The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces through safety and health research NIOSH

Alice B. Hamilton Awards 2011

2011 Awards, Honorable Mentions, Finalists, and Updates

Biological Sciences Category

Winner:

- **Title:** Mitochondrial dysfunction and loss of Parkinson's disease-linked proteins contribute to neurotoxicity of manganese-containing welding fumes
- **Authors:** Sriram K, Lin GX, Jefferson AM, Roberts JR, Wirth O, Hayashi Y, Krajnak KM, Soukup JM, Ghio AJ, Reynolds SH, Castranova V, Munson AE, Antonini JM
- **Source:** FASEB J 24:4989-5002, 2010
- **Description:** Welding generates complex metal aerosols, inhalation of which is linked to adverse health effects among welders. An important health concern of welding fume exposure is neurological dysfunction akin to Parkinson's disease (PD), thought to be mediated by manganese in the fumes. In addition, welding might accelerate the onset of PD. We have previously linked the presence of manganese in welding fume with dopaminergic neurotoxicity. To elucidate the molecular mechanisms further, we investigated the association of PD-linked (Park) genes and mitochondrial function in causing dopaminergic abnormality. This study demonstrated that exposure to manganese-containing welding fumes alters the expression of specific Park genes in brain areas associated with dopamine neurotransmission that regulate movement. As there is concern that exposure to welding fumes may accelerate the onset of Parkinsonism among welders, the current findings may provide early clues to the pathogenesis of the disease. Further, as the loss of these Park genes seems to precede any observable neurobehavioral or neuropathological abnormalities, their utility as early predictors or biomarkers of welding fume-related neurotoxicity is promising. Also, such biomarkers will be useful in identifying susceptible worker populations at risk for adverse welding fume exposures.

Link to abstract in NIOSHTIC-2

Honorable Mention:

- **Title:** Comparison of stainless and mild steel welding fumes in generation of reactive oxygen species
- **Authors:** Leonard SS, Chen BT, Stone S, Schwegler-Berry DE, Kenyon A, Frazer DG, Antonini JM
- **Source:** Part Fibre Toxicol (7):32, 2010
- **Description:** Welding fumes consist of a wide range of complex metal oxide particles which can be deposited in all regions of the respiratory tract. Over 390,000 welders were reported in the U.S. in 2008 while over 1 million full-time welders were working worldwide. Many health effects from exposure to welding fumes are presently under investigation. Welding fume pulmonary effects have been associated with bronchitis, metal fume fever, cancer and functional changes in the lung. Our investigation focused on the generation of free radicals and reactive oxygen species (ROS) from stainless and mild steel welding fumes generated by a gas metal arc robotic welder. An inhalation exposure chamber located at NIOSH was used to collect welding fume particles. Our results demonstrated that both types of welding fumes are able to generate ROS and ROS-related damage over a range of particle sizes; however, the stainless steel fumes consistently showed a significantly higher reactivity and radical generation capacity. The steel's chemical composition had a significant impact on ROS generation capacity, with the stainless steel that contained chromium and nickel causing more damage than the mild steel. Our results suggest that welding fumes may cause acute lung injury. Since type of fume generated, particle size, and elapsed time after generation of the welding exposure are significant factors in radical generation and particle deposition, these factors should be considered when developing protective strategies.

Link to abstract in NIOSHTIC-2

Educational Materials Category

Winner:

- **Title:** Move It! Rig Move Safety for Roughnecks
- **Authors:** Cullen E, Hill R, Shannon J, Headding B
- **Source:** 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. 2011-108d, 2010
- **Description:** This video product makes a signification contribution to improving safety in the oil and gas extraction industry by targeting one of the most dangerous activities in the industry: the drilling rig move. Such a move includes all of the activities involved in disconnecting and disassembling an oil and gas drilling rig and its components, loading all of the equipment onto trucks, transporting the equipment to the next well site, and reassembling and reconnecting the rig and its components. During a rig move, there are dozens of workers and vehicles at the well site, resulting in what is referred to as "controlled chaos." This video features workers identifying the major hazards encountered during a rig move and describing ways to avoid them. The use of workers speaking in their own words makes this product compelling to oil and gas extraction workers. We did not use a script or solicit specific responses from the workers; all of the workers' comments are their own. So that the video represents the industry overall, we collected footage in two regions of the country, in austere conditions, and during actual rig moves. This video represents a major contribution to the oil and gas extraction industry because it was developed through an effective collaboration with safety and health experts as a training product specific to this industry and the only one on this topic. Based on the quality of two previous video products we developed to promote fall protection and seat belts in the industry, one company contacted us and proposed the development of a video focused on rig move safety. This and two additional companies provided us with access to their worksites and workers for the development of this product. We distributed nearly 1,500 copies of the video within six weeks of its release. The International Association of Drilling Contractors has also agreed to market this product to its members, on its website and at national meetings and conferences.

Link to abstract in NIOSHTIC-2

Honorable Mention:

- **Title:** Caring for yourself while caring for others: Practical tips for homecare workers
- **Authors:** Baron S, Stock L, Ayala L, Soohoo R, Gong F, Lloyd C, Haroon P, Teran S, Gonzalez P
- **Source:** Oakland, CA: Public Authority for In-Home Supportive Services in Alameda County, 2010, Dec:1-84
- **Description:** As the elderly and disabled population requiring long-term care has grown, there has also been a shift away from use of institutional care, such as nursing homes, and toward expanded use of in-home health and supportive services. Roughly 85% of the 1.5 million workers delivering in-home services are low-skilled paraprofessionals called homecare workers. This workforce is expected to increase by 50% by 2016, making it one of the five fastest growing occupations, and sustains injury rates 50% higher than those of workers in the private hospital sector. Challenges in designing educational intervention materials for homecare workers include that most of them work alone, each home environment is unique, and

access to protective equipment is limited due to cost and availability. Demographics compound these challenges as the majority of workers are older, 38% have less than a high school education, 25% are foreign born and may face language barriers, and 22% live below the poverty level. This document was developed as one part of a larger community-based participatory intervention research project. It was printed in three languages and will be distributed to approximately 5,000 home care workers by our community partners in California. The document uses a simple checklist to allow workers to identify which risky tasks they perform and to obtain information and referrals to local resources and low costs tools that would help them implement changes. The document also focuses on the partnership between the worker and the client, emphasizing how to explain to clients why the worker's own health and safety is important to providing good care. One of our goals was to learn how NIOSH might better develop low cost, easily reproducible materials for low literacy and non English speaking worker populations. We researched appropriate format and design for documents that can be transferable to other materials for similar populations that are hard to reach. While the current version was designed for Alameda County, it can be altered by other localities to include their appropriate resources. A more generic version is also being developed that can be more easily modified by other localities.

Link to abstract in NIOSHTIC-2

Engineering and Physical Sciences Category

Winner:

- **Title:** Aerosol monitoring during carbon nanofiber production: mobile direct-reading sampling
- **Authors:** Evans DE, Ku BK, Birch ME, Dunn KH
- **Source:** Ann Occup Hyg 54(5): 514-531, 2010
- **Description:** This was the first study to systematically assess the use of direct reading instruments in the nanotechnology work environment. The study used a suite of particle and air quality instrumentation to simultaneously monitor emissions into the work environment. Sampling from the same location, all instrumentation monitored the same contaminated air. This is important where strong concentration gradients exist, such as those found close to contaminant sources. Findings suggested that respirable mass estimated with the photometer, rather than particle number or active surface area, was a better monitoring metric for carbon nanofibers in this and likely other work environments. Even though this was a complex work environment with a mixed exposure, by using the multimetric monitoring approach described, several nanoscale particle sources were differentiated from one another and contributed significantly to the understanding of emissions and potential for worker exposure. Particle size distribution measurements suggested a primary carbon nanofiber mode at approximately 200 – 250 nm, with a secondary mode at 1 and 3 nm. Significant concentrations of carbon oxide were also noted. Transients up to 270 ppm, above the NIOSH exposure limit, were observed, with thermal decomposition of the metallocarbonyl catalyst precursor the underlying source during fiber production. The study findings support the use of NIOSH method 5040 in determining the mass of elemental carbon as a selective marker for carbon nanotube or nanofiber exposure, as is recommended in the current NIOSH CIB on carbon nanotubes and nanofibers. As a result of this study, NIOSH is currently revising the monitoring protocol for nanotechnology workplaces that is widely followed by practicing industrial hygienists worldwide; the next update of the NIOSH "Safe Approaches to Nanotechnology" document will incorporate these important revisions.

Link to abstract in NIOSHTIC-2

Honorable Mention:

- **Title:** Assessing the performance of various restraints on ambulance patient compartment workers during crash events
- **Authors:** Green JD, Yannaccone JR, Current RS, Sicher LA, Moore PH, Whitman GR
- **Source:** International Journal of Crashworthiness 15(5): 517-541, 2010
- **Description:** This study substantiated the NIOSH hypothesis that worker restraint systems could be developed that would allow mobility for ambulance-based emergency medical technicians while safely attenuating the loading experienced during front or side crash impacts. This has resulted in a dramatic shift in the safety paradigm associated with work in the patient compartment of an ambulance, is spurring new product innovations, and ultimately will result in fewer worker injuries and fatalities. This research aimed to determine whether or not mobility restraint systems, employed largely in military applications, could be utilized safely in an ambulance patient compartment, i.e., a large, mobile environment where most workers are often caring for a patient while completely unrestrained. We found only a few previously published studies, each with limited data, that characterized the belt loading applied to a simulated human, or crash test dummy, when seated on a bench or bench-like seat in a side facing position relative to a frontal impact. Furthermore, one study that had used only a handful of tests had concluded that it was not feasible to safely utilize an upper body restraining device to protect a human in a side facing seating position. Our research combined a comprehensive review of human musculoskeletal tolerance, as it pertains crash loading in the frontal and side impact planes, with an evaluation of new and innovative occupant restraint technology. We used a large dataset of crash tests and evaluated five different restraint types. This testing was very complex and comprehensive and would not have been possible without the collaboration with U.S. and Canadian industry and government partners. As a result of our findings, seven industrial partners are now in the process of designing and testing new seating and restraint systems which feature upper body restraint for use on the side-facing seating traditionally found in ambulances built in the United States.

Link to abstract in NIOSHTIC-2

Honorable Mention:

- **Title:** Recommendations for a new rock dusting standard to prevent coal dust explosions in intake airways
- **Authors:** Cashdollar KL, Sapko MJ, Weiss ES, Harris ML, Man CK, Harteis SP, Green GM
- **Source:** 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. 2010-151, 2010
- **Description:** Adding rock dust to the explosive coal dust produced in bituminous coal mines can reduce the potential for explosions Accordingly, guidelines have been established by the Mine Safety and Health Administration (MSHA) about the relative proportion of rock dust that must be present in a mine's intake and return airways. Current MSHA regulations require that intake airways contain at least 65% incombustible content and return airways contain at least 80% incombustible content. The higher limit for return airways was set in large part because finer coal dust tends to collect in these airways. Mining technology and practices have changed considerably since the 1920s, when the original coal dust particle survey was performed. Also, it has been conclusively shown that as the size of coal dust particles decreases, the explosion hazard increases. Given these factors, NIOSH and MSHA conducted a joint survey to determine the range of coal particle sizes found in dust samples collected from intake and return airways of U.S. coal mines. Results from this survey showed that the coal dust found in mines today is much finer than in mines of the 1920s, presumably due to the increase in mechanization. Given the results of the extensive in-mine coal dust particle size surveys and subsequent large-scale explosion tests, NIOSH recommended a new standard of 80% total incombustible content (TIC) be required in the intake airways of bituminous coal mines in the absence of methane. The NIOSH numbered publication 2010-151 detailed the findings that modern coal mines have finer coal dust particles in the intake airways than that on which the MSHA regulations were based to prevent propagating coal dust explosions. After the publication of NIOSH 2010-151, MSHA published an emergency temporary standard for rock dust that requires 80% TIC in the intake airways as well as the return airways.

Link to full publication

Human Studies Category

Winner:

(One submission of three articles considered as a group):

- **Title:** Development of retrospective quantitative and qualitative job-exposure matrices for exposures at a beryllium processing facility
  Authors: Couch JR, Petersen MR, Rice CR, Schubauer-Berigan MK
  Source: Occ Environ Med. Published online October 25, 2010. doi: 10.1136/oem.2010.056630
- Title:Cohort mortality study of workers at seven beryllium processing plants: update and associations with cumulative and maximum exposure
  Authors: Schubauer-Berigan MK, Couch JR, Petersen MR, Carreón T, Jin Y, Deddens JA

Source: Published online November 16, 2010. doi: 10.1136/oem.2010.056515

- **Title:** Risk of lung cancer associated with quantitative beryllium exposure metrics within an occupational cohort
  Authors: Schubauer-Berigan MK, Deddens JA, Couch JR, Petersen MR
  Source: Occup Environ Med. Published online November 16, 2010. doi:10.1136/oem.2010.056515
- **Description:** NIOSH has previously evaluated the risks of beryllium sensitization and chronic beryllium disease (CBD) among exposed workers. To understand the association between beryllium exposure and other diseases, including cancer, among beryllium workers, NIOSH also has been studying a seminal cohort of workers from one beryllium processing plant. This set of three manuscripts describes the efforts by NIOSH researchers to study additional populations of exposed workers to understand whether an association exists between beryllium and cancer. Couch et al. (2010) described the development of job-exposure matrices (JEMs) that include exposures to other potential carcinogens at an extant beryllium processing plant where exposures to beryllium were low. Combining this plant's JEM with those from two other beryllium plants, Schubauer-Berigan et al. (2010a) evaluated the risk of lung cancer and other diseases in a pooled cohort study of workers at seven beryllium processing plants, who were followed for mortality through 2005. This study found that rates of lung cancer, chronic obstructive pulmonary disease (COPD), and the cause of death categories containing CBD and cor pulmonale were elevated. In addition, for the three plants with quantitative JEMs, workers whose maximum beryllium exposure was 10 µg/m3 or greater had higher rates of lung cancer, urinary tract cancer, COPD, and the cause of death category containing cor pulmonale than workers with lower exposure. NIOSH researchers also published a detailed assessment based on the three plants with quantitative exposure information (Schubauer-Berigan et al. 2010b). This study found that lung cancer was strongly associated with mean, maximum, and cumulative beryllium exposure and that time-weighted average exposures at the current OSHA or NIOSH exposure limits may confer an unacceptably high risk of lung cancer.

Link to abstracts in NIOSHTIC-2

- Development of retrospective quantitative and qualitative job-exposure matrices for exposures at a beryllium processing facility
- Cohort mortality study of workers at seven beryllium processing plants: update and associations with cumulative and maximum exposure
- Risk of lung cancer associated with quantitative beryllium exposure metrics within an occupational cohort

Honorable Mention:

- **Title:** Evaluation of antineoplastic drug exposure of health care workers at three university-based US cancer centers
- **Authors:** Connor TH, DeBord DG, Pretty JR, Oliver MS, Roth TS, Lee PSJ, Krieg EF, Jr., Rogers B, Escalante CP, Toennis CA, Clark JC, Johnson BC, McDiarmid MA
- **Source:** Journal of Environmental and Occupational Medicine 52(10): 1019-1027
- **Description:** OSHA developed guidelines in 1999 for the safe handling of antineoplastic and other hazardous drugs that are known human carcinogens and teratogens. Although many improvements have taken place in the safe handling of antineoplastic and other hazardous drugs since that time, workplace contamination and worker exposure still remains an issue in health care. This study used the most comprehensive methodology to date to evaluate factors contributing to workplace contamination and worker exposure. While similar studies have made use of one or two parameters related to exposure, this study undertook a multifaceted approach utilizing surface wipe samples from pharmacy and nursing areas, area and breathing zone air sampling, measurement of two specific drugs in worker urine, a measure of worker DNA damage, and a 6-week drug handling diary kept by workers. Sixty-eight exposed and 53 unexposed workers were studied. Sixty percent of wipe samples were positive for at least one of the five drugs measured. Cyclophosphamide was most commonly detected, followed by 5-fluorouracil. Exposed workers recorded 10,000 drug-handling events during the 6-week period tracked. Three of the 68 urine samples were positive for one drug. No genetic damage was detected in exposed workers using the comet assay. Our findings demonstrated that, despite following recommended safe handling practices, workplace contamination with antineoplastic drugs in pharmacy and nursing areas continues at these locations and that health care workers are still being exposed to these drugs.

Link to abstract in NIOSHTIC-2

Finalists

The names are not necessarily listed in the order in which they were ranked.

Engineering and Physical Sciences

Evans DE, Ku BK, Birch ME, Dunn KH. Aerosol monitoring during carbon nanofiber production: mobile direct-reading sampling. Ann Occup Hyg 54(5):514-531, 2010.

Green JD, Yannaccone JR, Current RS, Sicher LA, Moore PH, Whitman GR. Assessing the performance of various restraints on ambulance patient compartment workers during crash events. Int J Crashworthiness 15(5):517-541, 2010.

NIOSH Report of Investigation (RI) 9679: Recommendations for a new rock dusting standard to prevent coal dust explosions in intake airways. By Cashdollar KL, Sapko MJ, Weiss ES, Harris ML, Man CK, Harteis SP, Green GM. Pittsburgh, PA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2010-151, 2010.

Biological Sciences

Sriram K, Lin GX, Jefferson AM, Roberts JR, Wirth O, Hayashi Y, Krajnak KM, Soukup JM, Ghio AJ, Reynolds SH, Castranova V, Munson AE, Antonini JM. Mitochondrial dysfunction and loss of Parkinson's disease-linked proteins contribute to neurotoxicity of manganese-containing welding fumes. FASEB J 24(12):4989-5002, 2010.

Leonard SS, Chen BT, Stone SG, Schwegler-Berry D, Kenyon AJ, Frazer D, Antonini JM. Comparison of stainless and mild steel welding fumes in generation of reactive oxygen species. Part Fibre Toxicol 7(1):32, 2010.

Wang LY, Mercer RR, Rojanasakul Y, Qiu AJ, Lu YJ, Scabilloni JF, Wu NQ, Castranova V. Direct fibrogenic effects of dispersed single-walled carbon nanotubes on human lung fibroblasts. J Toxicol Environ Health, A 73(5-6):410-422, 2010.

Human Studies

Hanley KW, Petersen MR, Cheever KL, Luo L. Bromide and N-acetyl-S-(n-propyl)-l-cysteine in urine from workers exposed to 1-bromopropane solvents from vapor degreasing or adhesive manufacturing. Int Arch Occup Environ Health 83(5):571-584, 2010.

Connor TH, DeBord DG, Pretty JR, Oliver MS, Roth TS, Lees PSJ, Krieg EF Jr., Rogers B, Escalante CP, Toennis CA, Clark JC, Johnson BC, McDiarmid MA. Evaluation of antineoplastic drug exposure of health care workers at three university-based US cancer centers. J Occup Environ Med 52(10):1019-1027, 2010.

The following three articles were submitted as one nomination:

- Couch JR, Petersen MR, Rice CR, Schubauer-Berigan MK. Development of retrospective quantitative and qualitative job-exposure matrices for exposures at a beryllium processing facility. Occ Environ Med. Published online October 25, 2010. *doi: 10.1136/oem.2010.056630*.
- Schubauer-Berigan MK, Couch JR, Petersen MR, Carreón T, Jin Y, Deddens JA. Cohort mortality study of workers at seven beryllium processing plants: update and associations with cumulative and maximum exposure. Occ Environ Med. Published online October 15, 2010. *doi:10.1136/oem.2010.056481*.
- Schubauer-Berigan MK, Deddens JA, Couch JR, Petersen MR. Risk of lung cancer associated with quantitative beryllium exposure metrics within an occupational cohort. Occup Environ Med. Published online November 16, 2010. *doi: 10.1136/oem.2010.056515*.

Educational Materials

Slip, trip, and fall prevention for healthcare workers. By Bell J, Collins JW, Dalsey E, Sublet V. Morgantown, WV/Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2011-123, 2010.

Move it! Rig move safety for roughnecks. By: Cullen E, Hill R, Shannon J, Headding B. Spokane, WA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2011-108d, 2010.

Baron S, Stock L, Ayala L, Soohoo R, Gong F, Lloyd C, Haroon P, Teran S, Gonzalez P. Caring for yourself while caring for others: practical tips for homecare workers. In: Labor Occupational Health Program, National Institute for Occupational Safety and Health, Service Employees International Union. Edited by United Long Term Care Workers. Oakland, CA: Public Authority for In-Home Supportive Services in Alameda County, 2010.

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