NIOSH-Supported
Education and Research Center (ERC)

16th Annual

2015 Pilot Research Project (PRP) Symposium

October 8-9, 2015
Engineering Research Center, Auditorium
University of Cincinnati
Thursday, October 8th 1:00 pm—5:00 pm
Friday, October 9 th 8:00 am—12:00 pm

Keynote Speaker

James Thompson, PhD, PE
Chief of the Hearing Loss Prevention Branch of the Office of Mine Safety and Health Research
National Institute for Occupational Safety and Health (NIOSH)

Podium and Poster Presentations by PRP Awardees

Supported by NIOSH grant #T42-OH008432

UNIVERSITY OF Cincinnati

Pilot Research Training Program and Symposium

Welcome to the University of Cincinnati Education and Research Center's (ERC) **16th Annual Pilot Research Project (PRP) Symposium** on October 8-9, 2015**,** held in the Auditorium of the Engineering Research Center, College of Engineering. The purpose of the PRP is to increase the research capacity of research trainees and young investigators in occupational health and safety and to encourage those in related disciplines to pursue occupational health and safety research.

Under the administrative direction of Dr. Amit Bhattacharya, research proposals are solicited and peer-reviewed annually from qualifying faculty and graduate students from the **University of Cincinnati and the following PRP partnering institutions – Air Force Institute of Technology, Bowling Green State University, University of Toledo – Health Science Campus, Central State University, Purdue University, University of Kentucky, Western Kentucky University, Eastern Kentucky University, Murray State University, Ohio University and Kentucky State University.**

At this symposium, the 2014-15 awardees will be presenting the results of their research and the 2015-16 awardees will make poster presentations of their proposed work. The keynote speaker on Thursday, October 8, 2015 is **James Thompson, PhD, PE,** Chief of the Hearing Loss Prevention Branch of the Office of Mine Safety and Health Research under NIOSH, will deliver the keynote address on **"Noise Control of Large Mining Machines."**

The University of Cincinnati's Education and Research Center is one of 18 such centers funded by the National Institute for Occupational Safety and Health (NIOSH) nationally. Dr. Tiina Reponen serves as the director of the ERC, which is based in the university's Department of Environmental Health within the College of Medicine. The purpose of the ERC is to train professionals in the didactic and research skills necessary to lead the occupational safety and health disciplines. Results of research are translated into action through an outreach program and shared with professionals and practitioners in the region via continuing education.

Since 1999, the PRP program has allocated over $1.2 million to support 213 pilot research projects. These projects have served as a catalyst in bringing over $34 million in additional research support to the region from sources independent of the PRP program, such as, the National Institute for Occupational Safety and Health (NIOSH), National Institutes of Health (NIH), United States Department of Agriculture (USDA), National Science Foundation (NSF), and the Centers for Disease Control and Prevention (CDC). Additionally, the PRP has brought 46 new investigators from other fields of expertise to the area of occupational safety and health research.

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Symposium attendees are eligible for:

◊ **ABIH (IH) CM Points; apply online at http://www.abih.org/**

◊ **Meets BCSP criteria for continuation of certification credit**

The 16th Annual PRP Symposium is free and open to the public

For more information about the PRP program, please contact Dr. Amit Bhattacharya, PRP Program Director, at (513) 558-0503 or email Amit.Bhattacharya@uc.edu

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PODIUM PRESENTATION SCHEDULE

Thursday, October 8, 2015			
	Moderator: Emmanuel Iyiegbuniwe, PhD		
Time	**Title**	**Speaker**	**Affiliation**
1:00—1:05 pm	**Welcome**	**Amit Bhattacharya, PhD, CPE, PRP Program Director**	**Environmental Health University of Cincinnati**
	Welcoming Remarks	**Frank Gerner, PhD Sr. Assoc Dean**	**College of Engineering University of Cincinnati**
1:05-1:15 pm	**Introduction of Education and Research Center (ERC)**	**Tiina Reponen, PhD, CIAQP, ERC Director**	**Environmental Health University of Cincinnati**
1:15—1:20 pm	**Introduction of Keynote Lecturer: James Thompson, PhD, PE**	**Jay Kim, PhD, OSHE Director**	**College of Engineering University of Cincinnati**
1:20—2:10 pm	**Keynote Address: "Noise Control of Large Mining Machines"**	**James Thompson, PhD, PE**	**JKT Enterprises, Williamsburg, VA**
2:10—2:20 pm	**Keynote Q & A**		
2:20—2:40 pm	**A Pilot Study on Mn Exposure and Neurological Effects Using Bone Mn as a Biomarker**	**Linda Huiling Nie, PhD**	**Health Sciences Purdue University**
2:40—3:00 pm	**The Impact of Shift Length on Mood and Fatigue**	**Wendy Ungard MSN, RN, NEA-BC for Melanie Kroger-Jarvis, DNP, MSN, CNS**	**College of Nursing University of Cincinnati**
3:00—4:00 pm	**Break (15 minutes) and Poster Session I**		
4:00—4:20 pm	**Investigation of the Efficacy of Recovery Activities in Firefighters**	**Michael Sliter, PhD**	**Psychology Indiana University Purdue University Indianapolis**
4:20—4:40 pm	**Enhanced Cooling of Firefighter Helmets using Phase Change Materials**	**Marwan Al-Rjoub**	**Mechanical Engineering University of Cincinnati**
5:00 pm	**PRP Networking Picnic**		

PODIUM PRESENTATION SCHEDULE

Friday, October 9, 2015			
	Moderator: Diana Schwerha, PhD		
Time	**Title**	**Speaker**	**Affiliation**
8:00—8:10 am	**Opening Remarks**	**Amit Bhattacharya, PhD, CPE PRP Program Director**	**Environmental Health University of Cincinnati**
8:10—8:30 am	**Performance of Facepiece Respirators and Masks against Surgical Smoke: SWPF Study**	**Shuang Gao**	**Environmental Health University of Cincinnati**
8:30—8:50 am	**Airborne Particle Release and Exposure from Paper Shredding and Biological Response Potentials**	**Candace Tsai, ScD**	**Health Sciences Purdue University**
8:50—9:10 am	**Identification of Immunologic and Genetic Biomarkers for TMA Sensitization**	**Debajyoti Ghosh, PhD**	**Internal Medicine University of Cincinnati**
9:45—10:45 am	**Break (15 minutes) and Poster Session II**		
10:45—11:05 am	**Aligned Carbon Nanotube Sheets for Faster Heat Dissipation in Firefighter Garment**	**Rachit Malik**	**Materials Engineering University of Cincinnati**
11:05—11:45 am	**Discussion of the Podium Presentation Topics**	**Panel Discussion**	
11:45—12:00 pm	**Closing Remarks and Program Evaluation**		

2015 PRP AWARDEE POSTERS

No.	Title	Author	Affiliation
1	Antigen Profiling of Field Metalworking Fluids	Harish Chandra, PhD	Environmental Health, University of Cincinnati
2	Application of a Novel Sensor for Traffic-Related Indoor Air Pollution	Jennie Cox	Environmental Health, University of Cincinnati
3	Lightweight, Low Energy Consumption Heaters for Winter Gears	Seyram Gbordzoe	Materials Engineering, University of Cincinnati
4	Detecting, Localizing, and Tracking Wildfires Using an UAS	Kelly Cohen, PhD	Aerospace Engineering & Engineering Mechanics, University of Cincinnati
5	Chronic Exposure of Carbon Nano-materials Induces Malignant Transformation in Human Lung Cells	Aparna Shinde	Health Sciences Purdue University
6	Get ACTive! A pilot acceptance and commitment therapy workshop	Jessica Borushok	Psychology Bowling Green State University
7	A Test of the Work Stressor - Vulnerability Model of Alcohol Consumption	Kristin Horan	Psychology Bowling Green State University
8	Oral Microbiome Perturbations and Associated Risks in Firefighters	Sukanta Bhattacharya, PhD	Environmental Health, University of Cincinnati
9	Improvement of Machine Shop Safety for College Students	Briana Singleton, PhD	Engineering Physics Air Force Institute of Technology

INVITED STUDENT POSTERS

1	In Progress: Measuring the Impact of Integrating Safety and Ergonomics with Lean and Six Sigma Processes across Manufacturing Companies in Ohio	Nick Loree and Alyssa Boudinot	Industrial and Systems Engineering, Ohio University
2	Use of Lean Methodology to Streamline the Procurement Process for Office Equipment	Marie Hayden	Industrial and Systems Engineering, Ohio University
3	Performance of N95 Filtering Facepiece Respirators (FFRs) Used by Home Attending Health-care Workers (Pilot Study - Design and Methods)	Yousef Elmashae	Department of Environmental Health, University of Cincinnati

Keynote Speaker, Thursday, October 8, 2015

James Thompson, PhD, PE

Chief of the Hearing Loss Prevention Branch of the Office of Mine Safety and Health Research
National Institute for Occupational Safety and Health (NIOSH)

Dr. Thompson received his BS and MS from Virginia Tech and his PhD from Purdue University. He has over 30 publications in national and international journals. He is a registered professional engineer in Pennsylvania, Ohio, and Michigan. He is an Institute of Noise Control Engineering (INCE) Board Certified Noise Control Engineer. He has over 35 years of experience in noise control engineering in several industries with his current focus on mining. Dr. Thompson has served as President of INCE-USA and as Chairman of the SAE Noise and Vibration General Committee. He also is the Managing Editor of Noise/News International and an SAE Fellow.

2014-15 PRP Awardees
PODIUM PRESENTATION ABSTRACTS

A Pilot Study on Mn Exposure and Neurological Effects Using Bone Mn as a Biomarker

Linda H. Nie, Yingzi Liu, Danelle Rolle, Wei Zheng, Ellen Wells

Purdue University, West Lafayette, IN

Purpose: This study was conducted to investigate the association between Mn Exposure and Neurological Effects using bone Mn (MnBn) as a biomarker.

Design: Twenty volunteers from Purdue campus were recruited for this study, with 8 welders and 12 subjects who were not exposed to Mn.

Methods: A neutron activation analysis (NAA) system has been developed and validated for *in vivo* and non-invasive quantification of Mn in hand bone in our lab. The system consists of two parts: a compact DD neutron generator with a flux of up to $3 * 10^9$ neutrons/ sec for irradiation, and a 100% HPGe detector system for Mn gamma ray detection. Hand phantoms doped with different Mn concentrations were used to calibrate the system. Purdue Pegboard was used to test the subjects' motor function especially movement coordination.

Results: With the advanced MnBn measurement system, the detection limit was calculated to be about 0.43 mg Mn/g dry bone (ppm) with an irradiation dose of 36 mSv to the human hand. The detection limit can be reduced to 0.3 ppm with two 100% HPGe detectors. We observed significant decrease of Purdue Pegboard test score with the increase of bone MnBn among the 8 welders, and marginally significant decrease of Purdue Pegboard test score with the increase of MnBn for the whole group of 20 people.

Conclusions: The results indicate that MnBn is a good biomarker to assess cumulative Mn exposure.

Impact Statement: Occupational exposure to manganese (Mn) occurs among workers involved in welding, smelting, mining, and battery production. In the US alone, millions of workers, including over 300,000 welders, are at high risk of excessive Mn exposure. Mn exposure is associated with many types of diseases, and the most concerned is neurological disorders. No reliable biomarker is available to assess Mn exposure, which limited our capability to understand the toxicity of excessive exposure to Mn. The outcome of this project provides a promising biomarker for cumulative Mn exposure assessment.

Corresponding author: *Linda H. Nie, Associate Professor, School of Health Sciences, Purdue University; hnie@purdue.edu*

The Impact of Shift Length on Mood and Fatigue

Melanie Kroger-Jarvis (PI) and Wendy Ungard

College of Nursing, University of Cincinnati

Purpose: The aim of this study was to obtain a baseline measurement of sleep, physical activity, social support, work immersion, and shift length; and to relate these to the fatigue and mood states of registered nurses. Results will be used to design mitigation strategies to decrease nurse fatigue, improve mood, and improve work/life balance.

Design: This was a descriptive study using registered nurses (RN) working either an 8-hour shift or a 12-hour shift. Mood was measured for each group before and after each shift. Activity and sleep quality were collected 24 hours a day for seven days. Fatigue, social support, and work immersion were collected once.

Methods: Eighty RNs were recruited from randomly selected units in a pediatric inpatient hospital. Questionnaires were Profile of Mood States (POMS), Occupational Fatigue Exhaustion Recovery (OFER) (chronic and acute fatigue, and inter-shift recovery), Work Immersion Questionnaire (degree worker is unable to "leave work behind"), and the Social Support Questionnaire (perceived support from co-workers and managers).The Fitbit Flex® was used to measure physical activity, total sleep time and sleep quality,

Results Ninety seven percent of the RNs reported their work to be heavy or extremely heavy. Four Multiple regression analyses were conducted to predict chronic fatigue, acute fatigue, inter-shift recovery and general mood. Independent variables were Shift Length, Work Immersion, Sleep Quality and Physical Demands: 1) Shorter shift length, higher work Immersion and lower sleep quality, but not degree of physical activity predicted **chronic fatigue** (R^2 = *.26, F(4, 72) = 6.33, p* <.001); 2) Higher work Immersion was a significant predictor for **acute fatigue** , but not physical activity, sleep quality or social support (R^2 = .158, F(4,72) = 3.37, p = 0.014); 3); 3) the equations predicting **inter-shift recovery** (R^2 = .114, F(4, 72) = 2.31, p = 0.06), and 4) **mood state** (R^2 = .08*, F(4, 72) = .08, p = .158) were not significant.*

MANOVA was conducted to determine the effect of shift length (12 hr. vs 8 hr.) on Chronic and acute fatigue, inter-shift recovery and mood state. Wilks Lambda = .76, F(4, 74) = 5.68, p < .000. Scheffe's post hoc pairwise comparison showed a difference between OFER inter-shift recovery F(1,77) = 10.90, p < .000, with 8 hour shift recovery (M=35.3) compared to 12 hour shift (M=46.33). There was less inter-shift recovery for the 8 hr. shift RNs.

Conclusion: Findings were not expected. Nurses with longer shifts did not experience increased fatigue, and were better able to recover between shifts. These nurses were significantly younger than those working 8 hr. shifts and had higher sleep efficiency and lower work immersion scores..

Impact Statement: Older nurses are at a greater risk for fatigue. Mitigation strategies will focus on these nurses and toward work life balance.

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Investigation of the Efficacy of Recovery Activities in Firefighters

Michael T. Sliter (PI)

Department of Psychology, Indiana University-Purdue University Indianapolis

Purpose: The current study had three purposes: 1) Determine recovery activities that firefighters utilize to recover from stressors, 2) Investigate whether recovery activities ameliorate the negative relationship between chronic stressors and well-being in fire fighters, and 3) Investigate whether recovery activities ameliorate the negative relationship between traumatic stressors and well-being in firefighters.

Design: In the first phase, qualitative interviews were conducted on 20 firefighters. In the second phase, a two -time point survey methodology was used. Firefighters, as they have frequent exposure to stressful events, were used as the target sample for the current study.

Methods: A total of 20 firefighters were interviewed regarding recovery strategies. Interviews were transcribed, and the research team created items reflecting the most common recovery activities. Following, a total of 268 firefighters were recruited from a major Midwestern city for participation in two waves of surveys. Firefighters were sent hard copies of surveys, which contained validated measures of recovery activities, job stressors (chronic, traumatic), and employee outcomes (e.g., burnout, depression). A second set of surveys were sent 1 month following the first wave of data collection. Firefighters were incented to participate with gift cards.

Results: Recovery activities clustered into several categories: talking about work, asking about work stress, engaging in physical activities, engaging in recreational activities, engaging in relaxing/detachment activities, and working on job-related skills. Detachment-related activites tended to be most effective in reducing the effects of traumatic stressors. Relaxation activities tended to be the most effective in reducing the effects of physical stressors. Activation activities (recreation, physical activity) tended to be the most effective at reducing the effects of boredom-related stressors.

Conclusions: Both chronic and traumatic stressors do appear to have a negative impact on employee well-being outcomes. Effective recovery strategies depended on the experienced stressor, with certain types of stressors being more receptive to strategies that activate the correct psychological mechanisms. Future research could focus on developing training programs to train firefighters on how to recover, both in terms of coping and recovery.

Impact Statement: Ultimately, these results support the concept that there is not one 'best' recovery activity, but rather the activities should be tailored toward the stressors that one experiences most consistently. These results are unique to the field of Occupational Safety and Health, where recovery has largely been ignored, or has focused on experiences (as opposed to activities, which might relate to a variety of experiences). These results have the potential to inform important training programs, which would teach firefighters which strategies are most effective in combatting workplace stress.

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Enhanced Cooling of Firefighter Helmets using Phase Change Materials

Marwan Al-Rjoub (PI)[1], Pallavi Bulusu[1], Amit Bhattacharya[2], Rupak Banerjee[1]

[1]Department of Mechanical Engineering, University of Cincinnati
[2]Department of Environmental Health, University of Cincinnati

During firefighting activities, the increase in metabolic rate and high temperature surroundings lead to an increase in the head and core body temperatures. It is therefore essential to cool the body at such extreme conditions. Inability to cool the body leads to reduced work endurance, heat illness, and discomfort. Different cooling mechanisms have been developed to mitigate the heat stress. The use of phase change materials (PCM) is considered to be one of the most reliable methods for cooling the firefighter's body. This research is concerned with evaluating the influence of using PCM cooling techniques on the core body temperature (T_c) and head temperature (T_h) utilizing a 3D whole body computational model (using Pennes bioheat equation). Also, a bench-top experimental study is being conducted to evaluate the performance of PCM for the cooling of the firefighter's head. The results from the computational model showed a decrease of 0.27 ˚C in the head temperature when heat was extracted at a rate of 233 W/m^2 (within 2 min). Preliminary experimental results of PCM cooling showed that a 0.5 kg of the material can provide 2.5 hrs of heat removal from the firefighter's head at a rate of ~200 W/m^2. The results of this research showed the ability of PCM to store the generated heat during firefighting activities and hence, maintaining the temperature of the head within an acceptable range. This can help in limiting heat-induced stress, avoiding thermal shocks, and saving firefighters lives .

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Simulated Workplace Protection Factor (SWPF) of Filtering Facepiece Respirators and Surgical Masks against Surgical Smoke

Shuang Gao (PI) and Sergey A. Grinshpun

Department of Environmental Health, University of Cincinnati

Purpose: Determine the simulated workplace protection factor (SWPF) of two surgical masks and two NIOSH -certified N95 filtering facepiece respirators (FFRs) while being challenged with surgical smoke generated by an electrocautery unit applied to an animal tissue in a room-size chamber.

Design and Methods: Ten subjects were recruited for this study. Each subject wearing a surgical mask or an FFR applied an electrocautery unit to the animal tissue mimicking a conventional surgical procedure in an exposure chamber (24 m^3). The aerosol sampling probes were installed inside and outside the tested respiratory protection device to measure the aerosol concentrations C_{in} and C_{out}, respectively, using an optical particle counter (OPC) (Model 1.108, Grimm Technologies, Inc., Ainring, Germany) and an aerosol size spectrometer (Nanocheck, Model 1320, Grimm Technologies, Inc., Ainring, Germany). The SWPF were determined as C_{out}/C_{in}.

Results: For the two tested SMs, the geometric means of SWPF (based on the total aerosol concentration) were 1.49 and 1.76, indicating minimal protection. The SWPF values of the tested FFRs were 208 and 263, respectively. No significant difference was observed between either the two SMs or the two FFRs. However, the SWPFs of FFRs were significantly higher than those measured for SMs. No notable particle size dependency of the SWPF was observed, which was partially attributed to the faceseal leakage (the filter penetration depends on the particle size while the leakage does not size discriminate for the tested particle size range). The between-subject data variability was high for all the tested respiratory protection devices.

Conclusion: Wearing N95 FFRs significantly reduces the exposure to surgical smoke in an OR environment. The protection offered by the tested surgical masks was very low.

Impact Statement: This study will have a major impact on the evaluation of aerosol exposure of healthcare workers. Additionally, this investigation will provide preliminary data, which will help the respirator manufacturers to design devices offering a better protection against surgical smoke. The findings will also provide a scientific foundation for selecting respirators for healthcare workers exposed surgical smoke in operating rooms.

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Airborne Particle Release and Exposure from Paper Shredding and Biological Response Potentials

Candace Su-Jung Tsai[1], Sc. D (PI) and Jennifer Freeman, Ph.D[2]

Occupational Health and Industrial Hygiene School of Health Science, Purdue University[1]
Occupational Health and Toxicology School of Health Science, Purdue University[2]

Purpose: This project investigated airborne particle release and exposure to particles released from paper shredding. The focus of this project is the exposure characterization of particles in terms of the particle size distribution, particle number concentration, morphology and the associated biological response to the particles in different size ranges, particularly the nanometer-sized particles and fibers. The paper fiber dust released from paper material manufacturing or manipulating processes has been studied in the past using gravimetric methods, and some health effect symptoms were reported. However, there is lack of information that detailed particle exposure characteristics, and the potential biological responses associated with exposure to printer paper at the disposal stage using such methods as paper shredding.

Design: The exposure to dust particles was characterized and the associated biological response was analyzed. The biological response potential provided information needed to develop an exposure assessment protocol for nanoparticle exposure associated with paper dust and to hypothesize the associated lung tissue response, particle relocation and potential development alteration from inhalation exposure; information from this pilot project will form the basis for a future in vivo study.

Method: The exposure levels associated with two types of printer paper (regular and coated), two types of shredder use (straight cut and cross cut) and the shredding conditions were studied to analyze the released dust particles. The particle concentration during and post shredding process was monitored for particle size range of 10 nm to 10 μm. The released particles were collected for analysis on particle mass, size, morphology, elemental composition and distribution. The biological response potential was tested using human lung cell lines (in vitro) to predict cell uptake and toxicity and a zebrafish model to examine possible alteration of development later in life after exposure.

Results: Exposures to airborne and liquid suspension NPs were quantified from the instrument measurements. The corresponding biological responses were estimated and analyzed to interpret the likelihood of effects from such exposure. The dust released from paper shredding was found to contain particles in nanometer to micrometer size ranges. The paper dust released from shredding process contained metal elements including calcium, silica, aluminum and magnesium in the particles. A continuous shredding increased the magnitude of airborne particle exposure released from papers. The highest mass concentration was found during cross cut regular paper at a concentration of 3.54 mg/m3. The particle mass was dominated by large particles and this mass concentration result was consistent to the number concentrations measured at particles of 0.3-10 μm size range which cross cut regular paper had the highest average total particle number concentration of 1,492 particle/cm3. Comparing the mass of released paper dust, the cross cut shredder generated higher quantity of paper dust which was several times higher than the straight cut shredder for shredding both regular and coated papers. Also, the regular paper released more dust than coated paper for both shredding methods. Regarding the released paper dust in nanometer size range, the straight cut regular paper released the highest particle number concentration of particle size at 10-420 nm, which exceeded 105 particle/cm3 and other shredding results showed concentrations between 30,000-62,000 particles/cm3.

Regular paper suspension at lower concentration was found to be more toxic than coated paper suspension on both normal and cancer cells. Cell viability less than 75 % was observed for both normal and cancer cells following treatment with 25% (v/v) concentration of regular paper suspension whereas 25% (v/v) of coated paper suspension caused only 15% cell death in both normal and cancer cells. Regarding the exposure to zebrafish, for both regular and coated paper, no alterations were observed in mortality at 24, 48, 72, 96, or 120 hpf ($p>0.05$) and no significant alterations were observed in hatching success at 48, 72, 96, or 120 hpf ($p>0.05$). For exposure to regular paper dust, there was significant reduction on head length and eye diameter of zebrafish for higher concentrations of 50% and 75% respectively. Coated paper treatments resulted in a significant decrease in total larval length in the 75% and 100% treatment groups ($p=0.0434$) and no other decrease was observed.

Conclusion: A combination of particles consisting of various metals or carbon particle and/or fibers was released from the papers during shredding process. The exposure of such particles to human lung cells was found to cause cell death at high concentrations. Regular paper released more particles in nanometer size range than coated paper during shredding process, the released nanoparticles from regular paper caused higher toxicity response when human lung cells were exposed to such particles. The exposure to zebrafish didn't show observed mortality rate, but the exposure caused some development change including decreased head length and eye diameter.

Impact Statement: Results will provide scientific evidence for (1) identification and quantification of the mixture of airborne particles, in particular nanoparticles, released from paper shredding using a crosscut or straight cut shredder; (2) biological response, which will be used as a reference to further investigate interaction mechanisms of such particles through human inhalation exposure; (3) exposure scenarios to analyze exposure risk and produce guidance for consumer protection against exposure from shredding paper. The results have been partially presented at the NIOSH Pilot Project program symposium at the University of Cincinnati, and the American Industrial Hygiene Conference and Exhibition (AIHCE). The resulting manuscript will be submitted to peer-review journals

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Dendritic Cell Differential Gene Expression Associated With The Irritant Versus Allergenic Effect Of TMA Exposure

D. Ghosh (PI)[1] , I. Lewkowich[2] and J. A. Bernstein[1]

[1]Division of Internal Medicine (Allergy section), University of Cincinnati
[2]Division of Immunobiology, Cincinnati Children's Hospital and Medical Center

Purpose: Workplace exposure to Trimellitic Anhydride (TMA) can elicit either an irritant response caused by free TMA or an IgE-mediated immune response which can occur when TMA binds to endogenous proteins like human serum albumin (HSA). TMA, when bound to HSA, can result in Immunoglobulin E (IgE)-mediated sensitizations and potentially occupational asthma in susceptible individuals. Dendritic cells (DC) are critical for sensing environmental exposures, including irritants and allergens, and augmenting divergent down -steam molecular signals. The purpose of this study was to elucidate differential gene expression in DCs associated with the irritant *versus* allergenic effect of TMA Exposure.

Design: Plasmacytoid Dendritic Cells (pDCs), a DC sub-population which can express IgE receptor FcER1 were used to study irritant and allergenic responses. TMA-exposed factory workers sera, which contain TMA-specific IgE, were used to sensitize the DCs. Next, the sensitized DCs were exposed either to free TMA (for inducing irritant response) or to the TMA-HSA conjugate (for inducing allergenic response) and their gene expression patterns were compared.

Methods: Commercially obtained human FcER1+ pDCs were incubated with TMA-IgE sensitized worker sera (n=2) at a 1:20 dilution, washed and then exposed to either (a) HSA; (b) free TMA or; (c) a LPS-free TMA-HSA conjugate. Cells were harvested and analyzed by RNA sequencing. Unexposed DCs or DCs incubated with non-TMA exposed control sera served as additional controls. Differentially regulated genes (DEGs; adjusted p-values <0.05) were used for bioinformatic analyses.

Results: Free TMA exposure was associated with DEGs involved in innate immunity and cell migration including IL23A, IL15, epiregulin and endothelin. In contrast, TMA-HSA exposure was associated with DEGS involved in humoral immune responses including SORBS1, TNFSF13B, CD300LB and LYN tyrosine kinase. Pathway analyses revealed over-representation of Granzyme B pathway genes and inflammatory immune genes for the free TMA and TMA-HSA groups, respectively. Specific cytokines (IL1, IL6) and chemokines (CCL4, CCL20) were upregulated in both groups.

Conclusion: Gene expression of pDCs exposed to free TMA exposure is distinctly different from pDCs exposed to TMA-HSA. Real-time PCR studies are in progress to further understand these findings.

Impact Statement: TMA-exposed workers can develop a number of clinical symptoms some of which are related to its irritant effect, while others can be due to IgE-mediated immunologic effect. The present study provides the unique opportunity to better understand/identify molecular signatures associated with irritant *versus* allergenic effects. Therefore this would be helpful for better diagnosis and management of TMA-exposed factory workers.

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Aligned Carbon Nanotube (CNT) Sheets for Thermally Conductive Pathways in Cooling Vest for Firefighters

Rachit Malik (PI), Colin McConnell, Noe Alvarez, and Vesselin Shanov

Department of Materials Engineering, University of Cincinnati

Purpose: To explore the possibility of using CNT sheets to form conductive pathways so as to draw heat from the body and transfer it to a cold sink.

Design: CNT sheets integrated into conventional fabric and CNT-clad textile fibers to produce thermally conductive clothing/patches for transferring heat.

Methods: CNT sheets are manufactured from 'spinnable' arrays for CNTs produced by chemical vapor deposition. These sheets are then integrated onto clothing using simple, yet effective technique employing double sided scotch tape. 'Spinnable' arrays are also used to wrap textile fibers with CNTs thereby creating thermally conductive yarns which can be woven/knitted into fabric. Test methods were designed to qualitatively evaluate the thermal properties of CNT/fabric composite and compared to the performance of the fabric itself.

Results: CNT sheet performs better at dissipating heat than cooling fabric. However, the improvement is not as significant as expected. CNT-clad textile fiber knitted into a fabric demonstrates potential for future application.

Conclusion: Heat stress is a major health concern for firefighters. The turnout gear worn by all firefighters protects them from heat but also insulates their bodies thereby preventing evaporative cooling via body's natural cooling mechanism of sweating. This leads to build up of heat stress thereby affecting cognitive functioning which can result in slips, falls leading to injuries and even fatalities. Moreover, heat stress buildup in the body also affects functioning of vital organs and it has been linked with strokes among firefighters. Therefore, modified personal protective equipment (PPE) with active cooling technologies is needed to mitigate heat stress buildup. This report describes the application of CNT sheets as thermally conductive pathways to draw away heat from body to a cold sink. The manufacturing, processing and methods of integration of CNT sheets with conventional textile fabrics has been explored along with testing of thermal conductivity and moisture absorption of the same have been reported. The results obtained demonstrate that there is potential in development of a novel cooling vest that can be worn by firefighters which does not rely on heat removal through currently available liquid cooling and air cooling technologies.

Impact Statement: This research is aimed towards the development of a cooling vest which directly impacts the lives of firefighters and healthcare workers working in full body suits.

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2015-16 PRP Awardees
POSTER PRESENTATION ABSTRACTS

Antigen Profiling of Field Metalworking Fluids

Harish Chandra[1] (PI), Ying Wai Lam[2] and Jagjit S Yadav[1]

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Machine workers repeatedly exposed to the in-use contaminated metal working fluid (MWF) aerosols are at increased risk of developing occupational respiratory conditions including hypersensitivity pneumonitis (HP), asthma, or other respiratory symptoms over a period of time. Machinists' HP is a cell-mediated immune disease associated with repeated exposure to the mycobacterial species *Mycobacterium immunogenum* frequently isolated from these industrial fluids. However, the specific T-cell antigens/epitopes responsible for causing the MWF exposure-associated HP in the exposed machinists are not yet defined. In this study, we hypothesize that the prevailing field conditions in MWF can lead to induction and release of specific antigens from mycobacteria that are critical for HP etiology. Overall aim is to identify mycobacterium-specific critical HP-inciting antigens directly from the mycobacteria-contaminated in-use MWF samples from the automotive industries. We propose to accomplish this using cutting edge immuno-proteomics approach coupled with immunoinformatic tools. The in-silico identified candidate antigenic peptides will be validated for functional T-cell response in an in-vitro T cell assay. These identified antigens could provide a key to understanding the etiological aspects of the disease development and facilitate development of immunodiagnosis and intervention strategies for HP patients.

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Application of a Novel Sensor for Traffic-related Indoor Air Pollution

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Exposure to traffic-related air particulates (TRAP) is linked with reduced respiratory health in both public and worker populations. It has been determined that TRAP penetrates homes and occupational settings, affecting the indoor air quality. Better methods are needed for fast and accurate assessment of efficiency of control methods. A novel MicroPEM™ (Personal Exposure Monitor) device was recently developed at Research Triangle Institute (RTI) as a personal exposure monitoring device capable of direct reading measurement of PM2.5 with a simultaneous collection to a Teflon filter. No studies to date have determined if the MicroPEM, while being used for analysis of traffic-related airborne particles (TRAP) in the Cincinnati region, requires a correction factor. We hypothesize that the coefficient of variation for correction factor will be less than 20% for the Cincinnati region and that the correction factor for the PM2.5 real-time data is independent on the amount of different carbon species in the collected filter sample. One specific aim of this project is to determine a correction factor for the MicroPEM PM2.5 direct-reading data. Indoor filtered, indoor unfiltered, and outdoor air will be evaluated. The second specific aim is to evaluate the association between the correction factor and the ratio between different carbon species in Cincinnati for the assessment of traffic-related indoor pollution. A multiwavelength optical absorption technique has been developed for Teflon filters used for personal exposure sampling with sufficient sensitivity to allow apportionments of environmental tobacco smoke and soot (black) carbon to be made. The determination of tobacco smoke and carbon with reasonable accuracy is possible using an integrating sphere radiometer and multiple wavelengths to provide specificity. This work will be done in conjunction of an ongoing study funded by the U.S. Department of Housing and Urban Development Healthy Homes Technical Studies (HHTS). The MicroPEM, once an appropriate correction factor is determined, will be an easy, useful tool to determine occupational exposure to traffic-related indoor air pollution.

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Lightweight, Low Energy Consumption Heaters for Winter Gears

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With global warming, hotter summers and harsher winters are increasing yearly. There are some outdoor workers that are indispensable to their communities, however their safety and effectiveness has been compromised due to lack of proper technologies to protect them from the cold weather. Fortunately, the never ending search for new and more efficient materials has led to the discovery of carbon nanotubes (CNTs) as a heating material. They are excellent thermal and electrical conductors and these attributes make them useful as a good source of heating material. They also have high heating rates and have been shown to be more effective than some commercial heating materials such as nichrome. This project proposes the design and assembly of nanomaterials that are ideal for heating applications and their incorporation into fabrics. Due to the unique physical properties of CNTs, the heaters will have low power consumption, be light weight, have complete mechanical flexibility, and have fast heating rates Heating components manufactured from CNTs are extremely light weight, the density of these materials is close to 1 g/cc, almost 1/10 of Copper based heating components with density of ~8g/cc.

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Detecting, Localizing and Tracking Wildfires Using an UAS

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The goal of the proposal is to develop a unique human-robot system which would enable generation of comprehensive situational awareness during natural and man-made disasters. Every year, natural and man-made disasters cost approximately $52 billion in US in the form of lives lost, impact on economy, and public and private property damaged. During the period of 2001 - 2010, the US witnessed a total of 596 incidents where presidential disasters were declared. The focus area of this proposal, wildland fires, has caused huge devastations on a very regular basis. Apart from short term socio--economic impacts, large wildland fires have smoke-related health impacts and long-term environmental impacts. Generating situational awareness, which relates to developing current situational picture and future predictions based on information obtained from available sources, becomes an important aspect of disaster management and its mitigation Therefore, unmanned vehicles are prime candidates for tasks involving risk and repetition. The simplified goal of this task is to process images and locate the wild land fire for tracking, reconnaissance, and localization purposes. Therefore the ability to accurately determine the location of a ground-based fire using aerial images would contribute to the success of these tasks. Hence, to low-altitude and low-velocity Might capabilities, UAVs allow significant advantage in solving the problem. The objective of this proposal is to develop image processing algorithms that will allow an Unmanned Aerial Vehicle to generate situational awareness during large wildfires and provide advantages in safety, cost, and ability to gather real-time data. The system, consisting of ground station software and a quadrotor UAV platform with onboard sensing and communication facilities, would allow real-time UAV control, data processing, and visualization. Integrating real-time UAV sensory data into effective fire-predictor software will allow an incident commander to make timely and informed decisions which can optimize the resource allocation process and save fives.

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Chronic Exposure of Carbon Nano-materials Induces Malignant Transformation in Human Lung Cells

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Health effects associated with exposure to engineered nanomaterials (ENMs), an emerging technology product, have raised serious concerns because of the potential for high exposure combined with the risk of carcinogenicity. Carbon nanotubes (CNTs), one of the most popular ENMs, were found in animal studies to cause mesothelioma, a unique lung cancer previously only associated with asbestos exposure. Graphene and its derivatives are ideal candidates for biomedical, optical, renewable energy and chemical applications. Graphene nanoparticles have also been found to cause toxicity and oxidative stress in normal lung cells and low concentrations of graphene are shown to be more toxic as compared to CNTs. Investigating the relationship between ENM exposure and established carcinogenic mechanisms is critical to help scientists establish an understanding of medical causation from ENM exposure and furthermore to be able to protect humans and prevent associated cancer development. Manufacturing workers and users of these ENMs are at risk to inhale high numbers of ENMs; this inhalation exposure pathway allows nanometer-sized particles to easily reach the alveolar region of the lung, which has been identified as the highest risk factor leading to adverse respiratory system problems and other related health effects. Our research will use lung/bronchus epithelial cells to investigate how nanoparticle exposure leads to carcinogenesis in human lung cells exposed to multi-walled CNTs (MWCNTs) or graphene. Human normal lung cell line is proposed in this project to investigate the malignant transformation of cells.

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Get ACTive! A Pilot Acceptance and Commitment Therapy Workshop

Jessica Borushok (PI)[1], Robert Carels[2], & William O'Brien[1]

Bowling Green State University[1], East Carolina University[2]

Having a sedentary lifestyle and not engaging in regular physical activity are significant public health concerns in the US. Research indicates that physical inactivity and a sedentary lifestyle are independently associated with coronary heart disease, type II diabetes, colon cancer, and premature mortality. In addition to physical health consequences, physically inactive and sedentary workers face increased occupational stress, as well as lower and decreased overall wellbeing. Acceptance and Commitment Therapy (ACT) has shown promise in interventions designed to help individuals lose weight, engage in health behavior change, decrease anxiety and depression, and improve other physical and mental health issues. Using ACT to address these health concerns is a new and promising area of study.

This proposed project seeks to develop a brief ACT workshop to help increase physical activity and decrease sedentary behaviors for physically inactive, sedentary workers. The workshop is designed to create new ways to mindfully observe and interact with cognitive processes, and move towards values- based goals. It is hypothesized that an ACT-based approach to physical activity will be superior to a credible education only condition designed to teach the benefits of increasing physical activity and reducing sedentary lifestyle. Workers who are sedentary and not engaging in regular physical activity will be randomized into either an ACT or an educational one-day workshop. Participants will complete baseline questionnaires as well as collect pedometer (i.e., regular and aerobic steps, distance) and physical activity (i.e. minutes, intensity, type) data one week prior to the workshop. In addition, participants will collect pedometer and physical activity data for three months following the workshop and will complete three month follow-up questionnaires. It is hypothesized that the ACT workshop will significantly increase physical activity, decrease sedentary behaviors, increase overall wellbeing, and decrease occupational stress, relative to the education only workshop.

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A Test of the Work-Stressor – Vulnerability Model of Alcohol Consumption

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Purpose: To adapt the general Stressor-Vulnerability Model of Alcohol Consumption to the workplace. This model would emphasize the importance of measuring individual and organizational risk factors when predicting alcohol consumption in response to work stress.

Design: This study will utilize a daily diary method to assess between- and within-person effects in the relationship between work stress and alcohol consumption.

Methods: 70 participants in food service roles in the hospitality industry will participate in a daily diary study. An initial survey will measure trait alcohol outcome expectancies, work stressors, and perceived workplace drinking norms. A survey administered for 21 days will assess daily work stressors, desire to drink, and alcohol consumption. Data will be analyzed using hierarchical linear modeling.

Results: Both individual risk factors (tension reduction and careless unconcern alcohol outcome expectancies; tension reduction drinking motives) and organizational risk factors (perceived workplace drinking norms) are expected to moderate the positive relationship between work stressors and alcohol consumption.

Conclusion: If the expected results are found, the researchers would conclude that work stressors are related to desire to drink and alcohol consumption and that both individual and organizational risk factors moderate this relationship. The anticipated results would also suggest that interventions aimed at reduction of alcohol consumption among employees should address stress management, individual risk factors, and organizational risk factors.

Impact Statement: Employee alcohol consumption is of interest to researchers in occupational health psychology due to its deleterious effects on productivity, well-being, and safety. However, research on stress and alcohol consumption is complex and yields mixed results. The present study will test a model that would inform methodological considerations in alcohol research. The study would provide valuable insights into which types of work stressors, individual, and organizational risk factors are associated with employee alcohol consumption, in a sector that is associated with higher access to alcohol. This research could inform interventions aimed to reduce problematic alcohol consumption, which could ultimately increase employee productivity and decrease absenteeism and safety issues in the workplace.

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Oral Microbiome Perturbations and Associated Risks in Firefighters

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High risk occupational groups such as Firefighters have been identified to be at a higher risk for several health disorders such as different types of cancers Head and Neck squamous cell carcinoma (HNSCC), cardiovascular problems, respiratory disorders, diabetes etc. Firefighters are regularly subjected to smoke and heat exposures which involve inhalation of carcinogenic and proinflammatory chemicals such as PAHs and particulates as well as stressful work environment. All these factors have the potential to alter the consortium of oral microflora (microbiome) which in turn regulates many of these disorders. Normal Oral microflora is also perturbed by exposure to tobacco smoke, poor oral hygiene, alcohol as well as certain health conditions. In this investigation, we hypothesize that fire-associated smoke may cause oral microbiome perturbations in firefighters which may interact with other prevailing physiological stress factors thereby increasing the risk for occupational diseases. We propose to compare the oral microbiome of firefighters from their salivary samples using 16s rRNA gene sequencing and identify the microbiome constituents associated with occupational exposure. We will further correlate it with the exposure data and other metadata available. Completion of the study is expected to identify specific oral microbiome constituents and changes associated with the firefighters. Further analysis will provide insights into role of oral dysbiosis in predisposing firefighters to occupational health risks.

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Improvement of Machine Shop Safety for College Students

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Every year there are over 20,000 mechanical, aerospace and manufacturing engineering students in the USA required to use machine shops to make parts for their senior capstone projects. The machines normally used by these students include lathes, milling machines, saws, drill presses, grinders, sand blaster, shapers, broaching machines, and so on. The use of these machines and their associated tools exposes students to a very risk environment because these students are beginners to the machines and tools, not only they are lack of experience but also their knowledge on these machines and tools is inadequate. Injuries and even deaths in machine shops have been a serious concern to the schools and safety officials. In addition, as for direct working environment, there are some other issues as well, for example, bacterial growth in cutting fluids can lead to skin irritations and rashes, and the release of small fluid droplets (aerosols) into the atmosphere can cause illness due to toxicity.

The objective of the research is to develop a better safety procedure or policy for engineering students to use the machines and their associated tools in the machine shops and to investigate what types of safer devices should be installed to those considered unsafe or difficult-to-operate machines. In addition, a more rigorous training course will be developed and implemented such that engineering students may have more protective knowledge before they enter machine shops.

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INVITED STUDENT POSTER PRESENTATION ABSTRACTS

In Progress: Measuring the Impact of Integrating Safety and Ergonomics with Lean and Six Sigma Processes across Manufacturing Companies in Ohio

Nick Loree and Alyssa Boudinot

Industrial and Systems Engineering, Ohio University

Our poster presents the first several months of work on a research grant from the Ohio Bureau of Workers Compensation (BWC), focusing on the integration of safety into process improvement techniques such as Lean and Six Sigma. In the past these have been dealt with as separate issues and often overseen by different entities in a silo based management structure. There is limited research on the integration of safety and process improvement and the benefits of such a pairing, but the first step in our research was to conduct a systematic literature review on the current research in the field. This will be used to write a comprehensive review of the literature and guide our further research, which will include a survey of manufacturers in Ohio, fieldwork with several companies, and a final report of our findings.

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Use of Lean Methodology to Streamline the Procurement Process for Office Equipment

Marie Hayden

Industrial and Systems Engineering, Ohio University

Applications of lean methodology are expanding to different industries. The use of lean methodology can result in waste reduction, creating an efficient system. The system in this study focuses on the procurement of ergonomic office equipment at Ohio University. This study will focus on the time needed to procure the equipment, the cost of the equipment and whether the products were appropriate for the user's needs. The methods for this study that may be used include surveys, value stream mapping, and cost benefit analysis. Analysis of the data will help to identify total costs and areas for improvement in the system.

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Performance of N95 Filtering Facepiece Respirators (FFRs) Used by Home Attending Health-care Workers

(Pilot Study - Design and Methods)

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Background: Home-attending health-care workers are often exposed to various airborne hazards during care activities. This exposure can put them at a health risk. They often enter the homes environments unprotected or at best use surgical masks or NIOSH-certified N95 facepiece filtering respirators (FFRs). Using the personal respiratory protection equipment may mitigate the problem; however, there is no data that would allow assessing whether existing FFRs can provide an adequate protection to health-care workers during home visits. Generally, workplace protection factor (WPF) is used to determine the protection provided by an FFR to a worker. The WPF is determined as a ratio of the concentration outside of the respirator (C_{out}) to the concentration inside the respirator while worn at a workplace (C_{in}).

Purpose: This study is aimed at evaluating the protection offered by N95-certified FFRs to health-care workers exposed to aerosols while providing care in patients' homes. This study is expected to generate aerosol exposure and respiratory protection data that has not been collected before.

Methods: In this pilot study, we will determine the WPF for two types N95 FFRs that are used by health-care workers during home visits. Additionally, the aerosol particle concentration and size distribution in homes attended by health-care workers will be measured.
A total of 5 home-attending health-care workers serving in the Cincinnati area will be recruited to participate in approximately 20 home visits.

First, each subject who passed the OSHA respirator medical clearance questionnaire and OSHA fit test will be asked to wear the tested FFRs while providing health care to patients. Second, the C_{out} and the C_{in} of the tested N95 FFRs worn by the participants will be measured using a P-Trak condensation particle counter and Nano-Check Aerosol Spectrometer operating in parallel.
The data sets will be used to characterize the aerosols in the tested home environments and calculate the WPF.

The outcomes of this pilot study are expected to lead to establishing a full-scope research program and be the foundation for the development of new effective respiratory protection strategies for health-care workers attending patients in their homes.

Acknowledgement: This study was supported by the National Institute for Occupational Safety and Health Targeted Research Training Program of the University of Cincinnati Education and Research Center Grant #T42/OH008432.

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Selected PRP Awardee Publications, Conference Presentations, and New Grants Based on PRP Results for 2014- 2015

Peer-Reviewed Publications:

Kettleson EM, Adhikari A, Vesper S, Coombs K, Indugula R, Reponen T. Key determinants of the fungal and bacterial microbiomes in homes. Environmental Research. 2015; 138:130-5.

Matthews RA, **Ritter KJ**. A concise, content valid, gender invariant measure of workplace incivility. Journal of Occupational Health Psychology. (Accepted).

Park Y, Fritz C, Jex SM. Daily cyber incivility and distress: The moderating roles of resources at work and home. Journal of Management. 2015 Mar 24. (Epub ahead of print) doi:10.1177/0149206315576796

Peelukhana SV, Goenka S, Kim B, Kim J, Bhattacharya A, Stringer KF, Banerjee RK. Effect of higher frequency components and duration of vibration on bone tissue alterations in the rat-tail model. Industrial Health. 2015; 53:245–259.

Poole Wilson T, Davis KG, Kotowski SE, Daraiseh N. Quantification of patient and equipment handling for nurses through direct observation and subjective perceptions. Advances in Nursing. 2015; 2015. Article ID 928538, 7 pages, doi:10.1155/2015/928538.

Sergeev AV. Post-procedure mortality after cardiovascular treatment procedures in patients with pneumoconiosis. Occupational Diseases and Environmental Medicine. 2015; 3, 10-16. doi:10.4236/odem.2015.31002.

Stevenson M, **Alexander B**, Baxter SC, Leung YK. Evaluating endocrine disruption activity of deposits on firefighting gear using a sensitive and high throughput screening method. Journal of Occupational and Environmental Medicine. 2015 (In Press).

Zhao L, Dodge T, Nemani A, **Yokota H**. Resonance in the mouse tibia as a predictor of frequencies and locations of loading-induced bone formation. Biomechanics and modeling in mechanobiology. 2014;13(1):141-51.

Conference/Poster Presentations:

Acquavita SP, Zhang J, Boone X, Swoboda C, Yolton K. Exploring child welfare workers' receptiveness to addressing ETS and tobacco use in their clients. Paper presented at Society for Research on Nicotine and Tobacco, Philadelphia, PA, 2015.

Davis KG, **Poole Wilson, T**, He C. Patient handling: beyond using a lift assist device, Proceedings of the 2014 Safe Patient Handling East Conference, Orlando, FL, 2014

Frank E, Carreira V, Birch E, Yadav J. Exposures to carbon nanotubes and asbestos induced related but distinct profiles of toxicological lung pathology. Society of Toxicology 2015 Annual Meeting, San Diego, CA, March 22-26, 2015.

Kalathil RT, **Zachariah SA** (Co-I with PRP awardee Paul A), Bhattacharya A, Horn GP, Smith DL, Banerjee RK. Evaluating the influence of tissue properties on the core temperature using a 3D whole body model. Proceedings of Summer Biomechanics, Bioengineering and Biotransport Conference, SB3C2015-1037, Snowbird, Utah, June 17-20, 2015. (PRP awardee A. Paul)

Ritter KJ, Shapiro JC, Matthews RA. Running on empty? Daily-diary examinations of job demands and energy. Poster presentation at the 30th annual conference of the Society for Industrial and Organizational Psychology, Philadelphia, PA, April, 2015.

Ritter KJ, Matthews RA. Adaptation to role stressors over time. In Ford MT, Temporally Sensitive Perspectives on Control, Coping and Adjustment to Stress. Symposium presented at the 30th annual conference of the Society for Industrial and Organizational Psychology, Philadelphia, PA, April, 2015.

Sliter MT, Schultz N, Laughman C, Stafford J, Jones MD. Firefighter recovery from work-related stressors. In Jennings K and Britt T (Chairs). Paper presentation at Supporting Employees in High Stress Jobs: Benefits of Social Support for Physical and Psychological Health. Symposium presented at 11th Annual Work, Stress, and Health Conference, Atlanta GA, May 6-9, 2015.

New Grants Funded Based on PRP Results:

Davis KG (PI), **Poole WilsonT** (2011 PRP Awardee). Quantification of time to transfer patients utilizing manual and lift assist techniques. Hill-Rom, 9/1/13-5/31/15, $66,000.

Foster GC (PI), Horan K, Jex SM, **Ritter KJ** (Co-I) (2014 PRP Awardee). Health and satisfaction: A latent class cluster analysis approach. Bowling Green State University Internally Reviewed Grant, May 2015-May 2016, $825.

Papautsky I (PI) (2011 PRP Awardee), **Haynes E** (Co-PI) (2010 PRP Awardee) Validation and demonstration of point of care sensor for multi-metal exposure assessment. NIH/NIEHS R21/R33, 03/01/2015 - 02/28/2017, $275,000.

Yadav J (PI) (2000 PRP Awardee), **Frank E** (2013 PRP Awardee). Pulmonary toxicogenomic interactions during nanoparticle exposure using effector cell-specific approach. NIEHS, 02/2014-02/2015, $20,000.

Yuan Z (PI), **Park Y** (Co-PI) (2010, 2011 PRP Awardee), **Sliter, M** (2012, 2015 PRP Awardee), & Kraimer, M. Cyber incivility, employee well-being, and resource-based moderators: A daily investigation. National Institute for Occupational Safety and Health (NIOSH) Education Research Center Pilot Project Grant at the Heartland Center in the University of Iowa, 7/1/2015-6/30/2016, $9,750.

Yuan Z (PI), **Sliter M** (Co-I) (2012, 2015 PRP Awardee). Cyber incivility, employee well-being, and resource -based moderators: A daily investigation. Heartland Center for Occupational Health and Safety, 2015-2016, $14,750.

Inventions Disclosures:

Schulz M, Bhattacharya A, Jetter BJ, Song A, **Shanov V**, Schwartz A, Su R, Hou G, Wang A, Li W. Firefighter nanotechnology – Multifunctional cooled turnout gear with carbon nanotube layers, University of Cincinnati, 2015.

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We are especially grateful to the AIHA Ohio Valley Section for their generous support of the Annual PRP Symposium.

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