses. The study also found that signal conditioning is a must due to the somewhat noisy signal pattern.

This project also conducted a fault tree safety analysis (FTA) to examine the feasibility of the proposed monitoring method (strain gauges) for safer baler operations. For this analysis, the fault tree was created to determine what the critical steps are to prevent a person from being injured (top level of tree). In the initial analysis (no strain gauges), the jam buildup did not provide adequate visual or audible early warning that would have permitted reduced exposure for safer clearing. However, strain gauges could have provided this early warning. The FTA concluded with several factors that could affect the viability of strain gauge monitoring, including, location of the gauge, drift of the signal, and vibration or degradation of the gauge.

This project ultimately concluded that, until further research is conducted, mechanical blocking of the platen and proper lockout/tagout should remain the primary control of hazardous energy to prevent bailing equipment related fatalities and injuries.

INPUTS:

None to report.

PROJECT ID: Prevention of Vehicle and Mobile Equipment-Related Injury

END OUTCOMES:

INTERMEDIATE OUTCOMES (IO):

FINAL CUSTOMERS:

Contractors, contracting agencies, policy makers, manufacturers, law enforcement, the research community, labor unions, workers

INTERMEDIATE OUTPUTS:

Building Safer Highway Work Zones has been incorporated into new worker training materials and best work practice guides. For example, the National Safety Council (NSC) and the American Road and Transportation Builders' Association (ARTBA) worked with NIOSH to develop an OSHA 10-hour course specifically for the road construction industry. Modules addressing safety when working around construction vehicles and equipment as well as nighttime road construction were incorporated into this training program. The OSHA 10-hour course for roadway construction is provided to member construction companies by both the NSC and the ARTBA. The course is also a core component of the Northeast Regional Safety Academy's road construction safety training program in Montpelier, Vermont.

The Laborers' Health and Safety Fund of North America incorporated the document in its entirety as an Appendix to their 2003 "Highway Work Zone Safety Manual," and information on internal traffic control plans into their new worker orientation training program, "Roadway Safety."

Other ways that organizations use information from *Building Safer Highway Work Zones* include providing risk management recommendations to clients by both the St. Paul and the CNA insurance companies; supporting development of contract language to require disaster cleanup contractors to use high-visibility clothing during cleanup operations by the Federal Emergency Management Agency; developing two safety training videos, "Flagger Safety" and "Work Zone Safety for Construction and Utility Employees" by J.J. Keller & Associates; incorporating injury prevention measures into a best practices guide by the Dallas Area Road Construction Work Zone Task Force; developing a 3½-hour PowerPoint presentation by the Texas Engineering Extension Service and incorporating safety measures and case examples into tool-box safety talks by roadway construction companies.

A June 2000 article in the Engineering News Record noted the pending release of *Building Safer Highway Work Zones*, and included specific recommendations from the too-be-released report on traffic control, internal traffic control, high visibility clothing and the contracting process. The article also noted that "OSHA officials say they are awaiting the NIOSH report with great interest because the agency is launching its own assault." [Krizan 2000. Construction declares war on highway workzone carnage. Engineering News Record, 244 (23): 36-41.]

INTERMEDIATE CUSTOMERS:

Training organizations, safety consultants, labor unions, trade associations, state and federal agencies

TRANSFER ACTIVITIES:

NIOSH distributed the document, *Building Safer Highway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Equipment*, through targeted mailings, conference and exhibition handouts, and downloads from the NIOSH website. The publication went through 4 printings with approximately 15,000 copies distributed. External organizations that helped distribute the document include Occupational Safety and Health Administration offices in Washington, D.C. and Puerto Rico, the Laborer's International Union of North America, the American Road and Transportation Builders' Association, and the Washington State Department of Labor and Industries.

OUTPUTS:

Pratt SG, Fosbroke DE, Marsh SM [2001]. Building safer highway work zones: measures to prevent worker injuries from vehicles and equipment. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-128.

ACTIVITIES:

A workshop was held in December 1998 to gather input on perceived gaps in work zone safety standards and regulations, as well as input on safe work practices in road construction. The workshop was attended by a broad range of over 50 stakeholders in work zone safety including individuals from government, labor, industry, academia, and state departments of transportation. After a plenary session that included background information on the problem, attendees participated in breakout sessions that addressed four topic areas: safety of workers on foot around traffic vehicles; safe operation of construction vehicles and equipment in highway work zones; planning for safe operations within work zones; and special safety issues associated with night work in highway construction. NIOSH developed a white paper on each topic and provided it to attendees before the workshop, so attendees had time to consider work zone safety needs ahead of time. During the workshop breakout sessions, a series of questions was presented to stimulate discussion about preventing occupational injuries in highway work zones.

The general information, experiences, research results, resources, and suggestions for prevention shared during the four sessions were the starting point for the NIOSH publication, *Building Safer Highway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Equipment*, which contains specific measures that contractors, contracting agencies, policy makers, manufacturers, law enforcement, and the research community can use to reduce occupational injuries in highway work zones. This document also includes an Appendix with descriptions of highway construction fatalities investigated through the NIOSH Fatality Assessment and Control Evaluation (FACE) program. Each fatality description includes case-specific prevention recommendations.

INPUTS:

In 1997, NIOSH organized a series of forums for discussion of research needs with construction industry stakeholders and conducted a series of site visits to construction sites to validate concerns identified in the stakeholder meetings. This pilot project was funded by the NIOSH Construction Steering Committee.

One key area of concern for groups with interest in highway construction was prevention of injuries related to vehicles and equipment. NIOSH determined that a significant risk existed for workers in highway and street construction based on numbers of reported fatalities and injuries. NIOSH also determined that a broad effort to involve interested parties would be helpful in developing guidelines addressing work zone safety. The following year, the Jefferson Group approached NIOSH about sponsoring a workshop to address fatalities that were occurring in highway and street construction. NIOSH agreed to convene a workshop focused on prevention of injuries due to motor vehicles and equipment and undertook a comprehensive review of the scientific literature; data from the Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) and Survey of Occupational Injuries and Illnesses; and relevant investigations conducted by the NIOSH FACE program in preparation for this workshop.

PROJECT ID: 9278313 Workplace Violence Initiative: Research and Implementation

END OUTCOMES: During 1993-2002, the number of workplace homicides decreased from 1,074 in 1993 to 609 in 2002. The greatest declines have been in the retail industry. Late-night retail risk factor analysis conducted by NIOSH TI in the 1990s contributed to the decline of homicides in the retail industry. Although progress has been made in reducing workplace violence, the problem is still significant among police and security workers, late night retail workers, health care workers particularly in psychiatric facilities, teachers, and transportation particularly among truck drivers and taxicab drivers.

INTERMEDIATE OUTCOMES (IO): Using the NIOSH research as a basis for many recommendations, in 1998 OSHA published “Recommendations for Workplace Violence Prevention Programs in Late-Night Retail Establishments”. Several states have adopted these recommendations into laws related to prevention of violence against late-night retail staff.

FINAL CUSTOMERS:

Final customers include but are not limited to employers (private industry and government), managers, workers, academics, trade associations, and other organizations.

INTERMEDIATE OUTPUTS:

Throughout the year, many requests for workplace violence materials are directed to NIOSH by employers interested in developing or updating workplace violence prevention programs.

INTERMEDIATE CUSTOMERS:

Intermediate customers include but are not limited to employers (private industry and government), managers, workers, academics, trade associations, and other organizations.

TRANSFER ACTIVITIES:

Workshops and conferences

NIOSH TI sponsored workshop on occupational homicide held in Washington, DC on July 23-24, 1990. A panel of 14 experts from government agencies, academia, private industry, and trade associations participated by discussing limitations of available data, important research issues, areas where further research is needed, and evaluation of known prevention strategies. The discussions were summarized in: *Homicide in the Work place: A Strategy for Prevention and Research*. DHHS (NIOSH) Pub No. 92-103. September 1992.

NIOSH TI sponsored University of Iowa Workshop on Workplace Violence Intervention Research Held in Washington, DC on April 5-7, 2000. A panel of 37 invited participants representing private industry, organized labor, municipal, state, and federal governments, and academia met to examine issues related to all four types of violence in the workplace and to develop recommended research strategies to address this public health problem. A summary of the conference entitled “Workplace Violence: A Report to the Nation” was published by the University of Iowa in February 2001.

NIOSH Workplace Violence Prevention Stakeholder Meetings:

Healthcare industry – May 2003. A diverse group of 38 attendees representing trade associations, federal partners, state agencies, and labor unions participated in discussions concerning strategies for prevention of violence against healthcare workers. Presentations were designed to inform participants about the NIOSH TI and OSHA's efforts in prevention of violence directed towards healthcare workers. After these brief presentations, each person in attendance was given some time to describe their organizations' efforts, successes, and trials in preventing workplace violence directed towards healthcare workers. Attendees were asked to describe ways that NIOSH TI could assist them in preventing workplace violence. A recommendation from this group was that NIOSH TI organize and sponsor a conference designed to share the "best practices" of workplace violence prevention in the healthcare setting.

Domestic Violence in the Workplace – June 2003. A diverse group of 38 attendees representing trade associations, federal partners, state agencies, and labor unions participated in discussions concerning strategies for prevention of domestic violence incidents in the workplace. Presentations were designed to inform participants about the NIOSH TI, CDC, and FBI efforts in prevention of domestic violence in the workplace. After these brief presentations, each person in attendance was given some time to describe their organizations' efforts, successes, and trials in preventing domestic violence in the workplace. Attendees were asked to describe ways that NIOSH TI could assist them in preventing workplace violence. A recommendation from this group was that NIOSH TI organize and sponsor more meetings that address the issue of preventing domestic violence in the workplace.

Retail Industry – August 2003. Seventeen people representing a cross-sector of private industry, trade associations, federal partners interested in preventing retail industry violence participated. Presentations were designed to inform participants about the NIOSH TI and OSHA's efforts in prevention of violence directed towards retail workers. After these brief presentations, each person in attendance was given some time to describe their organizations' efforts, successes, and trials in preventing workplace violence directed towards retail workers. Attendees were asked to describe ways that NIOSH TI could assist them in preventing workplace violence. A recommendation from this group was that NIOSH TI research why the presence of certain risk factors makes an establishment an attractive target to someone intent on committing a crime.

Security/Law Enforcement – November 2003. A diverse group of 25 attendees representing trade associations, federal partners, state agencies, and labor unions participated in discussions concerning strategies for prevention of violence against security and law enforcement officers. Presentations were designed to inform participants about the NIOSH TI and OSHA's efforts in prevention of violence directed towards security workers. After these brief presentations, each person in attendance was given some time to describe their organizations' efforts, successes, and trials in preventing workplace violence directed towards security workers. Attendees were asked to describe ways that NIOSH TI could assist them in preventing workplace violence. A recommendation from this group was that NIOSH TI evaluate using community policing as a method of preventing violence against security personnel.

NIOSH Federal Interagency Task Force on Workplace Violence Research and Prevention (Jan. 2003, Sept. 2003, Apr. 2004 and Nov. 2005). Provides an opportunity for all of the agencies that

are doing work or who have an interest in workplace violence research to share information and identify opportunities for collaborative efforts.

NIOSH TI conference *Partnering in Workplace Violence Prevention: Translating Research to Practice*. Held in Baltimore, MD on November 17-19, 2004. A diverse group of 182 representatives from a cross-sector of private industry, academics, trade associations, and federal partners participated in this conference. The conference summary document entitled “Workplace Violence Prevention Strategies and Needs” will be published as a NIOSH numbered publication in September 2006.

OUTPUTS:

Four papers were published from four studies conducted to evaluate effectiveness of CPTED elements in reducing robbery and evaluating late night robbery and robbery-related injury risk factors. Results of these papers were presented at two national association of criminology meetings. These meetings were attended by criminologists and convenience store crime prevention experts from academia and industry. These papers have been cited 36 times in peer-reviewed publications from other researchers doing WPV research as well as by OSHA in their 1998 recommendations for workplace violence prevention programs in late night retail establishments.

Results of the OSHA guidelines, research from NIOSH TI and many other investigators which have confirmed the effectiveness of CPTED elements in late night retail culminated in the evaluation of a NIOSH TI funded UCLA administered CPTED program in 400 Los Angeles retail establishments realizing a reduction in all violent crimes of over 30% and in robbery over 50% in comparison to non-intervention comparison groups. Because only 45% of LA retail establishments approached volunteered to participate, future NIOSH TI research will focus on ways to develop community programs to increase participation as well as compliance to adoption of CPTED guidelines.

Four papers were published that presented national surveillance data on the number and risk factors for WPV homicides. These papers have been widely quoted in the literature on WPV and were cited in OSHA guidelines. These papers served to focus intramural and extramural NIOSH TI research priorities toward high risk industries and occupations such as late night retail, health care workers, teachers, truck drivers and taxicab workers.

Alerts, guidelines, and educational materials

The 1993 NIOSH TI ALERT was a ground breaking paper – one of the first to highlight the problem in WPV on the national level. Over 85,000 copies of the alert have been disseminated and it has been quoted frequently in journal articles and by OSHA guidelines.

The 1996 NIOSH TI Current Intelligence Bulletin 57 “Violence in the Workplace: Risk Factors and Prevention Strategies” summarized the information know at the time for fatal and nonfatal workplace violence in an effort to focus prevention and research. Just over 83,000 copies of this document have been distributed.

NIOSH TI contributed to the development, technical content, and production of the “Violence on the job” DVD which has had over 22,000 copies distributed since its 2004 release. Anecdotally the DVD is being used widely as a training mechanism for workplace violence prevention.

NIOSH TI developed a poster for use in the convenience store that participated in the NIOSH field study. The poster entitled “Reduce Your Risk for Robbery and Robbery-Related Injury” provides a concise easy to read outline of what to do in the event that the convenience store is being robbed.

ACTIVITIES:

TI researchers in the Division of Safety Research have taken the lead in the analysis of national statistics on workplace homicides such as in publishing reports on workplace homicides from NIOSH’s TI National Traumatic Occupational Fatality database and from the more current BLS Census of Fatalities from Occupational Injuries. TI has evaluated trends in workplace homicides as a check on the effectiveness of prevention efforts.

Because of the lack of non-fatal workplace violence data, TI researchers in the Division of Safety Research developed the following databases during 2002-2006 to address this gap: 1) a special victims survey of workplace risks conducted for TI by the Bureau of Justice Statistics as part of its National Crime Victimization Survey, 2) a telephone interview survey of workers who were treated for work-related assault injuries in a sample of U.S. hospital emergency departments through the Consumer Product Safety Commission’s National Electronic Injury Surveillance System, 3) a survey of employers with regard to workplace violence policies, training, and related issues conducted in collaboration with the Bureau of Labor Statistics during 2005 and 2006. These surveys will provide needed information on numbers of nonfatal WPV injuries and their risk factors, as well as provide input to guide intervention development and evaluation.

One publication has been submitted to the journals on homicide trends from 1993-2002. Three papers are in draft form on each of these surveys and should be ready for publication by December, 2006.

INPUTS:

PROJECT ID: VLE843 Homicide in Convenience Stores: An Evaluation of Prevention Strategies

END OUTCOMES:

NIOSH is currently working with former project director of the UCLA project to evaluate the effectiveness of disseminating UCLA's workplace violence prevention program through a community policing program. NIOSH and partners are developing protocols for future work to evaluate different models to increase compliance of late night retail establishments to NIOSH, OSHA, and industry guidelines.

INTERMEDIATE OUTCOMES (IO):

FINAL CUSTOMERS:

INTERMEDIATE OUTPUTS:

In August 2003, seventeen people representing a cross-sector of private industry, trade associations, federal partners interested in preventing retail industry violence participated. Presentations were designed to inform participants about the NIOSH TI and OSHA efforts in prevention of violence directed towards retail workers. After these brief presentations, each person in attendance was given some time to describe their organizations' efforts, successes, and trials in preventing workplace violence directed towards retail workers. Attendees were asked to describe ways that NIOSH TI could assist them in preventing workplace violence. A recommendation from this group was that NIOSH TI research why the presence of certain risk factors makes an establishment an attractive target to someone intent on committing a crime

INTERMEDIATE CUSTOMERS:

National Association of Convenience stores, retail chains, OSHA, and state departments of justice have benefited from findings of study. Results of NIOSH and other studies culminated in OSHA regulations and partner meetings to determine what needs to be done in the future.

TRANSFER ACTIVITIES:

Results were presented at an APHA conference. Posters to promote guidelines for prevention of robbery in late-night retail were developed and distributed to convenience stores. An industry meeting was held in 2003 to engage the industry about future research needs. UCLA used results of the NIOSH project and other studies and developed a workplace violence prevention program. UCLA disseminated this program to 400 retail establishments in Los Angeles and evaluated compliance to the guide lines.

OUTPUTS:

One paper was published from the study:

A Matched Case Control Study of Convenience Store Robbery Risk Factors. Hendricks, S., Landsittel, DP, Amandus, H, Malcan, J., Bell, J., November 1999. JOEM 41(11): 995-1004.

ACTIVITIES:

This study was causation research of robbery risk factors in convenience stores. A matched case-control study of 400 robbed and 1201 non-robbed control stores in areas in and around Richmond, Norfolk, and Fairfax, Virginia were evaluated for robbery risk factors. Crime reports on convenience store robberies were provided to the project team. Using GIS software, robbed stores were then matched to non-robbed stores within a 2 mile radius. Teams of off-duty police officers were then dispensed to visit case and control stores shortly after robbery and the stores were evaluated for environmental designs, staff training in cash handling and nonresistance, security equipment, proximity of the store to high risk areas and other robbery risk factors.

INPUTS:

This study was an epidemiologic case-control study of robberies in counties in and around Richmond, Fairfax, and Norfolk, Va. The purpose was to determine which environmental designs, engineering controls, organizational policies and practices, and other risk factors were associated with convenience store robbery.

Surveillance data: During the early 90's, workplace homicide was the leading cause of work-related traumatic injury. Additionally, the majority of workplace homicides were among late night retail workers and robbery was the primary cause leading to non-fatal and fatal injuries to workers.

Scientific knowledge base: NIOSH conducted studies during 1991-93 to assess the number and rate of fatal and non-fatal injuries in robbery situations among convenience store workers using police department records in approximately 10 major US cities (REF). Higher rates of robbery-related nonfatal injuries were found than reported in previous studies. During that time, approximately xx studies had been conducted by industry and academic groups to evaluate the effectiveness of robbery preventions, and thus, the effectiveness of elements of robbery prevention programs were questioned. None of these studies were well controlled epidemiologically. Thus, this a well designed case-control study of robbery-related risk factors in Virginia convenience stores was initiated and completed to determine the significant elements of robbery prevention and robbery risk factors.

Stakeholder input: (1) A partnership was formed with the State of Virginia Department of Criminal Justice and Statistical Analysis Center. This partnership grew out of partnerships with state Statistical Analysis Centers in approximately 10 states to support and complete previous robbery research in convenience stores injuries. The Virginia partnership opened doors to access of police department records in counties in and around Richmond, Norfolk, and Fairfax. (2) The research protocol was develop with input from the National Association of Convenience Stores, security experts in C-store crime, and with more than 10 convenience store companies including several national chains.

Legislative mandates: During the 1990's OSHA was being petitioned to consider regulating workplace violence under its General Duty Clause. Several state and local ordinances had appeared. There was considerable interest to validate elements of robbery prevention programs which had become part of industry programs.

Public health framework: advocacy groups in Virginia were suing companies for negligence in lack of robbery preventions in the workplace. The importance of knowing what worked and did not work needed to be confirmed.

PROJECT ID: 9277059 - Young Worker Regional Health Education Center

PROJECT OFFICER: Ray Sinclair

END OUTCOMES: A model for community health interventions

INTERMEDIATE OUTCOMES (IO): An intervention model for young worker issues in communities will be developed and described in the literature.

FINAL CUSTOMERS: Youth

INTERMEDIATE OUTPUTS: Interventions capitalize on lessons learned from previous young worker community health training intervention projects.

INTERMEDIATE CUSTOMERS: NS

TRANSFER ACTIVITIES: Analysis of community health education needs and opportunities will guide community-level efforts to raise the issue of young worker health with a variety of target audiences.

OUTPUTS: A draft document that summarizes projects.

ACTIVITIES: A community health education framework is being used to address the problem of high rates of occupational injuries among young workers.

INPUTS: Current Population Survey estimated that 35% of the nation's 7.5 million 16 and 17-year olds were employed. This figure is thought to be underestimated. High school surveys suggest that about 80% of students are employed at some time during their high school years. Data from the 1990 Census shows that 54% of youths worked in retail trades, 25% in services,

PROJECT ID: 9277269 - Injuries and Illnesses Among Farm Youth in the U.S.

Project Officer: Christy Forrester

END OUTCOMES: To provide guidance on future research in child agriculture. The overall objective of this project is reduce fatal and nonfatal injuries of children and adolescents working in the agricultural environment.

INTERMEDIATE OUTCOMES (IO):

FINAL CUSTOMERS: Practitioners responsible for the reducing or eliminating the hazards faced by children and adolescents in the agricultural environment,

INTERMEDIATE OUTPUTS: Project will provide necessary information to develop/refine intervention and educational programs and projects related to the National Occupational Research Agenda under Special Populations at Risk-Children/Adolescents.

INTERMEDIATE CUSTOMERS:

TRANSFER ACTIVITIES:

OUTPUTS:

ACTIVITIES: Evaluate the scientific basis for North American Guidelines for Children's Agricultural Tasks (NAGCAT) through the identification of empirical evidence which supports or refutes the guidelines. Research recommendations will be formulated in the absence of empirical evidence

INPUTS: Data from the National Center for Health Statistics that shows each year 100,000 children under 20 years of age are injured on farms and over 100 killed. A Bureau of Census Current Population Report suggests that approximately 126,900 individuals under the age of 19 lived on U.S. farms and ranches in 1991.

PROJECT ID: Childhood Agricultural Injury Surveillance (CAN 9278953)

END OUTCOMES:

The Childhood Agricultural Injury Surveillance project is one component of the NIOSH Childhood Agricultural Injury Prevention Initiative begun in 1997. Data generated throughout this project has been used by NIOSH and stakeholders to guide research and prevention efforts, and track progress over time. A major focus of the NIOSH Childhood Agricultural Injury Prevention Initiative and stakeholders has been development and promotion of the North American Guidelines for Childhood Agricultural Tasks (NAGCAT) released in 1999. The primary focus of the NAGCAT is to provide guidance to farm families on how to assign work to farm youth to reduce their risk of injury.

1. During the initiative, the total number of youth injured on farms has decreased from 37,800 in 1998 to 27,600 in 2004. For the same time period, the number of farm work-related youth injuries decreased by 51% from 16,695 down to 8,130 (Table 1). (Source: NIOSH CAIS). Injury rates for household youth show that farm injury risks have decreased in all regions of the U.S. (Figure 1) (Source: NIOSH CAIS).

Table 1. Injuries to youth less than 20 years of age that occurred on U.S farms during 1998, 2001, and 2004, by sex and work status (Source: NIOSH CAIS).

	1998	2001	2004
Injuries [‡]	37,774	29,207	27,590
Male	29,564	16,526	14,390
Female	8,210	12,641	13,201
Work	16,695	9,481	8,130
Non-work	18,169	19,611	19,439

[‡] Total injuries may not add up due to rounding or missing data.

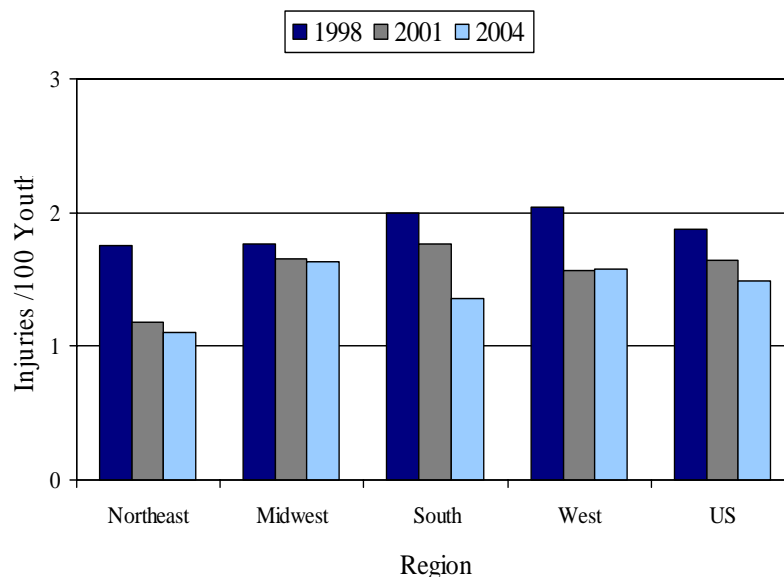


Figure 1. Farm Injuries Per 100 Household Youth by Region, 1998, 2001, and 2004 (Source: NIOSH CAIS).

2. Since the establishment and promotion of the NAGCATs, work-related farm injuries to youth living on farms have decreased from 11,600 injuries in 1998 down to 6,400 in 2004. The work-related injury rate for household youth decreased from 14.1 to 9.1 injuries per 1000 working household youth for the same period (*Figure 2*) (**Source:** NIOSH CAIS).

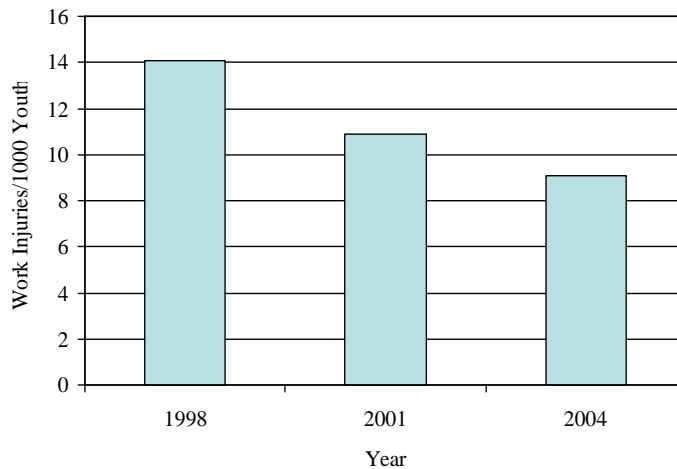


Figure 2. Work Injuries per 1000 Working Farm Household Youth, 1998-2004

3. Males account for 58% of the household youth who work on farms, and have traditionally accounted for most of the work-related youth injuries occurring on farms. Since the introduction of the NAGCATs, farm injuries to young males on farms decreased 50%. A major part of this decrease was seen for work-related farm injuries to males that decreased from 11,800 in 1998 to 5000 in 2004 (**Source:** NIOSH CAIS). The male household youth work-related injury rate decreased from 20.3 to 9.0 injuries per 1000 working household youth during this same time period (*Figure 3*) (**Source:** NIOSH CAIS).

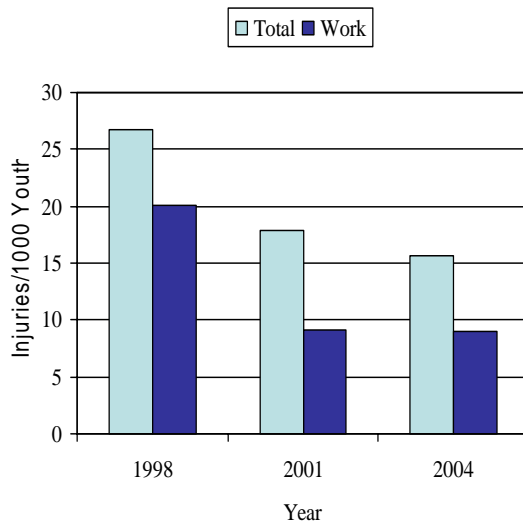


Figure 3. Injuries per 1000 Household Male Youth and Work Injuries per 1000 Working Household Male Youth, 1998-2004

INTERMEDIATE OUTCOMES (IO):

1. The U.S. Department of Labor is currently considering changes to federal child labor laws based on NIOSH recommendations. Data from the 1998 CAIS were used extensively by NIOSH staff in the preparation of recommended changes to the agricultural hazardous orders for the U.S. Department of Labor. The 1998 CAIS provided the most representative and current data on occupational youth farm injuries by covering youth of all ages and farms of all types.
2. One significant finding from the CAIS, Minority-CAIS, and NIOSH death certificate studies has been the importance of non-work injuries and fatalities to youth on farms. These findings led to the development of a new recommendation in the updated 2002 Childhood Agricultural Injury Prevention National Action Plan to address non-work injuries on farms. In response to this new recommendation, the National Children’s Center for Rural and Agricultural Health and Safety (NCCRAHS) produced several documents on the importance and design of safe play areas for children on farms. NCCRAHS also maintains a website dedicated to the topic of safe play areas on farms (see http://www.marshfieldclinic.org/nfmc/pages/default.aspx?page=nfmc_nccrahs_safe_play_welcome).
3. NCCRAHS is just one of the national child safety organizations that use the results from the NIOSH youth farm injury surveillance studies. Other organizations, such as Farm Safety for Just Kids and the National Safe Kids Campaign now use the NIOSH injury and injury rate estimates for children on farms as their official numbers.
4. The estimates of youth farm injuries produced by NIOSH have also been cited in proposed congressional legislation. In July 2005, the Children’s Act for Responsible Employment of 2005 (‘CARE’ Act of 2005, HR 3482) was submitted in the House of Representatives by Representative Roybal-Allard. The CARE Act proposed changes to child labor laws in agriculture, and identified the youth farm injury data collected by NIOSH CAIS as one source of data that would be used to develop an annual report on occupational injuries to youth working on farms in the US. At this time, no action has yet been taken on this proposed bill within Congress.
5. As part of a cost-benefit analysis of proposed changes to Child Labor hazardous orders for youth working on farms, a contractor for USDOL requested data from NIOSH in the spring of 2004. The contractor, SiloSmashers, requested information on estimates of youth less than 20 years old working on farms, estimates of working youth who operated farm tractors on farms, work-related injuries occurring to these youth, and non-work injuries occurring to youth on farms. SiloSmashers concluded that the NIOSH CAIS surveillance data were the only source of these data, and were critical to conducting the cost-benefit analysis requested by USDOL. This work is still in progress.
6. In 1999, Dr. Barbara Marlenga of the National Farm Medicine Center in Marshfield, Wisconsin, approached NIOSH to provide assistance on a research project. Dr. Marlenga’s research required a national sample of farms with household youth 7 to 16 years of age. NIOSH worked with the National Agricultural Statistics Service (NASS), who is a partner in NIOSH childhood agricultural injury surveillance efforts, to identify farms with household youth in this age range and asked if they would be willing to participate in this study as part of the CAIS data

collection effort. Dr. Marlenga was given access to those farm families who agreed to participate. Results of Dr. Marlenga’s study are reported in:

Marlenga BL, Pickett W, Berg RL. [2002]. Evaluation of an enhanced approach to the dissemination of the North American Guidelines for Children's Agricultural Tasks: a randomized controlled trial. *Preventive Medicine* 35:150-159. PubMed ID: [12200100](#)

7. NIOSH has also worked with NASS to provide CAIS data to Dr. Marlenga for two additional research studies. Results from the 1998 CAIS were used by Dr. Marlenga to assess whether guidelines for assigning youth work tasks based on their age would have prevented certain types of farm injuries. Results of this research are reported in:

Marlenga BL, Brison RJ, Berg RL, Zentner JL, Linneman JG, Pickett W. [2004]. Evaluation of the North American Guidelines for Children's Agricultural Tasks using a case series of injuries. *Injury Prevention* 10:350-357. PubMed ID: [15583256](#)

Data from the 1998 CAIS and 2000 Minority-CAIS have also been provided to Dr. Marlenga to assess the potential impact of applying Child Labor hazardous orders for youth working on farms to youth working on their family’s farm. This research is still in progress.

8. A search of the literature has identified a minimum of 22 peer reviewed journal articles that have cited surveillance data from the CAIS.

9. Dr. Barbara Lee, Director of the NCCRAHS, recently published an editorial in the *Journal of Agromedicine* (2005: Vol. 10(4)) entitled ‘NIOSH Fills Void with Surveillance of Injuries to Youth Living on U.S. Farms.’ This editorial commends the work that NIOSH has undertaken in collecting youth farm injury data that was previously unavailable. Additionally, Dr. Lee encourages others to give their support to NIOSH and the continuation of the NIOSH childhood agricultural injury surveillance plan.

10. Based on the 2004 journal article based on an analysis of death certificates (Childhood Agricultural Mortality Surveillance-CAMS), NCCRAHS requested NIOSH to provide additional analyses on suicide cases identified in the CAMS. NCCRAHS is now incorporating the results of these analyses in their suicide prevention programs and presentations (see http://www.marshfieldclinic.org/nfmc/pages/default.aspx?page=nccrahs_presentations).

FINAL CUSTOMERS:

Farm operators
Farm families
Farm resident youth
Hired farm workers

INTERMEDIATE OUTPUTS:

Esser N, Heiberger S, Lee B Eds. [2003]. Creating Safe Play Areas on Farms. Marshfield, WI: Marshfield Clinic.

Hanna C. [2005]. The Clock is Ticking: Rural Adolescent Suicide. http://www.marshfieldclinic.org/ldf/SPRC_presentation.ppt (last accessed September 18, 2006).

Lee B, Gallagher S, Marlenga B, Hard D Eds. [2002]. Childhood Agricultural Injury Prevention: Progress Report and Updated National Action Plan from the 2001 Summit. Marshfield, WI: Marshfield Clinic.

Marlenga BL, Brison RJ, Berg RL, Zentner JL, Linneman JG, Pickett W. [2004]. Evaluation of the North American Guidelines for Children's Agricultural Tasks using a case series of injuries. *Injury Prevention* 10:350-357. PubMed ID: [15583256](#)

Marlenga BL, Pickett W, Berg RL. [2002]. Evaluation of an enhanced approach to the dissemination of the North American Guidelines for Children's Agricultural Tasks: a randomized controlled trial. *Preventive Medicine* 35:150-159. PubMed ID: [12200100](#)

Safe Kids USA. [2005]. Facts About Injuries To Children Who Live In Rural Areas http://www.usa.safekids.org/content_documents/Rural_facts.pdf

INTERMEDIATE CUSTOMERS:

National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS)
Farm Safety for Just Kids
Safe Kids USA
Silo Smashers (contractor for U.S. Department of Labor, Wage and Hour Division)
Agricultural and childhood injury prevention professionals

TRANSFER ACTIVITIES:

Results from the Childhood Agricultural Injury Surveillance project are generally disseminated to our intermediate customers through the mailing of NIOSH numbered documents to a special group of agricultural and childhood injury prevention professionals. Our intermediate customers are also reached through the publication of peer-reviewed journal articles in professional journals, and through the presentation of results at national conferences and symposiums.

We also work with our partners to disseminate the surveillance results directly to farm families and farm operators. Two examples of this approach are:

1. NIOSH has also worked extensively with NASS to disseminate survey results and recommendations for keeping youth safe on farms. NASS has distributed more than 100,000 NIOSH pamphlets to farm operators across the U.S., including pamphlets specifically targeting minority farm operators. These pamphlets summarize common causes of childhood farm injury based on NIOSH surveillance data, and steps that farmers can take to foster safe and healthful farm environments for children.

2. National FFA and Department of Labor representatives from the Federal Interagency Working Group on Preventing Childhood Agricultural Injuries have agreed to help disseminate brochures on findings and recommendations of the latest childhood agriculture injury surveillance.

OUTPUTS:

Data Bases:

NIOSH has established four new surveillance systems as part of the childhood agricultural injury surveillance project:

- Childhood Agricultural Injury Survey (CAIS): data available for 1998, 2001, and 2004.
- Minority Childhood Agricultural Injury Survey (M-CAIS): data available for 2000 and 2003.
- National Agricultural Workers Survey (NAWS) Youth Injury Module: data are available for 1999, 2001-2004.
- Childhood Agricultural Mortality System (CAMS): data are available for the years 1995-2003.

Peer reviewed Journal Articles:

Castillo DN, Adekoya N, Myers JR. [1999]. Fatal work-related injuries in the agricultural production and services sectors among youth in the United States, 1992-1996. *Journal of Agromedicine*, 6(3):27-41.

Goldcamp E, Myers J, Hendricks K, Layne L, Helmkamp J. [2006]. Nonfatal All-Terrain Vehicle-Related Injuries to Youths Living on Farms in the United States, 2001. *Journal of Rural Health* 22(4):309-313. (*In press*).

Goldcamp EM, Hendricks KJ, Myers JR. [2004]. Farm fatalities to youth 1995-2000: a comparison by age groups. *Journal of Safety Research* 35(2):151-157.

Hard DL, Myers JR. 2006. Fatal Work-Related Injuries in the Agriculture Production Sector Among Youth in the United States, 1992-2002. (*In press*).

Hard DL, Myers JR, Gerberich SG. 2002. Traumatic injuries in agriculture. *Journal of Agricultural Safety and Health* 8(1):51-65.

Hard DL, Myers JR, Snyder KA, Casini VJ, Morton LL, Cianfrocco R, Fields J. [1999]. Young workers at risk when working in agricultural production. *American Journal of Industrial Medicine* 36 Supplement 1:31-33. (*cited 13 times per Google Scholar*)

Hendricks KJ, Layne LA, Goldcamp EM, Myers JR. [2005]. Injuries to Youth Living on U.S. Farms in 2001 with Comparison to 1998. *Journal of Agromedicine* 10(4):19-26.

Hendricks KJ, Myers JR, Layne LA, Goldcamp EM. [2005]. Household youth on minority operated farms in the United States, 2000: exposures to and injuries from work, horses, ATVs and tractors. *Journal of Safety Research* 36(2):149-157.

Hendricks KJ, Goldcamp EM, Myers JR. [2004]. On-farm falls among youth less than 20-years old in the U.S. *Journal of Agricultural Safety and Health*, 10(1):27-38.

Hendricks KJ, Adekoya N. [2001]. Non-fatal animal related injuries to youth occurring on farms in the United States, 1998. *Injury Prevention* 7(4):307-311.

Myers JR, Adekoya N. [2001]. Fatal on-farm injuries among youth 16 to 19 years of age: 1982-1994. *Journal of Agricultural Safety and Health*, 7(2):101-112.

NIOSH and USDA Numbered Documents, MMWR Articles:

Adekoya N, Castillo DN, Myers JR. [1998]. Youth agricultural work-related injuries treated in emergency departments--United States, October 1995-September 1997. *MMWR*, 47(35):733-737.

Adekoya N, Pratt SG. [2001]. Fatal unintentional farm injuries among persons less than 20 years of age in the United States: Geographic profiles. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-131.

Myers JR. [1998]. Injuries among farm workers in the United States--1994. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 98-153.

Myers JR. [2001]. Injuries among farm workers in the United States, 1995. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-153.

Myers JR, Hendricks KJ. [2001]. Injuries among youth on farms in the United States, 1998. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-154.

Myers JR, Hendricks KJ, Goldcamp EM, Layne LA. [2005]. Injuries and asthma among youth less than 20 years of age on Minority farm operations in the United States, 2000 Volume I: Racial minority national data. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005-147.

Myers JR, Hendricks KJ, Layne LA, Goldcamp EM. [2005]. Injuries and asthma among youth less than 20 years of age on Minority farm operations in the United States, 2000 Volume II: Hispanic national data. Cincinnati, OH: U.S. Department of Health and Human Services, Public

Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2006-109.

NIOSH. [2004]. Injuries to youth on minority farm operations. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-117.

NIOSH. [2004]. Asthma among household youth on minority farm operations. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-118.

NIOSH. [2004]. Worker Health Chartbook, 2004. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-146 (*Agricultural fatality and non-fatal injury section – pages 195-211*).

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NIOSH. [2004]. Injuries among youth on farms, 2001. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Pub. No. 2004-172.

Parker DL, Wahl GL, Higgins D. [1999]. Childhood work-related agricultural fatalities -- Minnesota, 1994-1997. 1999. MMWR, 48(16):332-335.

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USDA. [1999]. 1998 Childhood agricultural injuries. Washington, DC: US Department of Agriculture, National Agricultural Statistics Service, Sp Cr 8 (10-99).

USDA. [2002]. 2000 Childhood agricultural injuries on minority-operated farms. Washington, DC: US Department of Agriculture, National Agricultural Statistics Service, Sp Cr 9 (02).

USDA. [2004]. 2001 Childhood agricultural-related injuries. Washington, DC: US Department of Agriculture, National Agricultural Statistics Service, Sp Cr 9 (1-04).

Conference Reports and Papers:

Goldcamp EM, Hendricks KJ, Myers JR. [2002]. Farm fatalities to youth 1995-1997: a comparison by age groups. National Institute for Farm Safety 2002 Annual Meeting, June 23-27, 2002, Ponte Vedra Beach, FL. Columbia, MO: National Institute for Farm Safety.

Goldcamp EM, Myers JR, Hendricks KJ, Layne LA. [2003]. Non-fatal injuries: an overview of injuries to youth on racial minority operated farms in the United States, 2000. National Institute for Farm Safety 2003 Annual Meeting, June 22-26, 2003, Windsor, Ontario, Canada. Columbia, MO: National Institute for Farm Safety.

Goldcamp EM, Myers JR, Hendricks KJ, Layne LA. [2004]. Nonfatal all-terrain vehicle injuries to youth on farms in the U.S., 2001. National Institute for Farm Safety 2004 Annual Meeting, June 20-24, 2004, Keystone, CO. Columbia, MO: National Institute for Farm Safety.

Hendricks KJ, Adekoya N. [2001]. Non-fatal animal-related injuries to youth occurring on farms in the United States- 1998. National Institute for Farm Safety Annual Meeting, June 24-27, 2001, Pittsburgh, PA. Columbia, MO: National Institute for Farm Safety.

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Hendricks KJ, Myers JR, Goldcamp EM, Layne LA. [2003]. Farm hazards to household youth on minority operated farms in the United States, 2000: exposures and injuries from work, horses, ATVs and tractors. National Institute for Farm Safety 2003 Annual Meeting, June 22-26, 2003, Windsor, Ontario, Canada. Columbia, MO: National Institute for Farm Safety.

Hendricks KJ, Layne LA, Goldcamp EM, Myers JR. [2004]. Injuries among youth on farms in the United States, 2001. National Institute for Farm Safety 2004 Annual Meeting, June 20-24, 2004, Keystone, CO. Columbia, MO: National Institute for Farm Safety.

Layne LA, Myers JR, Hendricks KJ, Goldcamp EM. [2003]. Demographics and non-fatal injury patterns of youth less than 20 years of age on Hispanic operated farms in the United States, 2000. National Institute for Farm Safety 2003 Annual Meeting, June 22-26, 2003, Windsor, Ontario, Canada. Columbia, MO: National Institute for Farm Safety.

Layne LA. [2006]. Youth Living on Hispanic Operated Farms in the United States: An Examination of Population Growth and Changes in Risk Exposure and Injury Patterns between 2000 and 2003.” National Institute for Farm Safety 2006 Annual Meeting, June 25-29, 2006, Sheboygan, Wisconsin. Columbia, MO: National Institute for Farm Safety.

Presentations:

Adekoya N, Myers JR. [1999]. Farm and work injuries among youth 16-19 years of age, 1982-1994. Thirteenth Annual Childhood Injury Prevention Conference, October 25-27, 1999, San Diego, California.

Hard DL. [2003]. Agricultural Injury Surveillance Conducted by NIOSH. Presented at the 5th International Symposium: Future of Rural People – Rural Economy Health People, Environment, and Rural Communities, October 19-22, 2003, Saskatoon, Saskatchewan, Canada.

Hendricks KJ, Myers JR, Adekoya N. [2000]. Non-fatal childhood agricultural injuries in the U.S.–1998. Agricultural Safety and Health in a New Century, April 28-30, 2000, Cooperstown, New York.

Myers JR, Hendricks K. [2000]. NIOSH approach to childhood agricultural injury surveillance. Agricultural Safety and Health in a New Century, April 28-30, 2000, Cooperstown, New York.

Myers JR, Hendricks K. [2000]. NIOSH approach to childhood agricultural injury surveillance. Presented at the National Occupational Injury Research Symposium (NOIRS), Pittsburgh, PA, October 17-19, 2000.

Myers JR, Adekoya N. [2000]. Fatal on-farm Injuries to Youth 16 to 19 years of age: 1982-1994 (poster). National Institute for Farm Safety 2000 Conference, June 25-29, 2000, Dubuque, Iowa.

Myers JR. [2001]. Building Partnerships to Improve Rural Safety and Health. CSTE/APHL Annual Conference, Portland, OR, June 10-14, 2001.

ACTIVITIES:

The purpose of this project, funded through NIOSH's child agriculture injury prevention initiative, is to conduct surveillance of childhood agricultural injuries. NIOSH, in collaboration with the National Agricultural Statistics Service (NASS), is collecting childhood agricultural injury data through farm operator surveys that have a minority-specific component. Information gathered through personal interviews of farm workers in the US Department of Labor's National Agricultural Workers Survey provides additional surveillance data. NIOSH also conducts periodic analyses of the Consumer Products Safety Commission's National Electronic Injury Surveillance System, the National Center for Health Statistics' Vital Statistics Mortality data, death certificates from state vital statistics registrars, and the Bureau of Labor Statistics' Census of Fatal Occupational Injuries. This project provides important information for prioritizing research and intervention programs to reduce childhood agricultural injuries in the future.

INPUTS:

1. In Fiscal Year 1997, Congress appropriated NIOSH \$5 million annually to implement the 1996 National Committee for Childhood Agricultural Injury Prevention (NCCAIP) national action for preventing childhood farm injuries: *NCCAIP. [1996]. Children and Agriculture: Opportunities for Safety and Health. A National Action Plan. Marshfield, WI: National Farm Medicine Center.*
2. NIOSH held a public meeting on February 5, 1997, in Washington, DC, to allow stakeholders the opportunity to provide their opinions on the NIOSH plan for implementing the Childhood Agricultural Injury Prevention Initiative. This meeting was attended by 23 individuals representing farm families, a farmworker organization, an insurance agency, an equipment manufacturer, safety advocates and educators, researchers, and key federal agencies, and allowed

NIOSH to obtain diverse perspectives on the draft plan. Many of the comments received at this meeting dealt with the NIOSH plan for establishing a national surveillance program for childhood agricultural injuries. NIOSH received support that surveillance be an internal NIOSH activity, but recommended that NIOSH conduct a peer review of its surveillance plan before proceeding with its surveillance activities. Specifically, the meeting participants wanted to ensure that NIOSH conducted surveillance that would cover as many youth populations as possible, including young migrant and seasonal farm workers, and youth visiting farms in the U.S.

3. In response to comments from the February, 1997 public meeting, NIOSH held a separate peer review meeting to obtain additional input into its surveillance options. This meeting was held in Crystal City, Virginia, in October of 1997. Comments were received from: Dr. Paul Gunderson, National Farm Medicine Center; Dr. Susan Gerberich, University of Minnesota; Dr. Michael Schulman, North Carolina State University; and, Dr. Robert McKnight, University of Kentucky. Written comments were also provided by Dr. Lorann Stallones, Colorado State University, Dr. Frederick Rivara, University of Washington, and Dr. Dennis Murphy, Pennsylvania State University. Representatives were also present from the U.S. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS), and the U.S. Consumer Products Safety Commission (CPSC). These agencies were invited to the meeting because they were potential partners in any surveillance approach pursued by NIOSH.

4. In 2001, the NCCRAHS held a second national conference to assess the progress and priorities of the national childhood agricultural injury prevention action plan. Funding for the conference was provided by NIOSH with funds initiated by Senator Herb Kohl (D-WI). NIOSH staff worked with NCCRAHS in planning the conference, and participated on various special emphasis panels. Results of this conference were released in 2002: *Lee B, Gallagher S, Marlenga B, Hard D Eds. [2002]. Childhood Agricultural Injury Prevention: Progress Report and Updated National Action Plan from the 2001 Summit. Marshfield, WI: Marshfield Clinic.*

PROJECT ID: 9278954, Child Agriculture Injury Prevention

END OUTCOMES: The problem of children being injured while living, working, or visiting agricultural work environments (primarily farms), had been recognized for several decades. Youth deaths on farms during the 1980's averaged over 100 per year (*Figure 1*), while non-fatal injuries during this same time period were estimated to be as high as 100,000 farm youth per year. Although many individuals and groups crusaded for the prevention of childhood agricultural injuries over the years, there was not a national, coordinated effort. This changed in 1991, when the Surgeon General's Conference on Agricultural Safety and Health was held in Des Moines, Iowa. A session at this conference entitled *Intervention: Safe Behaviors Among Adults and Children* highlighted the risks faced by people, both young and adult, involved with production agriculture. The Surgeon General's conference led to a series of other national meetings specifically addressing agricultural youth injuries and diseases, culminating in the document "Children and Agriculture: Opportunities for Safety and Health, A National Action Plan". This document resulted in Congress appropriating funds to NIOSH in 1997 to establish the Childhood Agricultural Injury Prevention Initiative.

Over the course of the project, CAN 9278954 - Child Agriculture Injury Prevention, both the number of youth agricultural fatalities and the number of nonfatal injuries per 100 youth has shown a general decline (*Figure 2*, *Figure 3*). While it is impossible to attribute this downward decline solely to the project, it is believed the NIOSH Childhood Agricultural Injury Prevention Initiative, of which this project is a component, has had some influence on these statistics. The nonfatal injury data is available because of CAN 9278952 – Childhood Agricultural Injury Surveillance, another project in the NIOSH Childhood Agricultural Injury Prevention Initiative. This is the only national surveillance system tracking on-farm youth nonfatal injuries.

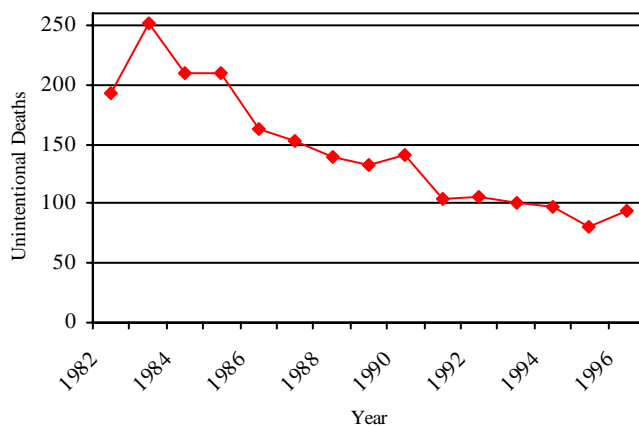


Figure 1. Unintentional farm deaths to youth less than 20 years of age, 1982-1996 (Source: National Center for Health Statistics, National Vital Statistics System).

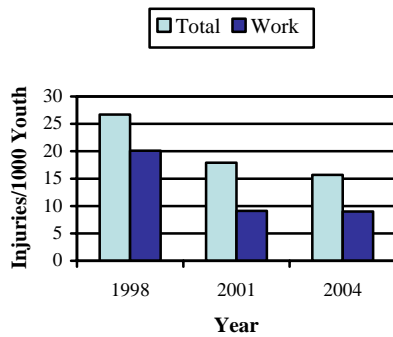


Figure 2. Injuries per 1000 Household Male Youth and Work Injuries per 1000 Working Household Male

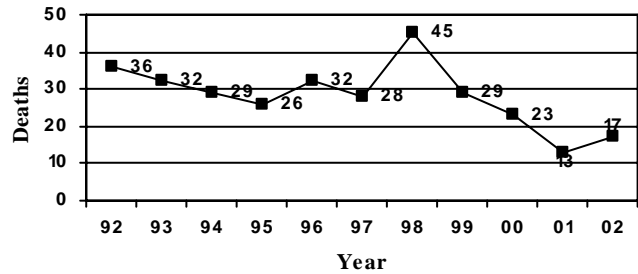


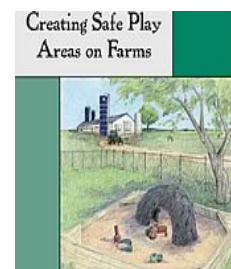
Figure 3. Frequency of Fatalities in Agriculture Production for Workers <20 Years of Age in the US, 1992-2002 from BLS CFOI

INTERMEDIATE OUTCOMES (IO):

Interactions With and Successes of Our Extramural Partners:

NIOSH has been working with our extramural partners from the beginning of the childhood agricultural injury prevention movement in the early 1990's. Intermediate outcomes from these relationships include:

1. Dr. Hard was an invited member of the Agricultural Engineering/Structural/Environmental working group perspective of the 1992 Childhood Agricultural Injury Prevention Symposium held April 1-3, in Marshfield, Wisconsin. As such, he had input into identifying major issues regarding childhood agricultural injury and proposed recommendations within this subject matter area. This helped develop working relationships with agricultural equipment manufacturer representatives and professional society representatives. Some of the same or similar issues were addressed in the National Action Plan, which was to come later.
2. NIOSH was represented by Dr. Hard as an active participant in the expert panel that developed the 62 North American Guidelines for Children's Agricultural Tasks (NAGCATs) by the NCCRAHS.
3. NIOSH sponsored research has shown that the NAGCATs can be an effective means of reducing injuries to youth on farms. This controlled study found that farm parents who used the NAGCATs reported a 50% reduction in youth farm injuries compared to youth in control farm families.
4. The NCCRAHS published *Creating Safe Play Areas on Farms* in 2003 to provide safety professionals and community leaders guidance on addressing this emerging issue. This document has significantly increased the attention to the development of safe, structured, supervised play areas for children on farms, and has prompted many Safety Day Camps for farm youth to offer parent-oriented programs to promote fenced, supervised play areas for children on farms.



5. NIOSH was represented by Dr. Hard on the National Committee for Childhood Agriculture Injury Prevention (NCCAIP). This committee developed the document *Children and Agriculture: Opportunities for Safety and Health: A National Action Plan* which was instrumental in obtaining Congressional funding for the NIOSH Childhood Agricultural Injury Prevention Initiative.

6. On September 22, 1999, NIOSH conducted a midcourse review of the Childhood Agricultural Injury Prevention Initiative. A Federal Register Announcement [Federal Register: July 7, 1999 (Volume 64, Number 129), Notices, Page 36693] was made informing the public of this event. Thirty-eight individual comments were received or made at the in-person meeting held in Washington, DC. These individuals represented a wide range of stakeholders, ranging from agricultural center directors, insurance companies, medical doctors, national organizations, and individual researchers. In general, no one disagreed with the course NIOSH had taken with the Childhood Agricultural Injury Prevention Initiative and all believed funding should be continued. This model was similar to the one used by the National Children's Center for Rural and Agricultural Safety and Health for their 2001 Summit review of the childhood agricultural initiative.

FINAL CUSTOMERS: Farm parents and agricultural safety and health professionals who work with farm parents and/or youth.

INTERMEDIATE OUTPUTS:

Dr. Barbara Lee, Director of the NCCRAHS, recently published an editorial in the *Journal of Agromedicine* (2005: Vol. 10(4)) entitled 'NIOSH Fills Void with Surveillance of Injuries to Youth Living on U.S. Farms.' This editorial commends the work that NIOSH has undertaken in their leadership role in the Childhood Agricultural Injury Prevention Initiative. Additionally, Dr. Lee encourages others to give their support to NIOSH and the continuation of the NIOSH childhood agricultural injury surveillance plan.

In 1995, the National Farm Medicine Center sponsored the Child and Adolescent Rural Injury Control Conference. The outcome of this conference was the establishment of the National Committee for Childhood Agricultural Injury Prevention (NCCAIP), which represented a core group of 42 individuals representing various national organizations as well as recognized authorities in the area of childhood agricultural injury or disease prevention. The chair of this committee was Dr. Barbara Lee, National Farm Medicine Center. Over a 16-month period, members of the committee finalized a national action plan to address childhood injuries on farms. NIOSH was represented by two scientists on NCCAIP: Dr. David Hard and Ms. Teri Palermo. Dr. Hard was the chair of the NCCAIP *Research* work group and as such had input into the development and the responsibility of generating the research recommendations for the final report. Ms. Palermo was an active member within the Empowerment working group. The final NCCAIP document was released in the spring 1996 and was entitled *Children and Agriculture: Opportunities for Safety and Health: A National action Plan*. NCCAIP. [1996]. *Children and Agriculture: Opportunities for Safety and Health. A National Action Plan*. Marshfield, WI: National Farm Medicine Center. As chair of the Research work group of the NCCAIP, Dr. Hard had input into the development of the recommendations and had the responsibility of generating the research recommendations for the NAP. The major areas identified in the report were leadership, surveillance, research, education, and public policy. In addition, the plan specifically

recommended that NIOSH serve as the lead federal agency in preventing childhood agricultural injury. As a result of this report, Congress appropriated NIOSH \$5 million in Fiscal Year 1997 to implement the NCCAIP plan, resulting in the NIOSH Childhood Agricultural Injury Prevention Initiative.

In 2001, a five year review was held of the activities of the NIOSH Child Ag Injruy Prevention Initiative by extramural partner, NCCRAHS. Lee, B., Gallagher, S., Marlenga, B., Hard, D Eds. [2002]. *Childhood Agricultural Injury Prevention: Progress Report and Updated National Action Plan from the 2001 Summit*. Marshfield, WI: Marshfield Clinic. *NIOSH was heavily involved in this summit meeting, due to the request of the summit organizers and because it was a cooperative agreement. In recognition of his input and involvement, Dr. Hard was invited to be an author of the final summit report.*

A major activity undertaken by NCCRAHS has been the development of the North America Guidelines for Children’s Agricultural Tasks (NAGCAT). The NAGCATs, which are a set of guidelines to assist parents in assigning farm jobs to their children 7 to 16 years of age, were developed in response to farm parent requests for such a resource. NAGCATs allow children and adolescents to gain meaningful work experience with minimal risk of agricultural-related injury. These recommendations were developed using a consensus approach using a panel of agricultural safety and health and child development experts. NIOSH was represented on this expert panel by Dr. David Hard. NAGCAT have been widely cited by both the professional and public press, and has been found to be effective in reducing youth farm injuries in one controlled study.

A major focus of the NIOSH Childhood Agricultural Injury Prevention Initiative has been working with the NCCRAHS on the development and promotion of the North American Guidelines for Childhood Agricultural Tasks (NAGCAT) released in 1999. The primary focus of the NAGCAT is to provide guidance to farm families on how to assign work to farm youth to reduce their risk of injury. The NAGCAT have been widely reported in the popular farm press, and have been shown to be effective in reducing injuries to household youth in one controlled study. Since the establishment and promotion of the NAGCATS, work-related farm injuries to youth living on the farms have decreased from 11,600 injuries in 1998 down to 6,400 in 2004. The work-related injury rate for household youth decreased from 14.1 to 9.1 injuries per 1000 working household youth for the same period (**Source:** NIOSH CAIS).

In fall of 1998, NIOSH, in conjunction with Purdue University, sponsored a workshop entitled “The Childhood Agricultural Injury Prevention Strategy Workshop: A Private Sector Perspective.” The purpose of the workshop was to obtain input from the private sector on ways they could become active partners in the Childhood Agricultural Injury Prevention Initiative, a stated goal of the NCCAIP action plan. NIOSH contacted more than 250 groups representing the following industrial areas: agricultural chemical manufacturers, agricultural cooperatives, insurance companies, private consultants and legal professionals, farm media, safety equipment manufacturers, feed and grain suppliers, utilities, commodity groups, farm structure providers, suppliers of farm services, medical professionals and lending institutions. As a result of these contacts, forty-three individuals attended and participated in the workshop.

Workshop participants identified corporate image, name recognition, media attention, and increased leverage in future litigation as important justification for involvement in injury

prevention programs. Reasons for supporting specific activities included consistency with corporate mission, enhanced public relations, and the potential for successful outcomes. However, budget constraints and a perceived lack of benefits to the organization were identified as primary reasons why requests for support by organizations such as NCCAIP were rejected. Other Internal barriers for organizational support of injury prevention programs were the potential for creating a liability risk, and the lack of support from management. Finally, workshop participants indicated the private sector should be recognized and acknowledged by planners of agricultural childhood injury prevention efforts. Participants felt the private sector commitment to injury prevention was a reflection of concern for families that use their products and services. Participants believed the problem was a community problem which requires a broad-based collaborative effort involving all stakeholders and that additional regulations were not needed. Purdue University produced a final report summarizing the workshop which has been made available through the National Technical Information Service.

In addition to this workshop, NIOSH has organized several special sessions on the topic of childhood agricultural injuries at various conferences. Five such conferences were:

- Fourth International Symposium: Rural Health and Safety in a Changing World, October 18-22, 1998, Saskatoon, Saskatchewan, Canada.
- Agricultural Safety and Health in a New Century, April 28-30, 2000, Cooperstown, New York.
- National Occupational Injury Research Symposium, October 17-19, 2000, Pittsburgh, Pennsylvania.
- National Institute for Farm Safety 2001 Annual Meeting, June 24-27, 2001, Pittsburgh, Pennsylvania.
- National Occupational Injury Research Symposium, October 28-29, 2003, Pittsburgh, Pennsylvania.
- National Injury Prevention and Control Conference, May 9-11, 2005, Denver, Colorado.

INTERMEDIATE CUSTOMERS:

TRANSFER ACTIVITIES: NIOSH established a website (<http://www.cdc.gov/niosh/childag/>) dedicated to providing current information regarding the NIOSH Childhood Agricultural Injury Prevention Initiative. The National Children's Center for Rural and Agricultural Safety and Health also established a website for providing current information on farm youth injury statistics (utilizing NIOSH survey information), injury prevention information and translating research findings into useable information for lay people.

OUTPUTS:

Conferences sponsored:

Special Session: Intervention--Safe Behaviors Among Adults and Children, Surgeon General's Conference on Agricultural Safety and Health, April 1991 Des Moines, IA.

The Childhood Agricultural Injury Prevention Strategy Workshop: A Private Sector Perspective, November 90-11, 1997, Indianapolis, IN.

Special Session: Childhood Agricultural Injuries, Fourth International Symposium: Rural Health and Safety in a Changing World, October 18-22, 1998, Saskatoon, Saskatchewan, Canada.

Special Session: Childhood Agricultural Injuries, Agricultural Safety and Health in a New Century, April 28-30, 2000, Cooperstown, NY.

Special Session: Childhood Agricultural Injury Prevention, National Occupational Injury Research Symposium, October 17, 2000, Pittsburgh, PA.

Special Session: Childhood Agricultural Injuries, National Institute for Farm Safety 2001 Annual Meeting, June 24-27, 2001, Pittsburgh, PA.

2001 Summit on Childhood Agricultural Injury Prevention, April 30-May 1, 2001, Brooklyn Park, MN.

Special Session: Childhood Agricultural Injury Prevention, National Occupational Injury Research Symposium, October 28-29, 2003, Pittsburgh, PA.

Special Session: Agricultural Injuries, National Injury Prevention and Control Conference, May 9-11, 2005, Denver, Colorado.

Peer reviewed Journal Articles:

Hard DL, Myers JR. 2006. Fatal Work-Related Injuries in the Agriculture Production Sector Among Youth in the United States, 1992-2002. Accepted by the Journal of Agromedicine, 6-29-06.

Hard DL, Myers JR, Gerberich SG. 2002. Traumatic injuries in agriculture. Journal of Agricultural Safety and Health 8(1):51-65.

Hard DL, Myers JR, Snyder KA, Casini VJ, Morton LL, Cianfrocco R, Fields J. [1999]. Young workers at risk when working in agricultural production. American Journal of Industrial Medicine 36 Supplement 1:31-33. (*cited 13 times per Google Scholar*)

Castillo D, Hard D, Myers J, Pizatella T, Stout N. [1998]. A national childhood agricultural injury prevention initiative. Journal of Agricultural Safety and Health Special Issue 1:183-191.

Landsittel D, Murphy DJ, Kiernan NE, Hard DL, Kassab, C. 2001. An evaluation of the effectiveness of educational interventions in the Pennsylvania Central Region farm safety pilot project. American Journal of Industrial Medicine, 40(2):145-152.

Landsittel D, Hard DL, Murphy DJ, Kiernan NE. [1998]. The Pennsylvania Central Region Farm Safety Pilot project: Part II--Baseline data associations between approach-to-safety and hazard conditions. Journal of Agricultural Safety and Health Special Issue 1: 21-28.

Murphy DJ, Kiernan NE, Hard DL, Landsittel D. [1998]. The Pennsylvania Central Region farm safety pilot project: Part I--Rationale and baseline results. Journal of Agricultural Safety and Health 4(1):25-41.

NIOSH Numbered Documents:

Mason RW, ed.: Report to Congress on workers' home contamination study conducted under the Workers' Family Protection Act [281 pages]. NIOSH, US Dept Health & Human Services, Cincinnati, OH. September, 1995. *(cited 17 times per Google Scholar)* Dr. Hard developed a section devoted to caustic farm products. Farms were also highlighted (dealing with caustic substances ingested by children and pesticide exposures) along with sections on caustic farm products and pesticides.

Myers ML, Herrick RF, Olenchock SA, Myers JR, Parker JE, Hard DL, Wilson K (editors). [1992]. Papers and Proceedings of the Surgeon General's Conference on Agricultural Safety and Health. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Pub. No. 92-105. *(cited 20 times per Google Scholar)*

Fatal work-related injuries in the agriculture production sector among youth in the United States, 1992-2002. Hard-DL; Myers-JR Proceedings of the National Institute for Farm Safety (NIFS) Annual Conference, June 26-30, 2005, Wintergreen, Virginia. Technical Paper No. 05-07, Columbus, OH: National Institute for Farm Safety, 2005 Jun. (NIOSH TIC Number: 1-1220028967)

Conference Reports and Papers:

Hard DL. [2000 & 2003]. Special Session Moderator–Childhood Agricultural Injury Prevention. National Occupational Injury Research Symposium, October 17, 2000, Pittsburgh, PA.

Lee, B., Gallagher, S., Marlenga, B., Hard, D Eds. [2002]. Childhood Agricultural Injury Prevention: Progress Report and Updated National Action Plan from the 2001 Summit. Marshfield, WI: Marshfield Clinic. *NIOSH was heavily involved in this summit meeting, due to the request of the summit organizers and because it was a cooperative agreement. In recognition of his input and involvement, Dr. Hard was invited to be an author of the final summit report.*

[Childhood Agricultural Injury Prevention Strategy Workshop: A Private Sector Perspective. Final Report: A Summary of Strategies and Successes.](#) NTIS Order # PB99147597; Year : 1999.

NCCAIP. [1996]. Children and Agriculture: Opportunities for Safety and Health. A National Action Plan. Marshfield, WI: National Farm Medicine Center. *As chair of the Research work group of the NCCAIP, Dr. Hard had input into the development of the recommendations and had the responsibility of generating the research recommendations for the NAP.*

Presentations:

Hard DL. [2003]. Agricultural Injury Surveillance Conducted by NIOSH. Presented at the 5th International Symposium: Future of Rural People – Rural Economy Health People, Environment, and Rural Communities, October 19-22, 2003, Saskatoon, Saskatchewan, Canada.

Hard DL [2003]. The NIOSH childhood agricultural injury prevention initiative. National Occupational Injury Research Symposium, October 28-29, 2003, Pittsburgh, PA.

Hard D, Castillo D, Myers J, Pizatella T, Olenchock S. [2000]. Overview of the NIOSH childhood agriculture injury prevention initiative. National Occupational Injury Research Symposium, October 17-19, 2000, Pittsburgh, PA.

Hard DL, Layne LA. [1995]. A National Sample of Nonfatal Occupational Injuries Incurred by Youth Presenting to Hospital Emergency Departments: Agriculture Compared to Other Industries. Poster presentation at the Child and Adolescent Rural Injury Control Conference, March 8-9, 1995, Marshfield, WI.

ACTIVITIES:

Project Description:

The Childhood Agricultural Injury Prevention Initiative uses a triad approach of: surveillance, research and information dissemination. This project is designed to encompass non-surveillance components of the NIOSH Childhood Agricultural Injury Prevention Initiative. Activities within this project include: (1) assuming a leadership role in federal efforts to prevent childhood agricultural injuries; (2) assisting in the development of a grant/cooperative agreement program to stimulate research and the use of empirical data to reduce agricultural injuries to children; (3) eliciting feedback from stakeholders on progress of the Initiative and strategies or ideas for improving research and prevention efforts; (4) providing technical and programmatic assistance to the National Children's Center for Rural and Agricultural Health and Safety; and (5) serving as a liaison for NIOSH research activities in order to achieve wide dissemination of research results to childhood agricultural safety and health practitioners.

The leadership role in federal efforts to prevent childhood agricultural injuries is evidenced by NIOSH convening a Federal Interagency Working Group on Preventing Childhood Agricultural Injuries, consisting of 11 agencies or other government organizations with an interest in this area. The Federal Interagency Working Group serves as a mechanism for sharing information and facilitating collaborative efforts in the area of childhood agricultural injury prevention among federal agencies. By convening representatives of federal agencies with knowledge and interest in childhood agricultural safety and health, the Working Group will provide focus and emphasis to the childhood agricultural injury problem.

The research component is primarily R01 extramural grants. NIOSH has funded 31 extramural research projects to-date under the initiative, encompassing a range of areas identified as priorities by external constituents and partners. These research areas include: etiology, outcomes, intervention strategies, and rigorous evaluations of commonly available educational/training programs; evaluate the effectiveness of commonly used educational materials/training; understanding the magnitude and scope of childhood agricultural injuries and illnesses; evaluation of the effectiveness of currently used community-based interventions; develop and evaluate new or existing enhanced control technologies; develop and evaluate incentives which encourage adults to protect youth from farm hazards.

Funding/support for a National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS) is designed to help translate research into commonly understood concepts or terms

for lay users and practitioners and provide the latest up-to-date information on childhood agricultural injury prevention to stakeholders. Examples of this are the posting of the latest

NIOSH/USDA surveillance information on the NCCRAHS website, promulgating promising research findings and putting research findings into plain and easy to understand language for practitioners and farm families. This has resulted in the North American Guidelines for Children's Agricultural Tasks (NAGCAT) being developed (a developmental-based guide for work tasks for youth), an action plan for addressing Migrant and Seasonal Adolescent Farmworkers, Creating Safe Play Areas on Farms (to address the majority of youth who are injured on farms that are not working), and the promotion of promising research interventions for agricultural youth injury prevention. This project is best conducted as a coordination project because of the variety of issues that are to be addressed in recommendations from the 2001 Childhood Agricultural Injury Prevention Summit and the 1996 National Action Plan along with the large number of internal and external partners that are required to address these recommendations.

The ultimate goal of the project is to facilitate and enhance federal efforts to reduce childhood agricultural injuries.

NIOSH Funded RO1 Childhood Agricultural Injury Prevention Grants between 1997 and 2004.

RO1 Childhood Agricultural Injury Prevention Grant Title	PI
Occupational Injury in Hispanic Farmworker Families	McCurdy, Stephen
Community-based Health & Safety Interventions for Adolescents Working in	Lee, Barbara
Risk Factors for Injury among Migrant and Seasonal Farmworker Children	Amandus, Harlan
Youth Teaching Youth: Are TASK Teens Ready to Teach	Petrea, Robert
Childhood Health Outcomes in a Rural Cohort	Merchant, James
Ag Disability Awareness and Risk Education	Reed, Deborah
Enhancing Agricultural Safety and Health through Education	Parker, David
Evaluating Ohio's Tractor Certification Program: Traditional and Novel	Wilkins, III, J.R.
Childhood Injuries in Washington State Agriculture (paper copy)	Alexander, Bruce
Childhood Agricultural Safety and Health Intervention (paper copy)	Chapman, Larry
Etiology and Consequences of Injuries Among Children in Farm Households	Gerberich, Susan
Work Guidelines: Evaluation of Dissemination Methods	Marlenga, Barbara
Empirical Derivation of Work Guidelines for Youth in Agriculture	Wilkins, III, J.R.
An Evaluation of the North American Guidelines for Children's Agricultural Tasks	Wright, Sue
Evaluation of NAGCAT Using case Series of Injuries	Marlenga, Barbara
Teaching Kids Safety on the Farm: What works	Gadomski, Anne
Childhood Agricultural Safety and Health	Parker, David
Pesticide Training for Adolescent Migrant Farmworkers	McCauley, Linda
Using the ASHBMP Manual as a Tool to Reduce Farm Hazards	Legault, Malcom
Evaluating Teen Farmworker Education	Baker, Robin
Adapting NAGCAT for Ethnic Communities: A Research model	Shutske, John
Childhood Agricultural Trauma Evaluation System	Boyle, Debra

RRIS II: Agricultural Injury Surveillance	Gerberich, Susan
Effectiveness of Farm Safety Day Camps for Children	McCallum, Debra
Evaluation of Farm Safety 4Just Kid Day Camps	Reed, Deborah
Removing the HOOA Family Farm Exemption: Impact On Injury	Marlenga, Barbara
Biomarkers of Pesticide Toxicity Among Teen Farmworkers	McCauley, Linda
Evaluation of Occupational Carrying Tasks for Farm Youth	Schwab, Charles
Adherence to the NAGCAT and Injury Risk Reduction	Wilkins, J. R.
Effect of Work Permits In Protecting Youth Workers	Dal Santo
Work Injury and Young People: A Prospective Survey	Breslin
Farm Family Total Noise Exposure Assessment	Milz

Federal agencies invited to participate in the NIOSH Federal Interagency Working Group on Preventing Childhood Agricultural Injuries during 2006.

Participating Federal Agencies

Consumer Products Safety Commission
HRSA, Maternal Child Health Bureau
US Department of Education, National FFA Advisor
National Center for Injury Prevention and Control
USDA, NASS
US Department of Education, Office of Migrant Education
USDOL, Occupational Safety and Health Administration
Division of Community and Migrant Health Centers
National Institute of Child Health and Human Development
USDA, Cooperative State Research, Education, and Extension Service
USDOL, Employment Standards Administration
USDOL, Employment and Training Administration
Indian Health Service

INPUTS:

PROJECT ID: 927006N - OS&H Assistance to Vocational/Technical Schools

PROJECT OFFICER: John Palassis

END OUTCOMES: To promote occupational safety and health among vocational and technical schools among the 11 million young workers and teachers in 20,000 schools in the U.S.

INTERMEDIATE OUTCOMES (IO):

FINAL CUSTOMERS: Young workers

INTERMEDIATE OUTPUTS: To produce a NIOSH publication as a result of the site visits to include respirator program for schools in order to prevent young worker/student' exposure to organic chemicals in auto body repair shops.

INTERMEDIATE CUSTOMERS:

TRANSFER ACTIVITIES: This project translates research into practice for safety and health professionals, employers, and workers.

OUTPUTS: collaboration with CPSC and other agencies and organizations for the development of chemical safety guide to students in postsecondary schools.

ACTIVITIES: provide funding and judging assistance for two national competitions in OS&H - one among students, and the other among teachers and provide award

INPUTS:

PROJECT ID: 927008W - Evaluation of OSH Training of Young Workers

PROJECT OFFICER: Carol Stephenson

END OUTCOMES: an evaluation of OSH training materials

INTERMEDIATE OUTCOMES (IO):

FINAL CUSTOMERS: young workers

INTERMEDIATE OUTPUTS:

INTERMEDIATE CUSTOMERS:

TRANSFER ACTIVITIES:

OUTPUTS:

ACTIVITIES: collaborating with partners to implement, evaluate, and institutionalize an occupational safety and health curriculum in high schools nationwide.

INPUTS Information from the National Electronic Injury Surveillance System (ER data) and Survey of Occupational Injuries & Illnesses (annual BLS survey of employees).

PROJECT ID: CAN 9277187R, Young Worker Safety

END OUTCOMES:

The rates of young worker injury deaths have fluctuated over the last decade. Rates since 2000 are generally lower than rates in the 1990s (Figure 1).

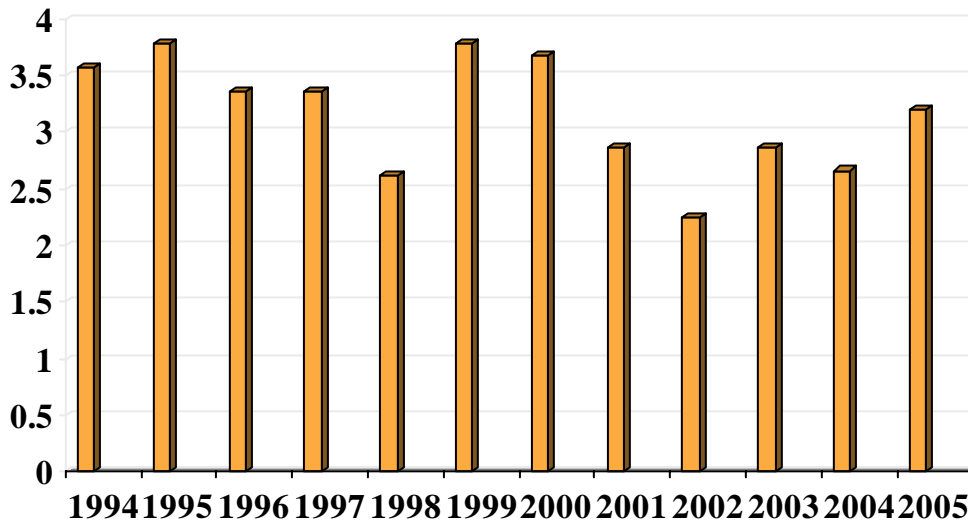


Figure 1. Fatality rates per 100,000 fulltime equivalents, youth 15-17 years of age (Source: Bureau of Labor Statistics, Census of Fatal Occupational Injuries (CFOI))

While there appear to be positive reductions in rates of young worker injury deaths for 16- and 17- year-olds generally since 1996, there has been little change for youth 15 years of age, and apparent increases in fatality rates for 15- and 16-year-olds in agriculture (Table 1). It is important to note that youth less than 14 years of age work, especially in agriculture, but the absence of official statistics for youth employment preclude the ability to calculate comparable fatality rates.

Age (Years)	All Industries			Ag Production		
	1992-96 Rate	1997-02 Rate	% Change	1992-96 Rate	1997-02 Rate	% Change
15	5.2	5.1	-1.9	13.3	24.1	81.2
16	3.6	2.8	-22.2	10.5	15.2	44.8
17	3.5	2.9	-17.1	16.8	12.9	-23.2

Table 1. Fatality rates per 100,000 fulltime equivalents for youth 15-17 years of age for all industries and the agricultural production industry for select time periods. (Source: CFOI. Numbers and rates were calculated by NIOSH and may differ from previously published BLS CFOI numbers and rates. We are currently seeking review by BLS of updated numbers.)

INTERMEDIATE OUTCOMES (IO):

1. Changes to child labor laws based on NIOSH recommendations.

A final rule published by the Department of Labor (DOL) in 2004 incorporated NIOSH recommendations, referring to NIOSH comments and recommendations in the accompanying narrative [69 Fed. Reg. 75382 (2004)]. The new federal child labor regulations went into effect on February 14, 2005. NIOSH research and recommendations were cited among the justifications for the rule changes. NIOSH recommendations were submitted to DOL in response to a public comment period on the proposed rule, and a report that NIOSH developed at the request of DOL recommending changes to Hazardous Orders (those activities deemed to be especially dangerous for youth, and prohibited for youth less than 18 years of age in non-agricultural industries, and youth less than 16 years of age in agriculture). These changes have the potential to reduce young worker deaths and injuries associated with working on roofs, compactors and balers, driving, and the manufacture of explosives.

2. Calls for the Department of Labor (DOL) to implement NIOSH recommendations for changes to Hazardous Orders

Since the release of the NIOSH Hazardous Orders recommendations in May 2002, numerous researchers, standards-setting bodies, legislators, and advocacy groups nationally and internationally have called for implementation of its recommendations or cited them as justification for the need to update child labor laws. Several examples of the many ways in which the report has been used are detailed below.

Action by the International Labour Organization (ILO) Related to U.S. Compliance with Convention No. 182, 2006:

At the 2006 annual meeting of the ILO in Geneva, Switzerland, the Conference Committee on the Application of Standards discussed the U.S. application of Convention No. 182 (Elimination of the Worst Forms of Child Labour) as it relates to children performing hazardous work in agriculture. The Committee of Experts report used as a resource by the ILO Conference Committee mentions the NIOSH recommendations on Hazardous Orders, noting that the U.S. Government has indicated that it is “in the process of determining which recommendations concerning the Hazardous Orders will be presented in a first round of proposed rules” [International Labour Organization 2006, p. 231]. The Conference Committee requested that the U.S. Government provide copies of any new Hazardous Orders when adopted. In addition, the Conference Committee requested the U.S. government to “indicate, in its next report to the Committee of Experts, the measures taken or envisaged (including but not limited to legislation) to ensure that work performed in particular in the agricultural sector was prohibited for children under 18 years where it was hazardous work within the meaning of the Convention” [International Labour Organization 2006, p. 230].

Letter from Child Labor Coalition to Secretary of Labor Elaine Chao requesting action on child labor regulations for agriculture, June 28, 2006:

The Child Labor Coalition followed the action by the ILO Conference Committee with a letter to Secretary of Labor Elaine Chao requesting that forthcoming proposed changes to child labor laws focus on agriculture. The letter references the 2002 NIOSH report recommending changes to Hazardous Orders (HOs), and the discussions at the 2006 annual ILO meeting questioning

U.S. compliance with ILO Convention No. 182 (Elimination of the Worst Forms of Child Labour) in relation to children working in agriculture:

“The Child Labor Coalition strongly urges the Labor Department to make agricultural HOs a top priority within the anticipated child labor regulatory action in 2006. Given that the lead advocacy group (CLC) and the lead group of health and safety experts on child labor (YWH&S Network); and the government’s lead agency on occupational safety and health (NIOSH) recognize the pressing need to strengthen the agricultural HOs, it would be deplorable if the 2006 proposed child labor regulations do not include agriculture in the scope of proposed rulemaking. Furthermore, in light of increased attention by the ILO on the issue of children in hazardous agricultural employment and their request for more information related to measures taken or envisaged, it would certainly not be overlooked if the DOL’s regulatory changes in child labor exclude or minimize agriculture.” [Child Labor Coalition 2006]

Proposed legislation that references NIOSH Hazardous Orders recommendations:

In 2003 and again in 2005, Representative Tom Lantos (D-California) introduced the Youth Worker Protection Act, which would amend the Fair Labor Standards Act of 1938 (FLSA) to revise requirements relating to child labor and to set forth new requirements for the employment of minors. The Act included a provision directing the Secretary of Labor to promulgate a rule relating to particularly hazardous occupations for children between the ages of 16 and 18, specifying that this rulemaking was justified based on the Hazardous Orders recommendations released by the National Institute for Occupational Safety and Health in 2002 [GovTrack.us 2006a, 2006b].

FINAL CUSTOMERS:

Employers, young workers, parents, and educators.

INTERMEDIATE OUTPUTS:

DOL stakeholder meetings: In response to the release of the NIOSH Hazardous Orders recommendations, the DOL/Employment Standards Administration convened a series of stakeholder meetings to gather input on priorities for future rulemaking in 2003. Authors of the NIOSH recommendations participated in these meetings, segmented by the agricultural and nonagricultural sectors. Organizations with interests in youth work in agriculture that participated in the agricultural meeting included the Farmworker Justice Fund, the U.S. Department of Agriculture, the Pennsylvania State University, and the Tennessee Agricultural Extension Service. Organizations who participated in the nonagricultural meeting included the Center to Protect Workers’ Rights, which focuses primarily on the safety and health of workers in the construction industry; the AFL-CIO; the National Consumers League; and the United Food and Commercial Workers Union.

Press release from Farmworker Justice Fund cites NIOSH Hazardous Orders recommendations, 2003:

In 2003, the Farmworker Justice Fund called for DOL to revise the Hazardous Orders for youth in agricultural occupations, citing the NIOSH recommendations as the basis for these revisions [Farmworker Justice Fund, Inc. 2003].

Comments and prioritization of recommendations by Young Worker Health & Safety Network, 2003:

In March 2003, the Young Worker Health and Safety Network (YWH&S) released its report, NIOSH Recommendations for Changes to the Federal Child Labor Regulations: A Response from Members of the Young Worker Health and Safety Network. The network is a subcommittee of the Occupational Health and Safety section of the American Public Health Association, comprised of public health professionals, advocates, educators, and government agency staff. More than 25 individuals from a variety of disciplines collaborated to develop the network's response to the NIOSH Hazardous Orders recommendations [Young Worker Health & Safety Network 2003].

The YWH&S Network agreed with all NIOSH recommendations pertaining to the existing Hazardous Orders (HOs) for agriculture, and flagged four agricultural HOs as top priorities for regulatory action. These are: HO 1, Tractors; HO 6, Ladders and Scaffolds; HO 7, Motor Vehicles; and the new NIOSH proposed HO related to respiratory protection (for both agricultural and non-agricultural industries). The YWH&S Network identified four additional HOs for non-agricultural occupations as top priorities for revision per NIOSH recommendations: HO 5, Woodworking Machines; HO 7, Hoisting Apparatus Operations; HO 14, Power-driven Saws; and HO 16, Roofing.

The YWH&S Network comments were also the topic of a peer-review journal article, which further encouraged implementation of the NIOSH recommendations by DOL/ESA [Miller and Bush 2004].

Use of NIOSH Hazardous Orders recommendations in report by Child Labor Coalition, 2005: In 2005, the Child Labor Coalition (CLC) prepared a report entitled *Protecting Working Children in the United States: Is the Government's Indifference to the Safety and Health of Working Children Violating an International Treaty?* [Child Labor Coalition 2005]. The CLC is a group of non-governmental organizations whose mission is to end child labor exploitation in the U.S. and abroad and to protect the health, education, and safety of working minors. The CLC report was submitted in June 2005 to the ILO Committee of Experts, which is an independent body charged with examining the application of ILO conventions in member states. In the report, the CLC questions whether the U.S. is in compliance with ILO Convention No. 182 (Elimination of the Worst Forms of Child Labour), with particular emphasis on Hazardous Orders and children working in agriculture. Several pages of the report are devoted to a discussion of needed revisions to agricultural HOs 1, 6, 7, and 9. Data and rationale from the NIOSH Hazardous Orders report are used as the primary justification for changes. The report urges DOL/ESA to take action on NIOSH recommendations, particularly those which focus on the agricultural HOs.

INTERMEDIATE CUSTOMERS:

- World Health Organization and International Labour Organization who held an expert meeting on the development of guidelines for defining hazardous child labor. The NIOSH recommendations for changes to Hazardous Orders were put forward as one approach.
- U.S. Congress, as evidenced by the use of the NIOSH recommendations to justify introduction of new legislation in 2003 and 2005 to protect working youth.
- The U.S. Department of Labor, Employment Standards Administration, Wage and Hour Division responsible for promulgating and enforcing federal child labor laws.

- Occupational Safety and Health Administration who is involved in educational efforts to protect young worker
- Child Labor Coalition, a non-governmental organization whose mission is to end child labor exploitation in the U.S. and abroad and to protect the health, education, and safety of working minors.
- Young Worker Safety & Health Network, a subcommittee of the Occupational Health and Safety section of the American Public Health Association, comprised of public health professionals, advocates, educators, and government agency staff.
- Interstate Labor Standards Association, an association of state government staff responsible for promulgating and enforcing state labor laws.
- Researchers and public health practitioners

TRANSFER ACTIVITIES:

NIOSH Hazardous Orders Recommendations

NIOSH provided this report to the Department of Labor, Employment Standards Administration, Wage and Hour Division in May, 2002. A presentation was given by request to the Child Labor Coalition in September, 2002. The report was also provided in response to specific requests, including to the World Health Organization and International Labour Organization, and subsequently posted on the NIOSH internet. In 2003, the Department of Labor distributed the report to groups invited to participate in stakeholder meetings to gather input on priorities for future rulemaking.

NIOSH Young Worker Alert

In August 2003, NIOSH published an Alert, *Preventing Deaths, Injuries, and Illnesses of Young Workers*, summarizing current statistics and providing prevention recommendations for employers, parents, educators and youth. Partners such as the Child Labor Coalition, Interstate Labor Standards Association, OSHA and state governmental agencies helped distribute over 31,000 copies. Examples of dissemination of the document by state groups include:

- Maryland Occupational Safety and Health (MOSH) Training and Education -- 100 copies distributed in their Teen Train-the-Trainer program
- Virginia Department of Labor & Industry -- 50 copies used for consultation program
- Massachusetts Fatality Assessment and Control Evaluation program -- 560 copies sent to the Massachusetts Department of Education
- Nebraska Fatality Assessment and Control Evaluation program – distributed at every presentation, briefing, or booth attended by program staff, including “Husker Harvest Days” and “Farm Safety Day Camps”

Fatality Assessment and Control Evaluation (FACE) reports on young worker injury deaths

Finalized reports were provided to the Department of Labor, Employment Standards Administration, Wage and Hour Division, and posted on the NIOSH internet.

In December 2002, NIOSH in collaboration with the Department of Labor, Employment Standards Administration, Wage and Hour Division, mailed a packet on forklift safety to over 10,000 retail warehouses. The packet included FACE reports of young worker fatalities involving forklifts in warehouse-type settings, and stickers provided by the Department of Labor that indicate that persons less than 18 years of age are prohibited from operating forklifts. The

mailing resulted in requests for 6,000 additional stickers. A similar mailing was subsequently conducted in conjunction with the Occupational Safety and Health Administration, including OSHA materials in the informational safety packet.

OUTPUTS:

Top-level category:

Castillo DN, Pratt SG, Mardis AL, Hendricks KJ [2002]. National Institute for Occupational Safety and Health (NIOSH) recommendations to the U.S. Department of Labor for changes to Hazardous Orders. Report to the U.S Department of Labor, Employment Standards Administration, Wage and Hour Division. May 3, 2002.

NIOSH [2000]. Comments of the National Institute for Occupational Safety and Health on the Department of Labor Notice of Proposed Rulemaking and Request for Comments on Child Labor Regulations, Orders and Statements of Interpretation; Child Labor Violations – Civil Money Penalties, 29 CFR Parts 570 and 579. January 28, 2000.

NIOSH Publication Sub-category:

Mardis AL, Pratt SG [2003]. NIOSH Alert: Preventing deaths, injuries, and illnesses of young workers. Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH) Pub. No. 2003-128.

NIOSH [1999]. Youth dies in trench collapse B Arizona. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 99-02.

NIOSH [2000]. 15-year-old campground laborer dies after striking a camper trailer hitch while operating a utility vehicle B Ohio. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 99-05.

NIOSH [2000]. 16-year-old ride attendant dies after being caught and dragged by amusement park ride B Connecticut. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 99-06.

NIOSH [2000]. Three tower painters die after falling 1,200 feet when riding hoist line B North Carolina. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-07.

NIOSH [2000]. 16-year-old farmworker dies in a cotton packing machine after being covered with a load of cotton B Georgia. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-06.

NIOSH [2000]. Youth laborer dies in trench collapse B Michigan. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-03.

NIOSH [2000]. 16-year-old laborer at a building supply center crushed by forklift that tipped over B Ohio. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-09.

NIOSH [2000]. 15-year-old part-time worker at retail grocery store suffers amputation while assembling meat grinder - Utah. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-13.

NIOSH [2000]. Sixteen-year-old mechanic=s assistant died after being run over by the rear wheels of a tub grinder B Connecticut. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-14.

NIOSH [2001]. Sixteen-year-old produce market worker dies from crushing injuries after being caught in a vertical downstroke baler B New York. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-19.

NIOSH [2001]. Seventeen-year-old laborer at salvage lumber operation crushed by forklift that tipped over B New York. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-22.

NIOSH [2001]. Fourteen-year-old youth pulled into operating wood chipper B Florida. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-21.

NIOSH [2001]. A 17-year-old life guard died from injuries sustained after she fell into an empty pool during pre-season maintenance work B Pennsylvania. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-17.

NIOSH [2001]. A sixteen-year-old male died after falling 27 feet at a residential construction site B Alabama. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-16.

NIOSH [2001]. 17-year-old bagger at retail grocery store suffers amputation while operating a meat grinder B Pennsylvania. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2001-05.

NIOSH [2002]. Fourteen-year-old laborer dies after a stored piece of hoisting apparatus fell on him at an automobile repossession yard B Pennsylvania. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-04.

NIOSH [2002]. Seventeen-year-old window washer dies after falling 180 feet due to a rigging anchor failure B PA. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-08.

NIOSH [2002]. A 15-year-old male farm laborer dies after the tractor he was operating overturned into a manure pit B Pennsylvania. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-18.

NIOSH [2002]. A 16-year-old roofer helper dies after 28-foot fall down an unguarded elevator shaft opening B Pennsylvania. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2000-23.

NIOSH [2002]. A 15-year-old youth fell through a skylight 24 feet while he was helping a repairman on the roof of a stone-casting company B Florida. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2001-04.

NIOSH [2002]. Fourteen-year-old laborer dies after falling through a skylight B Alabama. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2001-07.

NIOSH [2002]. Seventeen-year-old warehouse laborer dies after the forklift he was operating tipped over and crushed him B Arizona. Morgantown, WV: Fatality Assessment and Control Evaluation (FACE) report no. 2002-02.

External Publication Sub-Category:

Hendricks KJ, Layne LA [1999]. Adolescent occupational injuries in fast food restaurants: An examination of the problem from a national perspective. *J Occup Environ Med* 41:1146-1153.

Mardis AL, Pratt SG [2003]. Nonfatal injuries to young workers in the retail trades and services industries in 1998. *JOEM* 45(3): 316-323.

Publications resulting from Cooperative Agreements, “Research on Young Worker Safety and Health Risks in Construction”

Lipscomb HJ, L Li [2001]. Injuries among teens employed in the homebuilding industry in North Carolina. *Inj Prev* 7:205-209.

O’Connor T, Loomis D, Runyan C, Abboud dal Santo J, Schulman M [2005]. Adequacy of health and safety training among young Latino construction workers. *J Occup Environ Med* 47:272-277.

Runyan CW, Dal Santo J, Schulman M, Lipscomb HJ, Harris TA [2006]. Work hazards and workplace safety violations experienced by adolescent construction workers. *Arch Pediatr Adolesc Med* 160:721-7.

Seixas NS, Goldman B, Sheppard L, Neitzel R, Norton S, Kujawa SG [2005]. Prospective noise induced changes to hearing among construction industry apprentices. *Occup Environ Med* 62:309-317.

Suruda A, Philips P, Lillquist D, Sesek R [2003]. Fatal injuries to teenage construction workers in the US. *Am J Ind Med* 44:510-514.

ACTIVITIES:

Activity: NIOSH Recommendations to the U.S. Department of Labor for Changes to Child Labor Laws

In response to a recommendation in the National Research Council monograph *Protecting Youth at Work*, the U.S. Department of Labor (DOL) provided funds for NIOSH to develop a report on the adequacy of Hazardous Orders (HOs) based on a review of data and the scientific literature. The report was developed as a deliverable in interagency agreements between NIOSH and the DOL/Employment Standards Administration (ESA) in fiscal years 1999 to 2001. ESA is the agency within DOL that is directly responsible for developing and enforcing child labor laws. Primary data sources used by NIOSH were the Census of Fatal Occupational Injuries, the Survey of Occupational Injuries and Illnesses, the National Electronic Injury Surveillance System, and the Current Population Survey. In addition, hundreds of scientific articles and reports were reviewed. Considerable staff resources in the Division of Safety Research were devoted to the analysis and interpretation of data and preparation of the report. The equivalent of two full-time staff worked on the report between January 2001 and June 2002. Staff in other NIOSH divisions provided supporting data.

This comprehensive report, which was released to the DOL in May 2002, made specific recommendations for each of the HOs that defines prohibited occupations. It did not address statutory issues such as the minimum age for work in HOs and exemptions from the FLSA, such as work on family farms. The development of recommendations was driven by data on high-risk activities for all workers, not just patterns of fatalities and serious injuries among young workers. The general rationale for recommending an HO was that the associated fatality rate had to be at least 10 per 100,000 workers, or about twice the fatality rate for all U.S. workers. The number and severity of nonfatal injuries were also considered, as well as research on health effects of workplace exposures.

NIOSH found justification for all of the existing HOs. Review of available data and scientific evidence found that work currently prohibited by HOs continued to pose risks for death, serious injuries, and disabling health conditions. NIOSH proposed several types of revisions to HOs: better definition of prohibited activities, incorporation of associated legislative provisions, and in some cases, removal of current exemptions. In addition, NIOSH made recommendations to expand several HOs to include similar work with comparable or greater risk. Table 2 below summarizes NIOSH recommendations for changes to the 17 existing HOs for nonagricultural occupations, and Table 3 provides the same information for the 11 existing HOs for agricultural occupations.

NIOSH recommended the development of several new HOs to protect youth from especially hazardous work not adequately addressed in the existing regulations. The recommended HOs encompassed work associated with deaths and severe injuries of youth, work with especially high fatality rates, and work associated with disabling health conditions. In several instances, NIOSH recommended extending prohibitions now in place for agricultural occupations to similar tasks in nonagricultural occupations, e.g. pesticide handling, work in confined spaces, and tractor operation. Recommended new HOs are detailed in Table 4.

Activity:

Fund Cooperative Agreements, “Research on Young Worker Safety and Health Risks in Construction”

The interagency agreements with ESA also provided funds for NIOSH to administer an extramural research program to provide empirical data to guide future rulemaking to protect young workers in construction. NIOSH developed a Request for Applications and funded three extramural research projects focusing on health and safety hazards to youth working in the construction industry. The first project, at the University of North Carolina, examined work patterns, practices, and injury experiences among young construction workers in North Carolina, with special emphasis on Latino workers. The objective of the second project, at the University of Utah, was to calculate and compare fatality rates among young (< age 18) and older construction workers according to injury circumstances, establishment size, union affiliation, and employer gross income, using 15 years of OSHA investigation data and employment data. Partial funding was also provided for a third project at the University of Washington that was a prospective study of noise-induced hearing loss in newly hired construction workers.

Activity: Updated NIOSH Alert on Young Worker Safety and Health

NIOSH scientists involved in research on child labor saw the need to update the NIOSH Alert on adolescent workers published in 1995. The updated Alert built on the 1995 NIOSH Alert on the same topic, adding updated statistics, illustrative case studies, a discussion of health risks to young workers, and detailed information on child labor laws. Particular effort was made to ensure that the Alert would appeal to the widest possible audience by including information for parents, educators, employers, and youth.

INPUTS:

Funds for the “Young Worker Safety” project were provided through an interagency agreement with the U.S. Department of Labor, Employment Standards Administration, Wage and Hour Division in fiscal years 1999 through 2001. In part, impetus for this agreement was the recommendation in the National Research Council monograph *Protecting Youth at Work*, that U.S. Department of Labor (DOL) provide funds for NIOSH to develop a report on the adequacy of Hazardous Orders based on a review of data and the scientific literature. The interagency agreement provided for development of such a report, supported Fatality Assessment and Control Evaluation (FACE) investigations of young worker fatalities, and supported intramural and extramural research on injuries and fatalities of young workers.

EXTERNAL FACTORS:

The scope of the NIOSH recommendations on changes to Hazardous Orders was delineated in interagency agreements between NIOSH and DOL/ESA in fiscal years 1999, 2000, and 2001. However, as the NIOSH report neared completion, the change in Administration in January 2001 led to changes in leadership at DOL and at DOL/ESA. New leadership had no investment in the NIOSH report, reacting somewhat defensively to the efforts of NIOSH and other stakeholders to promote it as an important tool for guiding future rulemaking.

In general, regulatory actions by DOL agencies have become increasingly difficult to initiate, as Federal agencies that wish to propose new rules are now required to evaluate the economic impact of these proposals. It is possible that the increased complexity of the rulemaking process has contributed to inaction by DOL/ESA on rulemaking related to the HOs for young workers.

Statutory provisions of the Fair Labor Standards Act (FLSA) also limit the potential impact of regulatory changes. Large numbers of working youth are not covered by the FLSA, including youth who work on their parents' farms, and youth 16- and 17- years of age who work on any farm.

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recommendations; Report III, Part 1A; General Report and observations concerning particular countries. Pages 229-233. Available: <http://www.ilo.org/public/english/standards/relm/ilc/ilc95/pdf/rep-iii-1a.pdf>. Date accessed: July 18, 2006.

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Table 2. Summary of NIOSH Recommendations Pertaining to Existing Nonagricultural Occupation HOs

Existing Nonagricultural HO	Retain	Revise	Training exemption	Specific recommendations
HO 1: Manufacturing or Storage Occupations Involving Explosives		X	n/a	Revise the definition to include the current ATF list of explosive materials.
HO 2: Motor Vehicle Occupations		X	n/a	1) Incorporate provisions of the Drive for Teen Employment Act; 2) Provide guidance on Aurgent, time-sensitive deliveries@ and Aincidental and occasional driving@; 3) Delete exemption for school bus driving.
HO 3: Coal Mine Occupations	X		n/a	
HO 4: Logging and Sawmilling Occupations		X	n/a	1) Expand to cover similar work in operation of timber tracts, tree farms and forestry services; 2) Remove the current exemptions for construction work for living or administrative quarters.
HO 5: Power-Driven Woodworking Machines		X	Retain	Expand to include similar power-driven machines used to operate on materials other than wood.
HO 6: Occupations Involving Exposure to Radioactive Substances and to Ionizing Radiation		X	n/a	Revise to reflect current risks to youths for occupational radiation exposures.
HO 7: Power-driven Hoisting		X	n/a	1) Expand to cover repairing, servicing, disassembling and

Existing Nonagricultural HO	Retain	Revise	Training exemption	Specific recommendations
Apparatus Operations				assisting in tasks being performed by the machine; 2) Expand to prohibit youth from riding on any part of a forklift as a passenger, and from working from forks, platforms, buckets, or cages attached to a moving or stationary forklift; 3) Expand to prohibit work from truck-mounted bucket or basket hoists, commonly termed Abucket trucks@ or Acherry pickers@; 4) Expand to include commonly used manlifts that do not meet the current definition, specifically aerial platforms.
HO 8: Power-driven Metal Forming, Punching, and Shearing Machine Operations		X	Retain	Expand to include several types of metalworking machinery currently excluded from this HO, including milling, turning, grinding, and boring machines.
HO 9: Occupations in Connection with Mining, Other than Coal		X	n/a	1) Expand to include all work performed in connection with petroleum and natural gas extraction; 2) Remove exemptions permitting repair and maintenance of roads, and work on track crews.
HO 10: Occupations in the Operation of Power-driven Meat-Processing Machines and Occupations Involving Slaughtering, Meat Packing or Processing, or Rendering		X	Add partial exemption	1) Expand to prohibit work in all meats products manufacturing industries, including poultry slaughtering and processing; 2) Consider a revision* to allow use of meat and food slicers in retail, wholesale and service industries; 3) Allow apprentice/student learner exemptions in retail, wholesale or service industries.
HO 11: Power-driven Bakery Machine Occupations		X	n/a	Consider a revision* to allow the use of Acounter-top models@ of power-driven bakery machines.
HO 12: Power-driven Paper-Products Machine Occupations		X	Retain	1) Incorporate provisions of the Compactor and Baler Act; 2) Expand to include similar power-driven machines used to operate on materials other than paper products.
HO 13: Occupations Involved in the Manufacture of Brick, Tile, and Kindred Products	X		n/a	

Existing Nonagricultural HO	Retain	Revise	Training exemption	Specific recommendations
HO 14: Occupations in the Operation of Power-Driven Circular Saws, Band Saws, and Guillotine Shears		X	Retain partial exemption	Consider revising definition to include other machines which perform cutting and sawing functions through direct contact between the cutting surface and the material (the current definition is based on the presence of a continuous series of notches or jagged teeth).
HO 15: Occupations Involved in Wrecking, Demolition, and Shipbreaking Operations	X		n/a	
HO 16: Occupations in Roofing Operations		X	Remove	1) Expand to include all work performed on roofs; 2) Remove the exemption for apprentices/student learners.
HO 17: Occupations in Excavation Operations	X		Remove	Remove the exemption for apprentices/student learners.

* Any revisions of HOs that would allow work that was previously prohibited should be accompanied by a mandatory reporting period in which all serious youth injuries and deaths resulting from previously prohibited activities are promptly reported to the U.S. Department of Labor. This would allow an assessment as to whether the revision should be rescinded or further refined to best protect working youth, while not unnecessarily limiting job opportunities.

Table 3. Summary of NIOSH Recommendations Pertaining to Existing Agricultural Occupation HOs

Existing Agricultural HO	Retain	Revise	Specific Recommendations
HO 1: Operating a Tractor Over 20 PTO Horsepower or Connecting or Disconnecting an Implement or Any of Its Parts To or from Such a Tractor		X	1) Revise to remove the 20 PTO (power take-off) horsepower threshold; 2) Revise exemption for 14- and 15-year olds with tractor certification to require tractors to be equipped with a rollover protective structure (ROPS) and mandate the use of seatbelts.
HO 2: Operating or Assisting to Operate (including starting, stopping, adjusting, feeding or any other activity involving physical contact associated with the operation) any of the following machines: corn picker, cotton picker, grain combine, hay mower, forage harvester, hay baler, potato digger, or mobile pea viner; feed grinder, crop dryer, forage blower, auger conveyor, or the unloading mechanism of a nongravity-type self-unloading wagon or trailer, or power post-hole digger, power post driver, or nonwalking-type rotary tiller		X	Combine HO 2 and HO 3, and expand prohibition from lists of specific machines to machines that perform general functions (e.g. harvesting and threshing machinery; mowing machinery; plowing, planting and fertilizing machinery; other agricultural and garden machinery; excavating machinery; loaders; wood processing machinery, such as wood chippers and debarkers; sawing machinery, including chain saws; powered conveyors; and, mobile equipment, including forklifts).
HO 3: Operating or assisting to operate (including starting, stopping, adjusting, feeding, or any other activity involving physical contact associated with the operation) any of the following machines: trencher or earthmoving equipment; fork lift; potato combine; power-driven circular, band, or chain saw		X	See comments above pertaining to agricultural HO 2.
HO 4: Working on a Farm in a Yard, Pen, or Stall Occupied By a: (i) Bull, boar, or stud horse maintained for breeding purposes; or (ii) Sow with suckling pigs, or cow with newborn calf (with umbilical cord present)	X		
HO 5: Felling, Bucking, Skidding, Loading or Unloading Timber with Butt Diameter of More than 6 Inches.		X	Remove 6 inch diameter threshold.

Existing Agricultural HO	Retain	Revise	Specific Recommendations
HO 6: Working from a Ladder or Scaffold (Painting, Repairing, or Building Structures, Pruning Trees, Picking Fruit, etc) at a Height of Over 20 Feet		X	1) Expand to include work on roofs, on farm structures including silos, grain bins, windmills, and towers; and, on vehicles, machines, and implements; 2) Reduce the maximum height at which youth may work in these settings from 20 feet to 6 feet.
HO 7: Driving a Bus, Truck, or Automobile When Transporting Passengers, or Riding on a Tractor as a Passenger or Helper		X	1) Expand to prohibit driving of all motor vehicles and off-road vehicles (including all-terrain vehicles), with or without passengers, on or off the highway; 2) Expand to prohibit work as an outside helper on a motor vehicle; 3) Retain the provision prohibiting riding on a tractor as a passenger or helper, but move it under Agricultural HO 1.
HO 8: Working Inside: A fruit, forage, or grain storage designed to retain an oxygen deficient or toxic atmosphere; an upright silo within 2 weeks after silage has been added or when a top unloading device is in operating position; a manure pit; a horizontal silo while operating a tractor for packing purposes		X	Expand to prohibit <i>all</i> work inside (i) a fruit, forage, or grain storage, such as a silo or bin; (ii) a manure pit.
HO 9: Handling or Applying (including cleaning or decontaminating equipment, disposal or return of empty containers, or serving as a flagman for aircraft applying) Agricultural Chemicals Classified Under the Federal Insecticide, Fungicide, and Rodenticide Act (as amended by Federal Environmental Pesticide Control Act of 1972, 7 U.S.C. 136 et seq.) as Toxicity Category I, Identified by the Word ADanger@ and/or APoison@ with Skull and Crossbones; or Toxicity Category II, Identified by the Word AWarning@ on the Label		X	Expand to be consistent with EPA Worker Protection Standard for pesticides, encompassing prohibitions against pesticides with chronic health effects as well as pesticides with recognized acute toxicity.
HO10: Handling or Using a Blasting, Including but Not Limited to Dynamite, Black Powder, Sensitized Ammonium Nitrate, Blasting Caps, and Primer Cord	X		
HO 11: Transporting, Transferring, or Applying Anhydrous Ammonia	X		

Table 4. New Hazardous Orders Recommended by NIOSH

- \$ Commercial Fishing Operations
- \$ Construction Occupations
- \$ Work in Refuse Occupations
- \$ Water Transportation Industries
- \$ Work in Scrap and Waste Materials Industry
- \$ Farm Product Raw Materials Wholesale Trade Industry
- \$ Railroad Industry
- \$ Work at Heights
- \$ Tractors (in nonagricultural occupations)
- \$ Heavy Machinery
- \$ Welding
- \$ Confined Spaces (in nonagricultural occupations)
- \$ Work Involving Powered Conveyors (in manufacturing industries)
- \$ Pesticide Handling (in nonagricultural occupations)
- \$ Exposure to Lead
- \$ Exposure to Silica
- \$ Work Requiring the Use of Respiratory Protection

PROJECT ID: National Traumatic Occupational Fatalities (NTOF) Surveillance System

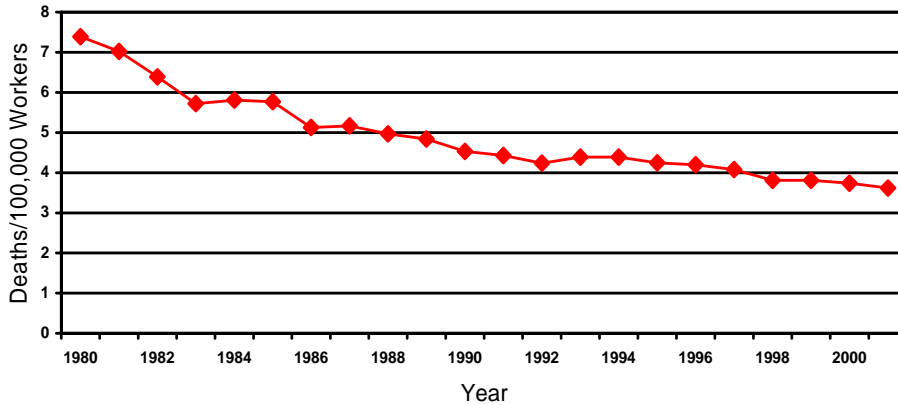
END OUTCOMES:

OVERALL FATALITIES

In the mid 1980s, NIOSH initiated a systematic national collection of workplace fatalities through the National Traumatic Occupational Fatalities (NTOF) surveillance system. For the first time, NTOF provided a uniform surveillance system of work-related fatal injuries for all industries. NTOF successfully filled a critical data need by providing a measurement system for tracking outcomes and important data that many in NIOSH and elsewhere used to direct more detailed projects to address specific causes of death or high-risk worker groups.

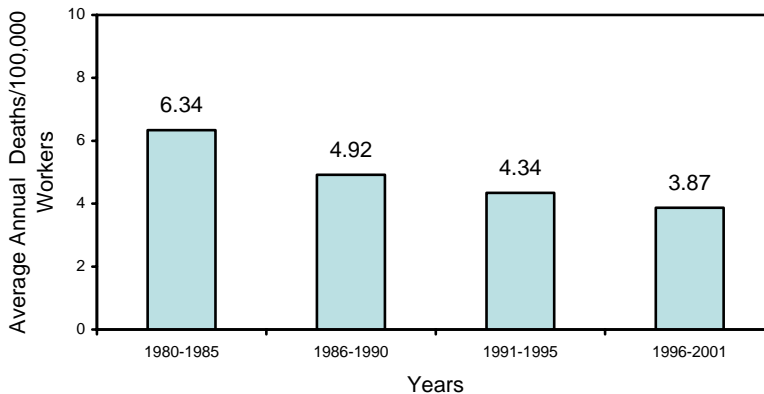
Work-related fatality rates in the U.S. have decreased 51% from 1980 through 2001 based on data from the NTOF surveillance system (*Figure 1*). The 6-year average fatality rate for the period 1996-2001 decreased 39% compared to the 6-year time period 1980-1985 (*Figure 2*).

*Figure 1. Occupational Fatality Rates by Year**
 (Source: NIOSH NTOF 1980-2001)



*Data for 2001 exclude deaths associated with September 11.

Figure 2. Annual Average Fatality Rates for Four Time Periods Between 1980 and 2001 (Source: NIOSH NTOF)*



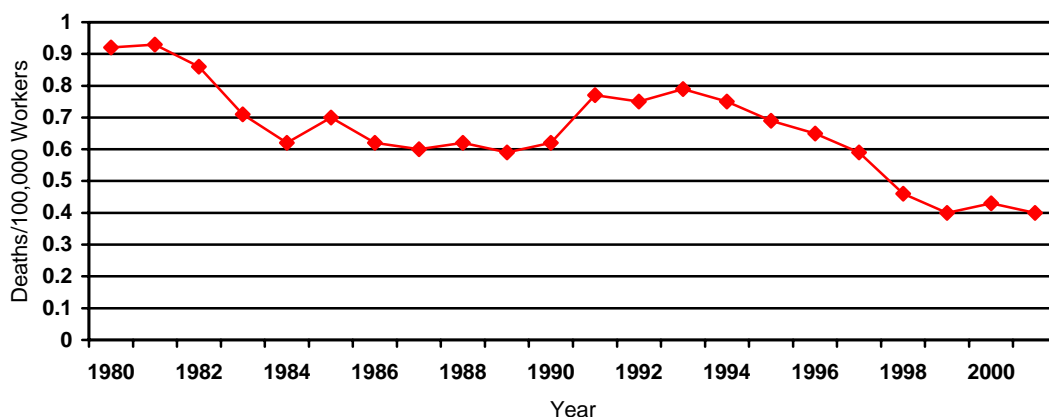
*Data for 2001 exclude deaths associated with September 11.

HOMICIDES

In the late 1980s, NIOSH’s NTOF surveillance system identified homicides as a leading cause of work-related injury death in the U.S. This national recognition formed the basis of NIOSH’s efforts that began in the early 1990s to address this serious public health problem. The NTOF data have supported and directed further research into the characteristics of homicides and provided an index for tracking improvements.

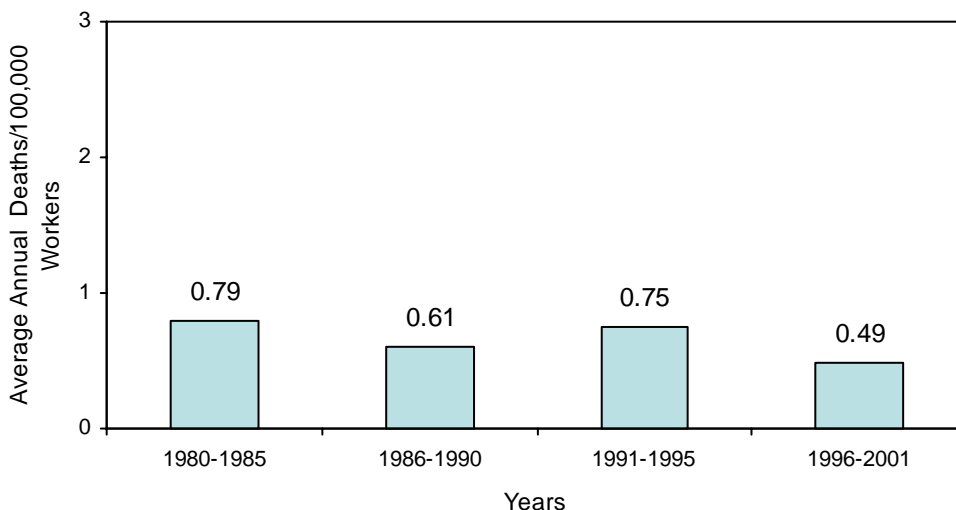
Work-related fatality rates for homicides have decreased 130% from 1980 through 2001 based on data from the NTOF surveillance system (*Figure 3*). The 6-year average fatality rate for the period after NIOSH began its focus on workplace homicides decreased 37% compared to the rate for the 6-year time period 1980-1985 (*Figure 4*).

*Figure 3. Occupational Fatality Rates for Homicide-related Deaths**
 (Source: NIOSH NTOF 1980-2001)



*Data for 2001 exclude deaths associated with September 11.

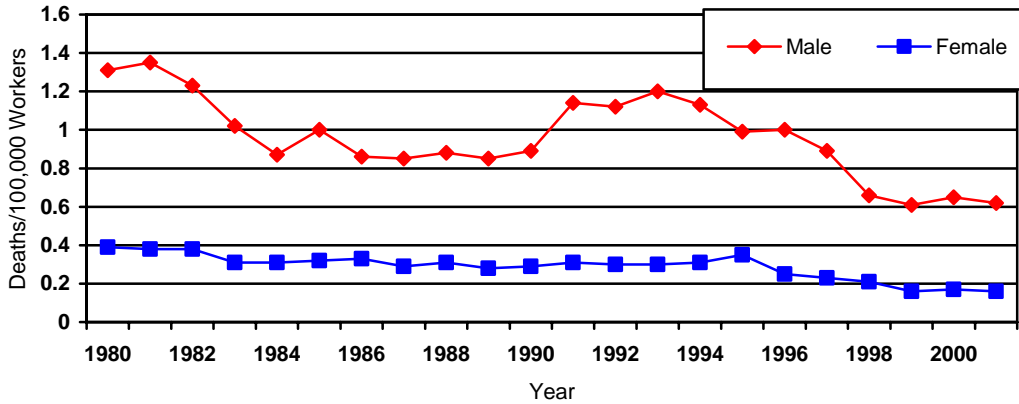
*Figure 4. Annual Average Homicide Fatality Rates for Four Time Periods Between 1980 and 2001** (Source: NIOSH NTOF)



*Data for 2001 exclude deaths associated with September 11.

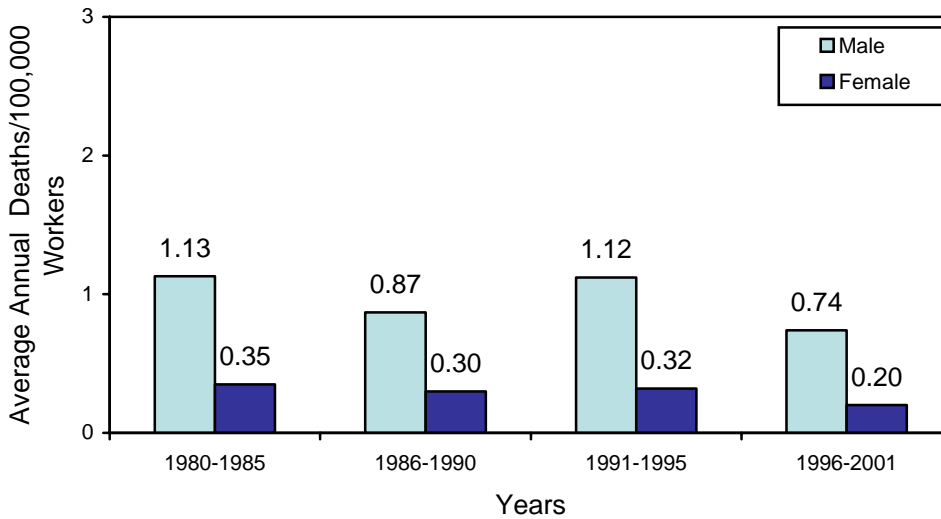
Although the majority of workplace homicides occurred to men, homicides were the leading cause of death among women. Fatality rates for homicides among women decreased 59% from 1980 through 2001 compared to a 53% decrease for men for the same period (Figure 5). The 6-year average fatality rate for the period after NIOSH began its focus on workplace homicides decreased 43% for women and 35% for men compared to the rates for the 6-year time period 1980-1985 (Figure 6).

Figure 5. Occupational Fatality Rates for Homicide-related Deaths by Sex*
 (Source: NIOSH NTOF 1980-2001)



*Data for 2001 exclude deaths associated with September 11.

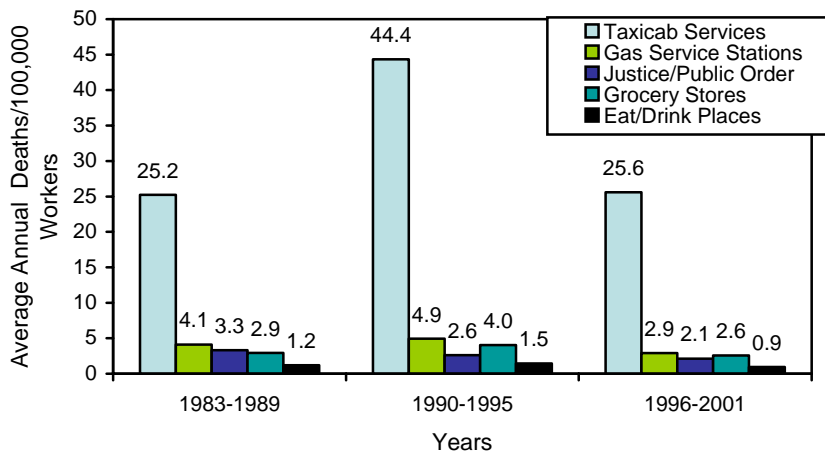
Figure 6. Annual Average Homicide Fatality Rates by Gender for Four Time Periods
 Between 1980 and 2001 (Source: NIOSH NTOF)



*Data for 2001 exclude deaths associated with September 11.

NIOSH researchers identified five primary industries as having either a high number of workplace homicides or a high rate of homicides. The number and rate of fatality in all five industries (Taxicab Services, Gas Service Stations, Justice/Public Order Establishments, Grocery Stores, and Eating/Drinking Places) decreased for the period after NIOSH began its focus on work place homicides (*Figure 7*).

Figure 7. Annual Average Homicide Fatality Rates by Selected Industries for Three Time Periods Between 1983 and 2001 (Source: NIOSH NTOF)*

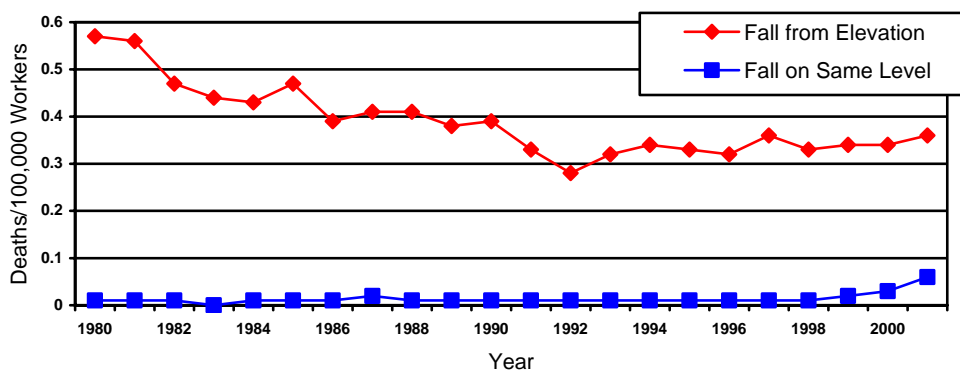


*Data for 2001 exclude deaths associated with September 11.

FALLS FROM ELEVATION

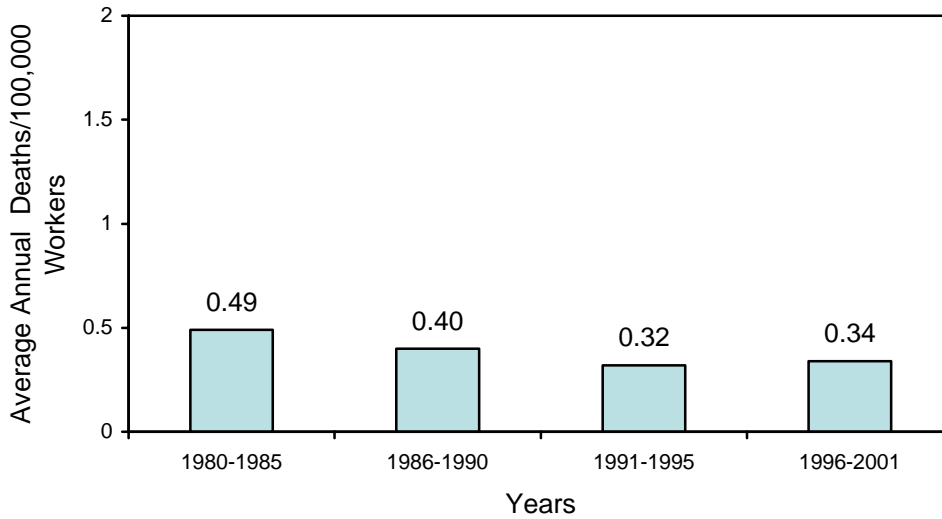
In the late 1980s, through the NTOF surveillance system, NIOSH identified falls as the fourth leading cause of work-related injury death in the U.S. The majority of work-related falls were from an elevation (e.g., ladders, scaffolding, or stairs or steps) (*Figure 8*). Fatality rates for falls from elevation have decreased 37% from 1980 through 2001 based on data from the NTOF surveillance system (*Figure 8*). The average fatality rate for falls from elevation for the period 1996-2001 decreased 31% compared to the rate for the time period 1980-1985 (*Figure 9*).

Figure 8. Occupational Fatality Rates for Fall-related Deaths by Fall Type (Source: NIOSH NTOF 1980-2001)*



*Data for 2001 exclude deaths associated with September 11.

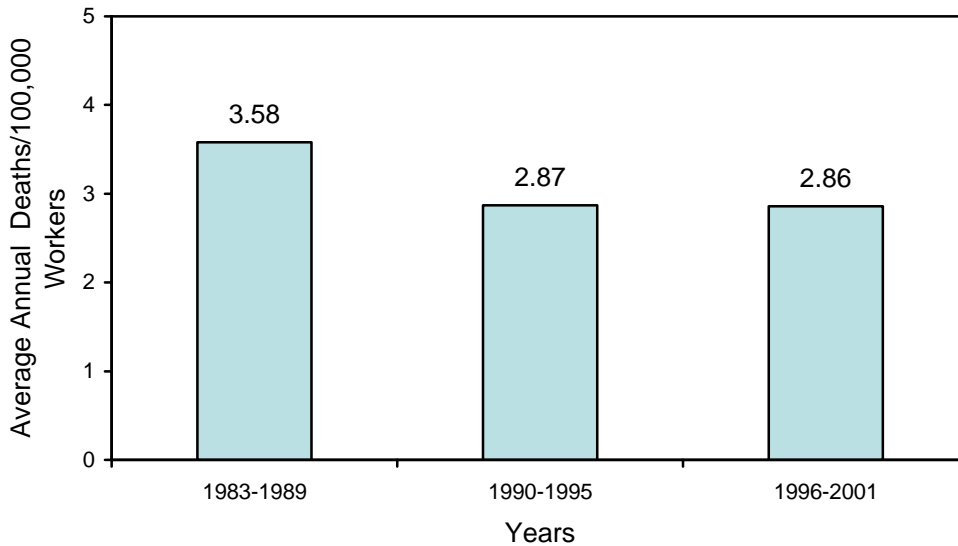
Figure 9. Annual Average Fatality Rates for Falls from Elevation for Four Time Periods Between 1980 and 2001* (Source: NIOSH NTOF)



*Data for 2001 exclude deaths associated with September 11.

NIOSH researchers identified workers in construction as having the highest risk of fatal falls from elevation. The rate of fatal falls from elevation in construction has decreased 20% since NIOSH began collecting NTOF data (Figure 10).

Figure 10. Annual Average Fatality Rates for Falls from Elevation by in Construction for Three Time Periods Between 1983 and 2001* (Source: NIOSH NTOF)



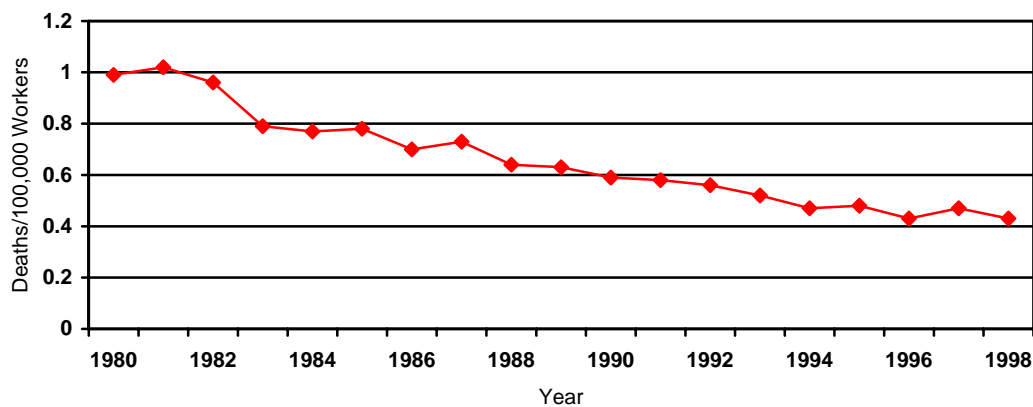
*Data for 2001 exclude deaths associated with September 11.

MACHINES

NIOSH has been conducting research on machine safety since the early 1970s. With the introduction of the NTOF surveillance system, NIOSH was able to quantify the number of machine-related fatalities and the characteristics of the machines that caused many of the reported fatalities. These results helped stimulate and direct NIOSH’s research on machine safety, especially in the agriculture industry.

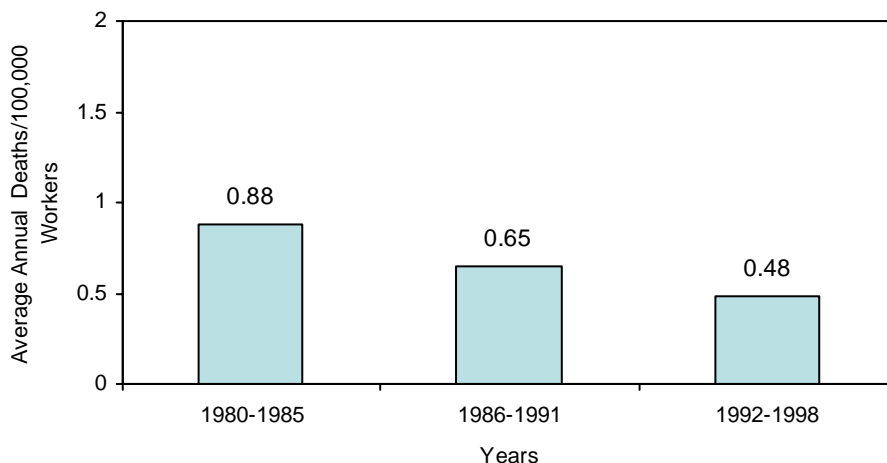
Work-related fatality rates for all machines have decreased 57% from 1980 through 1998 based on data from the NTOF surveillance system (*Figure 11*). The average fatality rate for machine-related deaths for the 7-year period 1992-1998 decreased 45% compared to the fatality rate for the time period 1980-1985 (*Figure 12*).

Figure 11. Occupational Fatality Rates for Machine-related Deaths
 (Source: NIOSH NTOF 1980-1998*)



*Because of significant inconsistencies in machinery codes assigned to the 1980-1998 and 1999-2001 data, data for the later years of NTOF are not presented.

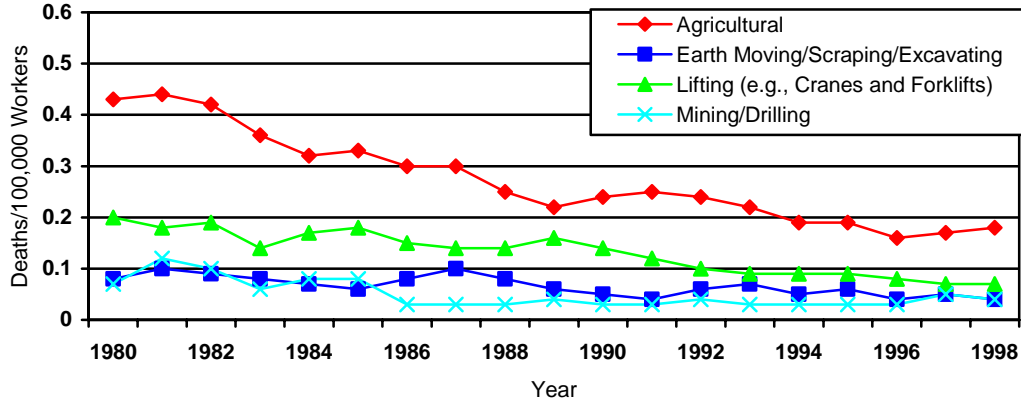
*Figure 12. Annual Average Machine-related Fatality Rates for Three Time Periods Between 1980 and 1998** (Source: NIOSH NTOF)



*Because of significant inconsistencies in machinery codes assigned to the 1980-1998 and 1999-2001 data, data for the later years of NTOF are not presented.

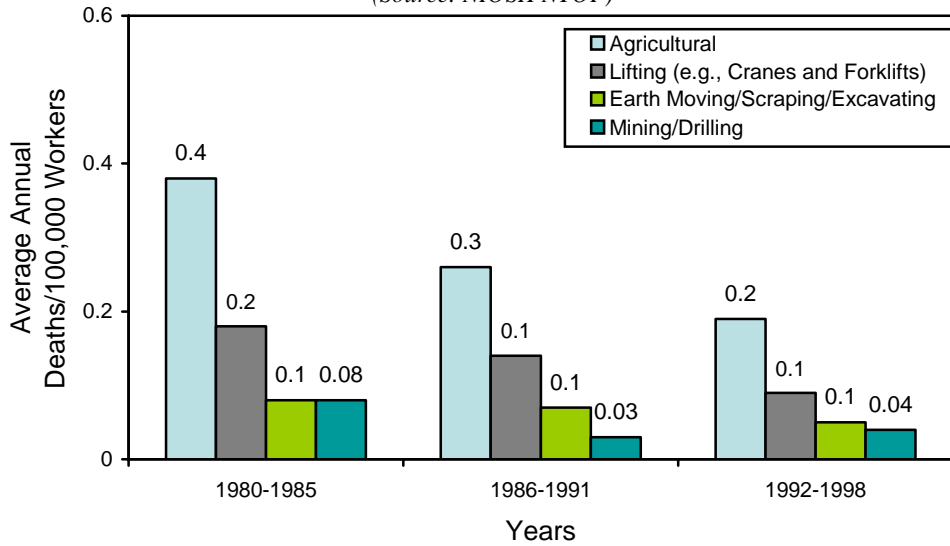
NTOF surveillance data enabled NIOSH researchers and others to establish research priorities for projects targeting specific machine types (e.g., tractors). From 1980 through 1998, rates for agricultural machinery-related fatalities decreased 58% (Figure 13). The fatality rates for selected machine types for the 7-year time period 1992-1998 decreased 38-50% compared to the rates for the 6-year time period 1980-1985 (Figure 14).

Figure 13. Occupational Fatality Rates for Machine-related Deaths by Selected Machine Types (Source: NIOSH NTOF 1980-1998*)



*Because of significant inconsistencies in machinery codes assigned to the 1980-1998 and 1999-2001 data, data for the later years of NTOF are not presented.

Figure 14. Changes in Annual Average Machine-related Fatality Rates by Selected Machine Types for Three Time Periods Between 1980 and 1998* (Source: NIOSH NTOF)

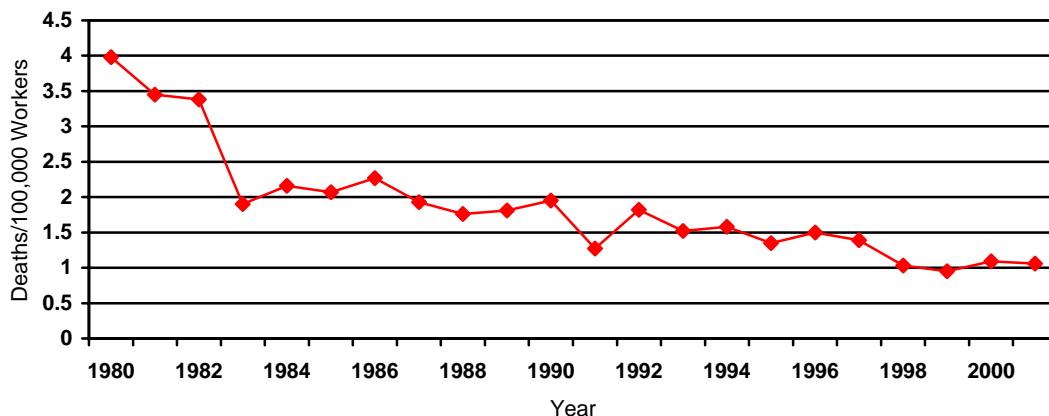


*Because of significant inconsistencies in machinery codes assigned to the 1980-1998 and 1999-2001 data, data for the later years of NTOF are not presented.

YOUTH

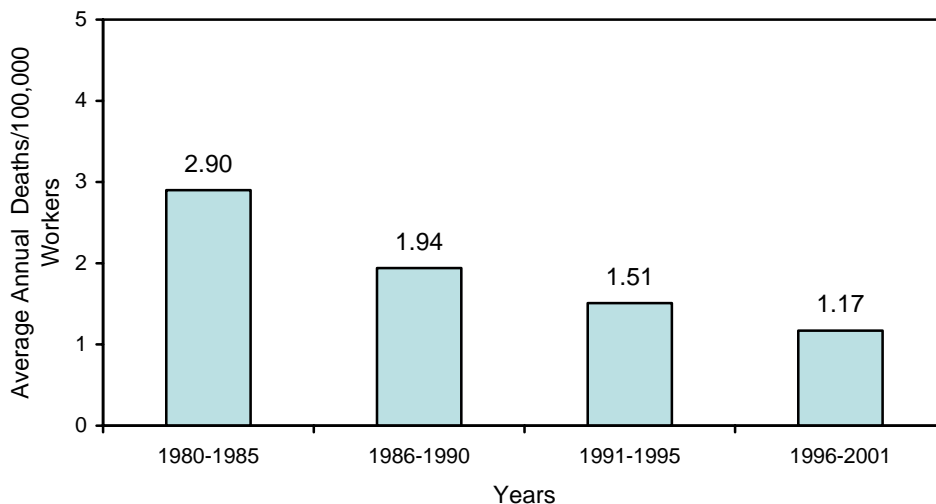
In the early 1990s, NIOSH researchers found that the risk of injury death for workers 16 and 17 was similar to that of adult workers aged 18 and older when comparing rates based on full-time equivalency. Because young workers are less likely to be employed in especially hazardous jobs, this finding raised concern within NIOSH and throughout the occupational safety and health community. NIOSH has worked closely with safety and health officials, researchers and advocacy groups to improve the safety of these young workers. Since 1980, work-related fatality rates for youth aged 16-17 years old have decreased 73% (*Figure 15*). The average fatality rate for workers aged 16-17 years old for the 6-year period 1996-2001 decreased 60% compared to the rate for the time period 1980-1985 (*Figure 16*).

*Figure 15. Occupational Fatality Rates for Workers Aged 16-17 Years Old**
 (Source: NIOSH NTOF 1980-2001)



*Data for 2001 exclude deaths associated with September 11.

*Figure 16. Annual Average Fatality Rates for Workers Aged 16-17 Years Old for Four Time Periods Between 1980 and 2001** (Source: NIOSH NTOF)



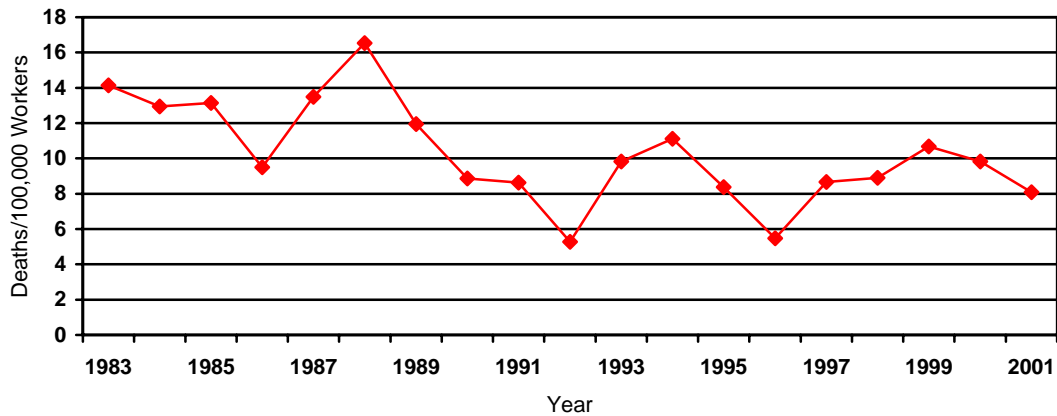
*Data for 2001 exclude deaths associated with September 11.

FIRE FIGHTERS

Investigations conducted through NIOSH’s Fatality Assessment and Control Evaluation (FACE) program in the mid 1990s drew attention to the number of fire fighters that lose their life in the line-of-duty. In FY 1998, Congress began funding NIOSH to formally conduct fire fighter fatality investigations as a means to address this national problem. The NTOF data provided an index for tracking improvements through 2001.

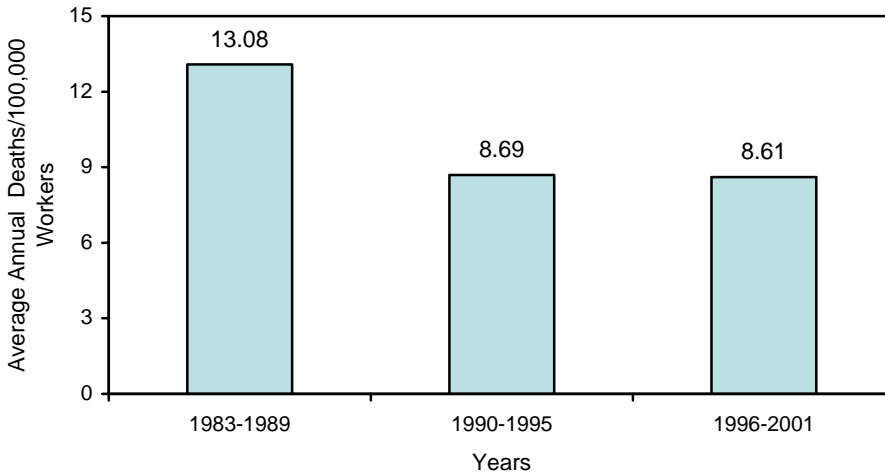
Although fatality rates have fluctuated considerably since 1983, in general, work-related fatality rates for fire fighters have decreased 43% (*Figure 17*). The 6-year average fatality rate for the period during which funding for NIOSH’s fire fighter fatality investigation program began was 34% lower compared to the fatality rate for the 7-year time period 1983-1989 (*Figure 18*).

Figure 17. Occupational Fatality Rates for Fire Fighters and Supervisors
 (Source: NIOSH NTOF 1983-2001)*



*Data for 2001 exclude deaths associated with September 11.

Figure 18. Annual Average Fatality Rates for Fire Fighters and Supervisors for Three Time Periods Between 1983 and 2001 (Source: NIOSH NTOF)*

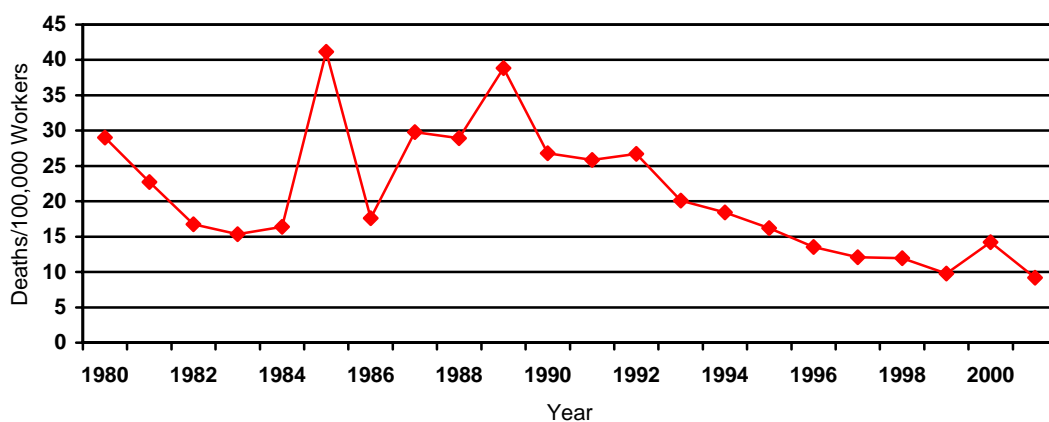


*Data for 2001 exclude deaths associated with September 11.

ALASKA

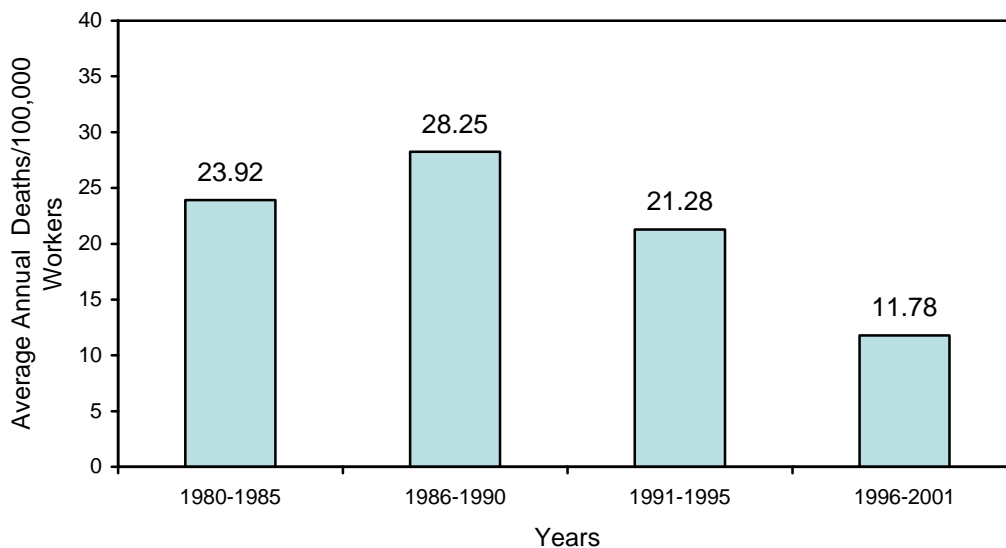
Through NTOF, NIOSH found that the State of Alaska had, by far, the highest occupational fatality rate of any state (NIOSH, 2002). To address this serious problem, the Alaska Field Station was created in 1991. The NTOF data were used to identify high-risk worker populations in Alaska and to track overall improvements in workplace fatalities. Since 1980, work-related fatality rates for the State of Alaska have decreased 68% (*Figure 19*) largely due to the increased attention from NIOSH. The 6-year average fatality rate for the period after the Alaska Field Station was established decreased 51% compared to the fatality rate for the 6-year time period 1980-1985 (*Figure 20*).

*Figure 19. Occupational Fatality Rates for the State of Alaska**
 (Source: NIOSH NTOF 1980-2001)



*Data for 2001 exclude deaths associated with September 11.

Figure 20. Annual Average Fatality Rates for the State of Alaska for Four Time Periods Between 1980 and 2001 (Source: NIOSH NTOF)*



*Data for 2001 exclude deaths associated with September 11.

INTERMEDIATE OUTCOMES (IO):

Since NIOSH began collecting data through the NTOF surveillance system in the mid 1980s, NIOSH has been a leader in improving knowledge on characteristics of occupational fatalities such as those described previously. Within NIOSH, the FACE program has relied heavily on NTOF data to select investigation priorities and support program recommendations. NTOF has also been frequently cited by many NIOSH researchers as evidence to support or influence more detailed analyses or direct specific safety research projects. NIOSH's fatality surveillance efforts have led to a greater understanding of the industries and occupations at high risk and a greater public awareness of the causes and circumstances surrounding workplace fatalities.

The utility of NTOF fatality surveillance data also influenced the National Academy of Science Panel on Occupational Safety and Health Statistics' recommendation for development of a more comprehensive national fatality census (Pollack & Keimig, 1987). This led directly to the development of the Bureau of Labor Statistics' Census of Fatal Occupational Injuries (CFOI) system that NIOSH continues to use for fatality surveillance.

FINAL CUSTOMERS:

- Employers;
- Supervisors;
- Safety Managers;
- Workers; and
- Manufacturers.

INTERMEDIATE OUTPUTS:

Since NIOSH began collecting data through the NTOF surveillance system, NTOF statistics have been routinely cited through newspaper articles, press releases, and on news and radio shows.

INTERMEDIATE CUSTOMERS:

- Bureau of Labor Statistics;
- National Center for Health Statistics;
- The Occupational Safety and Health Administration; and
- Members of the academic and public health research communities.

TRANSFER ACTIVITIES:

Findings from the NTOF surveillance data were routinely distributed through presentations to scientific conferences, research working groups, professional associations, and other audiences. Examples of groups or conferences to which NTOF data were presented include:

- American Public Health Association;
- Homicide Research Working Group;
- American Medical Association;

- Injury Prevention and Control World Conferences;
- National Occupational Injury Research Symposium;
- National Safety Council;
- Safe USA; and
- American Society of Safety Engineers.

OUTPUTS:

The primary output from this project is the NTOF database that is accessible by researchers within NIOSH. Results from these data have been disseminated per specific requests for NTOF analyses and through NIOSH publications and scientific journals.

NIOSH Publication Sub-category:

Overall Fatalities

CDC (1987). Traumatic occupational fatalities—United States, 1980-1984. MMWR 36(28):461-474, 469-470.

NIOSH [1989]. National Traumatic Occupational Fatalities: 1980-1985. Cincinnati, OH: U.S. Department of Health and Human Service, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Pub. No. 89-116.

NIOSH [1993]. Fatal Injuries to Workers in the United States, 1980-1989: A Decade of Surveillance, National Profiles. Cincinnati, OH: U.S. Department of Health and Human Service, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Pub. No. 93-108.

NIOSH [1993]. Fatal Injuries to Workers in the United States, 1980-1989: A Decade of Surveillance, National and State Profiles. Cincinnati, OH: U.S. Department of Health and Human Service, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Pub. No. 93-108S.

CDC (1998). Fatal occupational injuries—United States, 1980-1994. MMWR 47(15)/297-302.

CDC (1999). Achievements in Public Health, Improvements in Workplace Safety--United States, 1900-1999. MMWR 48(22)/461-469.

NIOSH (2000). Worker health chartbook, 2000. DHHS (NIOSH) Pub. No. 2000-127.

CDC (2001). Fatal occupational injuries—United States, 1980-1997. MMWR 50(16)/317-320.

NIOSH [2001]. Fatal Injuries to Civilian Workers in the United States, 1980-1995: National Profile. Cincinnati, OH: U.S. Department of Health and Human Service, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Pub. No. 2001-129.

NIOSH [2001]. Fatal Injuries to Civilian Workers in the United States, 1980-1995: National and State Profiles. Cincinnati, OH: U.S. Department of Health and Human Service, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Pub. No. 2001-129S.

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CDC [1994]. Occupational Injury Deaths of Postal Workers – United States, 1980-1989. MMWR 43(32): 587, 593-595.

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NIOSH [1992]. Homicide in U.S. Workplaces: A Strategy for Prevention and Research. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-103.

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ACTIVITIES:

Accurate reporting of workplace fatalities is a critical component for determining prevention priorities. Prior to the 1980s, however, no systematic national data collection of traumatic occupational fatalities existed. Recognizing this gap and the disparity in existing estimates, NIOSH began collecting fatality surveillance data through the NTOF surveillance system in the mid 1980s to gain a better understanding of the most severe work-related injuries. NIOSH developed NTOF by collecting death certificates from state vital registrars in all 50 states, New York City, and the District of Columbia. Demographic, industry, occupation, and circumstances of death were abstracted for fatalities occurring from 1980 through 2001. Through the NTOF, NIOSH provided for the first time a uniform surveillance system of work-related injuries for all industries and for all traumatic injury-related causes of death. This collection of death certificates filled a critical data need in identifying and understanding workplace fatalities. Through the identification of leading causes of death (e.g., homicides and machines) and high-risk worker groups (e.g., youth), NIOSH has created new or directed existing projects. NTOF fatality data have been disseminated in the scientific literature, NIOSH publications, and presentations to occupational safety and health, public health, and other audiences. These data have also been used by NIOSH and OSHA as a quantitative basis to guide national research priorities, in the development of recommendations for preventing occupational injury deaths, and to set occupational safety standards.

NTOF successfully filled a critical data need to drive occupational fatality research. However, the limitations inherent in conducting surveillance solely based on death certificates were well recognized. Based on the recommendations of the National Academy of Science Panel on Occupational Safety and Health Statistics (Pollack & Keimig, 1987), the BLS began collecting occupational fatality information from multiple sources. In 1992, the BLS CFOI was fully operational and continues through today. The use of multiple fatality data sources with improved case capture (~20% increase in fatalities vs. NTOF) and dual confirmation of work-relatedness by an agency dedicated to statistical data collection has provided an exceptional system for more detailed industry wide surveillance. After a decade of overlap, NIOSH

discontinued the NTOF data collection at the end of 2001 and now uses the CFOI data for occupational fatality surveillance. NIOSH and BLS have a mutually beneficial relationship that expands the utility of the CFOI data. NTOF provided an important data source as efforts to address occupational safety were growing. NIOSH continues to maintain these data as a resource for examination of trends over a 22 year period.

INPUTS:

Two publications influenced the direction of the NTOF surveillance system: recommendations of the National Academy of Science Panel on Occupational Safety and Health Statistics published in *Counting Injuries and Illness in the Workplace: Proposals for a Better System* (Pollack & Keimig, 1987) and the NIOSH strategic plan entitled *Tracking Occupational Injuries, Illnesses, and Hazards: The NIOSH Surveillance Strategic Plan* (NIOSH, 2001).

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PROJECT ID: CAN 8870, State-based Fatality Surveillance Using FACE Model

END OUTCOMES:

Data analysis has not been conducted on the impact of State-based Fatality Assessment and Control Evaluation (FACE) programs. Such an analysis has numerous complexities, including a dynamic set of states participating in the program over the years. Additionally, while State-based FACE programs make concerted efforts to reduce worker fatalities based on findings from fatality investigations, they rely on preventative actions taken by others, such as employers and regulators. Given numerous examples of intermediate outputs, it is likely that State-based FACE has contributed to reductions in worker injury deaths.

INTERMEDIATE OUTCOMES (IO):

- In February 2003, the Michigan (MI) FACE program investigated the death of a store manager who died of acute respiratory failure after suffering an acute asthmatic reaction due to inhalation of chemicals after spraying the floor and sides of a van with an isocyanate-based truck bed liner (TBL). This investigation identified a serious chemical exposure hazard not widely recognized by companies and workers involved with TBL applications. The MI FACE program contacted the Alliance for the Polyurethane Industry (API) for assistance in getting information to those at risk. The API formed a Truck Bed Lining Task Group to address the issues involved in the TBL application. Because API found very little public information on the truck bed liner application process, they decided to develop and disseminate an informational pamphlet to all member company franchises, to non-member franchises, and to all operators of companies offering truck bed liner services as identified through the business pages of the telephone book. The API Task Group is currently working on best practices and standardized training programs.
- After seeing a copy of the Michigan (MI) FACE report 04MI223, *19 Year-Old Female Waitress Died From an Asthma Attack While Working in a Bar*, Michigan State Senator Raymond Basham wrote an e-mail to the Michigan State University, Occupation and Environmental Medicine employee who had informed him about the report, saying he had used the report to make a very compelling argument in support of his legislation, Michigan Senate Bill 394 and its companion bill SB 395, that together prohibit smoking in all Michigan workplaces including restaurants and bars. These bills were introduced into the Michigan Senate on April 19, 2005. They were referred to Committees and have not been voted upon.
- The Oklahoma (OK) FACE program investigated the January 2003 death of an equipment operator who died from head injuries when another employee attempted to pull the road grader he was operating out of a ditch. The tow rope was attached to a “ripper tooth” on another grader that was being used to tow the victim’s machine out of a ditch. OK FACE disseminated the investigation report to a technical career center safety coordinator, who used the report in a training of Latimer County road worker employees. During the training, workers reported that it had been a common practice for years to use the ripper teeth to pull things with road graders. This practice was discontinued by the county following the dissemination of the report.

- The West Virginia (WV) FACE program developed a safety video entitled *Some Mistakes Last Forever* and a field guide entitled *West Virginia Logger's Safety Field Guide* based on findings from fatality investigations. From April 2002 through October 2003, the WV Department of Forestry incorporated both the video and safety guide into 80 logger safety training sessions (required for certification) attended by 1,197 loggers. Post-training surveys found statistically significant improvements in safety knowledge after viewing the video. Many loggers contacted at follow-up said they related to the real-life victim stories portrayed in the video, and that the field guide served as a quick and easy reference and taught them valuable tips on safe cutting and felling. Based on a survey conducted six months after training, 57% of loggers reported changing work site practices as a result of the training. Many loggers reported that the field guide was an excellent reference for safe cutting and felling techniques, was used in safety meetings, and was kept in work vehicles.
- The Washington (WA) FACE program has received feedback on intermediate outcomes through anonymous mail-back surveys following distribution of fatality investigation reports. Examples follow:
 - *Lineman Killed After Being Struck by a Car in Washington State* (00WA040) was mailed to 769 recipients on June 14, 2004. Evaluation surveys with postage-paid return envelopes were mailed to all recipients on August 30, 2004. One-hundred and twenty-seven (17%) surveys were returned by October 21st. The respondents reported that 37% had made changes as a result of the materials. Of those reporting changes, 84% reported that it was too early to tell if the changes had been effective, 7% stated that the changes had been effective, and 9% did not respond.
 - *City Worker Killed When Struck by a Dump Truck in Washington State* (00WA041) was mailed to 1,092 recipients in August 2004. One hundred and forty (13%) recipients responded to the survey, with 44% of respondents reporting changes as a result of the materials. Of those reporting changes, 84% reported that it was too early to tell if the changes had been effective, 12% reported that the changes had been effective, and 5% reported that the changes were not effective.
- In February 2004, the New York (NY) FACE program distributed a fatality investigation report and related fact sheet, *Truck Driver Run Over by Trash Compactor at Municipal Landfill* (FACE FACTS02NY007), to 48 landfill employers in New York. On June 5, 2004, the Albany Times Union published a story, *And now, a dump with a dress code of sort*, reporting that a town landfill in NY instituted new policies requiring all people who visit the landfill (e.g. to dispose of trash) to wear orange safety vests on site. This new policy was prompted, in part, by recommendations and outreach made by the NY FACE program following the investigation of the truck driver fatality.
- The Boston Globe Newspaper company printed an article entitled *Panel Targets Floor Finishing* on May 17, 2006. Massachusetts (MA) FACE is on this panel, along with contactors, public health and environmental activists, and Vietnamese community leaders. Information from MA FACE investigations, *04MA032: Two Vietnamese Floor Sanders Die When Floor Product Ignites* and *MA044: Floor Sander Dies When Wood Floor Refinish Product Ignites*, have been used to highlight hazards. A Vietnamese language cable series focused on occupational safety and health topics will address hazards of floor finishing in the first three shows, the first of which will be shown in September 2006. State Representative

Martin J. Walsh of Dorchester, MA has filed a bill that will require contractors and employees in Massachusetts to become trained and certified, and to use a safety checklist when refinishing wood floors. This bill is currently in the Rules Committee and will be re-filed during the next Massachusetts House Session.

- In 1994, MA FACE investigated the death of petroleum plant operator who was fatally injured by a fall when he was knocked off the top of a tanker truck while loading oil into the truck. A bubble of compressed air in the fuel caused the loading arm to recoil, striking the worker in the chest, and knocking him to a concrete floor 12 feet below. On September 7, 2000, the Boston Globe published an article, “Fuel tanker suit prompts changes,” describing changes made by the industry subsequent to this death. Though the MA FACE investigation and report were not mentioned in the article, preventive measures recommended by the MA FACE report were included in those described in the article, including, making fuel trucks with bottom loading charge ports and stabilizing load arm tubes when purging air from supply lines. The Boston Globe article made the following statement, “Overall fuel truck loading is becoming less hazardous due to advances in technology. Many newer trucks are now loaded from a pipe on the bottom of the tank rather through a hatch on the top, allowing the operator to stand safely on the ground.”
- The Nebraska (NE) FACE program widely distributed, NE 03-04 *Cattleman Dies Due to Accidental Injection*, including to all 720 registered veterinarians in Nebraska. The cattleman had died from an injection of Micotil 300®. Micotil 300® is typically dispensed by veterinarians to farmers, who in turn administer it or have their employees administer it to cattle or sheep. Veterinarians were also sent a survey on their use and practices related to Micotil 300®. Two-hundred and twenty-eight (32%) surveys were returned, with 107 (47%) of the responding veterinarians currently prescribing Micotil300®. All except one warned their customers each time about the dangers. Fourteen (12%) veterinarians prescribed an alternative drug and 15 (12%) stopped prescribing Micotil® based on the associated dangers. Seven that did not prescribe Micotil® still warned their customers.
- The Oregon (OR) FACE program communicated findings from an investigation OR2003-20-01, *Youth camp counselor killed when cannon burst into pieces*, to the Oregon Bureau of Labor and Industries, Wage and Hour Commission. Recommendations in the report were used to propose a child labor rules change that restricts minors under the age of 18 years old from using explosives in non-agricultural jobs. On January 3, 2005 a new rule addressing occupations involving the use of explosives by minors was passed (Stat. Auth.: ORS 653.305 & 653.525.)
- In 1994, the New Jersey Fatality Assessment and Control Evaluation (NJ FACE) program investigated a work-related fatality that involved a 20 year old lifeguard who was electrocuted when he touched a water pump that was energized due to an electrical fault in the pump motor. Recognizing that similar conditions might exist at other public pools within the state, NJFACE published a hazard alert bulletin entitled “Electrocution Hazard for Employees at Public Swimming Pools.” NJ FACE sent 3,200 bulletins to local health departments for distribution during their bi-annual swimming pool health inspections. As a follow-up, NJFACE sent surveys to 270 swimming pool directors to inquire whether their pools had been inspected and if electrical hazards were identified. Seventy three percent of the responders who had received the hazard alert indicated that they had their swimming

pools inspected. Thirty seven percent reported finding electrical problems. In response to the lifeguard electrocution, Old Bridge New Jersey passed an ordinance in October 1994 requiring periodic inspections of swimming pools to help prevent electrocutions. During 1995, 15 of the town's 21 pools (71%) failed their initial inspection because they did not meet electrical requirements. In 1996, members of the New Jersey State Assembly and Senate introduced bills modeled on the Old Bridge swimming pool ordinance. The New Jersey FACE hazard alert bulletin was cited in the bill's narrative to justify the new law. After several years of discussion and modification, New Jersey Pool Law, PL1998c137 was signed into law by Governor Whitman in December 1999. As of January, 2004 the NJ FACE program has not identified any additional work-related electrocutions at NJ swimming pools

FINAL CUSTOMERS:

Employers, safety managers, supervisors, workers, and health care professionals.

INTERMEDIATE OUTPUTS:

State-based FACE investigation findings, reports, and recommendations have been cited and used in trade journals and newsletters, occupational safety and health publications, public health media, and in the lay press. They have also been used by other states in safety alerts. The following are examples, and not an exhaustive list.

- The California (CA) FACE program was mentioned in an article, *Do your Hispanic Workers Understand You?*, published in the April 2006 edition of the Professional Landcare Network's (PLANET) newsletter *Safety Solutions*. This article went out to all PLANET members, approximately 4,300 companies. Reference to the NIOSH and CA FACE Websites were included in the article which can be found at www.landcaenwetwork.org.
- A trade journal mentioned the Iowa (IA) FACE report that dealt with a farm boy's death. *Rollover Fatality Mars Family Legacy*, authored by Cheryl Tevis. This article was published on the Special Bonus page in *Successful Farming* in March, 2005.
- The summary and recommendations section of the Kentucky (KY) FACE report, *Equine Farm Manager Dies From Accidental Overdose of Xylazine*, was published by the Kentucky Department of Agriculture in *Kentucky Proud*, in the column "From the Front Desk of the State Veterinarian" Volume 2, Issue 2 in April, 2005.
- A sticker developed by the MA FACE program conveying that workers less than 18 years of age are prohibited from operating forklifts was modified by the U.S. Department of Labor, Wage and Hour Division (WHD), and subsequently distributed broadly by WHD, OSHA, and NIOSH.
- The North Carolina Department of Labor issued an Alert entitled *Department of Public Works Employee Electrocuted Attempting to Read a Water Meter Located Behind an Apartment* (http://nclabor.com/boiler/alerts/alert_electrocution.htm) which cited MI FACE Investigation Report 03MI079.

- The MI FACE program was cited or mentioned in the following articles/websites:
 - *Breathing Better, Living Well*, has a link to MI FACE Investigation #04MI223: *19-year-old female waitress died from an asthma attack while working in a bar at* <http://www.breathingbetterlivingwell.com/archive/articles/faceindoorairdeath.pdf>;
 - Bed Liner Product Spray Resources: cites MI FACE Investigation #03MI018: *Manager of after-market truck bed liner store dies of asthma attack after spraying van with isocyanate-based truck bed liner at* <http://bedliners.aboutrapid.info/bed-liner-product-spray.html>;
 - Safety Lines from Minnesota OSHA, *Truck Bed Lining Industry No Breath of Fresh Air*, cites MI FACE Investigation #03MI018: *Manager of after-market truck bed liner store dies of asthma attack after spraying van with isocyanate-based truck bed liner at* <http://www.doli.state.mn.us/pdf/5006sl.pdf>;
 - Occupational Hazards, *Hammering Away at Construction Hazards – 5/12/06* used information from the MI FACE Investigation #04MI160, *Carpenter dies when 8-foot trench wall collapses during sewer pipe replacement*, as part of an article that informs readers about the most common causes of injury in construction and measures to prevent injury.
- Minnesota (MN) FACE supplied information used in an article on farm safety entitled: *Stored Grain-Hazardous Situations that Can Quickly Turn Deadly*, published in the *Southwest Minnesota Farmer*, November 19, 2004.
- The Nebraska Tribune used information from NE 03-04, *Cattleman Dies Due to Accidental Injection*, in a three-part article published in October, 2003: *Breaking the Silence, Haunted, and Under a Microscope*. Dialogue between NE FACE, Elanco (the manufacturer of Micotil®- the pharmaceutical involved in NE 03-04) and the Food and Drug Administration has resulted in the following:
 - The potentially fatal consequences of human injection are now more clearly noted by the manufacturer on prescription pads and the product label, and
 - New safety materials have been developed and distributed to veterinarians who distribute the antibiotic to farmers.
- Two investigations conducted by the NE FACE program, one worker killed and one injured in separate incidents due to an accidental injection of Micotil 300®, an animal antibiotic, were cited in an article entitled *NIOSH Report Details Exposure Risks of Exposure to Drugs Meant for Animals* which was published by Occupational Safety and Health in Volume 35, No 14, pages 314-315 on April 7, 2005.
- NE FACE supplied information used in an article entitled: *U.S. Mexican Agencies Team Up on Job Safety*, published January 20, 2006 in the *Omaha World Herald*.
- NY FACE supplied information used in an article about baler safety entitled, *Baler Safety a Must*, published in the *New York State Retailer*, Vol.3, Number 7, 2005.

- WA FACE supplied information used in an article on construction fall fatalities that ran on the front page of the Tacoma News Tribune on 12/5/04, *Construction workers' safety net full of holes*.
- The NIOSH FACE website address was included in Annex D of the draft ANSI Z133 Standard -The American National Standard for Tree Care Operations.
- A trade journal mentioned FACE reports that dealt with roadway work zone fatalities. *Roadway Work Zone Tragedies Can Be Prevented, American Society of Safety Engineers Say, Especially This Memorial Day*. Published at <http://www.asse.org> on May 26, 2005.
- Professional nursing journal coverage of *NIOSH Alert, Preventing Falls of Workers through Skylights and Roof and Floor Openings*. Summary information was published March, 2005 in the American Association of Occupational Health Nurses (AAOHN) Newsletter.
- Trade Journal coverage of *NIOSH Alert, Preventing Falls of Workers Through Skylights and Roof and Floor Openings*: December 13, 2004 Reed Business Information, Division of Elsevier, Inc-New England Construction Headline: New Literature; December 16, 2004: Business News Publishing company 2656-Best or e-mail bestsafe@capital.net to request a copy. Headline: Temporary skylight guarding.

INTERMEDIATE CUSTOMERS:

U.D. Department of Labor, Occupational Safety and Health Administration (OSHA) and State-plan OSH States
U.S. Department of Labor, Wage and Hour Division
U.S. Food and Drug Administration
Health and safety professionals
Academic professionals
Safety and health consultants
Trade groups, e.g. American Polyurethane Industry (API)

TRANSFER ACTIVITIES:

The NIOSH FACE program posts all state-based fatality investigation reports on the NIOSH FACE webpage, and includes links to each state-based FACE program where additional State-based FACE publications such as Alerts, FACE Fact sheets, fatality narratives and journal articles are located. (www.cdc.gov/niosh/face). NIOSH provides support to states in communicating findings amongst states, including helping to coordinate annual meetings. This helps foster the use of findings and products across states. NIOSH also incorporates findings from state-based fatality investigations into NIOSH Publications and other products, including NIOSH comments on proposed regulations.

State-based FACE programs share findings at national, state, and regional conferences; trade shows; county fairs; and employer sponsored tool box meetings. State-based programs also work with other state agencies, such as regulatory agencies, and state and community task forces and working groups. For example, Massachusetts FACE continues to coordinate the Preventing Falls in Construction Working Group, which met on February 15, 2006. This meeting included a

presentation by an occupational medicine resident working with the FACE project, *Fall Protection in Residential Construction: Should the Massachusetts Building Code Be Changed to Include Built-in Anchoring Systems (BIAS)?* A written report on which the presentation was based was disseminated at the meeting to 18 representatives of OSHA, BLS, Liberty Mutual Insurance Company, CPWR, University of Massachusetts, Harvard University, The Construction Institute, Massachusetts Division of Occupational Safety, Massachusetts Department of Public Health, and immigrant community organizations. Copies were also distributed at the Annual FACE Meeting on March 8, 2006.

OUTPUTS:

Top level category:

The NIOSH webpage <http://www.cdc.gov/niosh/face/> contains links to each State-based FACE program where additional State-based FACE publications such as Alerts, FACE Fact sheets, fatality narratives and journal articles are located.

States have produced state-based publications, such as videos, alerts, safety information packets, brochures, fact sheets, fatality narratives, news bulletins, and press releases. States have also produced training videos and programs. Select examples follow:

AK FACE [2004]. Faller Safety Interactive Video. Anchorage, AK: Alaska Fatality Assessment and Control Evaluation Program.

CA FACE [2005]. FACE FACTS: Crane Operator Crushed! Unsecured Load Falls During Riggings. Richmond, CA: California Fatality Assessment and Control Evaluation Program.

KY FACE [2004]. FACE the Facts: Fatal Occupational Motor Vehicle Collisions and Work Fatigue/Inattention in Kentucky. Lexington, KY: Kentucky Fatality Assessment and Control Evaluation Program.

MA FACE [2002]. FACE Facts: 16-year-old Massachusetts youth was fatally injured at work while operating a forklift. Boston, MA: Massachusetts Fatality Assessment and Control Evaluation Program.

MA FACE [2002]. FACE Facts: Massachusetts welders killed in explosions caused by torch cutting operations. Boston, MA: Massachusetts Fatality Assessment and Control Evaluation Program.

MA FACE [2003]. FACE Facts: Massachusetts police officers killed in highway and street work zones. Boston, MA: Massachusetts Fatality Assessment and Control Evaluation Program.

MA FACE [2006]. MA FACE and State Fire Marshall Fire Safety Alert. Boston, MA: Massachusetts Fatality Assessment and Control Evaluation Program.

MA FACE [1997]. Falls: The leading killer on construction sites. Boston, MA: Massachusetts Fatality Assessment and Control Evaluation Program.

MI FACE [2004]. MI Hazard Alert: Electrocuted While Welding. Lansing, MI: Michigan Fatality Assessment and Control Evaluation Program.

NE FACE [2003]. FACE FACTS: Energy—Friend or Foe? Omaha, NE: Nebraska Fatality Assessment and Control Evaluation Program.

NJ FACE [2004]. NJ Hazard Alert Bulletin: Warning! Dangers to Teens Working at Pizza Restaurants. Trenton, NJ: New Jersey Fatality Assessment and Control Evaluation Program.

NY FACE [2006]. FACE Facts: Truck driver run over by a trash compactor at a municipal landfill. Troy, NY: New York Fatality Assessment and Control Evaluation Program.

NY FACE [2006]. A NY FACE Training Guide for Safety and Health Professional Module 1: Preventing Deaths and Injuries to Public Workers While Working Around Mobile Equipment. Troy, NY: New York Fatality Assessment and Control Evaluation Program.

OK FACE [2003]. Injury Update: Construction-Related Fatalities in Oklahoma. Oklahoma City OK: Oklahoma Fatality Assessment and Control Evaluation Program.

OR FACE [2003]. OR FACE Fatality Alert: Truck-Mounted Pile Driver presents Fatal Electrocution Hazard. Portland, OR: Oregon Fatality Assessment and Control Evaluation Program.

WA FACE [2005]. Fatal Facts: Electrocution Hazards Working Near Overhead Power Lines. Olympia, WA: Washington Fatality Assessment and Control Evaluation Program.

WI FACE [2001]. Fact Sheet: Youth Farm Worker Pinned Under Overturned Horse-Drawn Manure Sled. Madison, WI: Wisconsin Fatality Assessment and Control Evaluation Program.

WV FACE [2002]. Video: Some Mistakes Last Forever. Morgantown, WV: West Virginia Fatality Assessment and Control Evaluation Program.

WV FACE [2002]. West Virginia Logger's Safety Field Guide. Morgantown, West Virginia Fatality Assessment and Control Evaluation Program.

NIOSH Publication Sub Category:

Fatality reports—974 finalized State-based FACE reports between 1996 through 2005. Of these, 407 were machine related and 149 were falls. These reports are available at <http://www.cdc.gov/niosh/face/>

Higgins DN [2004]. NIOSH Alert: Preventing Falls of Workers through Skylights and Roof and Floor Openings. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2004-156.

Higgins D, Parker DK, Wahl G [2001]. Hazards associated with using farm tractors to move large bales, Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Hazard ID 13.

Higgins DN, Hendricks K, Struttman T, Tierney J [1999]. Deaths among children aged ≤ 5 years from farm machinery runovers--Iowa, Kentucky, and Wisconsin, 1995-1998, and United States, 1990-1995. *MMWR* 48(28):605-608.

Burkhart J, Moore PH [2003]. Preventing deaths and injuries while compacting or baling refuse material, Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2003-124.

Casini V, Castillo DN, Lentz TJ, Ray TD [2001]. NIOSH Alert: Preventing injuries and deaths from falls during construction and maintenance of telecommunications towers, Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-156.

Moore, PH, Merinar TR [2006]. NIOSH Alert: Preventing worker injuries and deaths from mobile crane tip-over, boom collapse, and uncontrolled hoisted loads, Cincinnati, OH: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2006-142.

External Publication Sub-Category:

NIOSH authors or co-authors:

Styles L, Cierpich H, Rogge J, Higgins D, Harrison R [2005]. To live and die in Los Angeles: the California Fatality Assessment and Control Evaluation (FACE) program: 1992 - 2002, 2005 National Injury Prevention and Control Conference, Denver, Colorado, May 9-11, 2005 Atlanta, GA: Centers for Disease Control and Prevention.

Helmkamp JC, Bell JL, Lundstrom WJ, Ramprasad J, Haque A [2004]. Assessing safety awareness and knowledge and behavioral change among West Virginia loggers, *Inj Prev* 10(4):233-238.

Higgins DN, Tierney J, Lins M, Hanrahan L [2004]. School Nurses: A Resource for Young Worker Safety, *J Sch Nur* 20(6):317-323. *(The Editor's publication notification letter indicates that the article was sent to the 12,000 members of the National Association of School Nurses.)*

Tierney JM, Higgins DN, Hanrahan LP, Washburn MJ [2003]. Preventing Youth Worker Fatalities [Abstract] In: National Occupational Injury Research Symposium 2003, October 28-30, 2003, Pittsburgh, PA: <http://www.cdc.gov/niosh/noirs/noirmain.html>.

Higgins D, Tierney J, Hanrahan L [2002]. Preventing youth worker fatalities: the Fatality Assessment and Control Evaluation (FACE) Program, *AAOHN* 50(11):508-514.

Higgins DN, Casini VJ, Bost P, Johnson W, Rautiainen R [2001]. The Fatality Assessment and Control Evaluation program's role in the prevention of occupational disease, *Injury Prevention* 7(Suppl 1):i27-i33.

State-based authors-examples of external articles:

Hallman EM, Gelberg KH, and Hallisey JL. A NY FACE Case Study: Dairy Farm Owner Dies during Manure Pump PTO Entanglement, *Journal of Agromedicine*, 2005; Vol 10(3).

Chester DA, Hanna EA, Pickelman BG, Rosenman KD. Asthma death after spraying polyurethane, *American Journal of Industrial Medicine*, Volume 48, Issue 1, Date: July 2005, Pages: 78-84.

MN FACE [2004]. Summertime Baling: A Time of Increased Risk on Minnesota Farms. *Southwest Minnesota Farmer*, Vol 1 (15), 2004.

IA FACE [2003]. Investigating a Fatal Tree Shear Incident. *Arbor Age*, April 2003.

Parker D, Wahl G [1998]. Fatalities associated with large round hay bales -- Minnesota, 1994-1996. *MMWR* 47(2):27-30.

Targeted dissemination efforts:

OK FACE report 03OK 016-01, “Waste disposal worker was crushed between a waste disposal truck and a dumpster in Oklahoma,” along with a cover letter and a copy of the NIOSH Alert “Preventing workers injuries and death from moving refuse collection vehicles” was distributed to 210 waste hauling companies and to 812 persons on the OK FACE mailing list which included vocational school instructors, medical examiners, high school teachers, and others. OK FACE developed a survey to measure reader response. Seventy-two surveys were returned, a 7% response rate. In response to the question how will you use the enclosed materials? (responders could check all that applied): 35 responded that they would use the materials in training and safety meetings; 23 said they would distribute it to employees; 22 said they would post the material on the bulletin board; 21 responded that they would file it for future use; 14 responded that they would not use it as they did not operate waste disposal trucks; and, 14 had a variety of additional narrative responses. No-one checked the response that they would not use the material because the information was not helpful. One of the additional responses was “Thanks for the packet. The City of Nicholas Hills now contracts out our commercial accounts with dumpsters. Safety concerns were part of that decision. The NIOSH Alert I ordered over the Internet. I used it in training and incorporated it into our safety manual. Any and all additional information in the future is welcome.”

MA FACE disseminated a work zone FACE Facts packet to all MA Police Chiefs (348). The packets consisted of the MA FACE Facts, a letter explaining the mailing, a MA FACE Brochure, and a FAX request sheet for ordering additional copies of the work zone FACE Facts work zone fact sheet. Thirty police departments requested an additional 1,972 copies.

MA FACE and the MA teens at Work Project mailed 199 packets to all employers in the Department of Industrial Accidents database that had an injured teen worker file a workers compensation claim. These packets consisted of a letter explaining the mailing, a copy of the MA employers guide to child labor laws, the young worker forklift safety FACE Facts and sticker, and a FAX request form for additional copies of the materials. Eleven requests were made for additional copies.

MA FACE developed a database of 28 Spanish community organizations. Informational packets which consisted of a letter explaining the mailing, Spanish and English versions of the MA FACE young worker forklift safety FACE Facts and sticker, Torch Cutting FACE Facts, MA FACE Fall Prevention Brochures, and a fax form for additional copies of the materials. Fifty requests were received for the forklift safety FACE Facts; 40 for the torch cutting FACE Facts, 60 for the falls brochures, and 50 for forklift warning stickers.

In October 2003, 3,354 copies of the NIOSH Alert, “Preventing Worker Deaths from Uncontrolled Release of Electrical, Mechanical, and Other Types of Hazardous Energy,” published in August 1999, were mailed to companies in Nebraska and California as part of a state-based dissemination effort. These mailings included cover letters from the Nebraska Department of Labor and the California Department of Public Health, respectively. One-thousand, five-hundred and fifty-four Alerts were distributed in Nebraska, and 1,800 in California. Sixty-six readers returned reader response cards, 25 from Nebraska and 41 from California. Summaries of these responses follow:

- Forty-seven (71%) responders identified themselves as managers, 10 (15%) as safety professionals, 8 (12%) as employees, and 1 as other.
- Forty-nine (74%) responders reported that they worked in private industry, 14 (21%) owned their own business, and 4 (6%) of the respondents reported that they worked in a government agency.
- Seventeen (26%) respondents reported that they used the document to change the work environment or procedure, 16 (24%) used it to assist in ongoing or new research, 16 (24%) reported that they used the document to change training or course curriculum, and 9 (14%) reported that the document was not used.

The WI FACE program sent the article, *School Nurses: A Resource for Young Worker Safety*, to 530 school nurses in WI along with a survey to assess the utility of the article. One-hundred fifty-eight nurses responded to the survey. Summaries of responses follow:

- 31% reported that they used information in the article to promote young worker safety;
- 85% reported that the article increased their understanding of child labor laws;
- 78% reported that the article increased their understanding of safety training.
- When asked to report how they would use the materials to promote young work safety, the majority reported that they would share the information with colleagues.

ACTIVITIES:

State-based FACE is a continuing extramural program of identification and epidemiologic investigation of selected occupational fatalities. The objective of the FACE project is to prevent fatal work-related injuries through an integrated program of surveillance, on-site investigation, and dissemination and prevention activities. The project is implemented through cooperative agreements with State health and labor departments.

The purpose of State-based Fatality Assessment and Control Evaluation (FACE) is to identify work environments that place workers at high risk for fatal injury, identify potential risk factors, and formulate and disseminate prevention strategies to those who can intervene in the workplace. State-based FACE identifies work-related deaths and investigates selected cases through a network of cooperative agreements with states using the NIOSH FACE model. Investigative findings and prevention recommendations are broadly disseminated through health

communication documents at state and national levels, and are used by employers and manufacturers to increase worker safety, and by OSHA and other organizations to support promulgation of safety standards and compliance directives. Numerous fact sheets, alerts, hazard IDs, Workplace Solutions, journal articles, posters, and presentations are made based on information gained through investigations.

INPUTS:

Until recently, NIOSH identified specific types of deaths that all state-based FACE programs would investigate, and states identified additional targets based on surveillance data in their states, and opportunities for prevention. NIOSH has used both the NIOSH National Traumatic Occupational Fatality (NTOF) database and Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI) data system to identify targets for the FACE project. Other inputs have also been used to identify targeted areas for investigation. Specifically, the 1998 Research Council report, “Protecting Youth at Work,” as well as input from the U.S. Department of Labor, Wage and Hour Division, influenced the FACE program targeting young worker deaths. OSHA interest and focused prevention activities in falls from telecommunication towers and Hispanic worker fatalities influenced the FACE program targeting Hispanic worker deaths. In the future, targets for investigation by all states will likely be identified by the State-based FACE Coordination Consortium, which includes voting representatives from all states, and nonvoting representatives from NIOSH.

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END OUTCOMES:

None to report specific to this project.

INTERMEDIATE OUTCOMES (IO):

- NIOSH data analysis, information from fatality investigations, and FACE investigative reports were used in the development of the North Carolina Telecommunication Tower Standard, the first in the nation, promulgated by the North Carolina Department of Labor.
- NIOSH researchers provided information to Mr. Jake Verkerk, who is with the Safety and Environmental Compliance office of the Federal Aviation Administration (FAA) in Miami. This information led to the successful development of a scope of work involving the retrofitting of a damaged antenna tower at Great Inagua in the Bahamas. In a letter to NIOSH, Mr. Verkerk stated “Dear NIOSH Division of Safety Research: The Safety and Environmental Compliance office of the FAA in Miami, want to thank Mr. Virgil Casini for providing vital information to the successful development of a scope of work involving the retrofitting of a damaged NDB antenna tower at Great Inagua, the Bahamas. Mr. Casini's insight and his close working relationships with the task members of the National Association of Tower Erectors (NATE) have lead to the dramatic improvement of the FAA's regional perception of safe working at antenna tower structures, and Mr. Casini's ability to provide contact leads with industry professionals and regulators has proven paramount in the identification of the lack of proper safe guards in our local Elevated Work Surfaces program. Once again, we appreciate your West Virginia counterpart for his contributions to the well being of the local Federal employee safety program managed in Miami for South Florida and the Caribbean.”
- NIOSH researchers assisted OSHA and NATE in the development of a three-day train-the-trainer course designed for OSHA compliance officers, contractors, tower erectors, tower owners, wireless service carriers, and tower component manufacturers. At one training course held in Stowe, Ohio, 173 participants from 37 states were present. All course evaluations from participants were positive.
- A packet containing a sample of four crane-related FACE reports and a page from the NIOSH Alert, “Preventing Electrocutions of Crane Operators and Crew Members Working Near Overhead Powerlines” was mailed to approximately 4,600 crane rental and crane service establishments across the nation. The packet described crane-related injury risks and steps employers can take to prevent worker death and injury. Recipients were encouraged to use these materials for training purposes, toolbox talks, and as support for safety program development. A crane rental company requested over 100 copies to issue with each crane rented. A construction contractor who requested multiple copies praised the packet as the most useful safety tool he ever received from the government. “I had heard about the accidents, but didn't know the causes. I will circulate the publication among my employees who work with cranes. It will give us an opportunity to discuss crane safety using real life examples. I am sure my employees will find it as fascinating as I did.”

- The Agricultural Health Nurse Program of New York State, funded by NIOSH, identified an incident that resulted in the scalping of a woman in New York when her hair became entangled in the driveline of a hay bale thrower on a hay baling machine. Subsequent investigation by NIOSH personnel identified four additional cases. The same model machine was involved in all the incidents. NIOSH investigations indicated that when the women leaned under the driveline to adjust the tension on the hay bales, their hair became entangled in the driveline. The drivelines were covered by a U-shaped tunnel guard that left the bottom of the rotating driveline exposed. In response to these incidents, NIOSH developed an Alert entitled *Preventing Scalping and Other Severe Injuries From Farm Machinery*. Although only one model of machinery was involved in this incident, the hazards and recommendations identified in the document apply to many manufacturers and types of agricultural equipment. When contacted, the manufacturer informed NIOSH that a retrofit guard had been developed for the machine that would entirely enclose the rotating driveline. Dissemination of the NIOSH Alert to equipment dealers and county agricultural extension agents impacted end users; requests for the retrofit guard exhausted the manufacturer's inventory and resulted in additional production to fill orders.
- NIOSH, through its Community Partners for Healthy Farming program in New York, received two separate reports of farm workers who were injured while attempting to drill holes into sealed plow frames in order to mount a hitch or a "slow-moving vehicle" sign. These workers received serious skin burns and other injuries when the drill bits penetrated the frames releasing and igniting flammable gases. Subsequent NIOSH investigations indicated that hydrogen and methane gas may be produced within sealed frames that are filled during manufacture with scrap metal ballast. It was determined that the un-cleaned, assorted, machine shop metal scrap ballast apparently reacts electrochemically with water and emulsion-type cutting oils to liberate flammable gases. After NIOSH discussions with the manufacturer, the manufacturer ceased using the scrap for fill in their equipment frames and began using stainless steel punch-out scrap.

FINAL CUSTOMERS:

Employers, safety professionals, workers, and manufacturers.

INTERMEDIATE OUTPUTS:

- Sarah Sanders Smith, Assistant Professor of Organizational Leadership & Supervision, Purdue University North Central contacted the In-house FACE project officer and said that she is developing for Purdue University an Occupational Safety and Health training program that will establish Purdue University as the educational center for Occupational Safety and Health in the state of Indiana. She is using the NIOSH page in general and the FACE program in particular in the development of this program. The FACE program and the FACE reports and other FACE materials such as Workplace Solutions and Alerts will be used as a basis for training modules and in the development and establishment of prevention strategies for this program.

- Ms. Ellen Parson, contributing Editor for *American Reconstruction Magazine*, a new periodical aimed at contractors performing reconstruction after demolition efforts and/or after natural disasters, interviewed the FACE project officer. A discussion was held on the use of portable generators (electrical and CO hazards), the use of rough-duty extension cords, and the importance of treating all conductors as energized unless they have been verified as de-energized. Ms. Ayrd also wanted information on the FACE program, and liked the FACE reports written after the electrocutions investigated in Puerto Rico following Hurricane Hugo. Ms. Ayrd said she would reprint these reports in the magazine along with other relevant reports. The first few issues of the magazine will contain information from the NIOSH and FACE web pages. The first article entitled “The Shocking Truth—Beware of Electrical Hazards” was published in the July 2006 issue (<http://www.ecmweb.com/>).
- As part of a collaboration between NIOSH, OSHA, and the National Association of Tower Erectors (NATE), NIOSH provided technical assistance to OSHA in the development of a safety checklist for telecommunication tower construction safety and in the development and revision of a compliance directive (CPL 2-1.36- Interim Inspection Procedures During Communication Tower Construction Activities), both of which provide guidance on safe work practices in the construction and maintenance of telecommunication towers. The 100% fall protection and personnel hoisting requirements contained in the initial and revised directive were supported by NIOSH investigative findings and data input and, when used correctly, decrease worker exposure to fall hazards.
- OSHA and NATE developed, with technical assistance from NIOSH staff, a three-day train-the-trainer course designed for OSHA compliance officers, contractors, tower erectors, tower owners, wireless service carriers, and tower component manufacturers.
- NIOSH researchers provided OSHA with data, investigative findings, and preventive recommendations that were used in the development of the OSHA Training Institute’s *Course 350—Tower Safety*.
- NIOSH researchers provided NATE technical assistance in the development of their comprehensive safety manual. Additionally, NIOSH researchers provided the Advisory Committee for Construction Safety and Health (ACCSH) telecommunication tower subcommittee with technical assistance in the development of a *Recommended Best Practices Site Safety Manual*.
- NATE provides a direct link to the NIOSH homepage and to relevant NIOSH publications in their monthly association journal *Tower Times*.
- Mr. Craig Lekutis, President, Wireless estimator.com developed an article on the use of NIOSH telecommunication tower-related FACE reports as training aids for the wireless industry. Wireless Estimator.com is a free internet service for the wireless industry. The article provided links to the FACE reports and can be found at: http://www.wirelessestimator.com/breaking_news.cfm.

- While NIOSH was investigating the hazard of drilling into sealed frames of agricultural equipment, *Successful Farming* magazine ran a cover story detailing a project by the Future Farmers of America (FFA) in Kansas to replace slow moving vehicle signs on all agricultural machinery in the state. The cover picture was of two youth drilling into a sealed frame. Following NIOSH contact, the FFA issued a nationwide bulletin to all FFA chapters describing the hazard, and *Successful Farming* ran an article on the NIOSH Hazard ID summarizing the hazard and steps to reduce injury, *Ignition Hazard From Drilling Into Sealed Frames of Agricultural Equipment*.
- NIOSH has received feedback on a number of ways in which stakeholders use FACE findings and recommendations to educate employers, workers and the public about work hazards and prevention measures. For example, the Occupational Safety and Health Administration, the American Bureau of Crane Inspection, Inc., West Virginia University, North Carolina State University, and trade associations report using the materials for training. Publications such as *Technical Rescue*, based in the United Kingdom, reprint FACE reports.
- In a study funded by CPWR using NIOSH grant funding, Michael Behm from East Carolina University analyzed fatality reports from FACE investigations and linked them back to the design-for-safety concept (Linking construction fatalities to the design for construction safety concept, Behm M, SAFETY SCIENCE , 43 (8): 589-611 OCT 2005). FACE cases were used to assess the potential of designing safety into construction projects.
- In a Construction Bulletin entitled “How Much Do You Know About Forklift Safety,” Copyright 2005 Reed Business Information, US, a Division of Reed Elsevier Inc., information and cases from the NIOSH Forklift Alert were cited.
- Mr. Josh Cable, writer for Occupational Hazards magazine, wrote an article entitled “Hammering Away at Construction Hazards” that referenced the NIOSH FACE report 2005-11.
- FACE report 2005-06, Hispanic Worker Dies After Falling From a Pile of Construction Debris in the Bed of a Trash-Style Body Truck to a Paved Driveway Below—North Carolina, was printed in its entirety in the Spring 2006 issue of Blueprints, the American Society of Safety Engineers’ construction practice specialty newsletter. The Editor’s note gave an excellent description of both the in-house and state-based FACE program.

INTERMEDIATE CUSTOMERS:

- OSHA
- State Departments of Labor
- Researchers
- Journalists
- Trade and labor associations
- Trainers and training organizations

TRANSFER ACTIVITIES:

NIOSH uses multiple avenues to foster FACE findings and recommendations being put into action in the workplace. All FACE reports are posted on the internet: www.cdc.gov/niosh/face. An electronic communication link has been established on the FACE website that will alert key stakeholders when new FACE reports are available. The FACE dissemination list is being refined to ensure that FACE reports are reaching all key stakeholders. All FACE reports from FY2001 through the present have been linked to an electronic evaluation mechanism that will allow users to provide instant feedback on the reports. FACE personnel will receive quarterly reports of the feedback from EID that will be evaluated and will allow FACE personnel to improve the quality and usefulness of the reports as necessary

NIOSH has established routine mechanisms whereby FACE reports and products are disseminated to groups who use them in training and outreach to employers, such as the nine OSHA Consultation Programs, an OSHA Regional Training and Educational Center, and the American Society of Safety Engineers. Through the past fiscal year, over 12,000 NIOSH-numbered publications have been disseminated through these avenues. Additionally, seven trade publications with subscribers numbering over 360,000 have agreed to work with FACE personnel to disseminate FACE products.

NIOSH frequently undertakes targeted outreach (independently and with partners such as OSHA and the Wage and Hour Division, Department of Labor) to specific employer and worker groups and intermediaries. Examples include NIOSH outreach on crane-related injury risks, joint outreach with the Department of Labor on young worker deaths associated with forklifts, assistance from the Association of Equipment Manufacturers (AEM) in disseminating a Workplace Solution on hazards associated with excavators (provided an international mailing list), and assistance from the National Association of Tower Erectors in disseminating an Alert on preventing falls from telecommunication towers.

NIOSH also provides technical assistance and participates on working groups addressing specific hazards. Two examples are NIOSH working with OSHA, the National Association of Tower Erectors and state level regulators to improve safety for workers who erect and maintain telecommunication towers, and NIOSH working with the Association of Equipment Manufacturers, the International Union of Operating Engineers (IUOE), and OSHA to update OSHA regulations for ROPS on ride-on rollers.

Presentations are given to researchers and at professional conferences. Examples include:

“Ignition Hazard From Drilling Into Sealed Frames of Agricultural Equipment” presented to NIOSH staff in Pittsburgh, PA.

“Communication Towers: A Rising Injury Risk” presented to the Board of Scientific Counselors in 2000.

“Communication Towers: A Rising Injury Risk” presented as part of the OSHA train the trainer Telecommunication Tower course in Cleveland, Ohio 1999.

“Communication Towers: A Rising Injury Risk” presented at the NATE annual conference in Dallas, Texas 2001.

“NIOSH, OSHA, NATE Efforts for the Prevention of Injury to Telecommunication Tower Construction and Maintenance Workers” presented at the National Safety Council in Atlanta 2001.

“Communication Towers: A Rising Injury Risk” presented as part of the OSHA Telecommunication Tower course in Philadelphia, PA. 2001.

“The NIOSH Fatality Assessment and Control Evaluation (FACE) Program” presented to the IMHOTEP students in Atlanta, Georgia.

“Communication Towers: A Rising Injury Risk” presented to North Carolina stakeholders meeting in Raleigh, NC.

“Communication Towers: A Rising Injury Risk” presented at NOIRS 2000.

“The NIOSH Fatality Assessment and Control Evaluation (FACE) Program” presented at the National Safety Council in New Orleans, LA.

“The NIOSH, OSHA, NATE Partnership for the Prevention of Injury to Telecommunication Tower Construction and Maintenance Workers” presented to DSR staff and Dr. Linda Rosenstock.

“NIOSH, OSHA, NATE Efforts for the Prevention of Injury to Telecommunication Tower Construction and Maintenance Workers” presented at the 2000 NATE annual conference.

“Efforts to Prevent Crane-Related Fatalities” poster presentation for the ASSE conference in Las Vegas, Nevada 2004.

“Investigation of Hispanic Worker Fatalities to Identify Factors That Contribute to High Fatality Rates” poster presentation for the World Safety Congress Orlando, FL 2005.

“Communication Towers: A Case Study” presentation given at NATE 2003 annual conference.

“Efforts for the Prevention of Injury to Telecommunication Tower Construction and Maintenance Workers” presented at the NATE 2005 annual conference by OSHA personnel. Author could not attend due to weather.

“The NIOSH Fatality Assessment Control Evaluation (FACE) Project” presented via envision to Roger Rosa and the Department of Transportation 2005.

“NIOSH FACE Program: Hispanic Worker Fatalities” presented at the 2003 annual FACE meeting in Washington state.

“The NIOSH Fatality Assessment and Control Evaluation (FACE) Program for the Investigation and Prevention of Occupational Fatalities” presented at the OSHA Training Institute Des Plaines, IL, 1998.

OUTPUTS:

FACE findings are summarized in narrative reports for each fatality investigation (FACE reports), and are featured in NIOSH Alerts, Workplace Solutions, and journal articles. FACE findings are also included in NIOSH comments on proposed worker safety and health legislation (e.g. lockout/tagout, trenching and excavations, electrical safety and child labor laws).

Six hundred and forty-three FACE investigations have been conducted and 630 FACE reports have been completed and posted on the NIOSH FACE webpage. Since 1996, NIOSH personnel have conducted 145 FACE investigations. Of these, fifteen involved falls from elevation and seventy involved machinery. These reports can all be accessed at:

<http://www.cdc.gov/niosh/face/default.html> .

Twenty NIOSH Alerts on a variety of subjects including forklifts, balers, cranes, scalping, falls from telecommunication towers, falls through skylights, and falls from scaffolds have been developed using FACE findings and prevention recommendations. Eleven of these Alerts have been translated into Spanish. Three monographs (confined space, electrocution, and falls) have been published. Three NIOSH Hazard IDs have been developed pertaining to wood chippers, moving large hay bales, and ignitions during the penetration of sealed frames of agricultural machinery. Two Workplace Solutions involving backhoes/excavators and ride-on roller compactors were developed and disseminated internationally. These products may all be accessed at: <http://www.cdc.gov/niosh/face/othpubs.html>. Two new NIOSH Workplace Solutions based on FACE findings will be published in 2007, one addressing backovers in roadway work zones, and another that will be translated into Spanish addressing aluminum ladder/overhead powerline contact.

Citations for journal articles:

CDC [1996]. Skid-steer loader-related fatalities in the workplace--United States, 1992-1995. *MMWR* 45(29):624-628.

Moore P, Burkhart J [2001]. Baler and compactor-related deaths in the workplace--United States, 1992-2000, *MMWR* 50(16):309-313.

Higgins DN, Casini VJ, Bost P, Johnson W, Rautiainen [2001]. The fatality assessment and control evaluation program's role in the prevention of occupational fatalities. *Inj Prev* 7 (Suppl 1): i27-33.

ACTIVITIES:

The goals/objectives of this project are to prevent fatal work injuries by identifying work situations at high risk of fatal injury and developing prevention strategies for those who can intervene in the workplace.

NIOSH is voluntarily notified of selected occupational fatalities (currently machine-related, workers under 18 years of age, highway construction work zones, and Hispanic workers) by the Departments of Labor in the states of Maryland, North Carolina, South Carolina, Tennessee, and Virginia, Federal OSHA Area Offices in Ohio and Pennsylvania, and the Allegheny County Coroner's Office in Pittsburgh, Pennsylvania. NIOSH is notified of work-related deaths of youth under 18 years of age across the nation by the Wage and Hour Division, U.S. Department of Labor. Through on-site fatality investigations, FACE personnel collect agent, host, and environmental information from the pre-event, event, and post-event phases of the fatal incident via a case series design to facilitate descriptive analysis of the incidents. These investigations are not conducted to find fault or place blame, but to better understand the chain of events and contributing factors and develop recommendations for preventing similar deaths. Findings from FACE investigations are frequently combined with surveillance data to describe specific injury problems and develop broad-based prevention recommendations. The results of FACE investigations are disseminated through narrative reports for each fatality, NIOSH Alerts, Workplace Solutions, technical reports, targeted mass mailings, journal articles, MMWRs, and presentations. NIOSH Alerts and Hazard IDs have covered the topics of forklifts, skid steer loaders, telecommunication towers, skylights, moving large hay bales, and wood chippers among others. The results of the FACE program have the unique capability to reach workers at risk and provide timely intervention strategies to targeted areas.

All FACE products are available on the internet. Additionally, NIOSH frequently undertakes targeted dissemination efforts to provide prevention information to specific audiences. For example, in FY04 NIOSH mailed a packet documenting crane-related injury risks and steps that can be taken to prevent worker death and injury to approximately 4,600 crane rental and crane service establishments across the nation.

NIOSH also partners with other federal agencies and private sector groups to communicate prevention information from the FACE program. For example, NIOSH has worked for several years with OSHA and the National Association of Tower Erectors (NATE) to reduce extremely high fatality rates for workers who erect and maintain telecommunication towers. NIOSH data analysis, information from FACE investigations, and recommendations are used by OSHA and NATE as training materials. To address shared concerns about the incidence of young workers being fatally injured while operating forklifts, NIOSH and the Department of Labor's Wage and Hour Division (WHD) collaborated in December 2002 to send an information packet on forklift safety and young workers to more than 10,000 retail warehouses and storage facilities. NIOSH, WHD, and OSHA all participated in additional outreach efforts in January 2004 to distribute 5,000 copies of this same packet, along with an OSHA bulletin, in a broader mailing that included OSHA alliance partners such as the Industrial Truck Association (ITA).

The State-Based FACE Program and Fire Firefighter Fatality Investigation and Prevention Program were spawned from the In-House FACE Program and use the original FACE methodology in the implementation of their respective programs.

INPUTS:

Initially, the NIOSH National Traumatic Occupational Fatality (NTOF) database was utilized to identify targeted areas of investigation. These targets included confined spaces, electrocutions, falls, logging, agriculture, youth, and machines. Today, the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI) data system is used to identify targets for the FACE project. For example, BLS CFOI analyses demonstrating high occupational injury fatality rates among Hispanics were used to support the addition of Hispanics as a target for FACE investigations.

Other inputs have also been used to identify targeted areas for investigation. Specifically, the 1998 Research Council report, “Protecting Youth at Work,” as well as input from the U.S. Department of Labor, Wage and Hour Division influenced the FACE program targeting young worker deaths. OSHA interest and focused prevention activities in falls from telecommunication towers and Hispanic worker fatalities influenced the FACE program targeting Hispanic worker deaths.