NIOSH-Supported
Education and Research Center

12th Annual

2011 Pilot Research Project (PRP) Symposium

October 13—14, 2011

Kehoe Auditorium, Kettering Laboratory

Department of Environmental Health
University of Cincinnati College of Medicine

Thursday, October 13th 1:00 pm—5:15 pm

Friday, October 14th 8:00 am—12:15 pm

Keynote Speakers

John R. Balmes, MD

University of California at San Francisco/Berkeley

and

Thomas R. Waters, PhD, CPE

National Institute for Occupational Safety and Health, Cincinnati, OH

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) **12th Annual Pilot Research Project (PRP) Symposium** on October 13-14, 2011**,** held in Kehoe Auditorium at the Kettering Laboratory. 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 – Medical 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 2010-11 awardees will be presenting the results of their research and the 2011-12 awardees will make poster presentations of their proposed work. The keynote speaker on **Thursday, October 13, 2011** is **Dr. John R. Balmes,** Professor of Medicine at the University of California, San Francisco, and Professor of Environmental Health Sciences at the University of California, Berkeley**,** who will deliver his keynote address on ***"Occupational Contribution to COPD."*** **Dr. Thomas R. Waters,** Senior Safety Engineer with the Human Factors and Ergonomics Research at the National Institute for Occupational Safety and Health (NIOSH), Cincinnati, OH, will deliver his keynote address on ***"Healthcare Ergonomics – Safe Patient Handling"*** on **Friday, October 14, 2011.** There will also be opportunities to speak with all of the presenters individually.

The University of Cincinnati's Education and Research Center is one of 17 such centers funded by the National Institute for Occupational Safety and Health (NIOSH) nationally. Dr. Carol Rice 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 approximately $925 thousand dollars to support pilot research projects. These projects have served as a catalyst in bringing over $26.2 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 also brought 25 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:

- ◊ **1.0 ABIH (IH) CM Point Approval #10-4045**
- ◊ **Meets BCSP criteria for continuation of certification credit**
- ◊ **Approved contact hours: 7.9 Continuing education contact hours for nurses are approved by the Ohio Board of Nursing through the OBN Approver Unit at the University of Cincinnati College of Nursing, Continuing Education Program, (OBN-011-93). Contact hours are valid in most states. Program #111013_14-1**

The 12th 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

Keynote Speaker, Thursday, October 13, 2011

John R. Balmes, MD

Professor of Medicine,
University of California at San Francisco,
Professor of Environmental Health Sciences,
University of California at Berkeley

Dr. Balmes is a Professor of Medicine at the University of California, San Francisco (UCSF) where he is the Chief of the Division of Occupational and Environmental Medicine at San Francisco General Hospital (SFGH), Director of the Human Exposure Laboratory of the Lung Biology Center, and Attending Physician in Pulmonary and Critical Care Medicine at SFGH. He is also Professor of Environmental Health Sciences in the School of Public Health at the University of California, Berkeley where he is the Director of the Northern California Center for Occupational and Environmental Health. In December 2007, he was appointed by Governor Schwarzenegger to be the physician member of the California Air Resources Board. Dr. Balmes has been conducting research on the respiratory and cardiovascular effects of occupational agents and air pollutants for over 25 years.

Dr. Balmes has been a recipient of a number of scientific awards. His most recent awards include the 2006 Robert A. Kehoe Award of Merit from the American College of Occupational and Environmental Medicine, the 2006 Carl Moyer Award for Scientific Leadership and Technical Excellence from the Coalition for Clean Air, and the 2010 Rutherford T. Johnstone Award for Significant Contributions to Furthering of Occupational and Environmental Medicine from the Western Occupational and Environmental Medical Association.

Keynote Speaker, Friday, October 14, 2011

Thomas R. Waters, PhD, CPE

Senior Safety Engineer,
Human Factors and Ergonomics
Research Team, Division of Applied Research and Technology
National Institute for Occupational Safety and Health,
Cincinnati, OH

Dr. Waters is a certified professional ergonomist and holds advanced degrees in Engineering Science and Biomechanics from the University of Cincinnati. As a researcher at the National Institute for Occupational Safety and Health (NIOSH) for the past 22 years, Dr. Waters has published more than 60 papers and chapters on manual material handling and prevention of work-related low back disorders. He is holds faculty positions as an Adjunct Professor in the Department of Environmental Health at the University of Cincinnati and in the Systems and Industrial Engineering Department at The Ohio State University. Dr. Waters is recognized internationally for his work on the revised NIOSH lifting equation. His primary research interests include occupational biomechanics, work physiology, low back injury prevention, safe patient handling and movement, and ergonomic risk assessment.

Dr. Waters has received numerous scientific awards, such as the prestigious 2003 Volvo award for the best paper in Spine, 2006 CDC Award of Excellence in Public Health Training Programs, NORA 2008 Partnering Award for Worker Safety and Health, 2009 Bernice Owens Award for Research in Safe Patient Handling and Movement, 2009 College Industry Council on Material Handling Education's (CICMHE), and the 2009 Outstanding Material Handling Logistics Content Award. He is a two-time winner of the Alice Hamilton Award for Excellence in Occupational Safety and Health Research and he received an honorable mention for the 2007 Bullard Sherwood Research to Practice Award. Dr. Waters is internationally recognized for his research work in safe manual materials handling, and has presented numerous invited lectures at major conferences and workshops.

PODIUM PRESENTATION SCHEDULE

	Thursday, October 13, 2011		
	Moderator: Farhang Akbar, MSPH, PhD, CIH, CSP		
Time	**Title**	**Speaker**	**Affiliation**
1—1:30 pm	Welcome and Opening Remarks	Carol Rice, PhD, CIH ERC Director Amit Bhattacharya, PhD, CPE, PRP Program Director	Environmental Health University of Cincinnati Environmental Health University of Cincinnati
1:30—1:35 pm	Introduction of Keynote Lecturer: John R. Balmes, MD, Professor of Medicine/Environmental Health Sciences, University of California – San Francisco/Berkeley	Carol Rice, PhD, CIH ERC Director	Environmental Health University of Cincinnati
1:35—2:20 pm	Keynote Address: "Occupational Contribution to COPD"	John R. Balmes, MD, Professor	University of California – San Francisco/Berkeley
2:20—2:30 pm	Keynote Q & A		
2:30—2:50 pm	Firefighter Garment Based Carbon Foam Fabric	Ahmed Elgafy, PhD	School of Dynamic Systems University of Cincinnati
2:50—3:10 pm	Using Evidence Based Practice: The Relationship between Work Environment, Nursing Leadership and Nurses at the Bedside	Yvette M. Pryse, MSN, RN	College of Nursing University of Cincinnati
3:10—3:30 pm	Effect of Aging on Human Postural Control: A Predictive Modeling Approach	Amit Shukla, PhD and Carson Willey for Renu Sah, PhD	Psychiatry University of Cincinnati
3:30—4:10 pm	Poster Session I and Break		
4:10—4:30 pm	Tai Chi: A Possible Way to Reduce Cardiovascular Risk Factors in Firefighters	Jane Christianson, MSN, RN	College of Nursing University of Cincinnati
4:30—4:50 pm	A Novel Low-cost Microsensor for Point-of-care Multi-gas Monitoring	Michael Ratterman for Ian Papautsky, PhD	School of Electronic and Computing Systems University of Cincinnati
4:50—5:10 pm	Workplace Culture: Psychometric Evaluation of the Nursing Culture Assessment Tool	Andrea Borchers, RN, MSN and Susan Kennerly, RN, PhD	College of Nursing University of Cincinnati
5:15—7:00 pm	PRP Networking Picnic		Kettering Laboratory Front Lawn & Atrium

PODIUM PRESENTATION SCHEDULE

	Friday, October 14, 2011		
	Moderator: Susan Kennerly, RN, 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—8:15 am	**Introduction of Keynote Lecturer: Thomas R. Waters, PhD, CPE, Senior Safety Engineer, Human Factors and Ergonomics Research Team, Division of Applied Research and Technology, National Institute for Occupational Safety and Health (NIOSH)**	**Amit Bhattacharya, PhD, CPE PRP Program Director**	**Environmental Health University of Cincinnati**
8:15—9:00 am	**Keynote Address: "Healthcare Ergonomics – Safe Patient Handling"**	**Thomas R. Waters, PhD, CPE, Senior Safety Engineer**	**National Institute for Occupational Safety and Health (NIOSH), Cincinnati, OH**
9:00—9:10 am	**Keynote Q & A**		
9:10—9:30 am	**Cardiac Contractility and Oxygen Consumption in Work-related Heat Syncope**	**Thad E. Wilson, PhD**	**Heritage College of Osteopathic Medicine Ohio University**
9:30—9:50 am	**Reduction of Health-Care Worker Exposure to Pandemic Flu Virus in Hospital Rooms**	**Aravind Kishore**	**School of Dynamic Systems University of Cincinnati**
9:50—10:10 am	**Exposure Assessment and Real-time Evaluation of Roadway Surface Cleaner Particulate Suppression during Highway Construction**	**Beauregard Middaugh**	**School of Health Sciences Purdue University**
10:10—11:00 am	**Poster Session II and Break**		
11:00—11:20 am	**A Pilot Study: Body Damping and Bone Fracture**	**Hiroki Yokota, PhD for Ozan Akkus, PhD**	**Biomedical Engineering Purdue University**
11:20—11:40 am	**The Effects of Bullying on the Productivity of the Novice Nurse**	**Peggy Ann Berry, MSN, COHN-S, SPHR**	**College of Nursing University of Cincinnati**
11:40—12:00 pm	**Cyber and Face-to-Face Incivility and Employee Well-being: A Daily Investigation**	**YoungAh Park**	**Psychology Bowling Green State University**
12:00—12:10 pm	**Closing Remarks and Program Evaluation**		

PRP POSTER PRESENTATION LIST

No.	Title	Author	University
1	Comparative Effectiveness of Cardiovascular Procedures in Pneumoconiosis Patients	Alexander Sergeev, MD, PhD, MPH	Social and Public Health Ohio University
2	Documenting Amount of Manual Lifting Performed by Nurses in a Hospital Setting	Tiffany Poole Wilson	Environmental Health University of Cincinnati
3	Coping Strategies of Novice Nurses After Bullying	Peggy Ann Berry, MSN, COHN-S, SPHR	College of Nursing University of Cincinnati
4	Developing a Method to Assess Organizational Climate for Healthy Weight	Katherine Sliter	Psychology Bowling Green State University
5	Endocrine Disruptor Exposure in Firefighters	Yuet-Kin Leung, PhD	Environmental Health University of Cincinnati
6	Merits of Employing Carbon Foam Fabrics in Firefighter's Helmet Shell	Ahmed Elgafy, PhD	School of Dynamic Systems University of Cincinnati
7	Vibration-Frequency Induced Changes in the Bone Tissue Morphology	Srikara Peelukhana	School of Dynamic Systems University of Cincinnati
8	Effects of Coping Strategies on Chronic and Traumatic Stress Experience at Work	Michael Sliter	Psychology Bowling Green State University
9	Development of a Practical Method to Identify Fall-prone Individuals among Parkinson's Disease Patients	Ashutosh Mani	Environmental Health University of Cincinnati
10	Design of Novel In Vivo Neutron Activation Analysis System for Noninvasive Quantification of Mn in Bone with Monte Carlo Simulations	Linda (Huiling) Nie, PhD	Health Sciences Purdue University

NON-PRP INVITED POSTERS

11	Carbon Nanotube Textiles to Provide Advanced Personal Protection for Firefighters and First Responders	James Sullivan	School of Dynamic Systems University of Cincinnati
12	Modeling of Noise Created by Road Construction and Maintenance Works on Interstate Route 75 in Dayton, Ohio	Tinina Hale	Environmental Engineering Central State University
13	Collection of Micron Particles in a Continuous Open Water Channel System	Michael Martin	School of Dynamic Systems University of Cincinnati

Poster Sessions are held in the Atrium in Kettering Laboratory

2010-11 PRP Awardees
PODIUM PRESENTATION ABSTRACTS

A Pilot Study: Body Damping and Bone Fracture

Ozan Akkus[1], Mina Wanis[2], Ramez Ayoub[1], Nelson Watts[3], Alexander Robling[2, 4], Hiroki Yokota[2, 4]
[1]Department of Biomedical Engineering, Purdue University,
[2]Department of Biomedical Engineering,
Indiana University/Purdue University at Indianapolis,
[3]Bone Health and Osteoporosis Center, University of Cincinnati
[4]Department of Anatomy and Cell Biology, Indiana University School of Medicine

Emerging results from clinical studies indicate a difference between the whole body vibrational damping of individuals with low bone mass and normal bone mass. Since whole body level damping is a function of multiple tissues including skin, muscles and joints, the contribution of bone to these observations is largely unknown. In this study we investigated the damping capacity of bone and surrounding tissues using an in vitro mouse hind-limb model of enhanced loading in conjunction with finite element modeling. A question addressed herein was: Do both hard (e.g., bone) and soft (surrounding musculature or skin) tissues contribute equally to the load damping phenomenon? Our hypothesis was that loads are primarily absorbed by surrounding tissues, but that bone also contributes to damping through its compression and natural bending. To test this hypothesis, fresh mouse distal lower limb segments were cyclically loaded in axial compression (5N peak force) at two different frequencies (0.5 and 2.0 Hz) in sequential bouts, with each subsequent bout having less surrounding tissue present to participate in the damping effect. Finite element models of the limb were generated to model the damping effects *in silico*. Two damping-related parameters (phase shift angle and energy loss) were determined from the output of the loading experiments. The experimental and computational results revealed that both surrounding tissues and bone contributed to mechanical damping. About 60-70% of the phase shift was induced by bone itself and this shift was increased with bone curvature. The result suggests that in addition to bone's compressive damping capacity, surrounding tissues as well as naturally occurring bone curvature are important contributors to mechanical damping, which ultimately affects the likelihood of bone fractures. Whole tissue damping capacity should be considered in assessing bone strength.

***Corresponding Author**: Hiroki Yokota, PhD at hyokota@iupui.edu*

Using Evidence Based Practice: The Relationship between Work Environment, Nursing Leadership and Nurses at the Bedside

Yvette M. Pryse[1], Anna McDaniel[2], John Schaffer[1]
[1]College of Nursing, University of Cincinnati,
[2]School of Nursing, Indiana University

The multiplicity of variables that effect the implementation of evidence based practice (EBP) by staff nurses is complex and comprises multiple forms and layers of influence. Two of

these influences are identified as work environment and nursing management/leadership. There is limited research that explores the levels of influence that the work environment exerts on the practitioner.

The purpose of this research is to further our understanding of the impact of the work environment and nursing management on the staff nurse's abilities to implement EBP.

A descriptive, quantitative design was used. The sample population was comprised of 422 Registered Nurses from two large inner city hospitals in the state of Ohio, working at least a. 5FTE on their respective units for greater than 6 months. Respondents were asked to complete an online survey that included questions related to EBP beliefs, the influence of work environment and nursing leadership on EBP implementation practices. Data analysis included descriptive statistics, Pearson's r, ANOVA and generalized linear Poisson regression to determine if EBP beliefs, work environment, or nursing leadership predicted EBP implementation activities.

Results indicated statistical significance of the overall model ($X^2 = 789.17$, $df = 3$ $p < .0001$). Multivariate Poisson regression analysis identified one predictor of implementation activities and found beliefs about EBP to impact EBP implementation ($\beta = .056$, $p = <.0001$). However, when the variables of work environment and nursing leadership were examined in a univariate Poisson regression, significance was found. Statistical significance was found for nursing leadership ($\beta = ..046$, $p = <.0001$) and work environment ($\beta = .075$, $p = <.0001$). These findings indicate a relationship does exist between nursing leadership and work environment on the ability of staff nurses to engage in evidence based practice activities.

The results of this study supports that a chasm lays between the nurse manager/work environment and the staff nurse and their responses to external pressures to engage in evidence based practice. Staff nurses are currently being asked to engage in evidence-based practice, which requires the location, analysis and implementation of new research into the practice environment. Mounting pressure exists for the individual nurse to make clinical decisions based on the latest evidence prevails due to external pressures such as the pursuit of Magnet status, demands of third party reimbursement providers, governmental/regulatory mandates and the consumers themselves. This study provides a basis for developing and initiating strategies to support the staff nurses ability to engage in EBP.

***Corresponding Author**: Ms. Yvette Pryse, MSN, RN at pryseye@ucmail.uc.edu*

Effect of Aging on Human Postural Control: A Predictive Modeling Approach

Renu Sah[1], Amit Shukla[2], Carson Willey[2], Zhuo Chen[2]
[1]Department of Psychiatry, University of Cincinnati
[2]Department of Mechanical and Manufacturing Engineering, Miami University

Falls are a serious medical and public health problem facing adults aged 65 and older. Falling to the side is has been identified as an important causal factor for hip fracture, which is associated with up to 20% chance of death. Aging appears to present particular problems for lateral balance related to falls. A better understanding of the mechanisms underlying falls would be significant in designing risk assessment or interventions towards fall prevention. Further, this could lead to a diagnostic and prognostic tool for trauma injury and balance disorders. In this research, the effect of aging on human postural control is studied via developed models and their parametric analysis. Both one degree of freedom and a two degree of freedom model are used. These models demonstrate the role of two strategies of balance (ankle and hip) and the influence of parameters on the stability of human postural control model. The loss of stability for variation in parameters is shown for both models, thus resulting in falls. A correlation of L_2 norm analysis with the existing analysis techniques is also presented to highlight the pros and cons as applied to human postural balance. This study will provide a

basis for future development of a diagnostic and prognostic tool for balance disorders triggered due to aging and trauma such as Parkinson's disease and traumatic brain injury.

***Corresponding Author**: Amit Shukla, PhD at shuklaa@muohio.edu*

Tai Chi: A Possible Way to Reduce Cardiovascular Risk Factors in Firefighters

Jane Christianson[1], L. Sue Davis[1], Tracey Yap[1], John C. Shafer[1], Kermit Davis[2],
[1]College of Nursing, [2]Department of Environmental Health,
University of Cincinnati

Background and Purpose: The worksite can place additional stress on workers' musculoskeletal and cardiovascular system and can cause them harm. Often workers begin their shift fatigued, stressed, and inflexible. In fact, beginning work under these conditions may increase the prevalence of injury or even death. The purpose of this study was to determine if a program of Tai Chi is beneficial to maintain an optimal level of cardiac health with improved balance and lower body strength.

Subjects and methods: A repeated measure, quasi-experimental study was conducted with 63 adult volunteer firefighters (51 male and 2 female) between the ages of 21 and 64. The attrition rate was 10%: 32 firefighters received Tai Chi instruction and 25 firefighters were unable to attend any Tai Chi sessions. The participants all worked at fire stations operated by the city of Cincinnati, Ohio. All subjects were given the opportunity to receive Tai Chi lessons by a Master Instructor, once a week over a 10 week period, at their worksite. Each of the participating fire stations received a DVD and an illustrated book of Tai Chi movements to be used as resource and facilitate group practice. Participants were given a booklet for practice away from work. Demographic information as well as the Occupational Fatigue Exhaustion Recovery (OFER) was compiled at the beginning of study. Measures of blood pressure, pulse, lower body strength, and percentage of body fat were collected at the beginning of the study, at midpoint, and at the completion of the study. The participants' balance, assessed by measuring postural sway with a portable force platform, was measured at the beginning and after completion of the study. The participants' were also given the Holmes-Rahe Life Stress Inventory with the collection of final measurements.

Results: Preliminary analysis found those who practiced Tai Chi had significant improvement in blood pressure readings. On average, the firefighters in the intervention group (n=32) had a 13 point decrease in systolic and 10 point decrease in diastolic blood pressure. On average, the firefighters in the control group (n=25) had a 4 point decrease in systolic and a 4 point decrease in diastolic blood pressure.

The study's data is currently being analyzed to test the study aims:

1. To determine if Tai Chi is beneficial in reducing cardiac risk factors within the firefighter's population of Cincinnati.
2. To determine if Tai Chi will be beneficial in improving physiological endurance in lower body strength and balance.

***Corresponding Author**: Ms. Jane Christianson, MSN, RN at Jane.christianson@uc.edu*

A Novel Low-cost Microsensor for Point-of-care Multi-gas Monitoring

Ian Papautsky[1], Michael Ratterman[1], David Klotzkin[2]
[1]Electrical and Computer Engineering, University of Cincinnati
[2]Electrical and Computer Engineering, University of Binghamton

The long-term goal of this project is to develop a miniature, portable, low-cost sensor for detection of multiple (toxic and nontoxic) gases specifically encountered by the firefighting, mining, and scuba diving industries. This proposal was our first step in achieving this long term goal and we thus began with detection of nontoxic, yet critically important *O_2 and CO_2 gases*. Absorption-based infrared CO_2 detectors and Clark-type O_2 electrochemical sensors are the common methods for determining concentration of these gases in breathable air. These conventional methods pose numerous challenges such as degradation over time and high cost. Furthermore, the commercial sensors are bulky, and thus are not widely used by firefighters and miners. In our proposal we set out to address the unmet need for better and lightweight sensors by pursuing the following three specific aims. 1) Demonstrate a portable O_2 sensor, 2) Demonstrate a portable, optical CO_2 sensor, and 3) Demonstrate simultaneous detection of CO_2 and O_2 gases. The outcome of this project is the first demonstration of a low-cost optical CMOS sensor capable of detecting both of these gases simultaneously. Having demonstrated the concept, the sensor can now be integrated with autonomous data acquisition and miniaturized into a wearable sensor for use in a wide range of occupational settings.

***Corresponding Author**: Ian Papautsky, PhD at ian.papautsky@uc.edu*

Workplace Culture: Psychometric Evaluation of the Nursing Culture Assessment Tool

Andrea Borchers[1], Susan Kennerly[1], Tracey Yap[1], Annette Hemmings[2], Gulbahar Beckett[2], John Schafer[1]
[1]College of Nursing, [2]College of Education
University of Cincinnati

The Healthcare and Social Assistance sector comprised an estimated 15 million paid workers in 2005. These workers face risks including overexertion, shift work, and psycho-social stressors. Prolific nurse and certified nursing assistant (CNA) turnover rates are a critical issue; this growing worker shortage seriously threatens the quality of care delivered and co-worker safety. The highest healthcare turnover rate occurs within the first 90 days of employment, making it difficult to provide a stable workplace culture and a consistent safety level. Organizational culture is believed to affect workplace safety, efficiency, and effectiveness, thus the need to promote retention of and successful performance of the nursing workforce. By better understanding the workplace culture and its effect on licensed nurses and CNAs, it will be possible to design intervention strategies to reduce psychosocial stressors, thus reducing turnover and its latent impact on workload and worker safety (illness and injury). An interdisciplinary team of expert researchers was assembled to pilot test and evaluate the psychometric properties of the Nursing Culture Assessment Tool (NCAT) in preparation for its use in assessing the work place culture of healthcare workers. This cross-sectional, exploratory investigation of the NCAT's psychometric properties builds on a prior study that established the NCAT's face and content validity. A randomly selected sample of licensed nurses and nursing assistants (n=340) was used to establish a sample to test empirical construct validity. Confirmatory factor analysis and logistical regression yielded a six factor, nineteen item solution with six subscale dimensions. Evidence supports the tool as valid for assessing health care workers' nursing culture and shap-

ing workplace culture in ways that have a positive impact on care outcomes, worker safety, and turnover rates.

***Corresponding Authors**: Andrea Borchers, RN, MSN at borcheaa@mail.uc.edu and Susan Kennerly, RN, PhD at susan.kennerly@uc.edu*

Cardiac Contractility and Oxygen Consumption in Work-related Heat Syncope

Thad E. Wilson, Richard Klabunde
Heritage College of Osteopathic Medicine
Ohio University

Workers through a combination of physical job tasks and environmental conditions can increase their internal temperature 1-3ºC. Heat stress decreases orthostatic tolerance and increases incidences of work-related heat syncope. Fainting at the workplace can lead to personal injuries due to falls as well as place other team-based workers in dangerous situations. The mechanisms of work-related heat syncope are unclear but could be related to the regulation of stroke volume during heat stress. To determine temperature effects on the regulation of stroke volume during work, simulated work conditions on an isolated heart animal model was selected. 40 male Sprague-Dawley rat (275–325g) hearts were excised by bilateral thoracotomy and mounted in a Langendorff preparation. Frank-Starling relations were determined at 37 and 40ºC, and left-ventricular developed pressures (LVDP) to steady-state isoproterenol infusions (10^{-8} M) were determined at 37, 38, 39, and 40ºC. Time control experiments were conducted at 37ºC. Baseline pressures decreased as temperature increased to a greater extent than time controls (from 37ºC = 66.2 mmHg to 40ºC = 51.2 mmHg; $p<0.05$). LVDP significantly decreased at 40ºC to 42.6 mmHg, compared to the other temperatures (54.7, 55.1, 53.0 mmHg for 37, 38, and 39ºC, respectively; $p<0.05$). No differences were observed in LVDP in control trials. Frank-Starling relations decreased over time but were not significantly different between heat stress and control trials. These data indicated that heart contractility is not compromised by temperature until internal temperature increases to 40ºC, and local temperature does not alter the inherent pressure-volume relations of the heart.

***Corresponding Author**: Thad E. Wilson, PhD at thad.wilson@oucom.ohiou.edu*

Reduction of Health-Care Worker Exposure to Pandemic Flu Virus in Hospital Rooms

Aravind Kishore, Urmila Ghia, Santosh Konangi, Naveen Goyal
Department of Mechanical Engineering, School of Dynamic Systems
University of Cincinnati

The aim of this research is to develop recommendations for alternate ventilation-system configurations in Hospital Rooms (both in regular patient rooms as well as Airborne Infection Isolation Rooms (AIIRs)) so as to reduce the risk of Health Care Workers (HCWs) from contracting air-borne diseases from patients.

Air-borne pathogens are transmitted long distances when a patient coughs or sneezes. HCWs are placed at a high risk, especially when the HCW is performing cough-generating procedures on the patient in the same room. Using Computational Fluid Dynamics, we aim to simulate the dispersal of air-borne pathogen from a patient who is within a hospital room, track the pathogen carrying droplets, and investigate the effects of the ventilation-system configurations that are in-place. For the present study, we consider two configurations, a

regular patient-room and an Airborne Infection Isolation Room (AIIR) at a local hospital. The air-flow patterns in the rooms are numerically simulated, using room geometries and layout (room dimensions, bathroom dimensions and details, placement of vents and furniture), and ventilation parameters, and pressurization (flow rates at the inlet and outlet vents, diffuser design, thermal sources, etc.) corresponding to those measured at a local hospital. A patient-cough was instantiated into each simulation, and the cough-droplet dispersal was tracked in time using a multi-phase flow simulation approach.

The measured data showed that ventilation rates for both rooms exceeded 12 air-changes per hour (ACH), and the AIIR was at almost 16 ACH. However, the computed results revealed incomplete air mixing, and that not all of the room air was changed 12 (or 16) times per hour. In fact, in some regions of the room, the air merely recirculated, not refreshed. With the main exhaust flow rate exceeding the main inlet flow rate, mass flow rate conservation required a part of the deficit to be accounted for by air entering the room from the corridor through the gaps around the main door of the room. Hence, the AIIR was effective in containing the "infectious aerosol" within the room. However, most importantly, it showed increased exposure of the HCW to the AI pathogens, as the flow from the ceiling-mounted supply louver first encountered the patient and then the HCW almost directly on its way to the main exhaust, also located on the ceiling. The regular patient room exhibited a similar flow path. In addition, for the regular patient room, some airborne cough droplets were observed very close to the gaps around the door to the corridor, indicating that the cough-droplets may escape to the corridor, and spread the infection beyond the room.

While the AIIR met the recommended design criteria for ventilation rate and pressurization, the computational results demonstrate that ventilation arrangement can play an important role in better protecting the HCW from exposure to airborne infectious pathogens.

***Corresponding Author**: Mr. Aravind Kishore at kishora@email.uc.edu*

Exposure Assessment and Real-time Evaluation of Surface Cleaner Dust Suppression Technology during Highway Construction

Beauregard Middaugh[1], Bryan Hubbard[2] Neil Zimmerman[1], James McGlothlin[1]
[1]School of Health Sciences, [2]Department of Building Construction and Management,
Purdue University

During asphalt repair, dust and dirt left on the milled surface can compromise the longevity of new pavement overlays. A powered rotary broom is the generally accepted method to clean the residual asphalt from the roadway Powered brooms are closed or open cab machines that physically windrow material into manageable piles for removal by a milling machine or other equipment. The purpose of the study was to establish previously undocumented baseline respirable dust and quartz exposure levels for rotary brooms in roadway construction, and to determine design improvements and control recommendations using qualitative and quantitative field assessments. The operation-specific study of the rotary brooms attempted to evaluate the effect of four factors during the assessment including 1) the use of wet suppression versus no wet suppression, 2) the location of the powered broom in relationship to the milling machine during primary cleanup versus secondary cleanup, 3) the location of the samples collected inside the closed cab versus outside the closed cab, and 4) the type of cyclone device used to collect the sample (high flow rate versus low flow rate).

The difference in the respirable dust concentrations measured for the low flow rate cyclone (model 225-01-02; SKC, Inc) and the high flow rate cyclone (model GK2.69; BGI, Inc) did not appear to agree during the study. A linear regression analysis did reveal that there was a strong correlation ($R2=0.97$) in respirable dust levels between the cyclones, and that the respirable dust concentration measured by each cyclone was a significant predictor of the respirable dust concentration for the other cyclone ($p<0.001$). This appears to confirm prior laboratory research that the model GK2.69; BGI, Inc may overestimate mass concentration at the flow rate suggested by the manufacturer. The data from this study also suggests that quartz exposure for the

operator can be controlled adequately below the 0.025 mg/m3 ACGIH TLV for respirable quartz with a closed cab, and high ambient levels of dust can be reduced appreciably outside the cab with the use of wet suppression. Because the milling machine uses water for lubrication and dust control, water is readily available onsite for this dust control option. In addition, the settled dust within the cab did appear to result in excess exposure to respirable quartz under some conditions, and the researchers suggest that the cab is cleaned regularly and is not operated with the windows or doors open under any circumstance.

***Corresponding Author**: Mr. Beauregard Middaugh at bmiddaug@purdue.edu*

Firefighter Garment Based Carbon Foam Fabric

Ahmed Elgafy, Sarthak Mishra

School of Dynamic Systems, College of Engineering and Applied Science
University of Cincinnati

In the present work, a numerical study is performed to predict and investigate the performance of a thermal protection system for firefighter's garment consisting of carbon foam fabrics in both the outer shell and thermal liner. Several types of carbon foam with different thermal conductivity, porosity, and density are introduced to conduct a parametric study. Additionally, the thickness of the introduced carbon foam fabrics is varied to acquire optimum design. The new anticipated thermal protection system is tested under the same environmental conditions that firefighters are exposed to. Simulation is conducted for a square planar 2D geometry of the clothing comprising of different fabric layers and a double precision pressure-based implicit solver, segregated solver, under transient state condition is used. The results show that using of carbon foam fabric has reduced the weight of the outer shell layer by 70%, and the weight of the thermal liner by 71%. On the other hand, the temperature at the end of the new fabric layers has been reduced by 8.6%. As a result, carbon foam fabrics make the firefighter's garment more protective, durable, and lighter weight.

***Corresponding Author**: Ahmed Elgafy, PhD at elgafya@ucmail.uc.edu*

The Effects of Bullying on the Productivity of the Novice Nurse

Peggy A. Berry, Gordon L. Gillespie, Donna M. Gates, John Schafer
College of Nursing
University of Cincinnati

Purpose: To determine the effects of workplace bullying (WBP) on the work productivity of novice nurses.
Design: Internet-based descriptive cross-sectional design with 3 components survey.
Methods: Novice nurses (N=197; 91.4% female, 8.6% male) in practice less than two years completed the Negative Acts Questionnaire, Healthcare Productivity Survey and a demographic survey to determine the prevalence of WPB and its effect on productivity.
Results: A stunning ¾ of novice nurses (72.6%; n=147) reported a WPB event with 57.9% (n=114) the direct targets and another 14.7% (n=29) witnessing the WPB behaviors. The negative acts of WPB were primarily perpetrated by their more experienced nursing colleagues (59.4%, n=117), a cohort of individuals expected to mentor and provide support to the novice nurses. Further, WPB led to decreased work productivity for the novice nurses.
Conclusions: Workplace bullying is an alarming problem for novice nurses which creates an adverse psychosocial work environment impacting the novice nurse's productivity.

***Corresponding Author**: Ms Peggy Berry, MSN, COHN-S, SPHR at berrypa@mail.uc.edu*

Cyber and Face-to-Face Incivility and Employee Well-being: A Daily Investigation

YoungAh Park[1], Shuang-Yueh Pui[2], Steve M. Jex[1]
[1] Department of Psychology, Bowling Green State University
[2] Department of Psychology, University of Illinois at Springfield

The primary aim of this study was to examine whether day-to-day workplace incivility negatively affects employee well-being at the end of the work day and test whether *cyber incivility via email* inflicts additional distress to employees beyond the adverse effects of face-to-face incivility and other typical work stressors (i.e., daily work demand, daily email load). A total of 125 employees answered our initial survey which measured demographics and a stable individual characteristic as a covariate (i.e., negative affectivity). Two weeks after the initial measurement, the participants also responded two daily online surveys for five work days: one in the morning upon arrival at work (assessment of morning baseline well-being) and another in the afternoon before leaving for home (assessment of day-specific incivility and well-being). This longitudinal within-subject design provided 561 matched daily observations for data analysis with a hierarchical linear modeling. The findings support the hypotheses that both types of day-specific incivility (face-to-face, cyber) were significantly related to day-specific well-being indicators (i.e., affective distress, physical symptoms). In particular, cyber incivility was found to have an incremental negative effect on both well-being indicators after controlling for face-to-face incivility and other covariates. Given the prevalence use of email for work in many occupations and organizations, the current findings suggest that researchers and organizations should pay more attention to possible organizational interventions to mitigate cyber incivility, such as a code of conduct policy or training program targeting interpersonal mistreatment via online.

***Corresponding Author**: Ms. YoungAh Park at ypark@bgsu.edu*

2011-12 PRP Awardees
POSTER PRESENTATION ABSTRACTS

Comparative Effectiveness of Cardiovascular Procedures in Pneumoconiosis Patients

Alexander Sergeev
Department of Social and Public Health,
Ohio University

Pneumoconiosis is a major occupational disease that develops as a result of occupational exposure to dust via inhalation. Most pneumoconioses share some common pathophysiological mechanisms that include excessive development of fibrous (i.e., scar) tissue in the lungs – pneumofibrosis – that restricts respiratory lung capacity. In addition to its harmful effect on respiratory system, pneumoconiosis can increase vulnerability to coronary heart disease (CHD) – the leading cause of death in the U.S. and in the world. The long-term goal of the proposed study is to improve cardiovascular healthcare needs of the pneumoconiosis population. Currently, two types of cardiovascular intervention procedures for CHD treatment are percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG). The Agency for Healthcare Research and Quality points out that comparative effectiveness of PCI and CABG in patients with coexisting (comorbid) conditions remains an open question and needs to be investigated. The objective of this application is to investigate comparative effectiveness of the two major cardiovascular intervention procedures– PCI and CABG–in pneumoconiosis patients with CHD. The central hypothesis of this application is that in pneumoconiosis patients with coronary heart disease, percutaneous coronary intervention is (a) at least as safe as coronary artery bypass grafting; and, (b) more resource-effective than coronary artery bypass grafting. The specific aims of the study are: (1) compare post-PCI vs. post-CABG in-hospital mortality in pneumoconiosis patients with CHD, after adjusting for patient-related and hospital-related covariates; (2) investigate length of stay difference between percutaneous coronary intervention and coronary artery bypass grafting in pneumoconiosis patients with coronary heart disease, after adjusting for patient-related and hospital-related covariates; and, (3) investigate PCI-CABG cost-of-hospitalization difference in pneumoconiosis patients with CHD, after adjusting for patient-related and hospital-related covariates. This will be the first comparative effectiveness study comparing percutaneous coronary intervention and coronary artery bypass graft in patients diagnosed with pneumoconiosis.

This study has the potential to impact evidence-based clinical interventions that will improve cardiovascular health care of the individuals suffering from the debilitating effects of pneumoconiosis. Based on the study results, the most effective intervention strategies for improving cardiovascular healthcare needs of the pneumoconiosis population will be established.

***Corresponding Author**: Alexander Sergeev, MD, PhD, MPH at sergeev@ohio.edu*

Documenting Amount of Manual Lifting Performed by Nurses in a Hospital Setting

Tiffany Poole Wilson[1], Kermit Davis[1], Nancy M. Daraiseh[2]
[1]Department of Environmental Health, University of Cincinnati
[2]Cincinnati Children's Hospital Medical Center

A better delineation of the amount and type of lifting performed by nurses will more accurately represent the exposure to heavy lifting for nurses, potentially leading to more targeted interventions and better utilization of bed design parameters and assist devices. The objective of this proposed pilot study is to determine

the prevalence and types of nurse performed manual repositioning and transferring actions of hospital patients and medical equipment. Manual repositioning and transferring includes moving patients on the bed (pulling up in bed, rotating side to side, increasing comfort and administering treatment), moving patients from the bed to other locations or devices (to commode, wheelchair, chairs and medical devices) and moving patients from other devices to the hospital bed. Any medical equipment manually handled by nurses during the shift will also be documented. Medical equipment would include transportable medical devices such as defibrillators, crash carts, and electronic medical record (EMR) devices. Secondary objectives will be to identify the prevalence of using lift assists or other transfer assist devices as well as compare the objectively measured lifting prevalence to subjective assessment from the nurses. Data on the frequency and types of repositioning actions will be collected by observation with the assistance of a checklist recorded on a PDA (personal digital assistant).

***Corresponding Author**: Ms. Tiffany Poole Wilson at pooletn@uc.edu*

Coping Strategies of Novice Nurses After Bullying

Peggy Berry[1], Gordon Gillespie[1], Donna M. Gates[1], Bonnie Fisher[2], John Schafer[1]
[1]College of Nursing, [2]College of Criminal Justice,
University of Cincinnati

Over 70% of novice nurses were exposed to workplace bullying (WPB) within the first 2 years of nursing according to our recent pilot study (Berry, Gillespie, Gates, & Schafer, 2011). Our preliminary findings also indicate that 57.9% (n=114) of novice nurses were the target of WPB and 14.7% (n=29) observed WPB behaviors. The WPB behaviors were primarily perpetrated by their nursing colleagues (59.4%, n=117), leading to decreased work productivity. Novice nurses may be at high risk for developing anxiety and traumatic stress due to WPB exposures at a time when they should be focused on acclimating to the acute care environment of hospitals and increasing their nursing competency.

The *purpose of this study* is to determine the post-traumatic stress symptoms and/or coping strategies associated with WPB in a cohort of novice nurses. The **specific aims** of this study are to:

1. ***Determine the relationship of nurse characteristics (e.g. post traumatic stress disorder [PTSD], anxiety, perceived stress, age, gender, educational attainment) to continued victimization of workplace bullying.***
2. ***Determine the strategies used to manage or stop workplace bullying by novice nurses who remain with their employer.***

A mixed-method design will be utilized using descriptive statistics and Poisson regression (1st phase, quantitative data) and constant comparative analysis (2nd phase, qualitative data). Participants will complete web-based versions of the PTSD civilian survey, Stress Scale, Trait Anxiety scale, and a demographic questionnaire, which will capture date of licensure exam, and other workplace characteristics. A semi-structured telephone interview will be done in the second phase.

The National Occupational Research Agenda (NORA; 2009) identified the need for research focused on psychosocial factors, interpersonal conflict, and work-related violence. Understanding the dynamics surrounding workplace bullying and what strategies the nurse uses to maintain employment will continue to build toward prevention of workplace bullying in the healthcare environment.

***Corresponding Author**: Ms Peggy Berry, MSN, COHN-S, SPHR at berrypa@mail.uc.edu*

Developing a Method to Assess Organizational Climate for Healthy Weight

Katherine A. Sliter, Steve M. Jex, Michael J. Zickar
Department of Psychology,
Bowling Green State University

The obesity epidemic within the United States has resulted in a large and increasing proportion of the American workforce being categorized as overweight. As a result of this, an increasing amount of research is being conducted to better understand the antecedents and consequences of excess employee weight. For instance, we now know that the obesity epidemic has significant financial consequences for organizations: between 1996 and 1998, 9.1% of American businesses' health care costs- about $52 billion- could be directly attributed to overweight/obesity among employees.

Although the financial effects of the obesity epidemic have been studied by many, the effects of obesity on workers' themselves have only recently begun to be examined. One construct often of interest to organizational researchers wishing to understand and influence employee health is organizational climate. Unfortunately, a viable measure of climate as related to employee weight does not currently exist. This is an unfortunate oversight in the literature as it is critical that researchers be able to understand the climate of an organization (the collective views and perceptions of employees) before they can truly understand the people within the organization and how they are affected.

The purpose of the proposed set of studies is to remedy this oversight by developing a concise and psychometrically sound measure of climate for healthy weight. The items will be developed and validated using a large number of full-time employees in various industries. Climate for healthy weight is the shared perceptions among employees within an organization regarding how their organizations support, or do not support, maintenance of healthy weight. Considering that individuals spend a large proportion of their waking lives at work, being able to reliably determine how organizations influence employees' health and weight will provide a very important tool for researchers, consultants, and managers.

***Corresponding Author**: Ms. Katherine A. Sliter at wolfoka@bgnet.bgsu.edu*

Endocrine Disruptor Exposure in Firefighters

Yuet-Kin Leung , Max Stevenson, Barbara Alexander, Stuart Baxter
Department of Environmental Health,
University of Cincinnati

Firefighting is among the most dangerous of occupations, and firefighters are frequently exposed to countless known or unknown chemicals at fire scenes. Epidemiological studies showed the prevalence of multiple myeloma, non-Hodgkin’s lymphoma, prostate and testicular cancers is elevated in firefighters. The underlying mechanism of these cancers in firefighters remains unclear. Since both prostate and testicular cancers are hormone-sensitive, we believe that volatile chemicals that the firefighters absorb transdermally or by inhalation may act as endocrine disruptors to perturb hormonal homeostasis. Amongst the most prevalent of those chemicals are phthalate esters and their derivatives. Similar to hormones, these agents are highly lipophilic and hence readily absorbed through skin. More importantly, the firefighters may have higher absorption rates for those lipophilic compounds when their blood circulation rate and skin temperature increase during fire suppression or when working close to the fire scene. In this pilot project we therefore hypothesize that firefighters are exposed to smoke-derived chemicals, which have endocrine disrupting effects, directly from deposits on their skin and indirectly from clothing. We will use protective firefighter gear (gloves and hoods) which have been exposed extensively to smoke and volatile chemicals derived from municipal fires. We will then extract

the volatile chemicals using an organic solvent, concentrate them and apply them to a high throughput assay, with the use of genetically engineered yeasts, to determine their endocrine disrupting (estrogenic/ antiestrogenic/androgenic/antiandrogenic) potentials. If this project is successfully executed, the results may increase understanding of the mechanisms of cancer induction in firefighters, provide new guidelines for firefighters to evaluate levels of biohazard, minimize exposure to endocrine disrupting compounds during service and thereby set standards for maximal annual exposure.

***Corresponding Author**: Yuet-Kin Leung, PhD at ricky.leung@uc.edu*

Merits of Employing Carbon Foam Fabrics in Firefighter's Helmet Shell

Ahmed Elgafy
School of Dynamic Systems, College of Engineering and Applied Science,
University of Cincinnati

Firefighter's helmet shell should possess thermal and impact resistance, lightweight, accommodation and durability. Many manufacturers, in general, are using leather and polycarbonate materials. Numerous research work is conducted to comprehend the appropriate materials/composites that would achieve some of these characteristics. Yet, to find a material/composite that attains all these characteristics is still a challenge. Conversely, carbon foam fabric has a very light weight and possesses most of these characteristics. Additionally, its cellular structure would reduce damage from impacts and would provide at the same time insulation properties. For all these exceptional properties, carbon foam fabric would be used efficiently in firefighter's helmet shell.

The present work is a numerical parametric study to investigate and predict the merits of using carbon foam fabric as an alternative material for firefighter's helmet shell. In this context both thermal and mechanical characteristics for different carbon foams will be examined numerically under alternate thermal and mechanical stresses.

***Corresponding Author**: Ahmed Elgafy, PhD at elgafya@ucmail.uc.edu*

Vibration-frequency Induced Changes in Bone Tissue Morphology

Srikara V. Peelukhana[1], Shilpi Goenka[2], Keith F. Stringer[3], Rupak K. Banerjee[1]
[1]Mechanical Engineering Program, [2]Materials Engineering Program, University of Cincinnati
[3]Department of Pathology, Cincinnati Children's Hospital Medical Center

HAVS (Hand Arm Vibration Syndrome) is a major musculoskeletal disorder (MSD) that affects almost 50% of the 1.2-1.5 million US workers using hand-held power tools in the industrial workplace such as construction , mining and factories, to name a few. Even though the vascular and sensorineural disorders of HAVS have been extensively investigated, there is a gap in the data on bone disorders induced by vibration frequencies >100 Hz. Past research has documented that hand transmitted vibration (HTV) can lead to osteonecrosis, Kienbock's disease and bone cysts formation in the bone in longer term. However, at present, there is no study which has documented changes in bone tissue under vibration frequency in resonance range of the finger tissue (150-300 Hz) or higher frequencies.

The rat-tail model is a well validated model which mimics the biodynamic response of human finger tissue, hence, in this study, our aim is to use this model to study the early cellular changes in bone tissue under the influence of vibration frequencies >100 Hz. It is our hypothesis that vibration frequencies at range near

resonance and greater will produce disruptive changes in bone cells and change the normal mineralization pattern in the bone tissue.

The frequencies investigated in this pilot study will be 100 Hz, 125 Hz, 250 Hz, 500 Hz and 1000 Hz. The vibration will be carried out for duration of 30 days at a constant instantaneous acceleration of $49 m/s^2$ (unweighted). Immunohistochemical methods will be used to characterize the response of osteoblasts (bone-forming cells) and osteoclasts (bone-resorbing cells) and their possible apoptosis (cell death). Von Kossa histological staining will be used to assess mineralization changes in the undecalcified bone tissue harvested from the rats.

This will be the first study to investigate the effect of vibration frequencies near resonance range on bone tissue morphology and the potential damage thereof. Results from this study will pave the way for future studies which are expected to contribute further and aid in development of more accurate ISO 5349 guidelines for possible bone disorders linked to HAVS.

***Corresponding Author**: Rupak K. Banerjee, PhD at banerjr@ucmail.uc.edu*

Effects of Coping Strategies on Chronic and Traumatic Stress Experience at Work

Michael Sliter, Steve M. Jex
Department of Psychology,
Bowling Green State University

In most occupations, workers are exposed to everyday stressors, such as working with uncivil people and lacking the proper equipment to do their jobs. In addition, many occupations expose workers to traumatic stressors, such as being in danger and dealing with injured or dying people. Both types of stressors have been shown to lead to negative physical and emotional health outcomes in workers. However, research has not examined the interaction of exposure to both types of stressors over time. As such, one goal of this project is to determine if individuals who are exposed to many chronic stressors are more vulnerable to the negative effects of traumatic stressors, represented by physical symptoms, burnout, and sick-time used.

Secondly, when people are exposed to stressors, they tend to use certain coping strategies to help protect themselves from stressors. Some of these strategies, such as seeking social support, positive reinterpretation and growth, and acceptance, have been shown to be effective in reducing stress. Other methods, such as venting emotions, denial, and mental disengagement, have been shown to be somewhat ineffective. However, little research has examined the relative efficacy of each strategy as a buffer between specific workplace stressors, including traumatic stressors, and negative outcomes. As such, a second goal of the current study is to determine which coping strategies might weaken the relationship between both every day and traumatic stressors and their negative outcomes.

In order to attain the goals of this study, a longitudinal study design will be used, examining firefighters from a major U.S. city (the study is sanctioned by the chief of the fire department). Validated measures, assessing stressors and employee outcomes, will be given out at two time points to all firefighters, and archival data on workload and sick time will be collected. The data will be examined to determine if the proposed relationships exist.

***Corresponding Author**: Mr. Michael Sliter at msliter@bgnet.bgsu.edu*

Development of a Practical Method to Identify Fall-prone Individuals among Parkinson's Disease Patients

Ashutosh Mani[1], Fredy J. Revilla[2]
[1]Department of Environmental Health, [2]Department of Neurology
University of Cincinnati

One in three adults of age greater than 65 falls each year. In 2008, emergency departments in the US treated 2.1 million fall injuries among older adults. Parkinson Disease (PD) impairs balance and has been shown to increase the risk of falls. Up to 68% of individuals with PD will fall in a 1-year period, which can lead to injuries and large personal and societal costs. Fall events have major financial implications. Ideally, individuals with PD who have impaired balance and increased risk for falls should be identified prior to a fall so that appropriate, proactive intervention can be carried out. However, the best predictor of falling, as of now, is a history of prior falls. We need methods, independent of prior history of falls, to identify fall-prone individuals. This can be achieved by using wearable sensors. Most of the algorithms used to differentiate "fallers" from "non-fallers" use multiple sensors and linear methods (threshold velocity or acceleration of different parts of the body). Wearing multiple sensors in daily life might be impractical and considered intrusive. Moreover, most daily life activities do not follow a linear pattern. There is a need for a method which is sensitive enough to identify "fallers" without having to use multiple sensors. In this study, we aim at developing an algorithm which uses a single sensor and a dynamic approach based on Maximum yapunov Exponent (MLE) and Floquet Multipliers (FM) to identify fall-prone PD patients. In this study we will use a single sensor (3-D accelerometer with 3-D gyroscope) to capture kinematics data of center of mass for Parkinson's patients. This kinematics data will be collected while subjects simulate Activities of Daily Life (ADLs). MLE and FM calculated from the kinematics data will used to categorize PD patients as fallers and non-fallers. Using our method, fall-prone individuals can be identified at an early stage. This will help us design appropriate interventions to reduce their risk of falls and improve their quality of life. Our method to identify fall-prone people can be used in other populations like workers with manganese-induced parkinsonism and older workers.

***Corresponding Author**: Mr. Ashutosh Mani at maniah@email.uc.edu*

Design of Novel In Vivo Neutron Activation Analysis System for Noninvasive Quantification of Mn in Bone with Monte Carlo Simulations

Linda Huiling Nie, Yingzi Liu
School of Health Sciences,
Purdue University

Manganese (Mn) is a well known neuro-toxicant. Millions of workers have been exposed to elevated levels of Mn. Ample evidence has demonstrated neurotoxicities induced by exposure to Mn among welders and other populations. One pending issue in assessment of Mn exposure and toxicity pertains to the selection of a proper biomarker. Over 40% of Mn in human body is stored in bone, which renders bone Mn to be the ideal biomarker to assess cumulative Mn in the body with long-term, low dose exposure, a pattern typically seen among people exposed to Mn. There is no practical way at present to assess Mn levels in bone. Our group plans to develop a novel neutron activation analysis technology for noninvasive, *in vivo*, quantification of Mn in bone. The first step to develop such a system is to design the system in the aid of Monte Carlo (MC) simulations. In this project, a novel neutron activation analysis technology to noninvasively quantify Mn in bone *in vivo* will be designed using MCNP5/MCNPX, a well known MC simulation program to simulate particle transportations

especially neutron transportations. We will establish and construct an in vivo neutron activation analysis (IVNAA) model, modify the moderator, the reflector, the filter, and the shielding assembly in the MC simulation input card to optimize the neutron distributions, and find a design to provide the best sensitivity for neutron activation analysis of Mn in bone. At the completion of this project, a novel system for cumulative Mn exposure assessment will be designed. We will use the preliminary data to apply for a larger grant to build and validate the system. The new technology and knowledge will help to fill the data gaps regarding appropriate individual exposure assessment of Mn and to provide valuable information on early diagnose of Mn exposure and toxicity. The use of new biomarker to understand the neurotoxic effects of exposure to Mn is critical to millions of workers who have been exposed to Mn for two main reasons. First, neurophysiological disorder is one of the main health issues for these workers; second, neurological impairment reduces the workers' productivity and is a major cause for work related injuries.

Corresponding Author**: Linda Nie, PhD at **hine@purdue.edu

INVITED NON-PRP POSTER PRESENTATION ABSTRACTS

Carbon Nanotube Textiles to Provide Advanced Personal Protection for Firefighters and First Responders

J. Sullivan[1], V. Shanov[1], C. Jayasinghe[1], J. Kim[2], B.J. Jetter[3], A. Schwartz[4], G. Conroy[5], K. Simmons[5], J.T. Jones[5], R. Koenig[5], L. Lee[6], M. Schulz[1]

[1]Nanoworld Lab, [2] Department of Mechanical Engineering, College of Engineering and Applied Science, University of Cincinnati
[3]MiFireE,CFO,OFE,CHSIII, Sycamore Township EMS & Fire Director/Fire Chief
[4]Secretary, Corporate Counsel & Chief Procurement Officer, LION, Dayton, OH
[5]Atkins & Pearce, Inc., One Braid Way, Covington, KY 41017
[6]General Nano, LLC, 1776 Mentor Ave, Ste. 170, Cincinnati, OH 45212

Heat stress and exhaustion lead to decreased performance and increased risk of injury for firefighters and first responders. This poster presents results of an initial evaluation of carbon nanotube textiles as advanced personal protection technology to reduce heat stress and fatigue in firefighters and first responders. The research method taken was to integrate carbon nanotube yarn into a cotton swatch from the inner layer of a firefighter garment and use the nanotube yarn to pipe heat away from the cotton fabric to a cold sink. Nanotubes have several advantages related to improving protective gear for workers. Carbon nanotubes are grown as a vertically aligned forest on a silicon substrate. Nanotube ribbon is made by drawing a line of nanotubes from the forest. Layering the ribbon can form a sheet. Twisting the ribbon would form a thread. Multiple threads can be plied together and twisted to form a yarn. Ribbon, thread, yarn, braid, and sheet forms of nanotube textile materials are being tested for possible use as personal protective garments for firefighters, first responders, and soldiers.

Experiments were performed to measure thermal conductivity of cotton fabric alone and then with carbon nanotube yarn sewn in. The yarn was run from the fabric to a cold sink. Initial results indicate the nanotube yarn conducts heat away from the fabric to the cold sink. Improvements in the design of the heat path could be made by integrating the nanotube yarn into the fabric without stitching to reduce transverse heat conduction from the outside of the swatch (representing the hot outside surface of the garment) to the cooler inside layer of the garment. The improved approach will integrate a layer of nanotube sheet in between layers of the firefighter garment to pipe heat along the axis of the nanotubes to a cold area. Then transverse heat conduction

from the outside of the garment to the inside would be reduced because the nanotube sheet does not easily conduct heat laterally. NFPA standards outline all the design and performance requirements and test methods for these garments and accessories. The standards will be used to guide the testing of nanomaterial fabric.

Conclusions from this study indicate nanotube textiles may provide cooling, lighter weight, and abrasion resistance when used as a layer in firefighter garments. Designing the interface between the nanotube material and adjacent layers of the garment is a key factor in the performance of the cooling layer. Nanotube textiles may also be useful in reinforcing firefighter gloves, helmets, and shoes.

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Corresponding Author: *Mr. James Sullivan at sullivj8@mail.uc.edu*

Modeling of Noise Created by Road Construction and Maintenance Works on Interstate Route 75 in Dayton, Ohio

Tinina Hale, Ramanitharan Kandiah
Environmental Engineering Program, International Center for Water Resources Management, Central State University

While enhancing the convenience for the people in travelling and transporting goods, the road construction and maintenance works – at least, for a short period - also increase the environmental pollution. Air pollution and noise pollution relevant to the road work can cause shorter as well as longer health effects in the humans, especially the road workers. Hearing loss, the most expensive occupational health problem for the road workers is 10 times higher than any other risk related to them. Studying the health effects require the information of various air pollutant concentrations and the noise level resulted from the road work. However the pollution primarily depends on the scale of the road development project, traffic related to the road, the project time length and the environmental factors such as temperature and wind speed. Hence, estimating the air pollutants and the noise levels for a hypothetical scenario become a challenging task.

The noise a road maintenance worker receives comes from two components; the already existing (baseline) noise component and the additional noise that comes from the construction activities. For an expansion project, the existing noise is a result from traffic that can be modeled with traffic noise models such as Federal Highway Administration's Traffic Noise Model (FHWA-TNM). The construction equipment related additional noise can be modeled with FHWA's Roadway Construction Noise Model (FHWA-RCNM).

This ongoing study aims to model into the noise created by the ongoing highway expansion project on the interstate route, I-75 in Dayton, Ohio. The study is expected to cover a two day period at the road expansion site. The types of construction vehicles, their numbers and the hours they are put into work will be added into the database. The traffic data by this site will be obtained from Ohio Department of Transportation (ODOT). It will be used in computing existing noise using FHWA-RCNM. These estimates together with the construction vehicle and task information will be used in FHWA-TNM to estimate the noise created. This noise will be correlated to the noise measured with the dosimeter to evaluate the model accuracy. Finally, the propagated noise will be compared with the human noise tolerance level.

In the future, air pollution estimate with MOVES and NONROAD models will also be included in the study to see the overall health effects.

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Corresponding Author: *Ramanitharan Kandiah, PhD. PE at rkandiah@centralstate.edu*

Collection of Micron Particles in a Continuous Open Water Channel System

Michael D. Martin, Sang Young Son, Jay Kim
Department of Mechanical Engineering,
University of Cincinnati

A continuous particle collection system was designed and optimized for the collection of PSL (polystyrene latex) particles (aerodynamic diameter = 2 μm) into a continuous water flow. The particle size of 2 μm was selected in order to design the system to collect fungal spores which have aerodynamic diameters in that range. The collection system was composed of an open channel collector and a transport channel transferring the collected particles to a measurement site. The water concentration was estimated by particle counting utilizing inverted fluorescent microscopy. The dynamic collection efficiency was measured at the measurement site with time data. The static collection efficiency was calculated by sampling the total collected liquid after the test was completed. The collector with a 45 degree angled nozzle produced a peak static collection efficiency of 89.5 $\pm$ 7.5 %, at a Stokes number of 0.62. The water flow rate was required to be above 0.3 ml/min, and the surfactant concentration above 0.1 %, in order to reduce particle losses. When the water flow rate was between 0.3 – 1.0 ml/min, the average static collection efficiency was 87.9 $\pm$ 7.9 %. When the surfactant concentration was between 0.1 - 0.4 %, the average static collection efficiency was 89.6 $\pm$ 7.0 %. A constant concentration of aerosol was collected and measured with time data at the measurement site. The dynamic measurement system was tested at two water flow rates of 1 ml/min and 2 ml/min, producing total dynamic collection efficiencies of 74.1 $\pm$ 5.7 % and 71.4 $\pm$ 6.5 %, respectively. The response time was found to be 1.15 minutes when the water flow rate was 2 ml/min, while it was 2.15 minutes when the water flow rate was 1 ml/min. With the transport length (distance between the collector and measurement point) reduced from 455 mm to 200 mm, the total dynamic collection efficiency was 75.5 $\pm$ 9.2 % and the response time decreased to 0.58 minutes. Also, the decay time was decreased from 3.49 minutes in the 1 ml/min case to 1.68 minutes. It was concluded that reducing the transport length and increasing the water flow rate will effectively decrease the response and decay times.

The new collection system can be integrated into a device which will measure workers exposures to particles within the size range of fungal spores. Some applications include assessing exposure levels within moldy buildings, agriculture, road construction and building construction.

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Corresponding Author*: Mr. Michael Martin at martim4@mail.uc.edu*

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Department of Environmental Health
Kettering Laboratory, Suite 133
3223 Eden Avenue, ML 0056
Cincinnati, Ohio 45267-0056
Phone: (513) 558-5710 ◇ Fax: (513) 558-2722
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