NIOSH SCIENCE AWARDS RESULTS BOOKLET FOR 2017 PROGRAM

ALICE HAMILTON AWARD

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DIA

The Director's Intramural Award

JAMES P. KEOGH AWARD

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

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NIOSH Science Awards 2017

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

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NIOSH Presents 2017 Awards for Significant Scientific Contributions

The National Institute for Occupational Safety and Health (NIOSH) recognized several NIOSH researchers and partners for their significant contributions to the field of occupational safety and health in 2016.

John Howard, MD, NIOSH Director

NIOSH presents the annual awards to honor researchers for excellence in science that informs and supports the prevention of work-related injuries, illnesses, and deaths. The awards include the following:

- The Alice Hamilton Award, for scientific excellence of technical and instructional materials by NIOSH scientists and engineers.
- The James P. Keogh Award, for outstanding service by an individual in the occupational safety and health field.
- The Bullard-Sherwood Research-to-Practice Award, for exceptional efforts by NIOSH researchers and partners in applying occupational safety and health research to the prevention of workplace fatalities, illnesses, or injuries.
- The Director's Intramural Award for Extraordinary Science (DIA).

"The annual NIOSH Science Awards provides an opportunity to acknowledge the outstanding contributions NIOSH staff and partners have made to occupational safety and health," said NIOSH Director John Howard, MD. "Developing new knowledge to improve the safety and health of our nation's workers is at the core of what we do, and I am proud to honor the hard work and ingenuity that helps NIOSH achieve its mission."

Alice Hamilton Awards

Named after Dr. Alice Hamilton, a pioneering researcher and occupational physician, the Alice Hamilton Award honors exceptional contributions in biological sciences, engineering and physical sciences, human studies, and educational materials. The submissions go through a rigorous review by panels of scientific experts, including peers from both outside and inside NIOSH.

The work of this year's award recipients underscores the breadth and significance of occupational safety and health research. To protect U.S. healthcare workers faced with the Ebola epidemic, NIOSH scientists and their CDC colleagues helped implement safety and health controls for infectious disease in the first U.S. hospital to care for a patient with Ebola virus. Looking to examine the effectiveness of vibration-reducing gloves, NIOSH researchers tested the ability of different commercially available gloves to reduce

vibrations from powered hand tools, finding the gloves provide little protection to the worker. NIOSH researchers conducted the first-known study to calculate the overall number of years lost by U.S. workers due to work-related hearing impairment and provided an estimate of different levels of hearing impairment by industry. To protect workers exposed to heat and hot environments, NIOSH researchers published a new document with lifesaving, up-to-date information and recommendations for working in heat. NIOSH scientists also developed a new tool to measure airborne engineered nanomaterials.

James P. Keogh Award

The James P. Keogh Award for Outstanding Service in Occupational Safety and Health recognizes a current or former NIOSH employee whose career "exhibits respect and compassion for individual workers, with tireless leadership, courage, and a fierce determination to put knowledge into practice to enhance their well-being."

For 2017, NIOSH honors Diane Porter for her lifetime commitment to promoting worker safety and health. In more than 30 years in public service, Ms. Porter's efforts have reached millions of workers and improved countless workplaces and communities. She spent three decades at NIOSH, retiring in 2015 as the institute's founding deputy director. Ms. Porter provided leadership and direction during many pivotal times at NIOSH, which included implementing the National Occupational Research Agenda (NORA), establishing the NIOSH Division of Compensation Analysis and Support, integrating the Bureau of Mines into NIOSH, and moving the NIOSH World Trade Center Health Program from an extramural grant program to a NIOSH-administered program. Not only is she an advocate for worker safety and health, Ms. Porter is a natural mentor who devoted her time and talents to support and guide NIOSH employees leaving a legacy at NIOSH that endures.

Bullard-Sherwood Research-to-Practice Award

The Bullard-Sherwood Research-to-Practice Award, named for the inventor of the hard hat, Edward W. Bullard, and the inventor of the personal industrial hygiene sampling pump, R. Jeremy Sherwood, recognizes recipients for outstanding contributions in three categories: Knowledge, Interventions, and Technology. The awards honor outstanding projects in 2016 to increase worker protection in oil and gas extraction, healthcare, and mining. In the Knowledge category, NIOSH researchers were honored for their efforts to evaluate and raise awareness about the hazards to workers who manually gauge or collect fluid samples from storage tanks at oil and gas well sites. In the Interventions category, a training designed to educate nurses and nurse managers on how to reduce the health and safety risks of shift work and long work hours took top honors. A project in the Technology category was honored for the design and implementation of an engineering control to significantly reduce workers' exposure to silica during hydraulic fracturing operations. The award-winning project for Technology designed better lighting for areas in and around roof-bolting machines.

Director's Intramural Award for Extraordinary Science

The Director's Intramural Award for Extraordinary Science recognizes outstanding collective contributions to science excellence at NIOSH by individual intramural scientists and support staff. Dr. Charles Geraci, an internationally recognized leader in the nanotechnology field, received the Distinguished Career Scientist award for his contributions in policy, research, and field investigation strategies, and in the application of research to the health and safety approaches needed for the responsible development of emerging nanotechnologies. Dr. Candice Johnson received the Early Career Scientist award for her initiative and strong work ethic. Joining NIOSH less than 5 years ago, Dr. Johnson has initiated research to investigate occupational exposures, reproductive health, women's health, cardiovascular health, health disparities, and biases in epidemiologic studies, in addition to multiple deployments related to the Ebola and Zika viruses. Mrs. Vanessa Williams, the team lead for visual communications—with 35 years of government service—received the Scientific Support award for expertly assisting NIOSH staff as they develop and disseminate communication products to help get NIOSH's research and knowledge into the hands of workers, employers, and other stakeholders.

For more information about the NIOSH Science Awards, including winners and nominees for all categories, or for more information about NIOSH research activities, visit the NIOSH website.

NIOSH is the federal institute that conducts research and makes recommendations for preventing work-related injuries, illnesses, and deaths. For more information about NIOSH, visit http://www.cdc.gov/niosh/.

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Alice Hamilton Award for Occupational Safety and Health

The Alice Hamilton Award for Occupational Safety and Health recognizes the scientific excellence of technical and instructional materials by NIOSH scientists and engineers in the areas of Education and Guidance, Engineering and Control, Epidemiology and Surveillance, Exposure and Risk Assessment, and Methods and Laboratory Science.

The award honors Dr. Alice Hamilton (1869–1970), a pioneering researcher and occupational physician, and it is presented each year by NIOSH following reviews by panels of scientific experts from inside and outside the institute.

Education and Guidance

Winner

Addressing Infection Prevention and Control in the First U.S. Community Hospital to Care for Patients with Ebola Virus Disease: Context for National Recommendations and Future Strategies

Cummings KJ, Choi MJ, Esswein EJ, de Perio MA, Harney JM, Chung WM, Lakey DL, Liddell AM, Rollin PE

Cummings KJ, Choi MJ, Esswein EJ, de Perio MA, Harney JM, Chung WM, Lakey DL, Liddell AM, Rollin PE [2016]. Addressing infection prevention and control in the first U.S. community hospital to care for patients with Ebola virus disease: context for national recommendations and future strategies. Ann Intern Med *165*(1):41–49.
NIOSHTIC-2: 20048329 | NORA: Services

Abstract

Healthcare personnel caring for patients with Ebola virus disease (EVD) are at increased risk for infection with the virus. In 2014, a Texas hospital became the first U.S. community hospital to care for a patient with EVD; 2 nurses were infected while providing care. This article describes infection control measures developed to strengthen the hospital's capacity to safely diagnose and treat patients with EVD. After admission of the first patient with EVD, a multidisciplinary team from the Centers for Disease Control and Prevention (CDC) joined the hospital's infection preventionists to implement a

system of occupational safety and health controls for direct patient care, handling of clinical specimens, and managing regulated medical waste. Existing engineering and administrative controls were strengthened. The personal protective equipment (PPE) ensemble was standardized, healthcare personnel were trained on donning and doffing PPE, and a system of trained observers supervising PPE donning and doffing was implemented. Caring for patients with EVD placed substantial demands on a community hospital. The experiences of the authors and others informed national policies for the care of patients with EVD and protection of healthcare personnel, including new guidance for PPE, a rapid system for deploying CDC staff to assist hospitals ("Ebola Response Team"), and a framework for a tiered approach to hospital preparedness. The designation of regional Ebola treatment centers and the establishment of the National Ebola Training and Education Center address the need for healthcare personnel to be prepared to safely care for patients with EVD and other high-consequence emerging infectious diseases.

Honorable Mention

Will My Work Affect My Pregnancy? Resources for Anticipating and Answering Patients' Questions

Grajewski B, Rocheleau CM, Lawson CC, Johnson CY

Grajewski B, Rocheleau CM, Lawson CC, Johnson CY [2016]. "Will my work affect my pregnancy?" Resources for anticipating and answering patients' questions. Am J Obstet Gynecol *214*(5):597–602.
NIOSHTIC-2: 20048403 | NORA: Manufacturing

Abstract

Authoritative information on occupational reproductive hazards is scarce and complex because exposure levels vary, multiple exposures may be present, and the reproductive toxicity of many agents remains unknown. For these reasons, women's health providers may find it challenging to effectively address workplace reproductive health issues with their patients who are pregnant, breast-feeding, or considering pregnancy. Reproductive epidemiologists at the Centers for Disease Control and Prevention National Institute for Occupational Safety and Health answered more than 200 public requests for occupational reproductive health information from 2009 through 2013. The most-frequent occupations represented were healthcare (41%) and laboratory work (18%). The most common requests for exposure information concerned solvents (14%), anesthetic gases (10%), formaldehyde (7%), infectious agents in laboratories (7%) or healthcare settings (7%), and physical agents (14%), including ionizing radiation (6%). Information for developing workplace policies or guidelines was sought by 12% of the requestors. Occupational exposure effects on breast-feeding were an increasing concern among working women. Based on information developed in response to these requestors, information is provided for discussing workplace exposures with patients, assessing potential workplace reproductive hazards, and helping patients determine the best options for safe work in pregnancy. Appendices provide resources to address specific occupational exposures, employee groups, personal protective equipment, breast-feeding, and workplace regulations regarding work and pregnancy. These tools can help identify those most at risk of occupational reproductive hazards and improve workers' reproductive health. The information can also be used to inform research priorities and assist the development of workplace reproductive health policies.

Engineering and Control

Winner

Tool-specific Performance of Vibration-reducing Gloves for Attenuating Fingers-transmitted Vibration

Welcome DE, Dong RG, Xu XS, Warren C, McDowell TW

Welcome DE, Dong RG, Xu XS, Warren C, McDowell TW [2016]. Tool-specific performance of vibration-reducing gloves for attenuating fingers-transmitted vibration. Occup Ergon *13*(1):23–44.
NIOSHTIC-2: 20048402 | NORA: Construction

Abstract

Fingers-transmitted vibration can cause vibration-induced white finger. The effectiveness of vibration-reducing (VR) gloves for reducing hand-transmitted vibration to the fingers has not been sufficiently examined. OBJECTIVE: The objective of this study is to examine tool-specific performance of VR gloves for reducing finger-transmitted vibrations in three orthogonal directions (3D) from powered hand tools. METHODS: A transfer function method was used to estimate the tool-specific effectiveness of four typical VR gloves. The transfer functions of the VR glove fingers in three directions were either measured in this study or during a previous study using a 3D laser vibrometer. More than 70 vibration spectra of various tools or machines were used in the estimations. RESULTS: When assessed based on frequency-weighted acceleration, the gloves provided little vibration reduction. In some cases, the gloves amplified the vibration by more than 10%, especially the neoprene glove. However, the neoprene glove did the best when the assessment was based on unweighted acceleration. The neoprene glove was able to reduce the vibration by 10% or more of the unweighted vibration for 27 out of the 79 tools. If the dominant vibration of a tool handle or workpiece was in the shear direction relative to the fingers, as observed in the operation of needle scalers, hammer chisels, and bucking bars, the gloves did not reduce the vibration but increased it. CONCLUSIONS: This study confirmed that the effectiveness for reducing vibration varied with the gloves and the vibration reduction of each glove depended on tool, vibration direction to the fingers, and finger location. VR gloves, including certified anti-vibration gloves, do not provide much vibration reduction when judged based on frequency-weighted acceleration. However, some of the VR gloves can provide more than 10% reduction of the unweighted vibration for some tools or workpieces. Tools and gloves can be matched for better effectiveness for protecting the fingers.

Honorable Mention

Development of Noise Controls for Longwall Shearer Cutting Drums

Camargo HE, Azman AS, Alcorn LA

Camargo HE, Azman AS, Alcorn L [2016]. Development of noise controls for longwall shearer cutting drums. Noise Control Eng J *64*(5):573–585.
NIOSHTIC-2: 20048898

Abstract

Noise-induced hearing loss is the second-most pervasive disease in the mining industry. The exposure of miners to noise levels above the permissible exposure level results in hearing loss for approximately 80% of coal miners by retirement age. In addition, between 2002 and 2011, approximately 48% of longwall shearer operators were overexposed in U.S. coal mines. Previous research identified the two rotating cutting drums used by the longwall shearer to extract coal as the most significant sound-radiating components. In this context, the National Institute for Occupational Safety and Health conducted research to develop noise controls for longwall mining systems. To this end, structural and acoustic numerical models of a single cutting drum were developed to assess its dynamic and acoustic response, respectively. Once validated, these models were used to explore various noise control concepts including force isolation, varying structural damping, and varying component stiffness. Upon multiple simulations, it was determined that structural modifications to increase the stiffness of the outer vane plates were the most practical and durable approach to reducing the sound radiated by the cutting drums. Furthermore, these modifications did not adversely affect the cutting performance, nor the loading ability of the drums. As a result, these structural modifications were implemented into an actual set of drums for evaluation purposes. Results from the underground evaluation, when the modified cutting drums were used under normal operation conditions, showed noise reduction across the entire frequency spectrum, with an overall noise reduction of 3 dB in the sound pressure level at the operator location, confirming the validity of the developed noise controls.

Epidemiology and Surveillance

Winner

Hearing Impairment among Noise-exposed Workers—United States, 2003–2012

Masterson EA, Bushnell PT, Themann CL, Morata TC

Masterson EA, Bushnell PT, Themann CL, Morata TC [2016]. Hearing impairment among noise-exposed workers—United States, 2003–2012. MMWR *65*(15):389–394.
NIOSHTIC-2: 20047891 | NORA: Manufacturing

Abstract

Hearing loss is the third-most-common chronic physical condition in the United States, and is more prevalent than diabetes or cancer. Occupational hearing loss, primarily caused by high noise exposure, is the most-common U.S. work-related illness. Approximately 22 million U.S. workers are exposed to hazardous occupational noise. CDC compared the prevalence of hearing impairment within nine U.S. industry sectors using 1,413,789 noise-exposed worker audiograms from CDC's National Institute for Occupational Safety and Health Occupational Hearing Loss Surveillance Project. CDC estimated the prevalence at six hearing-impairment levels, measured in the better ear, and the impact on quality of life expressed as annual disability-adjusted life years, as defined by the 2013 Global Burden of Disease Study. The mining sector had the highest prevalence of workers with any hearing impairment, and with moderate or worse impairment, followed by the construction and manufacturing sectors. Hearing loss prevention, and early detection and intervention to avoid additional hearing loss, are critical to preserve worker quality of life.

Honorable Mention

Work-related Fatal Motor Vehicle Traffic Crashes: Matching of 2010 Data from the Census of Fatal Occupational Injuries and the Fatality Analysis Reporting System

Byler C, Kesy L, Richardson S, Pratt SG, Rodríguez-Acosta RL

Byler C, Kesy L, Richardson S, Pratt SG, Rodriguez-Acosta RL [2016]. Work-related fatal motor vehicle traffic crashes: matching of 2010 data from the Census of Fatal Occupational Injuries and the Fatality Analysis Reporting System. Accid Anal Prev *92*: 97–106.
NIOSHTIC-2: 20047876

Abstract

Motor vehicle traffic crashes remain the leading cause of work-related fatal injuries in the United States, with crashes on public roadways accounting for 25% of all work-related deaths in 2012. In the United States, the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI) provides accurate counts of fatal work injuries based on confirmation of work relationship from multiple sources, while the National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS) provides detailed data on fatal motor vehicle traffic crashes based on police reports. Characterization of fatal work-related motor vehicle traffic crashes is currently limited by data sources that lack either data on potential risk factors (CFOI) or work-relatedness confirmation and employment characteristics (FARS). BLS and the National Institute for Occupational Safety and Health collaborated to analyze a merged data file created by BLS using CFOI and FARS data. A matching algorithm was created to link 2010 data from CFOI and FARS using date of incident and other case characteristics, allowing for flexibility in variables to address coding discrepancies. Using the matching algorithm, 953 of the 1,044 CFOI "Highway" cases (91%) for 2010 were successfully linked to FARS. Further analysis revealed systematic differences between cases identified as work-related by both systems and by CFOI alone. Among cases identified as work-related by CFOI alone, the fatally injured worker was considerably more likely to have been employed outside the transportation and warehousing industry or transportation-related occupations, and to have been the occupant of a vehicle other than a heavy truck. This study is the first step of a collaboration between BLS, NHTSA, and NIOSH to improve the completeness and quality of data on fatal work-related motor vehicle traffic crashes. The feasibility and value of matching data on fatal work-related traffic crashes from CFOI and FARS has been demonstrated. The results will lead to improvements in CFOI and FARS case capture, while also providing researchers with a better description of fatal work-related motor vehicle traffic crashes than would be available from the two data sources separately.

Exposure and Risk Assessment

Winner

NIOSH Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments

Jacklitsch B, Williams WJ, Musolin K, Coca A, Kim J-H, Turner N

NIOSH [2016]. Criteria for a recommended standard: occupational exposure to heat and hot environments—revised criteria 2016. Criteria Document. By Jacklitsch B, Williams WJ, Musolin K, Coca A, Kim J-H, Turner N. 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. 2016-106.

NIOSHTIC-2: 20047464 **|** NORA: Agriculture, Forestry and Fishing / Construction / Services

Abstract

Occupational exposure to heat can result in injuries, disease, reduced productivity, and death. To address this hazard, the National Institute for Occupational Safety and Health has evaluated the scientific data on heat stress and hot environments and has updated the *Criteria for a Recommended Standard: Occupational Exposure to Hot Environments*. This document was last updated in 1986. In recent years, including during the Deepwater Horizon oil spill response of 2010, questions were raised regarding the need for revision to reflect recent research and findings. There is also evidence that heat stress is an increasing problem for many workers, particularly those located in densely populated areas closer to the equator, where temperatures are expected to rise in relation to the changing climate. This revision includes additional information about the physiological changes that result from heat stress; updated information from relevant studies, such as those on caffeine use; evidence to redefine heat stroke and associated symptoms; and updated information on physiological monitoring and personal protective equipment and clothing that can be used to control heat stress. Workers who are exposed to extreme heat or work in hot environments indoors or outdoors, or even those engaged in strenuous physical activities, may be at risk for heat stress. Exposure to extreme heat can result in occupational illnesses caused by heat stress, including heat stroke, heat exhaustion, heat syncope, heat cramps, heat rashes, or death. Heat can also increase workers' risk of injuries, as it may result in sweaty palms, fogged-up safety glasses, dizziness, and may reduce brain function responsible for reasoning ability, creating additional hazards. Other heat injuries, such as burns, may occur because of contact with hot surfaces, steam, or fire. Those at risk of heat stress include outdoor workers and workers in hot environments, such as fire fighters, bakery workers, farmers, construction workers, miners (particularly surface miners), boiler room workers, and factory workers. In 2011, NIOSH published with the Occupational Safety and Health Administration (OSHA) a co-

branded infosheet on heat illness. Through this combined effort, many recommendations were updated, including those on water consumption. In addition, factors that increase risk and symptoms of heat-related illnesses were more thoroughly defined.

Honorable Mention

A Pilot Study of Healthy Living Options at 16 Truck Stops across the United States

Lincoln JE, Birdsey J, Sieber WK, Chen GX, Hitchcock EM, Nakata A, Robinson CF

Lincoln JE, Birdsey J, Sieber WK, Chen G-X, Hitchcock EM, Nakata A, Robinson CF [2016]. A pilot study of healthy living options at 16 truck stops across the United States. Am J Health Promot: Epub ahead of print, September.
NIOSHTIC-2: 20048751 | NORA: Transportation, Warehousing and Utilities

Abstract

Purpose: There is a growing body of evidence that the built environment influences diet and exercise and, as a consequence, community health status. Since long-haul truck drivers spend long periods at truck stops, it is important to know if this built environment includes resources that contribute to the emotional and physical well-being of drivers. Setting: The truck stop environment was defined as the truck stop itself, grocery stores, and medical clinics near the truck stop that could be accessed by a large truck or safely on foot. Design: Researchers at the National Institute for Occupational Safety and Health (NIOSH) developed and utilized a checklist to record the availability of resources for personal hygiene and comfort, communication and mental stimulation, health care, safety, physical activity, and nutrition at truck stops. Subjects: The NIOSH checklist was used to collect data at a convenience sample of 16 truck stops throughout the United States along both high-flow and low-flow truck traffic routes. Measures: The checklist was completed by observation within and around the truck stops. Results: No truck stops offered exercise facilities, 94% lacked access to healthcare, 81% lacked a walking path, 50% lacked fresh fruit, and 37% lacked fresh vegetables in their restaurant or convenience store. Conclusion: NIOSH found that most truck stops did not provide an overall healthy living environment.

Methods and Laboratory Science

Winner

Development of Portable Aerosol Mobility Spectrometer for Personal and Mobile Aerosol Measurement

Kulkarni P, Qi C, Fukushima N

Kulkarni P, Qi C, Fukushima N [2016]. Development of portable aerosol mobility spectrometer for personal and mobile aerosol measurement. Aerosol Sci Tech *50*(11):1167–1179.
NIOSHTIC-2: 20048730 | NORA: Manufacturing

Abstract

We describe development of a portable aerosol mobility spectrometer (PAMS) for size distribution measurement of submicrometer aerosol. The spectrometer is designed for use in personal or mobile aerosol characterization studies and measures approximately 22.5×22.5×15 cm, weighing about 4.5 kg including the battery. PAMS uses an electrical mobility technique to measure number-weighted particle size distribution of aerosol in the 10–855 nm range. Aerosol particles are electrically charged using a dual-corona bipolar corona charger, followed by classification in a cylindrical miniature differential mobility analyzer. A condensation particle counter is used to detect and count particles. The mobility classifier was operated at an aerosol flow rate of 0.05 L/min, and at two different user-selectable sheath flows of 0.2 L/min (for wider size range 15–855 nm) and 0.4 L/min (for higher size resolution over the size range of 10.6-436 nm). The instrument was operated in voltage-stepping mode to retrieve the size distribution in approximately 1–2 min. Sizing accuracy and resolution were probed and found to be within the 25% limit of the NIOSH criterion for direct-reading instruments. Comparison of size distribution measurements from PAMS and other commercial mobility spectrometers showed good agreement. The instrument offers unique measurement capability for on-person or mobile size distribution measurement of ultrafine and nanoparticle aerosol.

Honorable Mention

Accumulation of Ubiquitin and Sequestosome-1 Implicate Protein Damage in Diacetyl-induced Cytotoxicity

Hubbs AF, Fluharty KL, Edwards RJ, Barnabei JL, Grantham JT, Palmer SM, Kelly F, Sargent LM, Reynolds SH, Mercer RR, Goravanahally MP, Kashon ML, Honaker JC, Jackson MC, Cumpston AM, Goldsmith WT, McKinney W, Fedan JS, Battelli LA, Munro T, Bucklew-Moyers W, McKinstry K, Schwelger-Berry D, Friend S, Knepp AK, Smith SL, Sriram K

Hubbs AF, Fluharty KL, Edwards RJ, Barnabei JL, Grantham JT, Palmer SM, Kelly F, Sargent LM, Reynolds SH, Mercer RR, Goravanahally MP, Kashon ML, Honaker JC, Jackson MC, Cumpston AM, Goldsmith WT, McKinney W, Fedan JS, Battelli LA, Munro T, Bucklew-Moyers W, McKinstry K, Schwegler-Berry D, Friend S, Knepp AK, Smith SL, Sriram K [2016]. Accumulation of ubiquitin and sequestosome-1 implicate protein damage in diacetyl-induced cytotoxicity. Am J Pathol *186*(11):2887–2908.
NIOSHTIC-2: 20048662 | NORA: Manufacturing

Abstract

Inhaled diacetyl vapors are associated with flavorings-related lung disease, a potentially fatal airways disease. The reactive a-dicarbonyl group in diacetyl causes protein damage in vitro. Dicarbonyl/L-xylulose reductase (DCXR) metabolizes diacetyl to acetoin, which lacks this a-dicarbonyl group. To investigate the hypothesis that flavorings-related lung disease is caused by in vivo protein damage, we correlated diacetyl-induced airway damage in mice with immunofluorescence for markers of protein turnover and autophagy. Western immunoblots identified shifts in ubiquitin pools. Diacetyl inhalation caused dose-dependent increases in bronchial epithelial cells with puncta of total ubiquitin and K63-8 ubiquitin, central mediators of protein turnover. This response was greater in DCXR knockout than in wild type mice inhaling 200 ppm diacetyl, further implicating the a-dicarbonyl group in the protein damage. Western immunoblots demonstrated decreased free ubiquitin in airway-enriched fractions. Transmission electron microscopy and co-localization of ubiquitin-positive puncta with lysosomal 12 markers LAMP1 and LAMP2, and with the multifunctional scaffolding protein, sequestosome-1 (SQSTM1/p62), confirmed autophagy. Surprisingly, immunoreactive SQSTM1 also accumulated in the olfactory bulb of the brain. Olfactory bulb SQSTM1 often congregated in activated microglial cells that also contained olfactory marker protein, indicating neuronophagia within the olfactory bulb. This suggests the possibility that SQSTM1 or damaged proteins may be transported from the nose to the brain. Together, these findings strongly implicate widespread protein damage in the etiology of flavorings-related lung disease.

Alice Hamilton Award Finalists for 2017

References are alphabetized by first author.

Education and Guidance

Cummings KJ, Choi MJ, Esswein EJ, de Perio MA, Harney JM, Chung WM, Lakey DL, Liddell AM, Rollin PE [2016]. Addressing infection prevention and control in the first U.S. community hospital to care for patients with Ebola virus disease: context for national recommendations and future strategies. Ann Intern Med *165*(1):41–49.
NIOSHTIC-2: 20048329 | NORA: Services

Grajewski B, Rocheleau CM, Lawson CC, Johnson CY [2016]. "Will my work affect my pregnancy?" Resources for anticipating and answering patients' questions. Am J Obstet Gynecol *214*(5):597–602.
NIOSHTIC-2: 20048403 | NORA: Manufacturing

NIOSH [2016]. Criteria for a recommended standard: occupational exposure to diacetyl and 2,3-pentanedione. Criteria Document. By McKernan LT, Niemeier RT, Kreiss K, Hubbs A, Park R, Dankovic D, Dunn KH, Parker J, Fedan K, Streicher R, Fedan J, Garcia A, Whittaker C, Gilbert S, Nourian F, Galloway E, Smith R, Lentz TJ, Hirst D, Topmiller J, Curwin B. 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. 2016-111.
NIOSHTIC-2: 20048854 | NORA: Manufacturing

Engineering and Control

Camargo HE, Azman AS, Alcorn L [2016]. Development of noise controls for longwall shearer cutting drums. Noise Control Eng J *64*(5):573–585.
NIOSHTIC-2: 20048898

McDowell TW, Welcome DE, Warren C, Xu XS, Dong RG [2016]. The effect of a mechanical arm system on portable grinder vibration emissions. Ann Occup Hyg *60*(3):371–386.
NIOSHTIC-2: 20047062 | NORA: Manufacturing

Welcome DE, Dong RG, Xu XS, Warren C, McDowell TW [2016]. Tool-specific performance of vibration-reducing gloves for attenuating fingers-transmitted vibration. Occup Ergon *13*(1):23–44.
NIOSHTIC-2: 20048402 | NORA: Construction

Epidemiology and Surveillance

Byler C, Kesy L, Richardson S, Pratt SG, Rodriguez-Acosta RL [2016]. Work-related fatal motor vehicle traffic crashes: matching of 2010 data from the Census of Fatal Occupational Injuries and the Fatality Analysis Reporting System. Accid Anal Prev *92*: 97–106.
NIOSHTIC-2: 20047876

Konda S, Tiesman HM, Reichard AA [2016]. Fatal traumatic brain injuries in the construction industry, 2003–2010. Am J Ind Med *59*(3):212–220.
NIOSHTIC-2: 20047226

Masterson EA, Bushnell PT, Themann CL, Morata TC [2016]. Hearing impairment among noise-exposed workers—United States, 2003–2012. MMWR *65*(15):389–394.
NIOSHTIC-2: 20047891 | NORA: Manufacturing

Exposure and Risk Assessment

Frasch HF, Barbero AM [2016]. In vitro human epidermal permeation of nicotine from electronic cigarette refill liquids and implications for dermal exposure assessment. J Expo Sci Environ Epidemiol: Epub ahead of print, 2016 December.
NIOSHTIC-2: 20049071 | NORA: Manufacturing / Services

Lincoln JE, Birdsey J, Sieber WK, Chen G-X, Hitchcock EM, Nakata A, Robinson CF [2016]. A pilot study of healthy living options at 16 truck stops across the United States. Am J Health Promot: Epub ahead of print, 2016 September.
NIOSHTIC-2: 20048751 | NORA: Transportation, Warehousing and Utilities

NIOSH [2016]. Criteria for a recommended standard: occupational exposure to heat and hot environments—revised criteria 2016. Criteria Document. By Jacklitsch B, Williams WJ, Musolin K, Coca A, Kim J-H, Turner N. 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. 2016-106.
NIOSHTIC-2: 20047464 | NORA: Agriculture, Forestry and Fishing / Construction / Services

Methods and Laboratory Science

Dong J, Ma Q [2016]. In vivo activation of a T helper 2-driven innate immune response in lung fibrosis induced by multi-walled carbon nanotubes. Arch Toxicol *90*(9):2231–2248.
NIOSHTIC-2: 20047956 | NORA: Manufacturing

Hubbs AF, Fluharty KL, Edwards RJ, Barnabei JL, Grantham JT, Palmer SM, Kelly F, Sargent LM, Reynolds SH, Mercer RR, Goravanahally MP, Kashon ML, Honaker JC, Jackson MC, Cumpston AM, Goldsmith WT, McKinney W, Fedan JS, Battelli LA, Munro T, Bucklew-Moyers W, McKinstry K, Schwegler-Berry D, Friend S, Knepp AK, Smith SL, Sriram K [2016]. Accumulation of ubiquitin and sequestosome-1 implicate protein damage in diacetyl-induced cytotoxicity. Am J Pathol *186*(11):2887–2908.
NIOSHTIC-2: 20048662 | NORA: Manufacturing

Kulkarni P, Qi C, Fukushima N [2016]. Development of portable aerosol mobility spectrometer for personal and mobile aerosol measurement. Aerosol Sci Tech *50*(11):1167–1179.
NIOSHTIC-2: 20048730 | NORA: Manufacturing

Alice Hamilton Award
Research Updates for 2016 Winning Projects

Education and Guidance 2016 Update

BG 4 Benching Trainer Software: Instructors Guide

Navoyski J, MacDonald B, Helfrich W, Brnich M, Mallet L, Beshero D, Roth P

> NIOSH [2015]. BG 4 benching trainer software: instructors' guide. CD-ROM. By Navoyski J, MacDonald B, Helfrich W, Brnich M, Mallet L, Beshero D, Roth P. Pittsburgh, PA: 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. 2015-189c.
> **NIOSHTIC-2:** 20046302 | NORA: Mining

The BG 4 Benching Trainer Software is an effective training tool created for mine rescue personnel to reinforce their skills and knowledge related to the maintenance of the Draeger BG 4, the most commonly used closed-circuit breathing apparatus. The software supplements traditional hands-on training by using a 3D interactive environment where users can practice "benching," the process of inspecting, installing, and testing the apparatus.

NIOSH created this software as a proof of concept tool using virtual reality (VR) technology in assessing mine emergency responders. Before creating the BG4 Benching Trainer, NIOSH worked on other mining-related VR software, including the following:

- Underground Coal Mine Map Reading Training—demonstration of mining terminology and concepts while teaching navigation through a virtual mine environment.
- Mine Emergency Escape Training (MEET)—a simulation that places users in an underground emergency in which critical decisions are made and assessed in a post-simulation debriefing application.

Virtual environments provide many benefits to training that would not be possible under normal circumstances. These benefits include 3D visualization of objects, being able to operate and test equipment without it being physically present, introducing trainees to dangerous situations and scenarios that would not be possible in real life, and conducting observable and repeatable experiments.

Although NIOSH conducted no formal follow-ups with trainers after the release of the software, NIOSH received data on 30 mine rescue team members who participated in the evaluation of the software. Participants had an average of 1.85 years of apparatus benching experience. Experience levels ranged from zero to 7 years, with nearly 67% of trainees having one year or less benching expertise. Following each session trainees filled out a post-training questionnaire to elicit feedback regarding their training experience

and opinions on the effectiveness of the software. Mine rescue team members and benchmen who participated in the testing provided mostly positive feedback:

- 87% agreed the training software reinforced knowledge and skills learned through previous mine rescue training.
- 84% agreed the training software made them more confident in having the ability to correctly bench a BG 4 during a real mine emergency.
- 71% agreed the training software helped to prepare them for a benching competition.
- 94% agreed the training software motivated them to learn about benching a BG 4.
- 94% agreed training in a virtual environment is a good supplement to training in a real-life environment.

NIOSH distributes the BG 4 Benching Trainer on its website via download and provides DVDs at conferences and when visiting mine sites. The lessons NIOSH learned while creating this software have helped steer the execution of its current research using virtual reality to study mineworkers self-escape during mine emergencies. NIOSH will publish new information as it becomes available on this research topic and the use of VR.

Engineering and Control 2016 Update

Shotcrete Design and Installation Compliance Testing: Early Strength, Load Capacity, Toughness, Adhesion Strength, and Applied Quality

Martin LA, Clark CC, Seymour JB, Stepan MA

> NIOSH [2015]. Shotcrete design and installation compliance testing: early strength, load capacity, toughness, adhesion strength, and applied quality. Report of investigations. By Martin LA, Clark CC, Seymour JB, Stepan MA. Spokane, WA: 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. 2015-107.
> **NIOSHTIC-2:** 20046014 | NORA: Mining

This research was undertaken to reduce mine worker fatalities and injuries resulting from ground falls in underground excavations where shotcrete is used. Although the information, techniques, and technology developed by this research impacts both the mining and construction sectors, the primary audience was the mining industry, particularly underground metal mining. The results of this research improved ground control safety by providing a better understanding of the use of shotcrete in a range of rock conditions. Developing improved field testing methods for determining the strength properties of shotcrete directly at a mine site, as well as developing a practical means of assessing quality control during shotcrete applications, were key elements of this research. Quantifying the strength characteristics of shotcrete during the curing process is critical to the safe use of shotcrete underground. The first and most important property of shotcrete support is the characteristic of early strength, which determines when it is safe to re-enter mining stopes that are not considered self-supporting. In addition, a minimum compressive strength is necessary before the shotcrete shell can be drilled to install additional support members, like secondary roof bolts and steel straps.

Since the publication of the comprehensive research report, a NIOSH Report of Investigations (RI 9697), 50 copies were distributed at the 2016 Society for Mining, Metallurgy & Exploration Annual Conference & Expo in Phoenix, Arizona, and 25 copies were distributed at the American Exploration and Mining Association's 2016 Annual Meeting in Reno, Nevada. A targeted mailing of 50 copies of the RI went to ground support design engineers, mining universities, shotcrete suppliers, and shotcrete contractors to generate industry awareness. Several western U.S. underground mines have embraced the testing protocols developed by this research and have adopted them into their routine ground control practice. Early strength and round determinate panel testing procedures and analysis provided engineering staff with a thorough strength profile of their in-place shotcrete. The guidance and practices developed by NIOSH help mining companies and shotcrete contractors by improving their mix design specifications, by maintaining installation quality control, and by upgrading the overall performance of engineered ground support systems. Mines implementing these design

techniques are improving mine stability and reducing ground fall fatalities and injuries. Additionally, mining universities use the RI to teach improved shotcrete testing procedures and design practices for underground applications.

The NIOSH Mining Program has funded a new project, "Durable Support for Western Underground Metal Mines," partly in response to requests for additional advice and technical support from the mining industry concerning the use of shotcrete. One aim of the project is to speed the adoption of the new shotcrete design and testing methods developed by NIOSH by demonstrating how the use of shotcrete can be effective incorporated into site specific ground control plans.

Epidemiology and Surveillance 2016 Update

NIOSH National Survey of Long-haul Truck Drivers: Injury and Safety

Chen GX, Sieber WK, Lincoln JE, Birdsey J, Hitchcock EM, Nakata A, Robinson CF, Collins JW, Sweeney MH

> Chen GX, Sieber WK, Lincoln JE, Birdsey J, Hitchcock EM, Nakata A, Robinson CF, Collins JW, Sweeney MH [2015]. NIOSH National Survey of Long-haul Truck Drivers: injury and safety. Accid Anal Prev 85:66–72.
> **NIOSHTIC-2: 20046814** | NORA: Transportation, Warehousing and Utilities

Approximately 2.6 million workers are employed as drivers of large trucks in the United States. Each year, about 4,000 people—including truck drivers, other vehicle occupants, and pedestrians—die in crashes involving large trucks and buses. In 2014, 657 occupants (90% drivers and 10% passengers) of large trucks died in crashes. Fatal crashes involving large trucks and buses cost the U.S. economy an estimated $41 billion in 2014, and the economic impact grows to $112 billion when crashes with injuries or property damage are included.

After receiving the Alice Hamilton Award, findings reported in the paper have been used by stakeholders to stimulate new research development, suggest areas where intervention is needed, and support the U.S. Department of Transportation's rulemaking. One important finding from the paper, "38% of LHTDs reported their entry-level training being inadequate" was cited by the Federal Motor Carrier Safety Administration (FMCSA) in its final rule, "Minimum Training Requirements for Entry-Level Commercial Motor Vehicle Operators." Transportation researchers at Virginia Tech Transportation Institute (VTTI) and overseas in Canada and China are using the survey as a model for surveys they are conducting. The lead author of the paper was invited to present the study findings at the 3rd International Behavioral Safety and Management Conference in Shanghai and the 5th Safety Science and Engineering Technology Symposium, Hangzhou, Zhejiang, China. The Chinese researcher, Dr. Zhenming Li, at the Zhejiang University of Technology, Hangzhou China, has also obtained funding from the National Natural Science Foundation of China to conduct a similar survey to study long-haul truck driver safety and injury in China. Findings from the NIOSH long-haul truck survey has stimulated further research into working conditions and safety among commercial truck drivers. Findings from this study were cited in the National Academies of Sciences report: "Commercial motor vehicle driver fatigue, long-term health and highway safety: research needs." Findings from this study also resulted in an additional NIOSH longitudinal study of commercial driver health status, and they led to the development of a FY18 large NORA proposal that is currently under consideration for funding. The proposal would partner with VTTI and the FMCSA "North American Fatigue Management Program Effectiveness in Reducing Commercial Truck Driver Fatigue."

The research team continues to analyze the survey data. Since the Alice Hamilton Award, the following papers based on analyses of the survey data have been published or are being developed:

- Lincoln JE, Birdsey J, Sieber WK, Chen GX, Hitchcock EM, Nakata A, Robinson CF [2016]. A pilot study of healthy living options at 16 truck stops across the United States. Am J Health Promotion: Epub ahead of print, September, http://dx.doi.org/10.1177/0890117116670289. The abstract was submitted to the 2017 NIOSH Research Partnership Conference in Colorado for presentation consideration.
- Sieber WK, Hitchcock EM, Robinson CF, Birdsey J, Chen GX, Lincoln JE, Nakata A, Sweeney MH [in development]. Fatigue in long-haul truck drivers: the National Survey of U.S. Long-haul Truck Driver Health and Injury.
- Chen GX, Sieber WK, Birdsey J, Collins JW, Hitchcock EM, Lincoln JE, Pratt SG, Robinson CF [in development]. Opinions on safety and its influence on driving behaviors: results from NIOSH National Survey of U.S. Long-Haul Truck Driver Health and Injury. The abstract was submitted to the 2017 NIOSH Research Partnership Conference in Colorado for presentation consideration.
- Sieber WK, Chen GX, Yiin J, Sweeney MH [in development]. Commercial motor vehicle driver health, fatigue, and highway safety. The abstract was submitted to 2017 NIOSH Research Partnership Conference in Colorado for presentation consideration.

Exposure and Risk Assessment 2016 Update

Trends of Occupational Fatalities Involving Machines, United States, 1992–2010

Dahm MM, Schubauer-Berigan MK, Evans DE, Birch ME, Fernback JE, Deddens JA

> Dahm MM, Schubauer-Berigan MK, Evans DE, Birch ME, Fernback JE, Deddens JA [2015]. Carbon nanotube and nanofiber exposure assessments: an analysis of 14 site visits. Ann Occup Hyg 59(6):705–723.
> **NIOSHTIC-2:** 20046053 | NORA: Public Safety / Manufacturing

As many automakers and aerospace companies strive to increase fuel efficiency without sacrificing size, industry steadily turns to carbon nanotube and carbon nanofiber (CNT/CNF) reinforced composites that increase strength while shedding weight. Similarly, as next-generation electronics strive to become smaller, faster, and smarter, capacitor and memory device manufacturers are increasingly incorporating various nanomaterials, including CNT/CNF, into their products. The global production capacity for carbon nanotubes had almost a 10-fold increase—from390 tons in 2008 to nearly 3,400 tons in 2010—and capacity has continued to expand. The materials are moving from research and development to industrial high-volume production. Carbon nanotubes and nanofibers are therefore among the nanomaterials of greatest interest from a public health perspective because of their potentially asbestiform properties (e.g., high aspect ratio) and toxicological evidence of possible fibrogenic, inflammatory, and clastogenic damage resulting from exposures at occupational levels. In response, NIOSH set a recommended exposure limit for CNT/CNF at 1 $\mu g/m^3$. More recently, the International Agency for Research on Cancer (IARC) has classified a specific brand of multi-walled CNT as group 2B, while all of other forms of multi-walled CNT were categorized as group 3.

The paper that won the 2016 Alice Hamilton Award provides detailed information on the characterization of personal workplace exposures to CNT/CNF. The authors collected exposure data from 14 companies over a 3-year period from four distinct industries where the materials were either produced or used. This comprehensive evaluation provides the first industrywide outlook of exposures occurring within the U.S. workforce and is the largest study of its kind globally. Since the manuscript was published in spring 2015, it has had more than 2,400 abstract and more than 800 full text downloads, ranking it in the top 10 articles downloaded in *Annals of Occupational Hygiene* during that period.

The exposure assessment methodologies developed in this manuscript laid the foundation for a successful NIOSH Nanotechnology Research Center (NTRC) funded epidemiologic study on U.S. CNT/CNF exposed workers. The now-complete cross-sectional study conducted an additional 12 exposure assessment site visits from 2013–2014, using similar sampling methodologies as well as the industry contacts developed from this manuscript to recruit additional participants. Results from these

studies are currently being analyzed with several publications expected in the coming year. Additionally, the knowledge gained and methods developed from this manuscript contributed to a newly funded NTRC project aimed at initiating a CNT/CNF worker registry, along with developing a job exposure matrix. The manuscript also has led to several cross-institute collaborations with researchers within DART, DSHEFS, HELD, and the NTRC, which led to several additional publications including the following:

Erdely A, Dahm M, Schubauer-Berigan M, Chen B, Antonini J, Hoover M [2016]. Bridging the gap between exposure assessment and inhalation toxicology: some insights from the carbon nanotube experience. J Aerosol Sci *99*:157–162.

Methods and Laboratory Science 2016 Update

Modifying Welding Process Parameters can Reduce the Neurotoxic Potential of Manganese-containing Welding Fumes

Sriram K, Lin GX, Jefferson AM, Stone S, Afshari A, Keane MJ, McKinney W, Jackson M, Chen BT, Schwegler-Berry D, Cumpston A, Cumpston JL, Roberts JR, Frazer DG, Antonini JM

Sriram K, Lin GX, Jefferson AM, Stone S, Afshari A, Keane MJ, McKinney W, Jackson M, Chen BT, Schwegler-Berry D, Cumpston A, Cumpston JL, Roberts JR, Frazer DG, Antonini JM [2015]. Modifying welding process parameters can reduce the neurotoxic potential of manganese-containing welding fumes. Toxicology *328*(February):168–178.
NIOSHTIC-2: 20045513 | NORA: Manufacturing

Summary of winning project: In this study, we demonstrated that modulation of welding process parameters can influence the fume composition and neurotoxicological potential of manganese-containing welding fumes. Specifically, we showed that fume particulates generated during welding at high-voltage conditions did not elicit neurotoxicity to dopamine-containing neurons in the striatum and midbrain, brain areas typically affected in Parkinson's disease. We associated the lack of neurotoxicity to the reduced bioavailability of the toxic metal manganese (Mn), a component of the welding fumes. Importantly, we demonstrated that such modifications to welding process conditions did not compromise the quality of the weld, suggesting the potential to translate such modifications and methodologies to workplace settings. Collectively, our findings showed promise for process control procedures in developing prevention strategies for Mn-related neurotoxicity during welding, which can have a significant impact in revising welding methods and protocols implemented at the workplace and thereby reduce adverse neurological health risks.

These studies directly addressed the NIOSH construction sector strategic goal 09PPCONSG6: Reduce welding fume exposures and future related health risks among construction workers by increasing the availability and use of welding fume controls and practices for welding tasks.

Research Update: Due to the health risks associated with welding processes, there is a critical need to reduce emissions of welding fumes and worker exposure. Because a large number of welding operations occur in confined spaces or difficult locations, local exhaust ventilation measures are difficult to implement. A safe and practical alternative will be to minimize fume generation at the source or reduce the toxicological potential of the hazardous components of the fume.

Since this publication, our laboratory continues research in this area to determine if other process parameters can similarly influence the fume profile and neurotoxicological potential of the welding fumes. This is important because there are several welding procedures that adapt specific welding parameters or processes depending on the welding task. Welding process conditions that can potentially influence fume generation, emission profile and elemental composition of the fumes include process parameters (voltage, current, wire feed rate), process mode (short-circuit, axial spray, pulsed-axial spray) and shielding gases (carbon dioxide, argon, oxygen, helium in various combinations). Changes in the process conditions can potentially influence the toxicological properties of the fume due to oxidation or speciation of elements like iron, manganese, chromium and nickel.

Emerging findings link manganese-containing welding fumes to neurotoxicity and Parkinson's disease-like neurological manifestations. It is therefore important to identify, develop, and validate reliable surrogates for biomonitoring exposures and biomarkers of exposure and neurotoxicity. Such information is critical for monitoring workplace exposure, assessing disease risk, establishing occupational exposure limits, and developing safe welding practices. Along these lines, ongoing studies in the laboratory focus on evaluating real-time changes in brain electroencephalograph (EEG) profiles to identify the earliest perturbations in brain electrical activity upon exposure to welding fumes. Studies to validate the utility of nail clippings as a surrogate for manganese exposure are in progress. Genomic and proteomic profiling studies to identify early biomarkers of effect, both in target organs and peripheral surrogates, have been planned and will be conducted this fiscal year.

The final outcomes and outputs from these studies will collectively address several strategic goals of NIOSH Construction and Manufacturing sectors, as well as the Respiratory Diseases and Exposure Assessment cross-sectors, such as the following:

1. Reduce welding fume exposures and future related health risks among construction workers by increasing the availability and use of welding fume controls and practices for welding tasks.
2. Enhance the state of knowledge of emerging risks to occupational safety and health in manufacturing.
3. Develop new or improved methods to measure chemicals or other occupational hazards in the work environment
4. Develop new biomonitoring methods, including biomarkers useful for mixed exposures.

Alice Hamilton's Pioneering Work

Alice Hamilton, MD

(February 27, 1869–September 22, 1970)

Many of the first laws and regulations passed to improve the health of workers were the direct result of the work of one dedicated and talented woman, Alice Hamilton, MD. Born into a prominent family in Indiana (her sister was the well-known classicist, Edith Hamilton), Dr. Hamilton graduated from medical school at the University of Michigan in 1893. After accepting a teaching position at the Women's Medical School of Northwestern University in 1897, she moved into Jane Addams' Hull House in Chicago. There she opened a well-baby clinic for poor families in the local settlement house neighborhood. As she acquainted herself with the families, she learned of their pains, strange deaths, lead palsy, "wrist drop," and of the high number of widowed women. Encouraged by the reformers of Hull House, she began to apply her medical knowledge to these social problems and thus began her scientific inquiry into occupational health, for which she became known.

Dr. Hamilton quickly realized that while some progress in understanding occupational illness and disease was being made in Europe, little was written or understood about occupational disease conditions in the United States. In 1908, she published one of the first articles on occupational disease in this country and was soon a recognized expert on the topic. Starting in 1910, under the sponsorship initially of a commission of the State of Illinois, and later the Federal Bureau of Labor Statistics, she conducted a series of brilliant explorations of occupational toxic disorders. Relying primarily on "shoe leather epidemiology," and the emerging laboratory science of toxicology, she pioneered occupational epidemiology and industrial hygiene in the United States. Her findings were so scientifically persuasive that they caused sweeping reforms, both voluntary and regulatory, to improve the health of workers.

In 1919, Dr. Hamilton was appointed assistant professor of industrial medicine at Harvard Medical School and became the first female faculty member at Harvard University. There she served two terms on the Health Committee of the League of Nations. When she retired from Harvard at the age of 66, she became a consultant to the U.S. Division of Labor Standards, and she served as president of the National Consumers League.

Alice Hamilton Laboratory for Occupational Safety and Health

On Friday, February 27, 1987, the National Institute for Occupational Safety and Health dedicated its facility at 5555 Ridge Avenue in Cincinnati to the memory of Alice Hamilton, MD. The facility is known as the "Alice Hamilton Laboratory for Occupational Safety and Health" in honor of the first American physician to devote her professional life to the practice of occupational health.

Construction of this facility began in fall 1952 and was completed in November 1954. For several years, it was used as the world headquarters and manufacturing plant of the Disabled American Veterans (DAV). In this facility, "Ident-o-Tags," miniature license plates for key chains, were manufactured by disabled veterans for distribution throughout the United States.

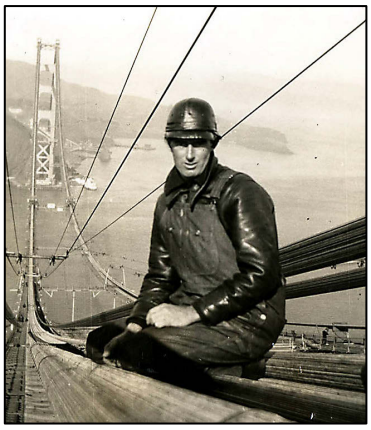
In the early 1960s, a portion of the facility was leased to the federal government to provide space for a small number of federal employees. From the early 1960s to the early 1970s more and more of the facility was used by the federal government. By 1973 the entire building was leased for federal offices and laboratories. In September 1974, the first employees of NIOSH were assigned to space in the facility. In December 1982, the U.S. Public Health Service purchased the facility for $3.5 million dollars. More than 200 people work there in such fields as engineering, epidemiology, general administration, industrial hygiene, and laboratory research. The facility contains some of the most-advanced laboratories and sophisticated scientific equipment in the institute.

Bullard-Sherwood Research-to-Practice Award

NIOSH presents the Bullard-Sherwood Research-to-Practice (r2p) Award to recognize outstanding efforts by its scientists and their partners in applying occupational safety and health research to prevent work-related injury, illness, and death. The award is named in honor of two distinguished inventers who made significant improvements in workplace injury and illness prevention.

Edward W. Bullard

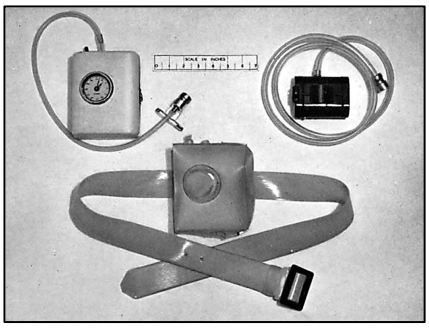
Edward W. Bullard designed the first "hard hat" as protective headgear for miners. He combined his experience with doughboy Army helmets during World War I and his understanding of customer needs to develop the "Hard Boiled Hat." The name was derived from the steam used to harden the hat as it was manufactured. Joseph Strauss, the engineer in charge of constructing the Golden Gate Bridge, requested that Mr. Bullard adapt his mineworker helmet to help protect bridge workers from falling rivets. The bridge site became the first designated "Hard Hat Construction Area." In related history, the steel used to build the bridge oxidized during transport to San Francisco from Pennsylvania, and it required sandblasting before it could be painted. As a result, Mr. Bullard designed and sold another helmet to the bridge builders to specifically protect the sandblasting workers. This helmet was similar to the Hard Boiled Hat, but it included in its design a hood or "canopy" over the hat, a window to see through, and supplied air for respiratory protection. The helmets helped to prevent death and injury during the project and have prevented countless injuries and deaths since. However, despite the exemplary safety precautions taken during the Golden Gate Bridge construction, a total of 11 workers died at the site—including 10 who were killed in 1937 when a scaffold collapsed. Today, about 6 million hard hats are sold annually throughout the world to protect workers. Bullard's family-owned company still produces many of those hard hats, as well as more-modern sandblasting helmets.



Labor Archives and Research Center, J. Paul Leonard Library, San Francisco State University

A Golden Gate Bridge worker wears a Bullard "hard boiled hat" in this photograph, circa 1935. This worker, Fred Dümmatzen, died on Feb. 17, 1937, when a scaffold at the bridge collapsed and killed 10 workers.

R. Jeremy (Jerry) Sherwood



Sherwood RJ and Greenhalgh DMS

The personal air sampler system designed by R. Jeremy Sherwood, as it appeared in a 1960 *Annals of Occupational Hygiene* article announcing its invention. From: Sherwood RJ, Greenhalgh DMS [1960]. A personal air sampler. Ann Occup Hyg *2*:127–132, https://doi.org/10.1093/annhyg/2.2.127.

R. Jeremy (Jerry) Sherwood successfully merged research and industrial hygiene by inventing the first practical personal sampling pump in the late 1950s. He identified a need for sampling pumps that could be worn by workers and not impede their work processes. Until then, sampling was done on an area basis, or an industrial hygienist followed a worker while carrying heavy, bulky, and short-term sampling equipment. Using the newly developed personal sampling pump, he demonstrated that area sampling often severely underestimated worker exposures. Within a few years of this invention, personal sampling pumps became the staple in industrial hygiene work that they are today. He also developed a miniature sampler for sulfur dioxide that became commercially available and was widely used throughout Europe. His research on respirators led to the first fit testing. While at the International Labour Organization and later at the World Health Organization, Mr. Sherwood put his own knowledge and research experiences into practice by training others in occupational safety and health, particularly in developing countries. This became one of his greatest passions, and many workers around the world have benefitted from his efforts.

Knowledge

Winner

Preventing Worker Deaths from Exposure to Hydrocarbon Gases and Vapors at Oil and Gas Well Sites

Retzer K, Ridl S, Esswein E, King B, Snawder J, Kiefer M, Hill R, Harrison B, Danni JD, Lynham M, Hodgson M, Jordan T, Kosnett M, Ingram R, Jordan K, Krake A, Caruso D.

Source: Western States Division (WSD)

Background: Workers at oil and gas extraction sites may be exposed to significant hazards when opening tank hatches to manually gauge or collect samples from tanks that contain process fluids. In opening the hatches, high concentrations of hydrocarbon gases and vapors may be released, resulting in serious and immediate health effects [NIOSH, 2016]. From January 2010–March 2015, nine deaths occurred during the collection of a fluid sample or during tank gauging [Harrison et al. 2016].

Relevance: NIOSH was alerted about two worker deaths that occurred while workers manually gauged fluid levels on crude oil tanks at oil and gas well sites, which is a common practice among workers in the oil and gas extraction industry. A NIOSH team investigated whether other fatalities had occurred under similar conditions. Seven additional deaths associated with manual tank gauging were identified. Together with stakeholders from industry and trade associations, the team characterized the hazard, identified potential controls, and subsequently disseminated various information products, including a NIOSH-OSHA Hazard Alert and MMWR, to raise awareness of the hazard and recommend actions to protect workers.

The NIOSH Oil and Gas Program worked closely with industry stakeholders to evaluate this newly recognized hazard. In 2014, a formal partnership (alliance) was established between NIOSH, OSHA, and the National Service, Transmission, Exploration & Production Safety (STEPS) Network, one of the largest industry health and safety organizations. This alliance not only strengthened relationships between these organizations for this project in particular, but also put forth a precedent to continue future collaborations. The NIOSH Oil and Gas Program also worked more closely with the primary standard-setting organization for the industry, the American Petroleum Institute (API), and OSHA to strengthen their work and impact to promote worker health and safety.

These relationships in particular enabled the NIOSH Oil and Gas Program and the alliance to realize several milestone successes. In terms of publications, the Alliance issued a Hazard Alert that is estimated to have reached more than 100,000 industry professionals. Beyond communication, the API developed and issued a critical new standard to its *Manual of Petroleum Measurement Standards* (MPMS) (Chapter 18.2) in response to the identification and characterization of the tank-gauging hazard. This standard described for the first time an industry-wide consensus of acceptable alternative

methods to manual gauging and sampling. Furthermore, the Bureau of Land Management (BLM) updated its rules for oil measurement on BLM leases—for the first time in more than 25 years—after the team traveled to Washington D.C. to share information about the hazards of manual gauging. In their update, they incorporated the API standard. Over the past year, several companies have reported their successes to NIOSH in implementing controls to reduce the frequency of manual gauging. There were no identified worker deaths associated with manual gauging in 2016, compared to six deaths identified in 2014.

More information about the NIOSH Oil and Gas Program and manual tank gauging can be found at the following websites:

- Oil and Gas Extraction Sector Program
- NIOSH-OSHA Hazard Alert: Health and Safety Risks for Workers Involved in Manual Tank Gauging and Sampling at Oil and Gas Extraction Sites
- Sudden Deaths Among Oil and Gas Extraction Workers Resulting from Oxygen Deficiency and Inhalation of Hydrocarbon Gases and Vapors — United States, January 2010–March 2015

References

Harrison RJ, Retzer K, Kosnett MJ, Hodgson M, Jordan T, Ridl S, Kiefer M [2016]. Sudden deaths among oil and gas extraction workers resulting from oxygen deficiency and inhalation of hydrocarbon gases and vapors, United States, January 2010–March 2015. MMWR Morb Mortal Wkly Rep *65*:6–9, http://dx.doi.org/10.15585/mmwr.mm6501a2.

NIOSH, OSHA [2016]. NIOSH-OSHA hazard alert: health and safety risks for workers involved in manual tank gauging and sampling at oil and gas extraction sites. Denver, CO: 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. 2016-108.

Intervention

Winner

NIOSH Training for Nurses on Shift Work and Long Work Hours

Caruso C, Geiger-Brown J, Takahashi M, Trinkoff A, Nakata A, Werren DM, Collins SS, Jones B, Williams V, Fazio G, Urban CW, Hitchcock EM, Leonard SR, Ziegler TE, Jones E, Shahan K

Source: Division of Applied Research and Technology (DART)

Background: According to the American Nurses Association, 74% of surveyed nurses in 2011 reported the acute or chronic effects of stress and overwork as their top health and safety concern. Furthermore, 55% of nurses reported working 41 to 60 hours per week, 56% reported their usual shift was 10 or more hours, and 53% reported working some mandatory or unplanned overtime each month [American Nurses Association 2011]. These demanding hours and work requirements often lead to difficulties with sleep. Several studies have found that when workers on shift work and long hours do not get sufficient sleep, cognitive performance declines, increasing the risk for personal injury to the nurse, as well as patient care errors [Caruso 2010].

Relevance: The ultimate goal of the NIOSH Training for Nurses on Shift Work and Long Work Hours is to minimize the health and safety risks associated with shift work, long work hours, and related workplace fatigue issues in nurses and patients. The training program offers nursing continuing education credits through CDC Training and Continuing Education Online. From the 2015 launch to the end of 2016, there were 37,200 visits to the training website, 3,067 people obtained certificates for Part I of the training, and 2,828 people obtained certificates for Part II of the training. Evaluation results showed that about 95% of respondents agreed or strongly agreed with positive characteristics of the training.

This training program was developed, managed, and disseminated with the joint efforts of several key partners. Staff from the School of Nursing at the University of Maryland authored the training program. Several Fellows of the American Academy of Nursing and other experts also added and revised content, as well as pilot-tested the training program. Staff from the American Nurses Association (ANA) participated in providing feedback and disseminated the training program through a variety of channels, including their newsletters, websites, and social media campaigns. In November 2014, ANA released its revised position statement, "Addressing Nurse Fatigue to Promote Safety and Health: Joint Responsibilities of Registered Nurses and Employers to Reduce Risk," which incorporated strategies included in the NIOSH training program. Furthermore, at least 45 additional websites of nursing and health associations, safety professionals, and government agencies provide information about and link to the training program.

In 2016, Claire Caruso formed a workgroup in the American Academy of Nursing to develop an Academy position and policy brief related to fatigue-related risks. Future

extramural studies are planned to further test the training program among nurses. This training program is intended to fill a need for available comprehensive, tailored, free, online training programs to address health and safety risks linked to shift work and long work hours among nurses.

More information regarding this training course and fatigue-related risks can be found at the following websites:

- NIOSH Training for Nurses on Shift Work and Long Work Hours
- Nurse Fatigue
- Addressing Nurse Fatigue to Promote Safety and Health: Joint Responsibilities of Registered Nurses and Employers to Reduce Risks

References

ANA [undated]. 2011 ANA Health and Safety Survey. American Nurses Association, http://www.nursingworld.org/MainMenuCategories/WorkplaceSafety/Healthy-Work-Environment/Work-Environment/2011-HealthSafetySurvey.html.

Caruso CC, Hitchcock EM [2010]. Strategies for nurses to prevent sleep-related injuries and errors. Rehabil Nurs *35*(5):192–197.

Technology

Winner

Improving Situational Awareness through Visual Interventions

Sammarco JJ, MacDonald B, Demich B, Matty T, Mayton A

Source: Pittsburgh Mining Research Division (PMRD)

Background: In the context of underground coal mines, roof bolters face serious safety hazards. From 2004 through 2013, roof-bolt machine operators had the highest number of machinery-related injuries at underground coal mines, accounting for 64.7% [Sammarco et al. 2016]. Federal regulations define illumination for the exterior working areas around a roof bolter, but do not define illumination of interior working areas. At the time these regulations were drafted, machines did not enable workers to access the interior areas. Workers are now able to access interior areas with newer designs, yet regulations have not been updated.

Relevance: J.H. Fletcher & Co., a leader in roof bolter machines for underground mining, contacted NIOSH with an interest in reducing roof bolter machine accidents. They were specifically interested in establishing safer interior lighting that would reduce glare so that workers would be better equipped to see safety hazards, as well as establish a scientific basis for a new federal regulation for interior machine lighting. J.H. Fletcher & Co. adapted the plastic laboratory prototype developed by NIOSH and created an explosion-proof, mine-worthy Saturn Light-Emitting Diode (LED) Area Light. They are also working on adapting this product for applications in different contexts where costly, explosion-proof designs are not needed.

To reach their goals, a unique three-pronged partnership was developed. Fletcher originally reached out to NIOSH and provided support for NIOSH research, including the use of a $600,000 roof-bolting machine, as well as feedback and support for commercialization and technology transfer. NIOSH conducted human subject testing to quantify the safety performance improvements, which demonstrated trip hazard detection improvements of up to 112% and a three-level reduction in glare when using the Saturn Area Light. NIOSH also initiated the partnership with MSHA, which served in an advisory role for the prototype design and provided assistance and support for commercialization to quickly introduce new technologies to improve mine safety.

Partnering with a private company, NIOSH and MSHA allowed the project to focus on commercialization, research, and regulations. Together, these partners have designed and tested a product intended to improve mine safety by implementing key technology transfer and research to practice principles.

More information regarding roof-bolter machine hazards and the Saturn LED Area Light can be found at the following websites:

- NIOSH Saturn Area Light
- Mining Project: Underground Coal, Metal, and Nonmetal Mine Illumination Systems for Improving Miner Visual Performance
- Best practices and bolting machine innovations for roof screening

Reference

Sammarco J, Podlesny A, Rubeinstein E, Demich B [2016]. An analysis of roof bolter fatalities and injuries in U.S. mining. Trans Soc Min Metall Explor *340*(1):11–20, https://doi.org/10.19150/trans.7322.

Honorable Mention

NIOSH Mini Baghouse Retrofit Assembly 40 Unit Fabrication and Operational Field Trial during Hydraulic Fracturing Operations

Esswein, EJ, Miller A, Alexander B, Berry C

Source: Western States Division (WSD)

Background: Workers involved in hydraulic fracturing may be exposed to dust with high levels of respirable crystalline silica, which can have serious negative health consequences. During this process, sand is delivered via truck and then loaded into sand movers, and transferred via conveyer belt. Throughout the different steps of this process, workers can be exposed if dust containing silica is released into the air and if workers breathe the dust into their lungs. Breathing silica can cause silicosis, a lung disease that can cause inflammation and scarring and reduce the lungs' ability to take in oxygen. Silica exposure has also been linked to lung cancer, tuberculosis, chronic obstructive pulmonary disease, and kidney and autoimmune diseases [OSHA-NIOSH 2012].

Relevance: NIOSH scientists were the first to determine the magnitude of exposure risks for respirable crystalline silica exposures during hydraulic fracturing operations, an estimated 10–50 times the OSHA PEL. These results were published in a peer-reviewed journal article that evaluated the NIOSH mini baghouse retrofit assembly. NIOSH researchers also identified the seven Primary Point Sources of Silica Dust Emissions on Hydraulic Fracturing Sites and proposed controls for silica dust emissions. Several private companies have begun developing and marketing controls to address these seven primary point sources.

Through the NORA Oil and Gas Extraction Sector, NIOSH was able to establish two partnerships and MOUs with private companies, Tucker Energy and Lewis Energy. Before conducting field studies, NIOSH implemented extensive quality control measures to ensure the 40 mini baghouse units were appropriately fabricated. Instead of having the units directly shipped to the field, they thoroughly examined each unit and inventory item and found that some critical parts were missing or incorrect. These trustworthy partnerships enabled them to conduct the field research evaluations of the mini baghouse assembly to confirm the fit and seal on sand-moving machinery at hydraulic fracturing operations in Oklahoma and Texas.

The NIOSH mini baghouse assembly is currently patent-pending, and the researchers are discussing licensing the technology with a potential licensee. Longer-term field trials to evaluate the technology are also planned. NIOSH researchers were able to leverage relationships and agreements with private company partners to evaluate and field test their technology designed to reduce workplace hazards.

More information on hydraulic fracturing operations and the NIOSH mini baghouse assembly can be found at the following websites:

- NIOSH Oil and Gas Extraction Program
- Worker Exposure to Silica during Hydraulic Fracturing
- The Development and Testing of a Prototype Mini-baghouse to Control the Release of Respirable Crystalline Silica from Sand Movers
- NIOSH-Designed Technology Can Reduce Workers' Exposure to Silica at Hydraulic Fracturing Sites

Reference

OSHA-NIOSH [2012]. Worker exposure to silica during hydraulic fracturing. OSHA-NIOSH hazard alert. Washington, DC: 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. 2012-166.

Bullard-Sherwood Research-to-Practice Award Finalists

Projects are listed by category, alphabetically by the last names of project officers.

Knowledge

Make it Bite-sized: Using Key Communication Tools and Fostering Partnerships to Move Construction Research Into Practice

Branche C, Earnest S, Garza E, Howard J, Romano N, Spring C, Sadeghpour N, Check P, Nickels L, Azman A, Randolph B, Micciche M, Das M, Fazio G, McCleery T, Lowe B, Cunningham T, Burnett G, Magnafichi D, Albers J, Hudock S, Kardous CA, Themann CL, Byrne DC, Morata TC, Murphy WJ, Beamer B, Hayden C, Stephenson M, Stephenson C, Meier A, Masterson E, Poynter H, Storms C, Afanuh S, Jones B, White T, Ebert T, Zimmer J, Graydon PS, Zechmann EL, Davis R, Brueck S, Whitacre M, Smith L, Stafford P, Cain CT, Baker R, Betit E, Chang C, Bunting J, Sinai C, Schulz J, Scruggs K, Okparanta C, Fletcher MK, Tolentino-Gonzalez K, Benjamin S, McKenzie D, Meilinger F, Kampert E, Davis N, Quintero D

Information and Technology Transfer for Aerial Lift Safety

Pan CS, Wimer BM, Powers JR, Ammons DE, Boehler B, Webb S, Chiou SS, Spiker JR, Dong R, Warren C, Romano N, Keane PR, Cantis D

Preventing Worker Deaths from Exposure to Hydrocarbon Gases and Vapors at Oil and Gas Well Sites

Retzer K, Ridl S, Esswein E, King B, Snawder J, Kiefer M, Hill R, Harrison B, Danni JD, Lynham M, Hodgson M, Jordan T, Kosnett M, Ingram R, Jordan K, Krake A, Caruso D

Intervention

LEED Pilot Credit for Advancing PTD in the Green Construction Industry

Branche C, Gillen M, Check P, Lowe B, Bach J, Earnest S, Garza E, Harper K, Langford H, Metalitz B, Kleiner B, Pearce A, Behm M, Piispanen W, Fullen M, Sokol R, Heinlein C, Fore G, Gambatese J, Toole M, Celenza J, Silins N, Hollowell M, Rajendran S

NIOSH Training for Nurses on Shift Work and Long Work Hours

Caruso C, Geiger-Brown J, Takahashi M, Trinkoff A, Nakata A, Werren DM, Collins SS, Jones B, Williams V, Fazio G, Urban CW, Hitchcock EM, Leonard SR, Ziegler TE, Jones E, and Shahan K

Staying Safe at Work—Teaching Workers With Intellectual and Developmental Disabilities About Health and Safety on the Job

Guerin R, Dewey R, Bush D, Miara C, Okun AH, Lechliter J, Romero N, and Baker DS

Technology

Design of Proximity Systems for Underground Mobile Equipment

Bissert P, DuCarme J, Noll J, Reyes M, and Klemetti AR

NIOSH Mini Baghouse Retrofit Assembly 40 Unit Fabrication and Operational Field Trial during Hydraulic Fracturing Operations

Esswein EJ, Miller A, Alexander B, and Berry C

Improving Situational Awareness through Visual Interventions

Sammarco JJ, MacDonald B, Demich B, Matty T, Mayton A

Previous Bullard-Sherwood Research-to-Practice Award Winners and Honorable Mentions

View the previous Bullard-Sherwood Research-to-Practice (r2p) Award Winners and Honorable Mentions

Director's Intramural Award for Extraordinary Science

Background

Science excellence is the foundation upon which NIOSH generates new knowledge to assure safe and healthful work for all. The Director's Intramural Award for Extraordinary Science (DIA) recognizes outstanding contributions by intramural scientists and support staff to science excellence at NIOSH. Winners of the NIOSH Director's Intramural Award for Extraordinary Science will receive a monetary award that augments the discretionary budget for the recipient for the following fiscal year. Winners are also recognized at the annual ceremony celebrating the Alice Hamilton Award for Excellence in Occupational Safety and Health.

The CDC-wide Charles C. Shepard Science Award and the NIOSH Alice Hamilton and Bullard-Sherwood Research-to-Practice Award recognize the scientific contributions of a single research project or activity. The Director's Intramural Award for Extraordinary Science honors individuals for their scientific contributions through a collective body of work. Although the James P. Keogh Award also recognizes a collective body of work, it is more oriented toward service than science, focusing on dedicated service, training, and research translation to achieve tangible effects on public health practice. The collective body of work recognized in the DIA represents extraordinary individual performance that clearly goes above and beyond past and present basic job requirements

The Director's Intramural Award serves as a tribute to NIOSH employees whose dedication to science excellence has made significant contributions to the NIOSH mission. Award categories recognize distinquished career scientists, early career scientists, and scientific support staff.

Director's Intramural Award for Extraordinary Science

Distinguished Career Scientist

Charles Geraci

Dr. Charles Geraci is the associate director for nanotechnology at the National Institute for Occupational Safety and Health. He provides overall strategic guidance to the nanotechnology research program at NIOSH and is recognized internationally for his leadership in the field. Dr. Geraci has more than 40 years of industrial hygiene practice experience. He brings to NIOSH a unique blend of skills, which he developed through his public and private sector professional practice. He has served at NIOSH for more than 24 years, starting at the beginning of his scientific career, and then rejoining the institute as an experienced professional after working in private industry. Dr. Geraci has made major contributions in the form of developing policy documents, refining research methods, developing field investigation strategies, and directly applying research outputs to effective worker health and safety approaches needed to responsibly develop emerging technologies. He serves as a subject matter expert on various national and international panels and advisory boards, including representing NIOSH on the U.S. National Nanotechnology Initiative and the Sub-Committee on Advanced Manufacturing. Dr. Geraci is also active on the International Organisation for Standardization Technical Committee 229 on Nanotechnology, as well as the Organization for Economic Co-operation and Development Working Party on Manufactured Nanomaterials, and serves on the executive committee of the American Industrial Hygiene Association Nanotechnology Working Group. Between 2006 and 2016, he delivered more than 200 combined invited technical presentations, panel discussions, briefings, and webinars on the occupational safety and health aspects of nanotechnology at national and international scientific meetings, symposia, and panels.

Early Career Scientist

Candice Johnson

Dr. Candice Johnson began her career at the National Institute for Occupational Safety and Health as an epidemic intelligence officer (2012–2014) and was then hired by the NIOSH Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS) as a senior service fellow epidemiologist. She quickly became known for her initiative and creativity, quantitative skills, productivity, volunteerism, and strong work ethic. Since arriving at NIOSH less than 5 years ago, Dr. Johnson has initiated research to investigate occupational exposures, reproductive health, women's health, cardiovascular health, health disparities, and biases in epidemiologic studies. While balancing a heavy workload, Dr. Johnson stepped forward to serve on multiple deployments, including several international deployments: two tours in Guinea for Ebola (requiring proficiency in French), a 2-month deployment to Atlanta for CDC Zika Virus Response/Pregnancy and Birth Defects Task Force, travel to Colombia for Zika (requiring knowledge of Spanish), and several other field studies ranging from windblade manufacturing in North Dakota to armed violence surveillance in Burundi. She has authored or co-authored 24 peer-reviewed publications (12 of those as first author), three book chapters (one as first author), 29 web pages, and a NIOSH Science Blog article (first-author). She has also given six first-authored oral presentations and seven first-authored poster presentations at national and international conferences.

Scientific Support

Vanessa Williams

Mrs. Vanessa Williams started her 35-year government career in 1982 at the Environmental Protection Agency (EPA) in Cincinnati. She worked for EPA until 1986. Mrs. Williams started her career at the National Institute for Occupational Safety and Health in February 1986. She completed her undergraduate studies in social science while attending evening college and working at NIOSH. Mrs. Williams began providing scientific support to NIOSH as a technical information clerk in the Technical Information Branch, Division of Standards and Technology Transfer. For this position, she was heavily involved in processing and disseminating NIOSH communication print products. In 1987, Mrs. Williams transitioned to the Education and Information Division (EID), Document Development Branch (DDB), as an editorial assistant. In this position, she became a member of the editorial team and worked alongside writer-editors. This team provided editorial services for authors of NIOSH policy documents, which included criteria documents, current intelligence bulletins, hazard reviews, alerts, and a number of research and communication products produced by the division and the institute. Her team is now part of the EID's Information Research and Dissemination Branch (IRDB). She currently serves as the project officer and team leader for the visual communication team and serves as the chair for the visual communications workgroup in the Communication and Information Dissemination Program. As the visual communications team leader, she assists and guides NIOSH staff as they develop communication products for disseminating through different media channels.

Director's Intramural Award for Extraordinary Science Finalists

Names are listed alphabetically.

Distinguished Career Scientist

Eileen Birch

Geoffrey Calvert

Charles Geraci

Early Career Scientist

David Blackley

Emily Haas

Candice Johnson

Scientific Support

Barbara Jenkins

Brian Tift

Vanessa Williams

Director's Intramural Award for Extraordinary Science Updates

Distinguished Career Scientist 2015

Raymond J. Roberge, MD, MPH

NIOSH is intimately associated with issues related to the effects of work and ambient temperature-related heat effects on workers. This is an important issue because an average of 113 heat-related deaths a year have been reported over the recent decade in the United States. Issues of heat-related illness and incapacity may affect millions of people each year in situations such as work pursuits, sports activities, and military maneuvers, to name but a few. Monitoring body temperature is essential in many of these situations, and core temperature monitoring (rectal, esophageal, intracranial, intra-abdominal) is considered the single best indicator of the body's thermal status. However, core temperature measurements are hampered by such issues as their invasive nature, discomfort, difficulty to safely maintain insertion, and association with hygiene issues. In addition, use of swallowed core temperature pills is hampered by the possibility of temperature gradients along the gastrointestinal tract, acute modifying effects of fluid and food ingestion on core temperature, and the uncertainty of sensor transit time. Because of these issues, much research interest has been directed over the past several decades to finding a skin site that might serve as a reliable surrogate for core temperature. Any such site would have to demonstrate significant correlation with core temperature measurements, but this goal has been elusive to date.

When Dr. Roberge was awarded the 2015 Director's Intramural Award for Extraordinary Science (Distinguished Career Scientist category), most of his NIOSH-related research over the past decade revolved around the effects of the use of personal protective equipment on various workers, especially healthcare workers. A significant portion of his research was related to the use of respiratory protective equipment. One aspect of that research—specifically the effect on body temperature of the use of respirators—was stimulated by requests to NIOSH from the Exxon Gulf of Mexico oil spill remediation workers concerned about the effect on body temperature of wearing respirators in the hot, humid ambient environment of the Gulf Coast. With this background, and the availability and expertise of NIOSH co-researchers, Dr. Roberge undertook a project to determine a skin site that could reliably correlate with core temperature.

The umbilicus was selected as a body temperature measurement site that offered a number of potential advantages (depth that allowed cross radiation of opposing walls, minimization of air current effects, closer proximity to core [intra-abdominal] temperature). However, using this site had not been investigated in depth. A total of 28 male subjects underwent measurement of average and peak rectal, chest wall, and abdominal temperatures during sedentary temperature stabilization baseline measurements, sedentary passive heating, and active exercise phases while wearing various types of clothing (i.e., athletic wear, a full-body spandex heating garment,

firefighter bunker gear). The results of the testing demonstrated that umbilical temperature correlated more closely with rectal temperature than did chest wall temperature. With this data available, the following steps have been taken:

- A manuscript detailing the results of the NPPTL study has been developed and submitted to the *International Journal of Hyperthermia*.
- Based upon experience from the research study, the need became evident for an efficient, user-friendly, umbilical temperature sensor that is resistant to motion artifact. Required elements for a prototype sensor were developed and a public posting has been prepared for the Federal Business Opportunities website (www.FedBusOpps.gov) so interested parties may respond. Funding from the NIOSH Director's Award has been allocated to develop a prototype umbilical sensor for monitoring body temperature that will incorporate such features as small size, insulation, adhesive component, and vibratory and audible warnings when umbilical temperature reaches 38°C.
- With the anticipated development of an appropriate umbilical temperature sensor, further human pilot testing will be undertaken to ensure the validity of the research results. If subsequent research findings corroborate the initial results, commercialization of the sensor will be considered, an example of NIOSH r2p (Research-to-Practice).

Given the toll on workers (and others) of heat-related illness, developing a non-invasive, accurate skin heat sensor that correlates with core body temperature could be a valuable addition to physiological monitoring capability and, by extension, worker safety.

Early Career Scientist Winner 2015

Lieutenant Commander Cara Halldin

Since receiving the 2015 Director's Award for Extraordinary Intramural Science in the category of Early Career Scientist, Lieutenant Commander (LCDR) Cara Halldin, PhD, continues to serve as the lead investigator for two projects on preventing occupational respiratory disease. The $5,000 award was used to augment funding for the Workforce Monitoring Using Pulmonary Function Testing project. Specifically, the award supported additional software programming to develop a web-based version of SPIROLA, a longitudinal lung function monitoring program. SPIROLA helps occupational health providers identify workers with excessive lung function decline and design individual and occupational interventions to prevent respiratory disease. LCDR Halldin proposed an overhaul of SPIROLA, improving the usability and versatility of the program by building a web-based version that will be released in summer 2017. SPIROLA will be showcased at the 2017 American Occupational Health Conference in Denver, Colorado, where investigators from OSHA, the U.S. Navy, and University of Maryland will join LCDR Halldin in describing how they use the program to identify workers with excessive decline in lung function.

Over the past 2 years, LCDR Halldin has also overseen an ongoing collaboration with the International Labour Office (ILO). The ILO classification system for pneumoconiosis, a dust-induced lung disease, has been used worldwide for more than 80 years in epidemiological research, public health surveillance, and various workers' compensation systems. However, the system has not kept up with the advances of modern technology and has not been updated to include digitally acquired images. This project's goals are to select candidate digitally acquired chest radiograph images by 2018, which will be considered by an international reading panel convened by NIOSH and the ILO to create digital standards for classifying pneumoconioses.

In 2016, LCDR Halldin's National Occupational Research Agenda (NORA) proposal was funded to support a project to partner with the Department of Labor (DOL). Through this partnership, NIOSH is receiving data from the DOL's Federal Black Lung Benefits Program. NORA is funding the project to link this data with data from NIOSH's Coal Workers' Health Surveillance Program. Additionally, Dr. Halldin is leading an effort to incorporate mortality information from the National Death Index with the linked DOL-NIOSH data. Analyses of these data will allow for an improved understanding of the spectrum and characteristics of coal mine dust lung disease, as well as, co-morbid conditions among U.S. coal miners. This unique collaboration between the two agencies provides an opportunity to identify surveillance and service gaps and will allow NIOSH to develop recommendations for both NIOSH and DOL to improve their respective program's outreach efforts.

LCDR Halldin continues to collaborate on several research studies aimed at identifying risk factors for respiratory disease among workers and evaluating and improving respiratory disease detection methods. Since receiving the Early Career Scientist award, she has authored or co-authored seven publications and given seven presentations to stakeholders at professional and scientific meetings.

Scientific Support Winner 2015

Jerry Kratzer

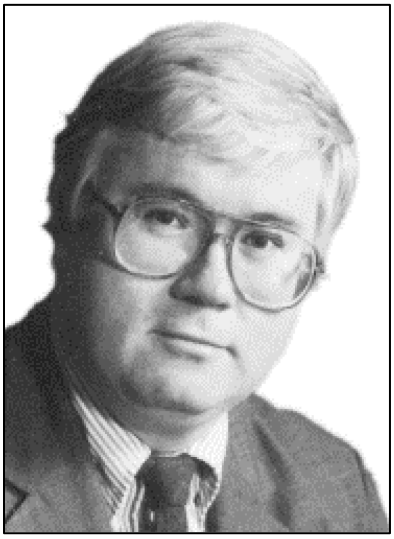
Since receiving the 2015 Director's Intramural Award for Extraordinary Science in the category of Scientific Support, Jerry Kratzer has continued his longstanding tradition of providing technical support to project officers in the Engineering and Physical Hazards Branch, Division of Applied Research and Technology. He used his award to purchase consumable supplies and equipment for the machine shop and ventilation laboratory. A portion of his award was allocated to purchase additional fabrication tooling, used in manufacturing devices and prototypes for various studies undertaken in the branch. Mr. Kratzer continued to participate in studies with his branch colleagues as well as assist researchers from other branches and divisions. Mr. Kratzer sincerely appreciated the award, and he was pleased that his award funding could further the mission of his team, branch, and division.

Previous Director's Intramural Award for Extraordinary Science Winners

View the previous winners of the Director's Intramural Award for Extraordinary Science (DIA)

James P. Keogh Award for Outstanding Service in Occupational Safety and Health

A tireless advocate for worker safety and health



The National Institute for Occupational Safety and Health is pleased to recognize one current or former NIOSH employee each year for exceptional service to the field of occupational safety and health. This award honors the contributions made by public health workers who fight long odds to achieve safer and healthier workplaces.

James P. Keogh, MD, was a tireless advocate for worker safety and health who died in June 1999 at the age of 49. His earliest work in academic medicine identified dimethylaminopropionitrile as the causal agent in an outbreak of bladder neuropathy in the 1970s. Dr. Keogh could determine this because—unlike many of the clinicians initially contacted by the workers—he took their complaints seriously and applied clear public health principles to his investigation. Throughout his life, he listened carefully to workers, characterized hazards and diseases, and then fearlessly worked to identify compensation for the individual and prevention strategies for others. Dr. Keogh was instrumental in including construction workers in the Maryland Occupational Safety and Health lead standard, a full decade before the federal standard included them. He was a leading medical educator who always focused on the need to incorporate clinical compassion with public health prevention. His most outstanding legacy, however, was his fierce determination to put knowledge into practice to benefit the worker.

James P. Keogh Award Winner for 2017

Diane Porter

Diane Porter has had a lifelong commitment to promoting worker health and safety. Her decades of putting knowledge into practice resulted in significant and positive impacts in countless workplaces, health contributions and impacts in communities, and in advancing occupational safety and health not only within agencies, but in tandem with business and labor organizations.

Her efforts have reached millions of workers of all types, especially under-served worker populations. Those with uniquely occupational-related health challenges (such as mine workers, energy employees, and those affected by the terrorist attacks of 9/11/2001) now have access to appropriate health care, health monitoring, and—in some cases—receive compensation for their occupational exposures because of Ms. Porter's tireless efforts. She began her career at OSHA, then spent more than three decades at NIOSH from 1981–2015, culminating with her tenure as the institute's founding deputy director.

Ms. Porter led efforts to block the attempted elimination of NIOSH while forging a bipartisan congressional alliance and involving a wide array of stakeholders to instead grow the NIOSH budget to its then-highest levels.

She conceptualized and oversaw NIOSH's success in acquiring the mining research and safety functions of the dismantled Bureau of Mines, ensuring that mine health and safety research was integrated into overall worker health and safety. Ms. Porter was able to understand the complexity of achieving this goal and was the chief architect of successfully incorporating these functions, facilities, people and budget into a reorganized NIOSH.

Ms. Porter also guided the conception and implementation of the National Occupational Research Agenda (NORA). She engaged government, private sector industries, labor unions, and other worker health and safety stakeholders to create a priorities-driven, stakeholder-engaged framework by which worker health and safety issues could be collaboratively addressed.

She provided programmatic direction and leadership as NIOSH established the Division of Compensation Analysis and Support (DCAS), and she guided the development and approval of an additional 42 Special Exposure Cohorts covered under this program. Ms. Porter ensured a separate budget line for the NIOSH dose reconstruction program and the Presidential Advisory Board on Radiation and Worker Health, which aided fiscal accountability.

Under the leadership and guidance of Ms. Porter, NIOSH developed a health-screening program for World Trade Center responders that evaluates, follows, monitors, and treats the physical and mental health needs of responders. With the NIOSH director, Ms. Porter negotiated the complex political and contracting concerns for this program, directly contributing to the program being established promptly and successfully.

Ms. Porter is a natural mentor who used her talents to support and guide newer, younger, and more junior NIOSH employees. As a trusted advocate towards the betterment of workers, she represented NIOSH at multiple global meetings, and she is recognized as a world leader for the improvement of worker health and safety.

Previous James P. Keogh Award Winners

2016: Thomas R. Waters

2015: Kathleen Kreiss

2014: Albert E Munson

2013: Michael Attfield

2012: Alice Suter

2011: Linda Rosenstock

2010: James W Collins

2009: John Howard

2008: Mitch Singal

2007: Steven Sauter

2006: Marilyn Fingerhut

2005: Rosemary Sokas

2004: Dawn Castillo

2003: James A. Merchant

2002: Philip J. Landrigan

2001: William Edward Halperin

2000: Richard A Lemen

NIOSH Nominations for the Charles C. Shepard Science Award

CDC/ATSDR established the Charles C. Shepard Science Award in 1986 in honor of Dr. Charles C. Shepard, MD, an internationally recognized microbiologist whose career was marked by a pursuit of scientific excellence. He served as chief of the Leprosy and Rickettsia Branch at CDC for more than 30 years, until his death on February 18, 1985. The Charles C. Shepard Science Award recognizes scientists who have made important research contributions to public health. The awards are given in five categories: one individual award (Lifetime Scientific Achievement), and four for journal articles during the previous year in the following categories:

- Assessment
- Data Methods and Study Design
- Laboratory Science
- Prevention and Control

NIOSH Nominations for the Charles C. Shepard Science Award for 2017

Scientific Publications

Assessment

Blackley DJ, Wiley MR, Ladner JT, Fallah M, Lo T, Gilbert ML, Gregory C, D'ambrozio J, Coulter S, Mate S, Balogun Z, Kugelman J, Nwachukwu W, Prieto K, Yeiah A, Amegashie F, Kearney B, Wisniewski M, Saindon J, Schroth G, Fakoli L, Diclaro JW II, Kuhn JH, Hensley LE, Jahrling PB, Stroher U, Nichol ST, Massoaquoi M, Kateh F, Clement P, Gasasira A, Bolay F, Monroe SS, Rambaut A, Sanchez-Lockhart M, Laney AS, Nyenswah T, Christie A, Palacios G [2016]. Reduced evolutionary rate in reemerged Ebola virus transmission chains. Sci Adv *2*(4):e1600378.

Masterson EA, Themann CL, Luckhaupt SE, Li J, Calvert GM [2016]. Hearing difficulty and tinnitus among U.S. workers and non-workers in 2007. Am J Ind Med *59*(4):290–300.

Data Methods and Study Design

Baughman P, Andrew ME, Burchfiel CM, Fekedulegn D, Hartley TA, Violanti JM, Miller DB [2016]. High-protein meal challenge reveals the association between the salivary cortisol response and metabolic syndrome in police officers. Am J Hum Biol 28(1):138–144

Bertke SJ, Meyers AR, Wurzelbacher SJ, Measure A, Lampl MP, Robins D [2016]. Comparison of methods for auto-coding causation of injury narratives. Accid Anal Prev 88:117–123.

Laboratory Science

Hubbs AF, Fluharty KL, Edwards RJ, Barnabei JL, Grantham JT, Palmer SM, Kelly F, Sargent LM, Reynolds SH, Mercer RR, Goravanahally MP, Kashon ML, Honaker JC, Jackson MC, Cumpston AM, Goldmith WT, McKinney W, Fedan JS, Battelli LA, Munro T, Bucklew-Moyers W, McKinstry K, Schwegler-Berry D, Friend S, Knepp AK, Smith SL, Sriram K [2016]. Accumulation of ubiquitin and sequestosome-1 implicate protein damage in diacetyl-induced cytotoxicity. Am J Pathology *186*(11):2887–2908.

Kulkarni P, Qi C, Fukushima N [2016]. Development of portable aerosol mobility spectrometer for personal and mobile aerosol measurement. Aerosol Sci Tech *50*(11):1167–1179

Lee T, Lee L, Cauda E, Hummer J, Harper M [2016]. Respirable size-selective sampler for end-of-shift quartz measurement: development and performance. J Occup Environ Hyg: Epub ahead of print, October.

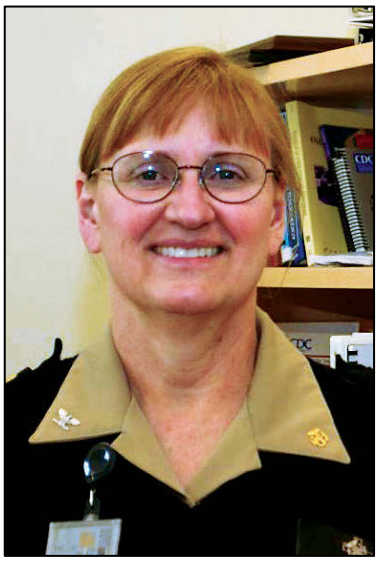
Prevention and Control

Camargo HE, Azman AS, Alcorn L [2016]. Development of noise controls for longwall shearer cutting drums. Noise Control Eng J 64:(5)573–585.

Jaques PA, Gao P, Kilinc-Balci S, Portnof L, Weible R, Horvatin M, Strauch A, Shaffer R [2016]. Evaluation of gowns and coveralls used by medical personnel working with Ebola patients against simulated bodily fluids using an Elbow Lean Test. J Occup Environ Hyg *13*(11):881–893.

Lifetime Scientific Achievement Award for 2017

Captain Gayle DeBord



This year, NIOSH is proud to nominate Captain Gayle DeBord for the Charles C. Shepard Lifetime Scientific Achievement Award. Since joining NIOSH in 1987, Capt. DeBord has designed, conducted, and overseen laboratory and field research that has not only advanced occupational safety and health knowledge, but has been the foundation for setting occupational safety and health policy and practices. She is a nationally recognized leader and expert in the fields of biomonitoring, exposure assessment, the exposome, hazardous drugs, and direct-reading instruments and sensors. Dr. DeBord is a scientist and has also served in several management capacities at NIOSH, including her current position as the interim director of the Division of Applied Research and Technology (DART), and in her previous role as the Division's associate director for science (ADS).

In her early work at NIOSH, she conducted laboratory research to develop biomonitoring methods for which she has gone on to be an institute leader and spokesperson. She led a research team, and later a branch, whose major focus was developing biomarkers of exposure, effect, and susceptibility to assess worker exposure to roofing asphalt, 1-bromopropane and JP-8 jet fuel. Later research on developing analytical methodology to assess worker exposure to occupational genotoxicants eventually led to developing biomarkers for several important chemical compounds. The research results from these studies have been used by the International Agency for Research on Cancer (IARC), the American Conference of Governmental Industrial Hygienists (ACGIH), EPA, and ATSDR as a basis for their regulatory recommendations.

Capt. DeBord was involved in significant collaborative research projects showing that healthcare workers continue to be exposed to antineoplastic drugs during their work, in spite of OSHA guidance thought to be protective. Capt. DeBord began the Hazardous Drug Program within her branch. She contributed to the high-impact NIOSH Hazardous Drug Alert on this topic, first published in 2004. This alert has the distinction of remaining one of the most-visited sites on the NIOSH website. The influence of this publication is even more far-reaching—three states have adopted the alert into their regulations to protect healthcare workers from exposure, and the recommendations are part of proposed legislation in five other states. They are also referred to in guidelines for handling hazardous drugs in healthcare by numerous professional and international organizations.

Capt. DeBord led research groups that have also been recognized for their outstanding scientific contributions and translational work. One significant project investigated the reproductive effects of bicycle seats on male bicycle police officers who are on their bikes for long periods. Her team developed a sensor to measure methamphetamine surface contamination. A number of health departments are also using the methamphetamine sensors to determine if buildings have been sufficiently cleaned to allow re-occupancy. Hazardous drug sensors, which detect these drugs on surfaces, have been developed and are also in the process of being commercialized by a different company. Dr. DeBord has served as the NIOSH genetics coordinator. She formed and chaired an advisory group within the institute to develop coordinated genetics research, and she also participated in several CDC-wide committees that developed a genomics strategic plan for CDC. She spearheaded efforts to develop institute policy on subject notification, a genetics research strategic plan, and the NIOSH contribution to the CDC Genetics Initiative. She was the first author on a NIOSH document to discuss issues of applying genetics to occupational health. The document, *Genetics in the Workplace: Implications for Occupational Safety and Health*, summarizes the NIOSH perspective in this area.

Nomination for this prestigious award recognizes not only Capt. DeBord's outstanding contribution to occupational safety and health, but also her dedication and commitment to the NIOSH mission.

Previous NIOSH Nominations for the Charles C Shepard Science Award

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