Student Abstract Book

AIHce
INNER HARBOR BALTIMORE
May 21-26, 2016  AIHce2016.org
www.AIHce2016.org

Poster Session 405
Author Attend Time
Wednesday May 25, 2016
10:00 a.m. – Noon

Student Poster Review Committee

Chair: T. Renee Anthony, Ph.D., CIH
University of Iowa, Iowa City, IA

Leo DeBobes, MA, CSP
Stony Brook University Hospital, Stony Brook, NY

Tran Huynh, Ph.D., CIH
University of Alabama-Birmingham, Birmingham, AL

Jun Wang, Ph.D.
University of Oklahoma, Oklahoma City, OK

Pathways to Progress
1. Environmental Justice and Health: Black Hair Salons and Elevated PM2.5  Sarah Lemelman, Cassidy Tatun, and Teleah Slater, Brandeis University, Waltham, Massachusetts (Undergraduate)

2. The Environmental Justice Youth Training Program: Increasing Community Capacity through A Youth-Based Drop-in Module Amy Hillerman, California State University, Fullerton, California (Graduate)

3. Modeling RF Electric Field Exposures for INTEROCC Subjects who Worked with Military Radar Antennas Taichi K. Murata, California State University, Fullerton, California (Graduate)

4. A Comparative Analysis Between rFC and LAL Endotoxin Assays for Agricultural Air Samples Laura Ann Krause, Colorado State University, Fort Collins, Colorado (Graduate)

5. Task-Based Exposures to Airborne Endotoxins and β-Glucans Among Dairy Workers Amanda VanDyke, Colorado State University, Fort Collins, Colorado (Graduate)

6. Implications of Variations Between and Within Worker of Dose on a Radiological Risk Assessment at the Hope Creek Nuclear Generating Station Kathryn McNamara, Drexel University, Philadelphia, Pennsylvania (Graduate)


8. Effect of Heavy Metal Exposures on Hearing Loss Among Shipyard Personnel Nicholas Cody Schaaf, Indiana University of Pennsylvania, Indiana, Pennsylvania & U.S. Navy (Graduate)

9. Evaluation of a Low-Cost Sensor for Monitoring Occupational and Environmental Ozone Nima Afshar-Mohajer, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland (Graduate)

10. Industrial Hygiene at Work: Developing and Implementing a Comprehensive Exposure Assessment Tool Alison Gauthier, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland (Graduate)

11. Exploratory Study of Work-Related Musculoskeletal Disorders in Cow Milking in the Province of Quebec, Canada Marie-Andrée Pâquet, Polytechnique Montreal, Université de Montréal, Montreal, Quebec, Canada (Graduate)

12. Job Stress and Oxidative Damage Biomarkers in ER Physicians and Nurses Rupkatha Bardhan, University of Alabama at Birmingham (UAB), Birmingham, Alabama (Graduate)

13. Formaldehyde Emission Profiles From Household Flooring Stephanie Jacobs, University of Alabama at Birmingham (UAB), Birmingham, Alabama (Graduate)

14. Effects of Body Orientation On Metal Fume Sampling in a Non-Ferrous Foundry Stephanie Caler, University of Arizona, Tuscon, Arizona (Graduate)

15. Characterization of Polycyclic Aromatic Hydrocarbon Exposure in Wildland Firefighters Kathleen Navarro, University of California at Berkeley, Berkeley, California (Graduate)

16. Row, Row, Row your Boat: Evaluation of Airborne Silica Exposures to Students Building a Concrete Canoe Alexander Neuhaus, University of California at Berkeley, Berkeley, California (Graduate)

17. Perfluorinated Compounds among Participants of the Women Firefighters Biomonitoring Collaborative Study Jessica Towbridge, University of California at Berkeley, Berkeley, California (Graduate)

18. Quantitative Investigation of Crystalline Silica and Metal Concentrations in a Ceramics Studio Marley Zalay, University of California at Los Angeles (UCLA), Los Angeles, California (Graduate)

19. Characterizing Ultrafine Particles in Nail Salons in the Greater Los Angeles Area Charlene Nguyen, University of California at Los Angeles (UCLA), Los Angeles, California (Graduate)

20. Assessing Ultra-Fine Particles (UFP) Exposure in Vape (Electronic Cigarette) Shops Chanbopha Amy Sen, University of California at Los Angeles (UCLA), Los Angeles, California (Graduate)

21. Job Hazard Analyses for a Leading Organic Milk and Non-Dairy Beverage Producer in Southern California Elaine Allison West, University of California at Los Angeles (UCLA), Los Angeles, California (Graduate)

22. Prevention through Design Business Case: Silicone Spark Plug Manufacturing Lyndsey Marie Hernandez, University of Central Missouri, Warrensburg, Missouri (Undergraduate)

23. Heat Stress in the Workplace: an Ergonomic Evaluation of an Electrical Contractor’s Warehouse in Missouri Argaron Washington and Todd Hocker, University of Central Missouri, Warrensburg, Missouri (Undergraduate)

24. Objective Evaluation of Dust Collection Methods of Indoor Air Fungal Exposure Assessment Using Quantitative PCR Jennie Dian Cox, University of Cincinnati, Cincinnati, Ohio (Graduate)

25. Performance of an N95 Filtering Facepiece Respirator and a Surgical Mask Used by Home Attending Health-Care Workers (Pilot Study) Yousef Elmashae, University of Cincinnati, Cincinnati, Ohio (Graduate)

26. Nitrogen Dioxide (NO2) Air Quality Measurement – Pilot Study Kelechi Isiugo, University of Cincinnati, Cincinnati, Ohio (Graduate)

27. Psychosocial and Musculoskeletal Concerns of Afro-Caribbean Dancers Kirsti Rahkel Gilmore, University of Illinois at Chicago, Chicago, Illinois (Graduate)
28. Testing A Screening Question for Elevated Prenatal Mercury  Nayila Mulati, University of Illinois at Chicago, Chicago, Illinois (Graduate)
29. Impact of Video-Based and Hands-On Training on Hearing Protector Attenuation  Takehito Nakagawa, University of Illinois at Chicago, Chicago, Illinois (Graduate)
30. Comparison of Perceived Environmental Risk and Modeled Environmental and Occupational Health in Southeastern Cook County, IL  Frank Pagone, University of Illinois at Chicago, Chicago, Illinois (Graduate)
31. The Impact of Assisted Donning on Fit Factors  Brian Justin Rembialkowski, University of Illinois at Chicago, Chicago, Illinois (Graduate)
32. Adverse Health Effects Associated with Generalized and Sexual Harassment in Employed Women  Mark Wilson, University of Illinois at Chicago, Chicago, Illinois (Graduate)
33. Method to Assess Low-Cost H2S Monitors for Use in Agriculture  Jessica Marie Beswick, University of Iowa, Iowa City, Iowa (Graduate)
34. The Development and Optimization of a DNA Extraction Method for Aerosol Samples Collected Using Polyvinylchloride Filter Media  Corey Lee Boles, University of Iowa, Iowa City, Iowa (Graduate)
35. Development of a Personal Aerosol Collector and Spectrometer (PACS): Part II: Laboratory Experiments for Particle Size Distributions  Changjie Cai, University of Iowa, Iowa City, Iowa (Graduate)
36. Assessment of Noise in a Medical Intensive Care Unit  Kathryn J Crawford, University of Iowa, Iowa City, Iowa (Graduate)
37. Evaluation of Consumer Photometers for Measuring Environmental and Occupational Aerosols  Laura Hallett, University of Iowa, Iowa City, Iowa (Graduate)
38. Production Practices Associated with Personal Exposure to Inhalable Aerosols during Work in Broiler Chicken Production  Sarah Williams Ischer, University of Iowa, Iowa City, Iowa (Graduate)
39. Developing a Sampling Strategy for Measuring Total Bacteria Aerosol Generated During Toilet Use in a Hospital Based Patient Care Setting  Samantha Dawn Knowlton, University of Iowa, Iowa City, Iowa (Graduate)
40. Design and Evaluation of a High-Flowrate (10 LPM) Nanoparticle Respiratory Deposition Sample  Theresa Iren Szabo McColom, University of Iowa, Iowa City, Iowa (Graduate)
41. A Task-Based Analysis of Black Carbon Exposure in Midwest Farmers  Emma Stapleton, Universidad Andres Bello, Santiago, Chile & University of Iowa, Iowa City, Iowa (Graduate)
42. Characterization of Sand Processed for Use in Hydraulic Fracture Mining  Aimee Lizabeth Stark, University of Iowa, Iowa City, Iowa (Graduate)
43. Utilizing Smart Devices to Measure Intermittent Noise Exposure in the Workplace  Benjamin James Roberts, University of Michigan, Ann Arbor, Michigan (Graduate)
44. Occupational Iron Exposures and Pleural Disease among Minnesota Taconite Mining Workers  Yuan Shao, University of Minnesota- Twin Cities, Minneapolis, Minnesota (Graduate)
45. Turbulent Eddy Diffusion Models in Exposure Assessment - Determination of the Eddy Diffusion Coefficient  Yuan Shao, University of Minnesota- Twin Cities, Minneapolis, Minnesota (Graduate)
46. Analyzing Sound Pressure Level Distribution from Monitoring of Research Animal Cage Washers  Ali Zhang, University of Minnesota- Twin Cities, Minneapolis, Minnesota (Graduate)
47. Hearing Loss, Noise Exposures, and Hearing Protection Use Among Midwestern Farmers: A Preliminary Analysis  Josie Jane Ehlers, University of Nebraska Medical Center, Omaha, Nebraska (Graduate)
48. U.S. Ebola Treatment Centers: An Inventory of Capabilities  Jocelyn Herstein, University of Nebraska Medical Center, Omaha, Nebraska (Graduate)
49. Assessment of Chemical Exposures in Nails Salons in Omaha: A Preliminary Study  Tai Anh Hoang, University of Nebraska Medical Center, Omaha, Nebraska (Graduate)
50. UV-Reflective Paint and Ultraviolet Germicidal Irradiation (UVGI) Improve Decontamination of Nosocomial Bacteria on Hospital Room Surfaces  Katelyn Jelden, University of Nebraska Medical Center, Omaha, Nebraska (Graduate)
51. Tobacco Harvesting Work, Exposure to Nicotine, Vital Signs and Nicotine Poisoning  Vedant Gohil and Nchekwubechukwu Okafor, University of North Texas, Fort Worth, Texas (Graduate)
52. Determinants of Nicotine Exposure in Tobacco Harvesting Workers: A Pilot Study  Nchekwubechukwu Okafor and Vedant Gohil, University of North Texas, Fort Worth, Texas (Graduate)
53. Evaluation of Physiological Strain in Hot Work Areas using Thermal Imagery  Clint Holm, University of Utah, Salt Lake City, Utah (Graduate)
54. Wind Tunnel Testing of a Disposable, Inhalable Aerosol Sampler at Two Sampling Rates  Justin Dean Stewart, University of Utah, Salt Lake City, Utah (Graduate)
55. Assessment and Prioritization of Mixed Exposures to Toner Emissions using an Asthma Risk Scoring Model  Alyson Johnson, West Virginia University, Morgantown, West Virginia (Graduate)
Abstract 1
Environmental Justice and Health: Black Hair Salons and Elevated PM2.5
Student Authors: A. Abrams, A. Marill, A. J. Cooper, R. Ramakrishna, J. Feinstein, R. Trott, S. Lemelman, T. Slater, A. Fortnow, C. Tatun, O. Kulkarni, and S. Watemberg
Faculty Authors: L. J. Goldin, T. A. Myatt, J.G. Allen, J.H. Stewart, and M. A. Fragala
Brandeis University Waltham, MA (Undergraduate)

Objectives: The purpose of this study was to quantify exposures to VOCs, aldehydes, ketones, PM2.5, and CO2 in black hair salons. Black hair salons are generally small, enclosed spaces that use specialized products marketed for particular types of hair styling.

Methods: We collected short-term, area air samples of VOCs (summa canisters; EPA method TO-14), aldehydes and ketones [EPA TO-11] in ten salons in the greater Boston area, along with real-time measures of fine particulate matter [PM2.5] (TSI DustTrak Aerosol Monitor) and carbon dioxide [CO2] (TSI Q-Trak).

Results: Seven out of the ten salons had very high fine particulate matter concentrations [average = 394 µg/m3; max = 1030 µg/m3]. To identify potential sources of PM2.5 in salons, we conducted a follow-up time-series investigation in a controlled study in one salon and identified PM2.5 peak concentrations during the use of irons and hair dryers. Regarding chemical exposures, short-term concentrations were below published occupational exposure limits [OELs], but five salons had chloroform concentrations above EPA's screening level carcinogenic target risk value [0.12 µg/m3], and all ten salons had benzene concentrations above EPAs carcinogenic target risk level [0.36 µg/m3]. Elevated levels of carbon dioxide in all salons suggested inadequate ventilation.

Conclusions: This study reveals higher than expected levels of PM2.5 inside salons, and two chemicals above EPA screening levels. Due to the short-term sampling and limited number of salons, further evaluation is recommended to: assess full-shift exposure; identify which products and services are contributing to the high PM2.5 levels; identify controls to reduce exposures; assess the potential health implications of these exposures; and determine if these findings are representative of a larger number of salons.

Abstract 2
The Environmental Justice Youth Training Program: Increasing Community Capacity through A Youth-Based Drop-in Module
Authors: A. Hillerman, L. Aguirre, and J. Breskey, California State University, Fullerton (Graduate)

Objectives: 1. Increase community capacity within neighborhoods inequitably exposed to environmental hazards through a youth-based drop-in environmental justice program; 2. Employ P-Trak© and AirBeam© air monitors for testing the air quality of surrounding neighborhoods to inform participant advocacy projects; 3. Promote future intentions to engage in advocacy by facilitating a participant led advocacy project.

Methods: 12 weeks of didactic instruction presented to two cohorts comprised of students from Magnolia High School in Anaheim, California. Sessions provided foundational knowledge of environmental justice and skill-building critical to advocacy including the use of hand-held air sensors in ascertaining air pollution levels in nearby neighborhoods. Pretest and posttest assessments were administered containing questions sorted into categories matching constructs of the Social Cognitive Theory. Final responses were assessed for changes in self-efficacy, beliefs, knowledge, and intention.

Results: Results were measured using Cohort One (n= 11) data, as Cohort Two is presently concluding instruction. Results indicated improved point estimates for each of the constructs. Scores for knowledge regarding air pollution monitoring, hazard assessment, and strategic planning increased 66% while intention to engage in advocacy improved only 2%. Comparative means assessments for knowledge showed statistically significant improvements [p = 0.034]. Correlations between beliefs about and intentions to participate in advocacy were statistically significant [p=0.009]. Correlations between all other constructs were not statistically significant.

Conclusions: Improvements across individual point estimates suggest that a drop-in curriculum for environmental justice may aid in lowering barriers to intention to engage in advocacy or environmental science in the future. However, limitations on sample size may have obscured potential correlations between constructs and improved intentionality. The authors recommend establishing an ideal sample size for future studies.

Abstract 3
Modeling RF Electric Field Exposures for INTEROCC Subjects who Worked with Military Radar Antennas
Authors: T. K. Murata [1], J. D. Bowman [2], M.R. Doczkat [3], J.Vila [4], and E. Cardis [4], INTEROCC Study Group
(1) California State University Fullerton (Graduate)
(2) National Institute for Occupational Safety and Health (NIOSH), Cincinnati, Ohio
(3) Federal Communications Commission, Washington DC
(4) Centre for Research on Environmental Epidemiology (CREAL), ISGlobal, Barcelona, Spain
California State University Fullerton (Graduate)

Objectives: The INTEROCC (INTERNational OCCupational) Study of brain cancer examines occupational exposures from radio frequency [RF] electromagnetic fields by linking interview data on RF exposures with study subjects to an occupational measurement database. Since RF measurements with military personnel are seldom published, this study was undertaken to create a mathematical model of their RF exposures for INTEROCC’s risk analysis.

Methods: INTEROCC’s interviews obtained subjects’ history, tasks involving radar, and the horizontal distance from radar antennas. The subject’s interview information on military radar and tasks were categorized into 13 radar "scenarios." For modeling, mobile and stationary radar equipment were selected from a US military RF safety manual in order to obtain detailed emission specifications such as frequency, aperture antenna dimensions, transmitted power, and duty factor. With the subjects’ interview information plus emission data from all
radars that fit their reported emission scenarios, an aperture antenna model gave estimates for their electric field exposure.

**Results:** From 35,263 jobs reported by 9,165 INTEROCC subjects, 81 subjects with jobs in the Army or Air Force reported working with radar. The distances INTEROCC military subjects reported working from military radar were 0.5 to 10,000 meters. The range of estimated electric field exposures from radar were from non-detectable to 5.09 V/m.

**Conclusions:** Our assessment of military personnel’s RF exposures from radar fills a gap in INTEROCC’s cancer risk analysis, which is potentially important because of their higher exposures. These modeled exposure estimates are not yet validated against measured RF fields from radar. Once our modeling method is validated, it can be used in other epidemiology studies.

**Abstract 4**
**A Comparative Analysis Between rFC And LAL Endotoxin Assays for Agricultural Air Samples**
**Authors:** L. Krause, S. Reynolds, A. VanDyke, and J. Schaeffer, Colorado State University (Graduate)

**Objectives:** The objectives of this study were to: 1. Evaluate endotoxin recovery from liquid-spiked filter samples and 2. Compare endotoxin measurements between the recombinant factor C (rFC; Lonza) and Limulus Amebocyte Lysate (LAL; Cape Cod Associates) assay.

**Methods:** For Aim 1, polyvinyl chloride (PVC) filters in replicates of 5 were spiked with 5 levels of known endotoxin amount. Each filter was then desiccated for 24 hours and loaded into SKC Button Aerosol Samplers. Air was pulled through filters for 4 hours at a flowrate of 4 L/min. Samples were then frozen at -80°C, thawed, and extracted. Each sample was analyzed using the rFC assay. For Aim 2, a combination of personal, area, and field blanks (n=31) were collected from two Colorado dairy farms. Samples were desiccated for 24 hours, frozen at -80°C, thawed, and extracted. Each sample was then analyzed using the rFC and LAL assay and the results were compared using the Bland-Altman statistical analysis.

**Results:** Endotoxin recovery for each known endotoxin amount ranged from 1-8%. For the full sample size, there was no significant difference between the rFC and LAL assay (p-value=0.71), as well as for the personal sample subset (p-value=0.38). There was a significant difference found between the assays for the area subset (p-value=0.070), and the lab and field blank subset (p-value=0.066). The area subset resulted in higher means with the rFC assay (485 vs. 312 EU/mL). The blanks subset found higher means for the LAL assay (38 vs. 0.11). A correlation was run between the rFC and LAL assay, and an R2 value of 0.75 was found.

**Conclusions:** Due to the hydrophobic nature of the PVC filter, it is likely that most of the liquid-spike evaporated rather than being absorbed. Overall, the rFC assay offered a wider detection range, higher standard curve correlation coefficients, and lower variability.

**Abstract 5**
**Task-Based Exposures to Airborne Endotoxins and β-Glucans Among Dairy Workers**
**Authors:** A. VanDyke, S. Reynolds, J. Schaeffer, S. Magzamen, and L. Krause, Colorado State University (Graduate)

**Objectives:** Characterize endotoxin and β-glucan exposure among dairy workers across different days and tasks (birthing, milking, irrigation, medical care, rebedding, mixing feed, truck driving, machine operators, and multi-task work).

**Methods:** Personal and area air samples were obtained at four Northern Colorado dairies spanning nine weeks from March-September 2015. The goal for each sampling week was to recruit and monitor seven workers performing different tasks during their full-shift (shift length varied from 8-12 hours). We sampled a total of 38 workers. The SKC Button Sampler was employed for both personal and area samples with a flowrate of 4 L/min. Area samples were completed in triplicate in three locations at each dairy (upwind, downwind, and inside the parlor). Inhalable dust concentrations were calculated based on the gravimetric data. Endotoxin assays have been completed (per Lonza standard protocol). β-glucan results will be completed in April (per Cape Cod standard protocol). Preliminary summary statistics were completed in Sigma Plot.

**Results:** The task with the highest average dust concentration was mixing feed (0.568 mg/m3) followed by working in the dry cow pen (0.459 mg/m3) and the birthing area (0.436 mg/m3). The endotoxin concentrations ranked differently by task in comparison to the dust concentrations. The task with the highest endotoxin concentration was the medical task (22.82 EU/m3) followed by the birthing area (16.23 EU/m3), and those working in the milking parlor (14.85 EU/m3). The area samples (both the dust and endotoxin concentrations) show that across the four dairies sampled the highest concentrations were found inside the parlor.

**Conclusions:** The next stage in this project is discussions with producers to design and evaluate interventions to reduce exposure to endotoxins, β-glucans, and dust concentrations in the areas with the highest exposure.

**Abstract 6**
**Implications of Variations Between and Within Worker of Dose on a Radiological Risk Assessment at the Hope Creek Nuclear Generating Station**
**Authors:** K. McNamara, C. Peters, and I. Burstyn
**Drexel University (Graduate)**

**Objectives:** To compare estimated annual doses from the Hope Creek Nuclear Generating Station with industry standards for radiation exposure, while accounting for between- and within-worker variability on monthly doses.

**Methods:** Personal dosimeter data from Hope Creek Nuclear Generating Station was obtained for January – December 2014 with 5,388 monthly dose measurements from 888 workers. Compliance with the Nuclear Regulatory Commission (NRC) annual Occupational Exposure Limit (OEL) of 5,000 millirem [mrem] was evaluated using three methods. First, a compliance estimate was calculated for the probability of any random worker exceeding the annual OEL. Second, estimates
of monthly mean dose, between-worker, and within-worker variances were obtained for all 14 departments. Left censored data below the limit of detection were accounted for using maximum likelihood estimation method of Jin et al [2010]. The probability of overexposure on a monthly basis using 1/12 OEL and the plant’s internal limit of 2,000 mrem was calculated for each department according to Rappaport et al [1994]. Third, bootstrapped estimates of annual dose were compared with cumulative dose data from the Department of Energy’s Radiation Exposure Monitoring System (REMS).

Results: Using the compliance test, no workers exceeded the annual NRC OEL. After considering between- and within-worker variances, 5 out of 14 departments had a >1% chance of exceeding the 1/12 OEL. However, external contractors, maintenance, and radiation protection departments had a greater than 5% chance of exceeding the internal limit of 2,000 mrem. Bootstrapped annual exposure doses revealed similar patterns.

Conclusions: Hope Creek Nuclear Generating Station appears similar to or more protective than its industry peers in terms of annual ionizing radiation doses. Some variations exist in between and within worker exposure that are not captured in an aggregated annual dose estimate. These individual and department-level variations are important to take into account when forecasting likelihood of exceeding the OEL at the station.

Abstract 7
Evaluating the Efficacy of an Alternative Method of Disinfecting Laminate Surfaces
Authors: G. Steiner, D. Petras, and M. Scannell
Illinois State University (Undergraduate)

Objectives: (1) Determine the effectiveness of a germicidal UV-C wand for surface disinfection and (2) evaluate changing relative humidity [RH] and different target distances on bacteria kill rates.

Methods: Tests involved these steps:
1. Three 7.5 cm by 10 cm laminate surfaces were streaked with a 105 concentration of S. epidermidis and dried for 10 minutes.
2. A UV-C photometer measured intensity, and psychrometer measured RH. The UV-C wand was positioned at 12.7, 27.9, and 50 cm above the test surfaces. One surface was centered under the lamp and the others were 6.5 cm to the left and right. There were 33 tests; 24 at 12.7 cm, six at 27.9 cm, and three at 50 cm. The 12.7 cm tests included high, low and optimum RH, while the others were at optimal RH [43-51%].
3. Replicate Organism Detection and Counting (RODAC) plates were used to count colony forming units (CFUs). After exposure to UV-C, the RODAC plates were gently pressed onto the contaminated laminate surfaces for 10 seconds.
4. RODAC plates were immediately incubated at 37-degrees Celsius for 24-hours and then CFUs were counted. Germicidal efficacy was determined by the log reduction of surface contamination.

Results: Kill rate was best at optimal RH. Both high and low RH interfered with the ability of UV-C to kill S. epidermidis. As expected, the UV intensity and kill rates results followed the inverse square law.

Conclusions: This research demonstrates that while UV-C was efficacious under optimal conditions [RH of 40 to 65%], under direct beam exposure, and a short target distance [12.7 cm], it is important to recognize its limitations when used in non-optimal conditions. Both low and high RH, increased distance, and indirect beam angles all resulted in lower kill rates. It is also important to minimize unnecessary patient and worker exposure during its use.

Abstract 8
Effect of Heavy Metal Exposures on Hearing Loss Among Shipyard Personnel
Authors: N.C. Schaal [1] [2], J. Slagley [1], M. Zreiqat [1], H. Paschold [1], and T. Cekada [1]

[1] Indiana University of Pennsylvania


Indiana University of Pennsylvania (Graduate)

Objectives: Evaluate the association between exposures to metals on hearing loss in shipyard personnel while controlling for noise, organic solvents, and other major risk factors.

Methods: Data for 1,546 personnel aged 18-77 from the years 2004-2015 were analyzed. Hearing threshold changes were analyzed across the 500-6000 Hertz [Hz] frequencies to identify development of a Permanent Threshold Shift [PTS]. Hearing change was assessed by subtracting each subject’s initial hearing threshold measured at the beginning of the 11 year time frame from subject’s final hearing threshold measured at the end of the timeframe. Noise and chemical exposure records were used to assign personnel into one of five exposure groups based on level of concentration: high noise, high metals/solvents, high metals/noise, high metals/solvents/noise, and low metals/solvents/noise. Specific chemicals targeted for analysis included lead, cadmium, arsenic, toluene and xylene. Personal protective equipment use information was not collected but personnel were expected to be compliant with personal protective equipment requirements implemented by the organization.

Results: Logistic regression indicated high concentrations of metals and solvents had an Odds Ratio [OR] = 2.4 and 95% Confidence Interval [CI] 1.02, 2.85. The metals, solvents, and noise group had an OR = 1.7; 95% CI 1.46, 3.94. Both groups were significantly associated with development of a PTS while controlling for the effects of age, gender and exposure duration.

Conclusions: Personnel with simultaneous exposures to high concentrations of metals such as lead, cadmium, and arsenic and solvents such as toluene and xylene beginning at high concentrations less than OSHA’s Permissible Exposure limits may damage hearing. Results suggest the need to consider expanding hearing conservation programs beyond just noise exposed workers by considering combinations of exposures to metals, solvents, and noise.
Abstract 9
Evaluation of a Low-Cost Sensor for Monitoring Occupational and Environmental Ozone Student Full
[1] Johns Hopkins Bloomberg School of Public Health
[2] University of Iowa, Iowa City, IA

Objectives: Efficacy of a customized low-cost ozone sensor as a proper candidate to be deployed in an occupational ozone network monitoring set-up was evaluated and its recorded voltages were correlated to ozone concentrations using reference ozone analyzers.

Methods: Concentration of the ozone was controlled inside a sealed chamber (0.5 x 0.5 x 0.5 m) using an ozone generator. Ozone concentration gradually increased to reach a targeted level (50, 100 or 150 ppb), then was maintained at the steady-state and finally was decreased back to zero. Real-time ozone concentration was monitored using a high-cost ozone analyzer (Model 1008PC, Dasibi Environmental Co., Glendale, CA which works based on UV absorption mechanism), two types of mid-cost ozone monitors (Model POM, 2B Technologies Inc., Boulder, CO, USA and Series 500, Aeroqual Inc., Auckland, New Zealand which works based on UV absorption and piezo-optical mechanisms) and three customized low-cost ozone sensors (Model OX-B421, AlphaSense Ltd., Great Notley, UK which works based on oxidizing semiconductor mechanism). A microcontroller of the low-cost sensor with Wi-Fi connectivity to a micro SD data storage recorded the voltage readings. Regression analysis correlated the voltage of the signal measured by the low-cost sensor to those of the high-cost and mid-costs instruments.

Results: A linear relationship (R2=0.75) was observed between the recorded voltages and ozone concentrations. In each ozone generation cycle, we observed about 1.6 times faster response in recorded voltage values by the low-cost sensor when the ozone concentrations were increasing compared to the case concentrations were decreasing. Slope of the time-series plots of the low-cost sensor when the ozone concentration was increasing was closer to the UV absorptive ozone monitors; and when the ozone concentration was decreasing was closer to the piezo-optical ozone monitors.

Conclusions: Results of this study can be used to calibrate an inventive low-cost ozone sensor to be deployed in any occupational or environmental monitoring network.

Abstract 10
Industrial Hygiene at Work: Developing and Implementing a Comprehensive Exposure Assessment Tool
Authors: A. Gauthier [1], K. Koehler [1], J. McNamara[2]
[1] Johns Hopkins Bloomberg School of Public Health
[2] Northrop Grumman Corporation, Linthicum, MD

Johns Hopkins Bloomberg School of Public Health (Graduate)

Objectives: The goal of this study was to develop a qualitative exposure assessment tool for an advanced electronics company in Baltimore, MD. The tool was intended to help environmental health and safety [EH&S] professionals evaluate worksites in a standardized way such that subjective professional judgment was minimized. It was also meant to aid EH&S professionals in deciding how to prioritize resources for exposure monitoring.

Methods: A literature review was performed to determine the state of the science in qualitative exposure assessment models. The American Industrial Hygiene Association’s Strategy for Assessing and Managing Occupational Exposures was followed to develop a tool for performing qualitative exposure assessments.

Results: The resulting qualitative exposure assessment tool consisted of two parts: a basic characterization questionnaire that helped users evaluate job tasks and identify the appropriate similar exposure groups (SEGs); and a risk-ranking algorithm that translated the qualitative data into a numerical score for each SEG. The algorithm used inputs such as task length, chemical vapor pressure, and degree of ventilation controls to arrive at an exposure score. Inputs for the hazard score included the Hazardous Materials Identification System rating or the order of magnitude of the occupational exposure limit. Once those scores were calculated, they were multiplied to arrive at an overall risk ranking that ranged from 0-5 (Low/Acceptable) to 16-20 (Very High/Unacceptable). This score is what was used to aid in prioritizing resources for sampling.

Conclusions: A qualitative exposure assessment tool can help companies prioritize limited resources by identifying SEGs for personal exposure monitoring. Although each industry and company will need to tailor their methodology to their own needs, this tool represents one approach that may be helpful to others in the future.

Abstract 11
Exploratory Study of Work-Related Musculoskeletal Disorders in Cow Milking in the Province of Quebec, Canada
Authors: M.A. Paquet and D. Imbeau
Polytechnique Montreal, Université de Montréal (Graduate)

Objectives: 1. To establish the prevalence of work-related musculoskeletal disorders (WRMSDs) in milkers of Quebec, by gender, herd size and milking system. 2. To compare WRMSD prevalence in milkers to literature and to a large scale survey in Québec’s general population.

Methods: 84 milkers filled a survey consisting of an expanded Nordic Questionnaire, demographics aspects, milking conditions
linear correlation (R²=0.49) was observed between ERR and was found in job stress indicators between two groups. Positive participants. No statistically significant difference (p > 0.05) detected in the urine samples of experimental vs. control.

Results: Significantly higher level of 8OHdG (p < 0.05) was measured from urine by ELISA.

Conclusions: The preliminary data indicated higher oxidative stress in ER physicians and nurses. Although job stress indicators measured as perceived stress, in limited participants did not show significant difference, ERR showed higher trends in experimental group than control. Positive association between job stress indicators and 8OHdG levels in experimental group is intriguing.
Abstract 14
Effects of Body Orientation On Metal Fume Sampling in a Non-Ferrous Foundry
Authors: S. Caler and T. Stobbe
University of Arizona (Graduate)

Objectives: To evaluate the effects of body orientation and handedness on metal fume sample results when tasks are predominantly performed on one side of the worker’s body.

Methods: Aluminum samples were collected on mixed cellulose ester filters simultaneously on the left and right sides of the breathing zone (n=10, or n=5 pairs) of two foundry workers only during aluminum pouring activities as short-term time-weighted average measurements over the course of four days. A dominant task side, or a side of the body where aluminum pouring consistently took place, was identified for each employee. The samples in each pair were collected simultaneously to compare dominant versus non-dominant task side exposure assessment results. In the comparison, it was determined that placement of the media on the dominant task side yielded metal fume sampling results significantly different from those results obtained from the non-dominant task side. The pairs of samples were analyzed via inductively coupled argon plasma, atomic emission spectroscopy. Results were compared for a statistically significant difference between sides based on dominant task side and body orientation using a paired t-test.

Results: Results show that body orientation as it relates to task location, which is impacted by task side and handedness, impacts the metal fume sample results and the estimated metal fume concentrations for occupational exposure assessments in the non-ferrous foundry (p=0.01).

Conclusions: Body orientation, handedness and the position of a task or operation adjacent to a worker should be considered when planning an exposure assessment for metal fumes. Fundamentally, choosing the appropriate side of a worker for sample media placement may impact the conclusions made in an exposure assessment.

Abstract 15
Characterization of Polycyclic Aromatic Hydrocarbon Exposure in Wildland Firefighters
Authors: K. Navarro [1], J. Balmes [1], S.K. Hammond [1], and R. Cisneros [2]

[1] University of California, Berkeley, CA
[2] University of California, Merced, CA
University of California, Berkeley (Graduate)

Objectives: Wildland firefighters working to control wildland fires work long shifts and are exposed to high levels of wood smoke with no respiratory protection. Polycyclic aromatic hydrocarbons (PAHs) are formed during incomplete combustion and are associated with cardiopulmonary mortality and immunotoxicity and some are known carcinogens. The objective was to assess PAH exposures of wildland firefighters during firefighting activities at two large wildland fire events in mixed conifer forests in the Southern Sierra Nevada Mountains.

Methods: PAHs were measured over 15 works shifts on 19 wildland firefighters (N=28) while constructing fire breaks (fire line), operating fire engines (engine operator), inspecting the active fire perimeter (holding), patrolling the fire perimeter (patrol) and extinguishing burning material post-fire (mop-up). Personal air samples were collected using actively sampled XAD-coated quartz fiber filters sampled at 1.5 L/min for 2 to 13 hours. Filters in cassettes were attached to the back of each wildland firefighter’s backpack. Samples were analyzed for 17 individual PAHs through extraction with dichloromethane and analyzed on a gas chromatograph with a mass selective detector.

Results: Mean total gas and particulate PAH concentration was highest while holding (12.4 µg/m3; SD: 13.1 µg/m3). Mean total PAH concentrations were higher for patrol (5.0 µg/m3; SD: 3.4 µg/m3) and engine operators (5.8 µg/m3; SD: 7.6 µg/m3) compared to mop-up (2.3 µg/m3; SD: 1.8 µg/m3) and fire line (2.8 µg/m3). Of the 17 PAHs that were analyzed, retene had the highest single measured concentration, 24 µg/m3 (mean: 3.8 µg/m3; SD: 5.5 µg/m3). Concentrations of benzo[a]pyrene, a carcinogen, ranged from non-detect to 0.14 µg/m3 (mean: .02 µg/m3; SD: 0.03 µg/m3).

Conclusions: Total PAH concentration was highest for wildland firefighters during tasks that involve the most direct contact with smoke near an actively burning wildland fire. It is important to characterize exposures from wildland fires to better understand any potential long-term health effects.

Abstract 16
Row, Row, Row your Boat: Evaluation of Airborne Silica Exposures to Students Building a Concrete Canoe
Authors: A. Neuhaus, T.Harris, and P. Maynard
University of California, Berkeley (Graduate)

Objectives: 1. To verify that levels of total and respirable airborne dust and crystalline silica are below Cal-OSHA PEL during active hand sanding of the concrete canoe by engineering students. 2. To evaluate whether current Standard Operating Procedure (SOP) protects students during production of the concrete canoe.

Methods: During concrete canoe production the process of hand sanding was identified as an area of airborne exposure concern for nuisance dust and silica exposure. Four personal and four area air samples were collected during the process of hand sanding the concrete canoe in an unventilated tent: to assess total nuisance particulates and crystalline silica, and subsequently to assess respirable nuisance particulates and crystalline silica using the respective NIOSH analysis methods. Additionally, a bulk sample of the settled dust particulates was analyzed.

Results: Hand sanding occurred in 2-hour periods and did not exceed the 8-hour time weighted average PEL set by Cal/OSHA. However, if the students sanded for 8-hours the airborne silica level would approach the new OSHA PEL for crystalline silica. Additionally, the students performing the hand sanding were covered in dust particulates that could irritate exposed eyes, nose, and mouth.

Conclusions: The continued voluntary use of N95 dust mask and safety glasses were recommended to students performing hand sanding to avoid sanding particulates irritating the eyes, nose, or mouth. Improvements to the SOP included: improve ventilation,
Abstract 17
Perfluorinated Compounds among Participants of the Women Firefighters Biomonitoring Collaborative Study
Authors: J. Trowbridge (1), R. Morello-Frosch (1), R. Gerona (2), R. Rudel (3), H. Buren (4), A. Stefani (5)
(1) University of California Berkeley
(2) University of California (UCSF) San Francisco
(3) Silent Spring Institute, Newton MA
(4) United Fire Service Women, San Francisco, CA
(5) San Francisco Firefighters Cancer Prevention Foundation, San Francisco, CA

University of California, Berkeley [Graduate]

Objectives: Occupational studies have found firefighters are at risk for different types of cancers and firefighter organizations in the US have raised concern about elevated rates of premenopausal breast cancer among women firefighters. San Francisco, California has one of the largest forces of women firefighters in the country (>250) making it an ideal location to understand exposure to compounds with potential links to breast cancer. The Women Firefighters Biomonitoring Collaborative is a community-based participatory research (CBPR) project analyzing exposures to environmental chemicals linked to breast cancer among female firefighters compared to non-firefighters. Women firefighters are involved in all aspects of the study, from study design, data collection, and results communication.

Methods: Between June 2013 and March 2014 we recruited women with at least 5 years of service in the San Francisco Fire Department (n=86). Controls are women employed by the City of San Francisco who are not first-responders (n=86). We conducted an exposure assessment interview and collected a one-time blood sample from each participant. Samples were analyzed for perfluorinated compounds (PFC) using liquid chromatography-tandem mass spectrometry (LC-MS/MS).

Results: Samples were analyzed for 12 PFCs. Seven compounds were detected in over 70% of participants at levels above the level of detection (LOD), five of which were detected in 98 -100% of participants. Four compounds were not detected above LOD. perfluorononanoic acid [p< 0.1] and perfluorohexane sulfonate [p <0.05] were higher for firefighters than controls; perfluoroundecanoic acid levels were higher in controls than firefighters [p <0.05]. PFC levels were comparable to levels measured in the 2011 NHANES and 2011 Firefighters Occupational Exposure [FOX] study in California.

Conclusions: This is the first chemical biomonitoring study in a cohort of exclusively women firefighters. Further research is needed to understand the health implications of PFC levels particularly for shorter chain compounds and their potential link breast cancer.

Abstract 18
Quantitative Investigation of Crystalline Silica and Metal Concentrations in a Ceramics Studio
Authors: M. Zalay, T. Hoang, R. Blythe, A. Raval, S. Liu, and S.K. Hammond

University of California, Berkeley [Graduate]

Objectives: 1) To characterize exposures of respirable dust, respirable silica, and total metals in a ceramics studio during glaze mixing, 2) To assess surface contamination of metals.

Methods: Area samples of total metal, respirable dust, and respirable silica were placed in the breathing zone of an employee performing glaze mixing. Respirable silica and total metal samples (n=2) were collected on two different dates for 8 hour and 4 hour periods. Wipe samples were performed on six surfaces in the studio; four metals were analyzed per sample via ICP-AES (n=6).

Results: Respirable dust time-weighted average concentrations were 0.049 mg/m3 and 0.14 mg/m3. Respirable silica levels were below the limit of detection (LOD); air concentrations were less than 0.012 and 0.024 mg/m3 for quartz and 0.025 and 0.048 mg/m3 for cristobalite and tridymite. Out of 29 airborne metals tested, 12 were detected. Notably, the cobalt concentration was 0.034 mg/m3 on Day 1. Results of the wipe samples include: chromium levels in all locations were below the LOD; cobalt was detected in four locations with an average of 65.4 ± 126.4 µg/ft2 and a maximum of 320 µg/ft2; manganese was detected in two locations with an average of 28.4 ± 34.2 µg/ft2; and copper was detected in two locations with an average of 13.7 ± 21.7 µg/ft2.

Conclusions: Respirable dust concentrations are below the California OSHA Permissible Exposure Limit (PEL). Cobalt was the only airborne metal to exceed the PEL. Cobalt was also detected at elevated levels on one surface in the glazing area. This level of 320 µg/ft2 exceeds available exposure limits for wipe samples [Brookhaven National Laboratory’s Wipe Sample Criteria of 278.7 µg/ft2]. There is no ventilation system in the studio. Results and suggestions for exposure controls were presented to the studio’s board. More sampling is necessary to quantify respirable silica at low levels.

Abstract 19
Characterizing Ultrafine Particles in Nail Salons in the Greater Los Angeles Area
Author: C. Nguyen

University of California at Los Angeles [UCLA] [Graduate]

Objectives: VOCs, dusts, and PM2.5 have been measured in nail salons, but ultrafine particles (UFP, diameter <100 nm) have not been studied. Indoor UV light is suspected to initiate chemical reactions among reactive VOCs, generating UFP. This study investigated UFP concentrations in nail salons in the Greater Los Angeles Area.

Methods: Seven nail salons were sampled for UFP concentrations indoor and outdoor using Condensation Particle Counters (CPC 3007, TSI) for 4 hours. Salon services and occupancy were recorded every 30 minutes. The correlations between UFP concentrations and number of nail services and occupancy were assessed. UFP concentrations were measured in a salon at two locations, one at a nail station and the other ~ 2 meters away, to
investigate if there is a concentration gradient.

Results: Indoor-to-outdoor (I/O) UFP number concentration ratios ranged between 0.2 to 5.4 among the seven salons. Maximum indoor UFP concentration measured was 1.15 x 10^5 #/cm^3. Mean and variation of outdoor UFP concentrations [GM=1.24 x 10^4 #/cm^3, GSD=1.67] are greater than indoor [GM=1.21 x 10^4 #/cm^3, GSD=1.53] (p<0.0001). Indoor concentrations followed closely with the outdoor concentrations for salons with entrances kept open, except for one salon, where the front entrance was kept shut. Significant correlations (Pearson r ≥ 0.5, p < 0.05) between manicure, gel manicure, acrylic nail services, and occupancy, and UFP I/O ratio were observed in 2, 1, 2, and 1 out of 7 salons, respectively. UFP concentrations increased by up to 44% when monitored at a nail station compared to concentrations measured ~ 2 meters away.

Conclusions: Nail salon workers can be exposed to significant UFP levels. Outdoor UFP is a dominant source of indoor UFP. Nail services and occupancy are weak contributors to indoor UFP levels. Indoor UFP emission sources, not directly involved in nail activities, may be stronger contributors resulting in higher I/O ratios.

Abstract 20
Assessing Ultra-Fine Particles (UFP) Exposure in Vape (Electronic Cigarette) Shops
Authors: C. Sen and Y. Zhu

University of California-Los Angeles (Graduate)

Objectives: 1. Quantify and understand the spatial distribution of ultra-fine particles in vape shops. 2. Identify factors that generate elevated levels of ultra-fine particles concentrations.

Methods: Two vape shops in Southern California were recruited to participate in the study. There were eight testing days for vape shop A and four testing days for vape shop B. Ultra-fine particles were collected using two TSI Condensed Particle Counters (CPC) 3007 and carbon dioxide, relative humidity and temperature were measured using a TSI Q-Trak Plus. The CPCs were split and located in different areas. The Q-Trak was placed with one of the CPCs during the sampling period.

Results: In vape shop A the inside concentration of UFP ranged from 4.01x10^4#/cm^3-4.39x10^5#/cm^3. The outside UFP ranged from 7.98x10^3#/cm^3-4.89x10^4#/cm^3. The indoor-outdoor ratio averaged of 10.42±6.9. In vape shop B the inside concentration of UFP ranged from 13.283#/cm^3-248,442#/cm^3. The indoor-outdoor ratio averaged 1.41±0.406. In vape shop A, the UFP averaged 1.38x10^4#/cm^3 ± 8.63x10^4#/cm^3, 1.55x10^4#/cm^3 ± 7.4x10^4#/cm^3, and 1.16x10^5#/cm^3 ± 6.05x10^4#/cm^3, 1.09x10^5#/cm^3 ± 4.98x10^4#/cm^3, and 2.01x10^5#/cm^3 ± 6.3x10^4#/cm^3 when zero, one, two, three and four people were smoking e-cigarettes respectively. In vape shop B, the UFP averaged from 2.83x10^4#/cm^3 ± 6.11x10^3#/cm^3, 3.73x10^4#/cm^3 ± 1.40x10^4#/cm^3, 4.38x10^4#/cm^3 ± 1.13x10^4#/cm^3, 4.69x10^4#/cm^3 ± 1.11x10^4#/cm^3 for zero, one, two and three smoking e-cigarettes respectively.

Conclusions: E-cigarettes are a major source of UFP in the vape shops. There were no significant differences in UFP activity between weekends and weekdays or between night and day shifts for both vape shops. Differences in UFP could be caused by the number of people smoking and the air exchange rate of the shops.

Abstract 21
Job Hazard Analyses for a Leading Organic Milk and Non-Dairy Beverage Producer in Southern California
Authors: E. West and W. Robbins

University of California, Los Angeles (Graduate)

Objectives: 1. To develop Job Hazard Analyses (JHAs) for a leading organic milk and non-dairy beverage producer in Southern California. 2. To achieve compliance with JHA requirement in Cal-OSHA’s Injury and Illness Prevention Plan standard (CCR 8 § 3200) 3. To reduce recordable injuries and first aid incidents in a manufacturing plant with an unusually high rate of workplace accidents.

Methods: 1. Identify and evaluate hazards in three production departments. 2. Prioritize evaluation by level of hazard, starting with tasks that have been identified as causing recordable injuries. 3. Implement administrative and personal protective equipment controls and make suggestions for capital requests for the 2016-17 H&S budget.

Results: Over 100 JHAs were completed over three manufacturing lines during the summer internship period. Major identified hazards included: risk of amputation when servicing pneumatic valves; cut hazards and repetitive motion injuries from frequent loading of corrugated packing material; muscle strains from unassisted heavy lifting jobs; and inhalation hazards during equipment sterilization procedures. By the end of the internship period, engineering controls including a trash lifter were installed. New administrative controls were adopted, including updated training in proper lifting techniques and requirements for assistance lifting more than 50 pounds. Standard operating procedures were also created for servicing pneumatic valves. Personal protective equipment is now required for manual chemical pouring during sterilization process and when handling corrugated packaging.

Conclusions: Full compliance to CCR 8 § 3203 standard was not achieved during the summer internship period due to the complex nature of beverage processing and sheer number of JHAs to complete. JHAs are still needed for many maintenance and logistics department tasks. Implementation of training and new personal protective equipment requirements led to plant achieving 100 days without a recordable injury, a milestone for this manufacturing facility and in line with corporate H&S goals.

Abstract 22
Prevention through Design Business Case: Silicone Spark Plug Manufacturing
Authors: L. Hernandez, G. Popov, and K. Smith

University of Central Missouri (Undergraduate)


Methods: Silicone spark plug wires manufacturing requires significant amount of repetitive movements. Musculoskeletal Disorders [MSDs], lower back, and Carpal Tunnel Syndrome injuries are common. Human Resources reported difficulties hiring new employees and the company experienced high
Conclusions: Overall, this company appeared to use control measures and work practices that corresponded to OSHA’s campaign to reduce the risk of heat-related illnesses. However, the fact the warehouse is not air-conditioned may still be a factor on extremely hot days.

Abstract 24
Objective Evaluation of Dust Collection Methods of Indoor Air Fungal Exposure Assessment Using Quantitative PCR
Authors: J. Cox (1), T. Reponen (1), R. Indugula (1), and S. Vesper (2)
(1) University of Cincinnati (Graduate)
(2) U.S. Environmental Protection Agency, Cincinnati, Ohio
University of Cincinnati (Graduate)

Objectives: To evaluate dust collection methods for the analysis of fungal species by quantitative Polymerase Chain Reaction (PCR).

Methods: Four types of dust collection methods were compared in 11 homes (n=11): two types of electrostatic dust cloths (EDCs), vacuum dust, and surface wipes. EDC sedimentation dust collection trays were collocated for four weeks utilizing Dutch (Albert Heijn, Zaandam, Netherlands) and Swiffer Extra-Large cloths (Procter & Gamble, Cincinnati, OH). In addition, floor dust from the bedroom area was collected in nylon socks by vacuuming 1 m² of a rug for 4 minutes. Wipe samples using dry Swiffer cloths were collected on bedroom surfaces focusing on door frames, book shelves and window sills. Concentrations of 36 fungal species were determined using qPCR. Results were evaluated based on the sum of total spores per milligram (spores/mg) and the ERMI (Environmental Relative Moldiness Index) values per sample. Statistical analyses were Mann-Whitney U test and Spearman’s correlation coefficient for the sum of spores, and t-test and Pearson’s correlation coefficient for ERMl values.

Results: Geometric mean (the geometric standard deviation) for spores/mg were as follows: Swiffer EDC, 4765(3.8); Dutch EDC, 3565(5.4); Vacuum, 6720(1.9) and Wipe, 2164(3.3). The ERMI ± standard deviation results were as follows: Swiffer, -1.8 ± 3.8; Dutch, -1.2 ± 3.6; Vacuum, -1.6 ± 6.9; Wipe, -0.3 ± 2.4. There were no significant differences either in the spores/mg or ERMI values obtained with the different methods. Significant correlation was found between Swiffer and Dutch EDCs in the spores/mg [r =0.88, p<0.01] and ERMI [r=0.83, p<0.01]. Furthermore, ERMI values correlated significantly between Swiffer EDCs and vacuum samples [r=0.63, p=0.04] and between vacuum and wipe samples [r=0.77, p<0.01].

Conclusions: Based on the correlation analysis, the most consistent results were obtained with the two types of EDCs both in spores/mg and ERMI.
Abstract 25
Performance of an N95 Filtering Facepiece Respirator and a Surgical Mask Used by Home Attending Health-Care Workers (Pilot Study)
Authors: Y. Elmashae [1], S.A. Grinshpun [1], T. Reponen [1], M. Yermakov [1], S. Gao [1], R. Riddle [2]

[1] University of Cincinnati (Graduate)
[2] Cincinnati Children’s Hospital Medical Center

University of Cincinnati (Graduate)

Objectives: This study aimed at determining the Workplace Protection Factor (WPF) for one model of N95 filtering facepiece respirator (FFR) and one model of surgical mask (SM) that are widely used by the home attending health-care workers to reduce their exposure to potentially hazardous agents during home visits, such as respiratory pathogens, aerosolized secretions originated during tracheal suctioning and nebulized medications.

Methods: Four home-attending health-care workers serving in the Cincinnati area were recruited as subjects. Prior to the field experiment, each subject was cleared using the OSHA respirator medical clearance questionnaire and subsequently was fit tested with the selected N95 FFR using the standard OSHA protocol. At the workplace, the aerosol concentration outside [Cout] and inside [Cin] of the tested respiratory protective device (either the N95 FFR or SM) were measured on a subject using two simultaneously operating P-Trak condensation particle counters [Model 8525, TSI Inc., Shoreview, MN] within the particle size range of 20 to > 1,000 nm. The WPF was defined as Cout/Cin and determined from multiple samples [scans] ranging from 100 to 279, depending on health care procedure.

Results: This pilot study demonstrated that the WPF of the N95 FFR consistently exceeded that of the tested SM (with the overall mean WPF values being 18 and 4 respectively). In most cases, the N95 FFR’s WPF was above the OSHA’s assigned protection factor of 10 whereas the SM often provided little protection (the WPF ranged from 1.3 to 14). The protection levels provided by both devices were affected by the activity; e.g., for subject #1 wearing the N95 FFR, the activity-specific WPF was as high as 643 during tracheal suctioning and 59 during nebulizer treatment.

Conclusions: Wearing an N95-certified respirator significantly improves the respiratory protection of home-attending health-care workers (as compared to a SM). The WPF depends on the activity.

Abstract 26
Nitrogen Dioxide (NO2) Air Quality Measurement – Pilot Study
Authors: K. Isiugo, N. Newman, J. Cox, R. Indugula, and T. Reponen

University of Cincinnati (Graduate)

Objectives: NO2 is a pulmonary toxin, produced as a byproduct of combustion. Fuel burning appliances are major contributors to indoor and outdoor NO2. Home health aides are examples of occupations exposed to NO2 in home environments. This study was designed to assess the level of exposure to NO2 in environments representative of settings where home health aides work.

Methods: Long-term average exposure to NO2 was collected with passive samplers and short-term fluctuations were measured with an NO2 sensor. The measurements were conducted in homes of participants of an ongoing study (Efficiency of HEPA air cleaners in reducing traffic-related air pollution). The Ogawa NO2 passive samplers were placed outdoors and indoors of 6 homes without known sources of NO2 for a 48-hour period and the Cairpol NO2/03 Sensor simultaneously measured indoor levels of NO2 in one of the six homes. 2 passive samplers and a blank were placed in each location. The logging period for the sensor was 48 hours. After measurement, 36 passive samplers were analyzed for NO2 by an accredited laboratory and the readings from the sensor were downloaded. The data were compared to the threshold limit value [TLV] for NO2 and results of relevant studies.

Results: Indoor NO2 concentration varied from 2.5 to 11.7 ppb, while outdoor varied from 9.7 to 21.5 ppb. The sensor detected intermittent indoor NO2 peak levels of 13 ppb for 45 minutes in a home which had a mean outdoor concentration of 9.7 ppb.

Conclusions: Although the detected levels of NO2 were below the TLV of 200 ppb, studies have found incident wheezing to occur from exposure to 9.3 ppb. Home health aides in environments near dense traffic with presence of indoor sources of NO2 may be exposed to elevated intermittent peak levels of NO2, which may be sufficient to elicit acute effects.

Abstract 27
Psychosocial and Musculoskeletal Concerns of Afro-Caribbean Dancers
Authors: K.R. Gilmore, L. Brosseau, and D. Hinkamp

University of Illinois at Chicago (Graduate)

Objectives: There is research indicating that ballet dancers suffer from lower extremity injuries and stress related to inconsistent employment. Other dance styles have not been as thoroughly investigated. The objectives of this research were to (1) describe musculoskeletal injuries and psychological stressors among Afro-Caribbean dancers, (2) identify working conditions that contribute to injury and (3) develop suggestions for improving physical and mental health.

Methods: A self-administered survey was given to Afro-Caribbean dancers of the Muntu Dance Theater. Questions addressed injury, work experience, and the impact of dancing on work and personal life.

Results: Twelve dancers completed the survey (6 male, 6 female); they ranged in age from 18 to 40 plus years old. Dance experience varied from participants dancing from childhood to those just starting a dance career. Female participants reported more injuries, with the highest numbers in the foot, ankle, lumbar, knee, hip and thighs. The respondents of the survey indicated that they had strong social support and access to health care, indicating low psychosocial stressors.

Conclusion: The types of injuries are consistent with previous research with ballet dancers, however the psychosocial concerns of the Afro-Caribbean dancers are not consistent with research of ballet dancers. Warm up techniques, stretching, rest, and training may lower the rate of lower extremity injuries in Afro-
Caribbean dancers. Research with ballet dancers suggests that increasing muscular strength and using the proper footwear can contribute to lower injury rates.

**Abstract 28**

**Testing A Screening Question for Elevated Prenatal Mercury**

*Author: N. Mulati*

*University of Illinois at Chicago (Graduate)*

**Objectives:** Mercury is a potent neurotoxin, and exposure to methyl mercury during the prenatal period via maternal fish consumption can result in adverse neurologic effects in offspring. In addition, according to the National Health and Nutrition Examination Survey, Asians have elevated methyl mercury levels compared to other races. To our knowledge, there are no guidelines for mercury testing in the clinical setting. The aim of this study is to evaluate a single fish consumption screening question to predict elevated blood mercury levels. This will be a first step toward implementing targeted screening for methyl mercury during routine prenatal care.

**Methods:** 195 pregnant patients were recruited from Chinatown clinic. Patients were asked “In general, do you eat fish more than twice a week?” Patient’s blood and demographics were collected. SAS Enterprise Guide 6.3 was used to determine the preliminary data analysis. This study was approved by the UIC IRB, Protocol 2012-1091. The provider site completed the CITI Human Subject Protection Training.

**Results:** In total of 195 Chinese pregnant women, 39% of them reported eating fish more than twice a week. The average blood mercury level for pregnant women who responded affirmatively to the screening question was significantly higher than women who answered negatively to the question (P<.0001). The result of regression analysis indicated age was positively correlated with total blood mercury level and later pregnancy trimester was negatively correlated with total blood mercury level. The positive predictive value, negative predictive value, sensitivity and specificity of the fish consumption screening question were not high as we expected.

**Conclusions:** Eating fish more often, regardless of fish species or portion size, increased the likelihood of elevated prenatal mercury level; Age was positively associated with elevated mercury levels; Later pregnancy trimester was negatively correlated with blood mercury level; In our research with small sample size, the screening question would not be a good predictor for elevated blood mercury level due to low negative predictive value and sensitivity.

**Abstract 29**

**Impact of Video-Based and Hands-On Training on Hearing Protector Attenuation**

*Authors: T. Nakagawa, S. Cali, and L. Brosseau*

*University of Illinois at Chicago (Graduate)*

**Objectives:** The personal attenuation rating (PAR) of an individual’s earplugs is a more accurate measure of hearing protection performance than the manufacturer’s noise reduction rating. The method of training (video vs. hands-on) may have an effect on whether an individual is able to obtain an adequate PAR. The goal of this project is to compare the impact of video-based and hands-on training on the personal attenuation rating (PAR) measured for earplugs using two hearing protection fit test systems using a microphone-in-real-ear or loudness-balance method.

**Methods:** Participants watched a short training video prior to performing two hearing protection fit tests using the EARfit (3M) and VeriPro (Howard Leight) instruments. Each participant selected foam or flanged earplugs, watched the appropriate training video, and donned the earplug. A fit test was then conducted with one instrument (order randomized). The participant then removed and re-donned the earplug, with assistance from and visual inspection by the investigator, and completed a second fit test. The same set of experiments was repeated with the second fit test instrument.

**Results:** Eleven participants (6 male; 5 female) completed the experiment. Mean (standard deviation (SD)) PARs from the EARfit instrument for earplugs worn in the right ear were 20.7 dBA (10.1 dBA) before assistance and 24.4 dBA (6.1 dBA) after assistance; these values were 25.2 dBA (7.9 dBA) and 24.2 dBA (5.13 dBA), respectively, for the left ear. Mean (SD) PARs from the VeriPro instrument for the right ear were 16.2 dBA (5.0 dBA) before assistance and 19.7 dBA (4.6 dBA) after assistance; their values were 14.1 dBA (6.6 dBA) and 19.3 (7.3 dBA), respectively, for the left ear.

**Conclusion:** The t-tests indicate that assistance did not make a significant difference in the PAR received for either instrument (p=0.05).

**Abstract 30**

**Comparison of Perceived Environmental Risk and Modeled Environmental and Occupational Health in Southeastern Cook County, IL**

*Authors: F. Pagone and S. Erdal*

*University of Illinois at Chicago (Graduate)*

**Objectives:** Southeastern Cook County (SCC), which contains a number of socio-economically disadvantaged communities, is one of the most polluted areas to both live and work in the nation. The goal of this research study is to assess the validity of micro-scale grass-roots level environmental/health risk perception data collected from residents/workers in SCC by comparing this micro-scale data to data from an environmental macro-scale analysis employing community-level air and land pollution information.

**Methods:** Risk perception data was collected in community meetings organized in partnership with five community organizations. The meeting participants were asked to rank each environmental threat. The survey results were then, evaluated based on the results of the USEPA 2011 National Air Toxics Assessment (NATA) and IEPA Brownfield site location/size data.

**Results:** Based on the 2009–2013 American Community Survey, the working population of the target community areas are, primarily, service workers (i.e. Harvey 29.6%) and production/transportation (i.e. Blue Island 18.2%). The environmental indicators ranked highest by the community members included “air pollution from documented/undocumented industrial sources”, “surface water run-off from contaminated areas”, and “undocumented hazardous waste sites in the neighborhood”. Cancer incidence was ranked as the health outcome with the
most community concern. The median NATA excess cancer risk for the community areas was 3.4E-5, which is below the Cook County median of 3.9E-5. In 2014, 9.2% of active Brownfield sites in Cook County were within the community areas, with both the mean (11.2) and median (2.0) acreage greater than that of Cook County [Mean: 8.28/Median: 1.2]. A risk score that accounts for combined air and land pollution health risk is under development.

Conclusions: These preliminary results help to steer public policy about environmental restoration and neighborhood revitalization in SCC. In addition, our study provides a novel approach for assessing environmental health threats using both community-level survey and environmental measurement/modeling data.

Abstract 31  
The Impact of Assisted Donning on Fit Factors  
Authors: B. Rembialkowski, M. Sietsema, and L. Brosseau  
University of Illinois Chicago (Graduate)  

Objectives: Investigators have shown that annual respirator fit testing is effective at ensuring on-going protection. However, there have been few studies examining the impact of hands-on training on respirator fit. The goals of this study are: 1) Compare a NIOSH-certified N95 filtering facepiece respirator to a non-certified adhesive mask; 2) Assess the impact of assisted donning on fit and 3) Analyze the impact of time on correct donning and fit.

Methods: Two PortaCount Plus condensation particle counters (TSI 8020) equipped with N95-Companions [electrostatic classifier] (TSI 8095) were used to perform each fit test; sampling continuously from inside and outside the facepiece. Fifteen subjects [5 male; 10 female] participated in two lab visits at least one week apart. During the first visit subjects randomly selected the respirator or mask and reviewed and followed the manufacturer’s donning instructions. Subjects then performed a fast fit test with five exercises each performed for 30 sec. The mask was removed, re-donned with investigator assistance and a second fit test was then performed. The donning procedure was then repeated for the second mask. The same protocol was followed on the second visit.

Results: Average fit factors for the certified respirator were higher than for the non-certified mask [GM1 = 101.7, GM2 = 64.31, p = .0003]. Fit factors significantly increased from unassisted to assisted donning during both visits (p < .05). Unassisted fit factors were not significantly different between visits 1 and 2 (p > .05). Assisted fit factors showed greater improvement with the non-certified respirator compared to certified respirator (127% vs. 47%).

Conclusions: Reviewing manufacturer instructions may not ensure adequate fit; assistance from someone familiar with respirator fit appears to be important. The effect of assisted donning does not appear to be lasting, as initial unassisted donning was not different between the two visits.

Abstract 32  
Adverse Health Effects Associated with Generalized and Sexual Harassment in Employed Women  
Authors: M. Wilson, K. Rospenda, and L. Conroy  
University of Illinois at Chicago (Graduate)  

Objectives: Work-related stress is associated with adverse health outcomes. Workplace harassment, however, has not been investigated as fully, particularly whether different forms of harassment are associated with different health outcomes. The objectives of the study are 1) to quantify different types of workplace harassment, and 2) to describe their relationship with health outcomes.

Methods: Participants were recruited from a large urban university. Generalized and sexual workplace harassment, along with physical symptom severity, demographic, lifestyle, and occupational characteristics were assessed with questionnaires. Adiposity (waist to hip ratio), and blood pressure were also measured. The associations between generalized, as well as sexual harassment, and overall physical symptoms were assessed via linear regression. Subscales comprised individual physical symptoms associated with specific body systems. The association of harassment with demographic and occupational characteristics was investigated with linear regression and ANOVA.

Results: Cross-sectional data were obtained from 75 participants. A significant positive association was found between generalized harassment and adverse physical symptoms (β = 0.397, p<0.001). Significant associations of cardiovascular and gastrointestinal symptoms with generalized harassment were noted. Stomach pain and heart pounding & racing were associated with both generalized and sexual harassment. Elevated resting blood pressure (β = 0.251, p=0.028), higher waist-to-hip (β = 0.388, p=0.001) ratio were only associated with sexual harassment. Generalized harassment varied by race, while sexual harassment by occupational class. Generalized harassment was associated with increased sick leave (β = 0.377, p=0.001).

Conclusions: Adverse health outcomes are associated with harassment; cardiovascular and gastrointestinal systems are most affected. Various forms of harassment are distributed differently among occupations and racial groups. Sexual harassment does not exhibit the significant association with sick leave as generalized harassment, possibly due to the low prevalence of sexual harassment in this study. Longitudinal research, with a larger population, is needed to determine the causal contribution of each source of work-related harassment to health outcomes.

Abstract 33  
Method to Assess Low-Cost H2S Monitors for Use in Agriculture  
Authors: J. Beswick, T. Peters, and T.R. Anthony  
University of Iowa (Graduate)  

Objectives: Agricultural work presents some of the highest risk for occupational injuries, yet is one of the least-regulated industries in the United States. Hydrogen sulfide is commonly produced as a byproduct of livestock waste in confined feeding operations, and presents an unknown threat to agricultural
workers without detection equipment. This study was performed to evaluate low-cost H2S monitors to recommend to livestock producers for use in buildings and manure storage.

Methods: Initially, we identified the availability of low-cost sensors via farmer-accessible sources to determine what products are more likely to be procured, then qualitatively compared monitor features and performance to aid in selection by farmers. Monitors were exposed to low concentrations of H2S in order to characterize short-term performance of each sensor.

Results: Four low-cost monitors were selected, based on price, advertised maintenance requirements, and availability. Two models (MSA Altair and BW Clip) do not read concentration, but instead display a countdown of time left on the sensor. The Industrial Scientific T40 Rattler can be shut off when not in use, but if left on has very short battery life of approximately 2 weeks. The Drager 3500 has been shown to underestimate concentration of H2S in bench testing, with relatively low error at low concentrations rising to larger discrepancies as the concentration rises.

Conclusions: Side-by-side comparisons of monitors and notable differences will be used to inform farmers on selection and recommended use of low-cost H2S monitors. A more in-depth quantitative comparison of sensor performance will be evaluated in the next phase of the project.

Abstract 34
The Development and Optimization of a DNA Extraction Method for Aerosol Samples Collected using Polyvinylchloride Filter Media

Authors: C. Boles, M.W. Nonnenmann, and K.M. O’Brien

University of Iowa (Graduate)

Objectives: Develop and optimize a method for DNA extraction from aerosol samples collected using Polyvinylchloride (PVC) sampling media

Methods: A literature review was performed for DNA extraction methods for aerosol samples. Gaps were identified in DNA extraction methods for aerosols collected using PVC filters. Three DNA extraction methods [i.e., MoBio PowerSoil DNA Isolation kit, Cetyltrimethyl ammonium bromide (CTAB), and sucrose/tris-HC/EDTA (STE)] were selected to evaluate aerosol samples collected from broiler chicken production. The samples were analyzed gravimetrically and stored at -20°C until DNA extraction could be performed. Extraction of DNA was completed with samples that had a minimum dust mass of 0.1 mg. Extraction methods were evaluated using a NanoDrop 1000 spectrophotometer to observe ultraviolet light absorbance at 260 nm (i.e., DNA) and 280 nm (i.e., protein). The ratio of absorbance (i.e., 260/280) was used to assess the purity of DNA. Absorbance at 230 nm is also an indicator of contamination (e.g., phenol). Ratios between 1.7-2.0 were considered acceptable for further analysis of DNA using polymerase chain reaction methods. Both ratios (i.e., 260/280 and 260/230) were reported for samples extracted using all three DNA extraction protocols.

Results: The CTAB extraction method [n=4], produced 0% of the absorbance values in the desired range for both ratios. The MoBio kit [n=64], yielded 24% and 0.02% of the absorbance values in the desired range for 260/280 nm and 260/230 nm, respectively. The STE method [n=16] had 92% and 58% of the absorbance values in the desired range for 260/280 nm and 260/230 nm, respectively.

Conclusions: Using the STE extraction method, contamination was decreased and DNA purity was increased. Extraction of DNA should not be performed with samples that have a minimum poultry dust concentration less than 0.5 mg. A method for bacterial DNA extraction has been developed and optimized for aerosol samples collected using PVC filter media.

Abstract 35
Development of a Personal Aerosol Collector and Spectrometer (PACS): Part II: Laboratory Experiments for Particle Size Distributions


(1) University of Iowa (Graduate)
(2) Spectral Energies, LLC, Dayton, OH
(3) Wright Patterson AFB, OH

University of Iowa (Graduate)

Objectives: People are exposed to a variety of particles with a wide range of sizes. Current personal samplers cannot measure real-time exposures to all particle size ranges simultaneously. The aim of this study was to evaluate a real-time personal exposure monitor—the Personal Aerosol Collector and Spectrometer (PACS)—to measure particle number, surface area and mass concentration by size from 10 nm to 10 μm.

Methods: We designed the PACS to direct aerosol from the breathing zone sequentially through a series of impactors and diffusion screens to separate particles into six bins by size. The number and mass concentration of the airborne particles exiting each bin are then measured with a water condensation particle counter and a photometer, respectively. The best-fit tri-modal, log-normal distribution is then fit to this set of 12 measurements. In these experiments, we compared the number, surface area, and mass concentrations measured by the PACS for laboratory-generated fresh welding fume, aged welding fume and Arizona dust to that measured by a scanning mobility particle sizer (SMPS) and aerodynamic particle sizer (APS). For each aerosol, the normalized mean bias (NMB) was calculated as the sum of the differences between the fitted (from PACS) and reference (from SMPS/APS) concentrations divided by the sum of the reference concentrations. R squared (R2) was calculated based on fitting and reference concentrations.

Results: In this study, for number concentration, the NMB is 3% coupled with R2 of 0.98, (2) for surface area concentration, the NMB is -23%, with R2 of 0.98; (3) for mass concentration, the NMB is -13%. coupled with R2 of 0.95. Therefore, the tri-modal distributions estimated with the PACS agreed reasonably well with those measured with the reference instruments.

Conclusions: Particle size distributions measured with the PACS agreed reasonably well with those measured by reference instruments.
Abstract 36
Assessment of Noise in a Medical Intensive Care Unit
Authors: K.J. Crawford, L.A. Barnes, B.L. Gehlbach, J. Falk, and T.M. Peters
University of Iowa (Graduate)

Objectives: Exposure to noise in a medical intensive care unit (MICU) is common but can disrupt patient sleep and delay recovery. Our research group educated staff on ways to reduce noise in the MICU through behavior modification. The objectives of this work were to evaluate the effectiveness of the intervention in reducing noise in patient rooms and to evaluate the determinants of those noise exposures.

Methods: Noise, in A-weighted decibels, (dBA) was measured every minute in eight patient rooms in a university hospital MICU with sound level meters (SLM, SDL 600, Extech Instruments, Nashua, NH) for eight weeks prior to and eight weeks after an intervention. The intervention was a six-week education program designed to increase awareness among MICU staff of the adverse health effects of noise and ways to reduce noise in their daily activities. Sound equivalent levels (Leq) were calculated for each hour in each room for the duration of the study. A repeated measures statistical model (SAS, PROC MIXED) was used to estimate the significant determinants of the Leq in the MICU and to determine if the intervention was effective in reducing noise. The loudest time periods identified within the one-minute data were compared to activity logs to assess any association between noise and the equipment in use.

Results: The intervention was not effective in reducing noise in the MICU. Similar to the pre-intervention phase, approximately 50% of the daytime noise levels were above 55 dBA and 62% of the nighttime noise levels were above 50 dBA during the post-intervention phase. The loudest noises in the MICU were attributed to the use of high-flow respiratory support devices.

Conclusions: Behavior modification was ineffective at reducing noise in the MICU. Targeting reduction of noise from specific high-flow respiratory support devices with shielding may be effective in future work.

Abstract 37
Evaluation of Consumer Photometers for Measuring Environmental and Occupational Aerosols
Authors: S. Sousan (1), L. Hallett (1), K. Koehler (2), and T. M. Peters (1)
(1) University of Iowa [Graduate]
(2) Johns Hopkins Bloomberg School of Public Health
University of Iowa [Graduate]

Objectives: Photometers are direct-reading instruments that provide real-time aerosol mass concentrations inferred from scattered light by an assembly of particles. Photometers are effective for measuring fluctuations in concentrations of both environmental and occupational aerosols, although their cost (>$5,000) can make them outside the budget for many industrial hygiene programs. Recently, however, many low-cost photometers (<$300) have become available, marketed for in-home use. We evaluated the performance of these consumer low-cost sensors for occupational and environmental aerosols.

Methods: The response of three low-cost sensors (Foobot from Airoxlab, $200, Speck from Carnegie Mellon University, $200, and AirBeam from HabitatMap, $250), and a medium-cost aerosol photometer (pDR-1500, $6,000) was compared to reference instruments for concentrations up to 8500 µg/m3. Selected test aerosols were 0.9% salt solution (non-absorbing fine particles), welding fume (absorbing fine particles), and Arizona road dust (ARD; coarse particles).

Results: The Foobot exhibited the best performance of the low-cost photometers, approaching that of the pDR-1500. The mass concentration measured with the Foobot was linear and highly correlated to that measured with reference instruments. In contrast, the Speck and AirBeam responses were non-linear. As expected, the type of aerosol had a large impact on response of all photometers. Robust response was observed for salt and ARD, whereas, response was poor for welding fume, which is brown in color and dominated by sub-300 nm size particles. When compared to the reference instruments, all photometers had high bias values.

Conclusions: The Foobot ($200) responded similarly to the more expensive pDR-1500 ($6,000). Aerosol size and composition dramatically impact the response of these consumer-based instruments.

Abstract 38
Production Practices Associated with Personal Exposure to Inhalable Aerosols during Work in Broiler Chicken Production
Authors: S.W. Ischer, K.M. O’Brien, M. Farnell, T. Tabler, and M. W. Nonnenmann
University of Iowa (Graduate)

Objectives: Workers are exposed to organic dust, ammonia and bio-aerosols while completing tasks in broiler chicken production houses. Inhalation exposure to dust has been associated with respiratory disease in agriculture workers and animals. Currently, little information is available regarding personal exposure to inhalable aerosols or engineering exposure controls during broiler chicken production. The objective of this study was to determine which production practices result in personal dust and endotoxin exposures reduction.

Methods: Personal exposure to inhalable dust and endotoxin during work in commercial broiler farms was measured in this study. The impact of engineering control on inhalation exposure to dust and endotoxin were evaluated. Personal dust samples (n=69) were collected while workers completed litter sampling at farms similar in structure and production. Conditions evaluated were: litter amendment treatment (none, dry or liquid), ventilation (fan or tunnel) and heater use (brooder or no brooder).

Results: Geometric mean inhalable dust and endotoxin concentrations were 3.9 mg/m3 (GSD=2.8) and 474 EU/m3 (GSD=2.09), respectively. Preliminary analyses suggest that inhalable dust exposure concentrations collected inbroiler poultry houses using mechanical fan ventilation and a liquid litter amendment were significantly reduced, when compared to use of tunnel ventilation and dry litter amendment, p = 0.0005 and p = 0.009 respectively. Brooder heater use within these poultry houses had no significant effect on dust concentrations measured (p=0.255). Associations with endotoxin exposure are
Abstract 39
Developing a Sampling Strategy for Measuring Total Bacteria Aerosol Generated During Toilet Use in a Hospital Based Patient Care Setting

Authors: S.D. Knowlton, M.W. Nonnenmann, K. O’Brien, C.L. Boles, and T.A. Thedell
University of Iowa [Graduate]

Objectives: The flushing of fecal waste is hypothesized to generate bioaerosols that could contain infectious microorganisms. Once aerosolized, microorganisms could be spread to other patients. Little data exists characterizing the quantity of microorganisms aerosolized while flushing fecal wastes. The goals of this study are: 1) Develop a mobile sampling strategy to measure total bacteria aerosols generated during toilet use in a hospital based patient care setting. 2) Measure total bacteria aerosols associated with time and distance from flushing fecal material.

Methods: A strategy was established to identify defecation events among hospitalized patients and to deploy a bioaerosol sampling cart. Prior to flushing, the cart is placed to sample bioaerosols at distances of 0.15 meters, 0.5 meters, and 1 meter from the toilet for intervals of five, 10, and 15 minutes after the flushing of fecal material. The cart consists of three SKC BioStage samplers and an Aerotrak particle counter. Aerosol size distribution data were collected before and after flushing of the fecal material. Immediately after flushing, the bioaerosol sampling cart were activated. The culture media would be dependent upon the target microorganism (e.g., Cycloserine-Cefoxitin-Fructose agar; C. difficile). Preliminary data were collected using tryptic soy agar after flushing a toilet without fecal material. The plates were incubated for 24 hours at 37°C.

Results: Particle number per liter of air increased approximately by 156,000 (0.5 µm particles at 0.3 meters from the toilet) after flushing. Bacteria was detected while sampling with the cart, however concentrations were below the limit of quantification.

Conclusions: The sampling strategy can be used to measure total bacteria aerosolized during toilet use in a hospital. The mobile sampling cart can be quickly deployed and determine bacterial concentrations at a range of time and distances from flushing fecal material. This strategy will help determine environmental contamination from pathogens associated with nosocomial infections (e.g., C. difficile).

Abstract 40
Design and Evaluation of a High-Flowrate (10 LPM) Nanoparticle Respiratory Deposition Sampler


University of Iowa [Graduate]

Objectives: Current industrial hygiene practices rely on size-selective personal samplers which can obscure the quantification of nanoparticle exposures. The current 2.5-liter per minute NRD was designed mimic respiratory deposition and selectively collect particles smaller than 300 nm. Operating at 10 Lpm will optimize the current 2.5 Lpm design and facilitate lower limits of quantitation. The objective of this work was to develop a 10 Lpm nanoparticle NRD sampler that will facilitate lower detection limits for sampling of metal-based nanoparticles.

Methods: Two impactor sections (12-jets and 30-jets) were designed from theory for the new 10-Lpm NRD sampler. The volume of the polyurethane foam of the diffusion section was scaled up from the commercially-available 2.5-Lpm NRD sampler. The new design also included a backup filter. Pressure drop through each component of the sampler was measured with a differential pressure gauge. For a polydispersed salt aerosol, the collection efficiency by size of the two impactor sections was measured with a fast mobility particle sizer (FMPS; 3091, TSI, US) and of the foam diffusion stage with a scanning mobility particle sizer (SMPS; 5.402, GRIMM, Germany). The overall collection efficiency by size of the new NRD sampler was compared to the nanoparticulate matter sampling criterion, which approximates deposition in the human lung for particles smaller than 300 nm with a 50% collection efficiency cut-point at 40 nm.

Results: Pressure drop measured was comparable to the pressure drop measured in the 2.5-Lpm NRD sampler without a backup filter. The 12-jet impactor had a 50% collection cut-point of 280 nm, whereas the 30-jet impactor was 600 nm. The foam diffusion stage (porosity 90 ppi and depth 10 cm) exhibited the correct shape of the collection efficiency curve with a collection cut-point of 44 nm (target = 40 nm).

Conclusions: Early stages of design and evaluation of a high-flow NRD sampler show promising results. Investigation will continue to further evaluate design options with less pressure drop at the backup filter and with a new respirable inlet.

Abstract 41
A Task-Based Analysis of Black Carbon Exposure in Midwest Farmers

Authors: E. Stapleton [1] and P. O’Shaughnessy [2]

[1] Universidad Andres Bello, Santiago, Chile
[2] University of Iowa, Iowa City, IA [Graduate]

Objectives: 1) To identify task-specific black carbon (BC) exposures, due to diesel exhaust which contains carcinogenic particulate matter, from heavy machinery (i.e., tractor/combine) during harvest on Iowa farms; 2) To characterize time-weighted concentrations (TWCs) in common agricultural tasks; 3) To quantify farmers’ daily exposures, characterizing average exposure levels and peaks.
Conclusions: Results of the study indicate that exposure to raw sand is more hazardous than exposure to proppant or vibrated proppant. Workers may be exposed to raw sand in sand mines or quarries. Exposure to vibrated proppant carries the next highest risk ratio. Exposed workers include workers in transport sites or workers at the end use destination. The lowest risk of exposure is seen in proppant before it is transported, which would include workers at sand processing sites.

Abstract 43
Utilizing Smart Devices to Measure Intermittent Noise Exposure in the Workplace

Authors: B. Roberts and R. Neitzel

University of Michigan School of Public Health (Graduate)

Objectives: Assess the capability of iPods to accurately measure intermittent noise in a laboratory setting using an external microphone. Compare the accuracy of time-weighted average (TWA) measurements made by the iPods to traditional noise dosimeters.

Methods: Four iPod Touch devices running the SoundMeter application and connected to a MicW i436 external microphone were paired with Spark 706RC dosimeters. Each device and dosimeter were exposed to randomly generated intermittent noise in a reverberant sound chamber for varying lengths of time; measurements were logged in 1-second intervals. Additionally, 15 maintenance workers and 14 office workers had their personal noise exposures measured using a 3M Edge Dosimeter paired with an iPod Touch for 5 consecutive work days. The calculated time-weighted average and percent dose were compared between the devices. A mixed effects linear regression model with random effects for subjects and devices was used to account for the repeated measure design and to determine the systematic difference between the measurements of the two devices.

Results: Overall, 315,328 1-sec measurements were collected from the devices in the reverberant chamber. On average, the iPods measured 0.1 dB lower than the dosimeters when exposed to intermittent noise in a controlled setting. In an occupational setting, the iPods were found to measure, on average, 2.6 dB lower than the noise dosimeters for the cohort of maintenance workers. In the office worker cohort, the iPods were found to measure, on average, 0.7 dB lower than the noise dosimeters.

Conclusions: The results indicate that smart devices with an external microphone are capable of making very accurate noise measurements in a controlled setting. However, these devices become less accurate when used in the workplace. In addition, precautions should be taken to help protect the smart devices to prevent inaccurate measurements. Despite these limitations, there is still evidence that smart devices can be used as a cheap and effective alternative to traditional noise dosimeters when noise dosimeters are not available.
Abstract 44
Turbulent Eddy Diffusion Models in Exposure Assessment - Determination of the Eddy Diffusion Coefficient
Authors: Y. Shao, S. Ramachandran, S. Arnold, and G. Ramachandran

University of Minnesota, Twin Cities (Graduate)

Objectives: The main goal of this study was to accurately estimate the turbulent eddy diffusion coefficient (DT) for a range of the air change per hour (ACH) values by minimizing the difference between the concentrations measured and predicted by an isotropic eddy diffusion model. A second goal was to explore the relationship between DT and ACH and to find mathematical evidence to support our experimental findings. A third goal is to test whether our findings can be generalized to indoor air settings more broadly.

Methods: We constructed an experimental chamber with a spatial concentration gradient away from the contaminant source, and conducted 27 3-hr long experiments using toluene or acetone under different air flow conditions (0.43 to 2.89 ACHs). An eddy diffusion model accounting for chamber boundary, general ventilation, and advection was developed. A mathematical expression for the slope based on the geometrical parameters of the ventilation system was also derived.

Results: In this study, the measured and modeled data fit well over a range of experimental conditions [Chemical: Toluene / Acetone, ACH = 0.43 – 2.89]. There is a strong linear relationship between DT and ACH, providing a surrogate parameter for estimating DT in real-life settings. For the first time, a mathematical expression for the relationship between DT and ACH has been derived and the calculated value of the slope between these two parameters is not significantly different from the experimentally determined value. The values of DT obtained from the experiments are generally consistent with values reported in the literature.

Conclusions: These findings make the use of turbulent eddy diffusion models for exposure assessment in workplace/indoor environments more feasible.

Abstract 45
Occupational Iron Exposures and Pleural Disease Among Minnesota Taconite Mining Workers

University of Minnesota, Twin Cities (Graduate)

Objectives: To examine the association between exposure to airborne iron and pleural disease among Minnesota taconite mining workers.

Methods: The goal of this study was to assess the association between exposure to airborne iron concentrations and pleural abnormalities in 1176 current and former workers employed in various operations in mining and processing of taconite (a low grade iron ore). Pleural abnormality, consistent with pneumoconiosis, was identified by consensus of two certified B-readers based on a single radiograph of the taconite workers. The workers’ cumulative exposure to airborne iron was estimated using 679 present-day and 17,083 historical exposure measurements along with area measurements that were combined with the workers’ employment histories. Cumulative exposures to respirable silica (RS) and elongated mineral particles (EMP) were also estimated using present-day and historical measurements. Logistic regression was used to estimate associations between iron exposure and pleural abnormalities adjusting for possible confounders [EMP exposure, smoking status].

Results: Of the 1,176 participants 197 had pleural abnormalities. The averaged cumulative exposures to iron, RS, and EMP in the pleural abnormalities group were significantly higher than those in pleural normal group (Iron: 2.02 (mg/m3)×year vs 1.71 (mg/m3)×year; RS: 1.21(mg/m3)×year vs 1.08 (mg/m3)×year; EMP: 3.9 [EMP/cc]×year vs 2.8 [EMP/cc]×year). The crude OR for iron exposure was 1.21 (95% CI 1.07 to 1.36) and 1.12 (95% CI 0.98 to 1.27) after adjusting for EMP exposure, age and BMI.

Conclusions: This study provides modest evidence that Iron exposure may play a role in the development of the pleural disease among taconite workers. Given the correlated multiple exposures in the taconite mine, the joint effect of Iron and EMP exposure warrants future investigation.

Abstract 46
Analyzing Sound Pressure Level Distribution from Monitoring of Research Animal Cage Washers
Authors: A. Zhang

University of Minnesota, Twin Cities (Graduate)

Objectives: Assumptions that the sound pressure level data fit particular distribution models will influence the effectiveness and validity of identifying noise exposure categories when using Bayesian Decision Analysis (BDA). Therefore, the objective of this research is to test whether sound pressure level data collected repeatedly in occupational settings fit normal, lognormal, or other distribution models over different time scales.

Methods: Data were collected from the average or maximum of one-minute interval sound pressure level for 30 days, 8 hours per day from research animal cage washers in a cage washing facility at the University of Minnesota. Probability distribution functions were used to characterize random variables of sound pressure level for each 8-hour measurement and 8-hour averages for 30 days. The Cullen and Frey Analysis was then applied to screen out unlikely distribution models through skewness-kurtosis graphs. The sound pressure level data were used to fit different potential distribution models, such as lognormal, normal, Weibull, etc. Applying the comparison of goodness of fit (GOF) parameters including the Akaike Information Criterion (AIC) parameter and considering the skewness of the distribution helped us identify the best fitting model. Additional sampling was conducted to see how work tasks affected the distribution.

Results: The 8-hour averages of sound pressure level data for 30 days fits a normal distribution. However each of the 30 days of sound pressure level data distribution are negatively skewed, which indicates that the distribution is skewed towards the left. For the maximum sound level in one-minute interval, the skewness for each of the 30 days of sound pressure level data are also negatively skewed. From the GOF test, both one-minute and maximum sound level data are best fit by the Weibull distribution. The data from this location contains three modes on the left tails for each maximum sound level probability
distribution curve, suggesting that the skew is due to different tasks throughout the work day. After removing data which were taken when the washing machine generating the most noise in the room was turned off, we found a normal distribution for the one-minute interval averaged and maximum sound pressure level data measured when the noise source was operating.

Conclusions: We anticipated that the distribution of the sound pressure level would follow a normal or lognormal distribution. However the average sound level distribution is highly skewed to the left which indicates that the calculation of threshold could affect the distribution of the noise dose. The maximum sound level distribution is slightly skewed to the left with three modes on the left tails which indicates that it may be related with other tasks workers do. After removing data taken when the noise source was stopped, we found that the distribution of sound pressure level from a single noise source follow a normal distribution.

Abstract 47
Hearing Loss, Noise Exposures, and Hearing Protection Use Among Midwestern Farmers: A Preliminary Analysis
Authors: J. Ehlers and C. Achutan
University of Nebraska Medical Center (Graduate)

Objectives: 1. To characterize hearing loss among farmers; 2. To describe noise exposures on the farm; 3. To evaluate the change in the attitudes and beliefs regarding hearing loss and hearing protection over time for intervention and control farmers.

Methods: We analyzed a subset of the data collected from a randomized controlled intervention study assessing the impact of a point-source intervention designed to increase the use of hearing protection devices. Farmers were randomized into either control (n=36) or intervention (n=55) groups; both were visited at baseline and at year two. The intervention farms were given hearing protection and education about hearing loss; the control farms were only given education. In each year, we administered audiometric tests and the hearing protection device perception questionnaire.

Results: A majority of the farmers experienced some degree of hearing loss in at least one ear. Left ears had statistically worse hearing than the right ears at 3000 Hertz (Hz) and 4000 Hz. The poorest hearing occurred between 4000 Hz and 6000 Hz. More than half of the farmers were exposed to noise in excess of the National Institute for Occupational Safety and Health Recommended Exposure Limit. This study changed farmers’ attitudes and beliefs regarding hearing loss and hearing protection. Both intervention farmers and control farmers changed their current practices regarding hearing protection use between year one and year two, more specifically both groups appeared to use hearing protection more often at year two than year one. Intervention farmers changed their perceptions about comfort as being a barrier to using hearing protection between year one and year two compared to control farmers.

Conclusions: Study participants have a high prevalence of hearing loss which appears to be related to noise exposure and hearing protection device (HPD) use among this group of farmers.

Abstract 48
U.S. Ebola Treatment Centers: An Inventory of Capabilities

(1) University of Nebraska Medical Center, Omaha, Nebraska
(2) Harvard University, Boston, Massachusetts
(3) Columbia University, New York, New York
(4) Emory University, Atlanta, Georgia
(5) Indiana School of Public Health-Bloomington, Bloomington, Indiana

University of Nebraska Medical Center, College of Public Health (Graduate)

Objectives: 1. To detail initial costs incurred by the 55 U.S. Ebola Treatment Centers (ETCs) in attaining the advanced capabilities necessary to provide the comprehensive care required for patients with Ebola virus disease (EVD) while minimizing the risk of transmission to workers; 2. To identify infection control infrastructure features of ETCs, including waste-management capabilities [e.g., autoclaves] and existence of anterooms and HEPA filtration; 3. To determine clinical laboratory resources and capabilities of ETCs.

Methods: A 19-question survey was distributed electronically in April 2015 to all 55 ETCs. Surveys were collected via email; data was coded and analyzed in Microsoft Excel.

Results: Forty-seven (85%) ETCs responded; a majority have negative pressure isolation rooms, anterooms, and a process for Category A waste sterilization, although only 11 facilities (23%) have the capability to sterilize infectious waste on-site. The cumulative total cost incurred by the 45 (82%) ETCs reporting costs was $53,909,701 (median $1,000,000 and mean $1,197,993 per ETC). The most costly activity was construction and modification. Staff training, an ongoing expense, averaged $267,075. Forty-one (87%) ETCs planned to provide some laboratory support from within the patient isolation room and 40 of 44 (91%) ETCs reported BSL-3 laboratory support either through their clinical laboratory or jurisdictional Public Health Laboratory.

Conclusions: Hospitals developed ETCs guided by CDC recommendations, but specific capabilities are not currently mandated. Ebola virus is a highly infectious pathogen with high mortality rates that poses significant occupational risks if infection control and prevention measures are not strictly adhered. ETCs without autoclaves may heighten occupational exposure risks during the storage, packaging, and transportation of infectious waste. Further assessments are needed to determine the engineering and infrastructure features necessary to ensure that health, safety, and infection controls are properly implemented to protect healthcare workers and other workers involved in this high-risk setting.
Abstract 49
Assessment of Chemical Exposures in Nails Salons in Omaha: A Preliminary Study
Authors: T. Hoang and C. Achutan
University of Nebraska Medical Center [Graduate]

Objectives: The main objective of this study was to assess nail salon workers' exposures to ambient air quality chemicals and understand nail salon workers' work practices and knowledge of the chemicals they work with in Omaha.

Methods: We collected full-shift personal breathing zone samples on 13 workers working in two nail salons in Omaha over two days. Air samples for formaldehyde were collected using passive badges (Advanced Chemical Sensors, Boca Raton, Florida) and air samples for toluene were collected using charcoal tubes. We interviewed all participants using a guided questionnaire to evaluate their work practices and nail product chemical knowledge.

Results: The overall average concentration [and % coefficient of variation], and 95% CI relative to Occupational Safety and Health Administration’s (OSHA) Permissible Exposure Limits (PELs) of toluene was 0.128 parts per million (ppm) [104.4%], 95% CI [-344.4, 344.5] and the average concentration of formaldehyde was 0.044 ppm [23.9%], 95% CI [-0.249, 0.342]. These values are below the respective OSHA PELs. There were eight female workers and five male workers. Six of 13 workers (46%) worked more than 60 hours per week on average. Three workers [23%] said they did not speak English very well or did not speak English; five workers did not read English very well or could not read English. Eight workers did not know of three toxic chemicals - formaldehyde, toluene, and dibutyl phthalate. Seven workers did not know what information was found in the Material Safety Data Sheets. Of 13 workers, nine experienced headaches, six experienced shortness of breath and coughing, and nine experienced back or other musculoskeletal pain.

Conclusions: The personal air samples for formaldehyde and toluene were below the respective OSHA PELs. However, more research is needed to understand exposure variability in this industry. We identified several factors that can influence workers' awareness of chemical exposures.

Abstract 50
UV-Reflective Paint and Ultraviolet Germicidal Irradiation [UVGI] Improve Decontamination of Nosocomial Bacteria on Hospital Room Surfaces

[1] University of Nebraska Medical Center, Omaha, NE
[2] Indiana University School of Public Health, Bloomington, IN

University of Nebraska Medical Center [Graduate]

Objectives: To evaluate the efficacy of a portable ultraviolet germicidal irradiation [UVGI] generator in conjunction with UV-reflective paint to disinfect various environmental surfaces within a hospital room.

Methods: Surfaces composed of stainless steel, chrome, and plastic (bedrail) were inoculated with ~6 log10 CFU/mL of methicillin-resistant Staphylococcus aureus (MRSA) or vancomycin-resistant Enterococcus faecalis (VRE). Trials were completed in one hospital room; control trials were completed with standard paint and this room was coated in UV-reflective paint [UVC Max, Lumacept, Grand Forks, ND] for experimental trials. Each surface type was placed at 6 different areas [5 direct and 1 indirect exposure] within each hospital room and treated by 10-minute ultraviolet-C [UVC] exposures in three trials using the TORCH™ (ChlorDiSys Solutions, Lebanon, NJ) [0 to 688mJ/cm²].

Results: For surfaces indirectly exposed to UVC, the average MRSA concentrations were reduced by 1.3log10 with standard paint and 4.7log10 with UV-reflective paint (p<0.0001). Indirectly exposed VRE concentrations were reduced by 1.2log10 with standard paint and 4.6log10 with UV-reflective paint (p<0.0001). For directly exposed surfaces, no significant difference was seen with MRSA, and VRE concentrations were reduced by 4.4log10 with standard paint and 5.3log10 with UV-reflective paint (p=0.001). Average MRSA concentrations on bedrail surfaces were reduced by 3.8log10 with standard paint and 4.3log10 with UV-reflective paint (p=0.001) with no significant reduction differences on the other surfaces tested. Average VRE concentrations on bedrail surfaces were reduced by 4.1log10 and 5.6log10 (p=0.0002), on stainless steel by 3.6log10 and 5.0log10 (p=0.0001), and on chrome by 3.5log10 and 4.9log10 (p=0.0009) with standard paint and UV-reflective paint respectively.

Conclusions: UVGI in combination with UV-reflective paint lowered concentrations of MRSA and VRE indirectly exposed to UVC as compared to treatment with standard paint. Future studies should investigate the application of UVGI with UV-reflective paint with various organisms, surfaces, and in other clinical settings.

Abstract 51
Tobacco Harvesting Work, Exposure to Nicotine, Vital Signs and Nicotine Poisoning
Authors: V. Gohil [1], N. Okafor [1], Y. Liu [1], D. Sterling [1], R. Pearce [2], T. Prince [2], V. Davis [2], M. Carol [2], D. Reed [2], S. Biswas [3], A. Stinchcomb [4]

[1] University of North Texas Health Science, Fort Worth, TX
[2] University of Kentucky, Lexington, KY
[3] University of Texas, Dallas, TX
[4] University of Maryland, Baltimore, MD

University of North Texas Health Science Center [Graduate]

Objectives: This tobacco harvesting worker study was to investigate 1) nicotine exposure in different tasks, 2) changes in vital signs in different phases of the study and 3) occurrence of green tobacco sickness symptoms.

Methods: Forty three workers in 6 Kentucky farms were recruited and followed up for 6 days. Tasks each worker performed and task times were recorded in a daily work diary. Vital signs [blood pressure, body temperature and pulse rate] were measured 4 times [baseline, earlier and later in the study and at the end of the study]. Urinary levels of nicotine and cotinine from each worker were measured by post-shift urine samples using High Performance Liquid Chromatography/Tandem Mass Spectrometry (LC- MS/MS). Nicotine poisoning symptoms were
also collected in the work diary.

**Results:** Workers on average spent 4.5 hours for cutting tobacco stalks, 0.5 hours for pulling off leaves (pulling), 0.2 hours for loading them onto trucks (loading) and 3.3 hours for hanging them in barns (hanging). Urinary nicotine vs cotinine levels (µg/g creatinine) varied significantly among the tasks which ranged from [23351.7 vs 19807.0] to [2095047.9 vs 126882.2] for cutting, [18922.8 vs 41296.7] to [1509661.8 vs 982318.63] for pulling, [451631.7 vs 159151.2] to [1488265.6 vs 682261.2] for loading and [37634.4 vs 33733.1] to [5208333.3 vs 2258953] for hanging. Vital signs were within normal ranges during different phases of the study. However, 5 of the 43 workers reported skin irritation and nicotine poisoning symptoms [headache, dizziness, nausea and vomiting].

**Conclusions:** Exposure to nicotine during tobacco harvesting work is highly variable among different workers and tasks that causes green tobacco sickness in some workers although their vital signs were normal. Administrative changes, safe work practice and use of appropriate personal protective equipment are recommended to lower exposures.

**Abstract 52**

**Determinants of Nicotine Exposure in Tobacco Harvesting Workers: A Pilot Study**

**Authors:** N. Okafor [1], V. Gohil[1], Y. Liu[1], D. Sterling[1], S. Biswas [2], R. Pearce [3], T. Prince[3], V. Davis[3], M. Carol[3], D. Reed[3], T. Klingner[4], M. Tokarski[4], A. Stinchcomb[5]

[1] University of North Texas Health Science, Fort Worth, TX
[2] University of Texas, Dallas, TX
[3] University of Kentucky, Lexington, KY
[5] University of Maryland, Baltimore, MD

**University of North Texas Health Science Center (Graduate)**

**Objectives:** This study was conducted to assess the magnitude of nicotine exposure and to identify exposure determinants in migrant tobacco farm workers.

**Methods:** A total of 43 migrant farm workers from 6 tobacco farms in Kentucky were recruited and studied for 3 days in which they performed typical tobacco harvesting activity and 3 days of harvesting with the use of an investigational nicotine barrier cream. Post-shift urinary samples were collected and analyzed for nicotine and cotinine (µg/g creatinine) by High Performance Liquid Chromatography/Tandem Mass Spectrometry (LC-MS/MS). Demographic data were collected using a questionnaire. Mixed effects models with random effects for subjects were fitted to identify significant determinants of nicotine and cotinine (µg/g creatinine) by High Performance Liquid Chromatography/Tandem Mass Spectrometry (LC-MS/MS). Demographic data were collected using a questionnaire. Mixed effects models with random effects for subjects were fitted to identify significant determinants of nicotine and cotinine levels for univariate and multivariate analyses.

**Results:** Urinary levels were significantly higher in male workers than in female workers with geometric mean ± geometric standard deviation (GM±GSD) at 507182.0 (±1.8) vs 221699.1 (±1.7), p<0.05 for nicotine, and 297366.0 (±1.8) vs 96258.4 (±1.8), p<0.01 for cotinine, in workers with 1-8 years of schooling than workers without education [597992.8 (±1.6) vs 370441.7 (±2.1), p<0.05] for nicotine, and during the use of a cream formulation than in the days when no barrier cream was used [48594.7 (±2.1) vs 408553.4 (±2.0), p<0.001] for nicotine. The use of a barrier cream was identified as the only significant predictor of urinary nicotine level (p<0.01) in the multivariate model. No other factors were found as significant predictors.

**Conclusions:** Urinary nicotine and cotinine levels in tobacco harvesting are variable among different workers and potentially affected by tasks they performed and the use of other personal protective equipment. Further studies with larger sample size of workers and pre-shift urine measurements are needed for improved assessment.

**Abstract 53**

**Evaluation of Physiological Strain in Hot Work Areas Using Thermal Imagery**

**Authors:** C. Holm, L. Pahler, M. Thiese, and R. Handy

**University of Utah [Rocky Mountain Center for Occupational and Environmental Health] (Graduate)**

**Objective:** This study utilized thermal imaging and heart rate monitoring to calculate Physiological Strain Index (PSI) from predicted core temperature of human subjects wearing thermal protective garments during recovery from hot work.

**Methods:** Ten male subjects employed as copper furnace tappers were evaluated for physiological strain while wearing thermal protective clothing and participating in hot work. Thermal images of the head and neck were captured with a high-resolution thermal imaging camera concomitant with measures of gastrointestinal and skin temperature. Lin’s concordance correlation coefficient (ρ_c), Pearson’s coefficient (r) and bias correction factor (C_b) were calculated to compare thermal imaging based temperatures to gastrointestinal temperatures. Calculations of PSI based upon thermal imaging recorded temperatures were compared to gastrointestinal temperatures were also performed.

**Results:** Participants reached a peak PSI of 5.2 on a scale of 10, indicating moderate heat strain. Sagittal measurements showed low correlation [ρ_c = 0.133], moderate precision [r = 0.496] and low accuracy [C_b = 0.269] with gastrointestinal temperature. Bland-Altman plots of imaging measurements showed increasing agreement as gastrointestinal temperature rose, with higher levels of agreement in the sagittal views; however, the limits of agreement fell outside the ±0.25°C range of clinical significance. Bland-Altman plots of PSI calculated from imaging measurements showed increasing agreement as PSI calculated from gastrointestinal temperature rose; however, the limits of agreement fell outside the ±0.5 range of clinical significance.

**Conclusions:** This study confirmed previous research showing thermal imagery is not highly correlated to body core temperature during recovery from moderate heat strain in mild ambient conditions. Measurements display a trend toward increasing correlation at higher body core temperatures, which may enable use of thermal imagery as a screening tool for high heat strain. Accuracy was not sufficient at mild to moderate heat strain to allow calculation of individual physiological stress.
Abstract 54
Wind Tunnel Testing of a Disposable, Inhalable Aerosol Sampler at Two Sampling Rates
Authors: J. Stewart, D. Sleeth, L. Pahler, R. Handy, T. R. Anthony, and J. Volckens
University of Utah (Graduate)

Objectives: A newly designed, low-cost, disposable inhalable aerosol sampler was developed to assess workers personal exposure to inhalable particles. This sampler was originally designed to operate at 10 L/min to increase sample mass and, therefore, improve analytical detection limits for filter-based methods. Computational fluid dynamics modeling revealed that sampler performance (relative to aerosol inhalability criteria) would not differ substantially at sampler flows of 2 and 10 L/min. With this in mind, the newly designed inhalable aerosol sampler was tested, simultaneously, at flows of 2 and 10 L/min flow.

Methods: A mannequin was equipped with 6 sampler/pump assemblies (three pumps operated at 2 L/min and three pumps at 10 L/min) inside a wind tunnel, operated at 0.2 m/s. In separate tests, four different particle sizes were injected in order to determine if the sampler’s performance with the new 10 L/min flow rate significantly differed to that of its original flow rate. Isokinetic sampling was also performed to determine sample efficiency of the prototype sampler running at both flow rates.

Results: Mean concentrations at all particle sizes collected at 2 L/min and 10 L/min are comparable, however there are some discrepancies. A comparison between inhalable mass concentrations using a Wilcoxon signed rank test found that there was not a significant difference in the concentration of particles when operating the sampler at 10 L/min as compared to 2 L/min. The samplers at both flow rates slightly underestimated the low-wind inhalability curve, which could suggest that at both flow rates the sampler is potentially underestimating workers exposure to inhalable particles.

Conclusions: After conducting a side-by-side test of the newly designed inhalable aerosol sampler at different sampling flow rates, it is suggested that there is not a significant difference in either the concentration sampled or the sampler efficiency when operating the sampler at 10 L/min as compared to 2 L/min. There is a difference in mean concentration between 2 L/min and 10 L/min flow rates by as much as 15% at particle size 4.9 μm. This difference could be significant in practice and further research could be conducted to investigate this finding. Operating the new sampler at 10 L/min could improve accuracy as it pertains to assessing personal exposure by enabling lower concentrations to be quantified. This a preliminary study and further research needs to be conducted before using in the field.

Abstract 55
Assessment and Prioritization of Mixed Exposures to Toner Emissions using an Asthma Risk Scoring Model
Authors: A. Johnson (1), M. Virji (2), J. Ham (2), R. LeBouf (2), A. Stefaniak (2)
[1] West Virginia University, Morgantown, WV

West Virginia University School of Public Health (Graduate)

Objectives: Toner-based printers emit complex mixtures of volatile organic compounds (VOCs) and previous studies have observed that some emissions are associated with work-related asthma. The aims of this study are to (1) quantify VOCs emitted from desktop laser printers; (2) utilize existing quantitative structure-activity relationship (QSAR) models to screen identified VOCs for occupational asthmagenic potential; and (3) develop an asthma risk score model to assess mixed VOC exposures.

Methods: 12 newly purchased desktop laser printers from 4 manufacturers were assessed in triplicate for emission variances. VOC emissions from 36 printer experiments were collected in a chamber using evacuated canisters and thermal desorption tubes and analyzed by gas chromatography/mass spectroscopy. Asthmagenic potential of all VOCs was assessed using a QSAR asthma model (Hazassess) to obtain a hazard score [from 0 (low hazard index) to 1 (high hazard index)]. An asthma risk score for each emitted VOC was generated by weighting the hazard score by the observed VOC concentration.

Results: 21 VOCs were identified in air samples collected from the chamber study and a literature review. The majority of emitted VOCs were alcohols and aldehydes. VOC emissions ranged from 0.26 ppb (hexane) to 7.3 ppb (isopropyl alcohol). QSAR model hazard scores ranged from 0.0131 (1,2,4-trichlorobenzene) to 0.1988 (acetaldehyde). QSAR model hazard scores were below the potentially asthmagenic hazard index value. Weighted asthma risk scores were 0.2095 (isopropyl alcohol), 0.2616 (toluene) and 0.4095 (acetaldehyde).

Conclusions: QSAR models can be used to assess asthma risk; however, these models are limited to assessment of VOCs singly. In occupational settings, workers are often exposed to a mixture of VOCs. Our emission weighting method expands upon current QSAR models by accounting for exposures to a mixture VOCs. We incorporate compound structure and concentration into our risk model and provide an asthma risk score relevant to mixed exposures.