

#### UNIVERSITY OF CINCINNATI NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH (NIOSH)-SUPPORTED

EDUCATION AND RESEARCH CENTER (ERC)

# 2007 Pilot Research Project Symposium

October 11—12, 2007

Kresge Auditorium

Located in the College of Medicine's

Medical Science Building

University of Cincinnati

Thursday, October 11th 1 pm—5:30 pm

Friday, October 12th 8 am—12:30 pm

## **Keynote Speakers**

Adedeji Badiru, PhD, PE, Air Force Institute of Technology

And

Thomas Thundat, PhD, Oak Ridge National Laboratory

1.0 ABIH (IH) CM Points Available 8.6 CNE Hours Available

## Pilot Research Training Program & Symposium

October 11– 12, 2007 marks the University of Cincinnati Education and Research Center's (ERC) **8**<sup>th</sup> **Annual Pilot Research Project (PRP) Symposium** here at the University's Kresge Auditorium (located in the Medical Sciences Building). 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 2006-07 awardees will be presenting results of their research and the 2007-08 awardees will make poster presentations of their proposed work. This year's keynote speakers will be Dr. Adedeji Badiru, PE, Professor & Department Head, Systems & Engineering Management who will deliver his keynote address on, "Systems Engineering View of Global Health Delivery" on Thursday, October 10, 2007 at 1 pm. Dr. Thomas Thundat, Corporate Fellow and Leader of the Nanoscale Science and Devices Group, Oak Ridge National Laboratories, will deliver his keynote address on "Nanomechanics and Sensors", on Friday, October 12, 2007 at 8 am. Both presentations will be given in the University of Cincinnati's College of Medicine's Kresge Auditorium. There will also be opportunities to speaker with all of the presenters individually.

The University of Cincinnati's Education and Research Center is one of 16 such centers funded by the National Institute of Occupational Safety and Health (NIOSH) nationally. Dr. C. Scott Clark serves as the director of the ERC, which is based in the university's Department of Environmental Health within the College of Medicine. The ERC's purpose 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 \$600 thousand dollars to support pilot research projects. These projects have served as a catalyst in bringing over \$3.6 million in additional research support to the region from sources independent of the PRP program, such as, the National Institute of Occupational Safety and Health (NIOSH), United States Department of Agriculture (USDA) and the Centers for Disease Control and Prevention (CDC). Additionally, the PRP also brought 16 new investigators from other fields of expertise to the area of occupational safety and health research.

The 8th Annual PRP Symposium is free and open to the public. Symposium attendees are eligible for 1 ABIH CM points. For more information about the PRP program, please contact Dr. Amit Bhattacharya, PRP Program Director, at (513) 558-0503 or Amit.Bhattacharya@uc.edu

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We like to give a special thanks to the Academy of Kettering Fellows

for their continued support of the

Annual PRP Symposium And for Sponsoring

The Annual Networking Picnic!



# Adedeji Badiru, PhD, PE Head of Systems & Engineering Management Air Force Institute of Technology (AFIT)

**Dr.** Adedeji Badiru is the head of Systems & Engineering Management at the Air Force Institute of Technology (AFIT). He was previously the department head of Industrial & Information Engineering at the University of Tennessee in Knoxville; and formerly professor of industrial engineering and Dean of University College at the University of Oklahoma. He is a registered professional engineer, a fellow of the Institute of Industrial Engineers, and a Fellow of the Nigerian Academy of Engineering. He holds BS in Industrial Engineering, MS in Mathematics, and MS in Industrial Engineering from Tennessee Technological University, and Ph.D. in Industrial Engineering from the University of Central Florida. His areas of expertise cover mathematical modeling, project management, simulation, economic analysis, and productivity improvement. He is the author of several technical papers and books. He is the editor of the Handbook of Industrial & Systems Engineering and series editor for CRC Press Series on Industrial Innovation. He is a member of several professional associations including Institute of Industrial Engineers (IIE), Society of Manufacturing Engineers (SME), Institute for Operations Research and Management Science (INFORMS), American Society for Engineering Education (ASEE), American Society for Engineering Management (ASEM), Project Management Institute (PMI), and New York Academy of Science.

Professor Badiru has served as a consultant to several organizations around the world including Russia, Mexico, Taiwan, Nigeria, Ghana, and South Korea. He has conducted customized training workshops for numerous organizations including Sony, AT&T, Seagate Technology, U.S. Air Force, Oklahoma Gas & Electric, Oklahoma Asphalt Pavement Association, Hitachi, Nigeria National Petroleum Corporation, and ExxonMobil. He has won several awards including IIE Outstanding publication Award, University of Oklahoma Regents' Award for Superior Teaching, School of Industrial Engineering Outstanding Professor of the Year, Eugene L. Grant Award for Best Paper in Volume 38 of The Engineering Economist Journal, University of Oklahoma College of Engineering Outstanding Professor of the Year, Ralph R. Teetor Educational Award from the Society of Automotive Engineers, Award of Excellence as Chapter President from the Institute of Industrial Engineers, UPS Professional Excellence Award, Distinguished Alumni Award from Saint Finbarr's College, Lagos, Nigeria, and Distinguished Alumni Award from Department of Industrial and Systems Engineering, Tennessee Tech University. He holds a leadership certificate from the University Tennessee Leadership Institute. He has also served as a Technical Project Reviewer for The Third-World Network of Scientific Organizations, Italy and has served as an Industrial Development Consultant to the United Nations Development Program.

# Thomas Thundat, PhD Corporate Fellow and Leader Nanoscale Science and Devices Group Oak Ridge National Laboratory



Dr. Thomas George Thundat is a Corporate Fellow and the leader of the Nanoscale Science and Devices Group at the Oak Ridge National Laboratory. He is also a research professor at the University of Tennessee, Knoxville, and a visiting professor at the University of Burgundy, France. He received his PhD in physics from State University of New York at Albany in 1987. He is the author of over 220 publications in refereed journals, 45 book chapters, 24 patents and 7 pending patents. Dr. Thundat is the recipient of many awards that include the U.S. Department of Energy's Young Scientist Award, R&D 100 Awards (1996 &2004), Discover Magazine Award, FLC Awards (2000, 2003, and 2005), ASME Pioneer Award, Scientific American 50 Award, Jesse Beams Award, Nano 50 Award, and many UT-Battelle Awards for invention, publication, and Research and Development. Dr. Thundat was named ORNL Inventor of the Year in 2000 and in 2003. Dr. Thundat is a Battele Distinguished Inventor. Dr. Thundat is an elected Fellow of both APS and AAAS. Dr. Thundat's research is currently focused on novel physical, chemical, and biological detection using micro and nano mechanical sensors, and implanted sensors. His expertise includes physics and chemistry of interfaces, solidliquid interface, biophysics, scanning probes, nanoscale phenomena, and quantum confined atoms.

## 8th Annual PRP Symposium

	Title	Speaker	Affiliation
	Thursday, October 11, 200	7	
	Moderator: Gary Weckman, PhD		Ohio University
1—1:10 pm	Welcome and Opening Remarks	Carol Rice, Ph.D., CIH Director of Indus- trial Hygiene Pro- gram	Environmental Health University of Cincinnati
		Shuk-Mei Ho, Ph.D. Department Chair	Environmental Health University of Cincinnati
		The Honorable Mayor Mark Mallory	City of Cincinnati
		Amit Bhattacharya, Ph.D., CPE, PRP Program Director	Environmental Health University of Cincinnati
1:10-1:15 pm	Introduction of Keynote Lecturer: Dr. Adedeji Badiru, Ph.D., PE	Amit Bhattacharya, Ph.D., CPE, PRP Program Director	Environmental Health University of Cincinnati
1:15—2:00 pm	Keynote Address: "Systems Engineering View of Global Health Delivery"	Adedeji Badiru, Ph.D., PE; Profes- sor & Department Head, Systems & Engineering Management	Air Force Institute of Technology (AFIT) Wright-Patterson Air Force Base
2:00-2:10 pm	Keynote Q & A		
2:10-2:30 pm	Tailored Messages and Their Effect on Intentional Physical Activity	Tracey Yap	College of Nursing University of Cincinnati
2:30– 2:50 pm	Filtration Performance of N99 & N100 Facepiece	Robert Eninger	Environmental Health University of Cincinnati
2:50—3:10 pm	A Nanotube Immonosensor for Rapid Screening of Bone Health in Occupational Safety	Mark Schulz, Ph.D.	College of Engineering University of Cincinnati
3:10-3:30 pm	Genetic Susceptibility of Organophosphate- Induced Toxicity	Rickey Yuet-Kin Leung, Ph.D.	Environmental Health University of Cincinnati
3:30-4:15 pm	Poster Session I and Brea	k	
4:15-4:35 pm	Understanding Strain in Teaching: Determining Age Related Differences	Jennifer Yugo	Psychology Department Bowling Green State Univer- sity
4:35-4:55 pm	A Novel Approach to Understanding the Link Between Low Back Pain and Brain Response	Lisa Lemen, Ph.D.	Radiology University of Cincinnati
4:55—5:15 pm	Violence Against ED Workers in a Pediatric Hospital	Gordon Gillespie	College of Nursing University of Cincinnati
5:30—7:00 pm	PRP Networking Picnic Sponsored by the Academy of Ketter MSB Lawn (on Albert Sabin V		

	Friday, October 12, 2007		
	Moderator: D. Gary Brown, Ph.D. PH, CIH		Eastern Kentucky Univer- sity
8:00-8:10 am	Opening Remarks	Amit Bhattacharya, Ph.D., CPE PRP Program Direc- tor	Environmental Health University of Cincinnati
8:10-8:15	Introduction of Keynote Lecturer: Dr. Thomas Thundat, Corporate Fellow	Amit Bhattacharya, Ph.D., CPE PRP Program Direc- tor	Environmental Health University of Cincinnati
8:15– 9:00 am	Keynote Address: "Nanomechanics and Sensors"	Thomas Thundat, Ph.D. Corporate Fellow Nanoscale Sci- ence and Devices Group	Oak Ridge National Laboratory (ORNL)
9:00—9:10 am	Keynote Q & A		
9:10-9:30 am	Reducing Job Stress: A Comparison of CBT and ACT Based Work Stress Interventions	Heather Schwetchenau	Psychology Department Bowling Green State University
9:30—9:50 am	β-Glucan Level in Sub-Micrometer Particles Released from Different Moldy Buildings	Sung-Chul Seo	Environmental Health University of Cincinnati
9:50—10:10 am	Manganese and Hearing Loss	Scott Schneider	Environmental Health University of Cincinnati
10:10-10:30 am	Energy Expenditure, Heart Rate and Perceived Physical Exertion in ER Nurses	Jie Chen	College of Nursing University of Cincinnati
10:30—11:00 am	Poster Session II and Brea	ık	
11:00- 11:20 am	Postural Strain in Obese During Standardized Holding Task	Devender Singh	College of Engineering University of Cincinnati
11:20—11:50 am	A Longitudinal Study of Workplace Incivility in Hospitals	Scott Hutton	College of Nursing University of Cincinnati
11:50 – 12:10	"The Effects of Jet Fuel (JP-8) on Dermal Absorption of Used Engine Oil"	Gerald Kasting, Ph.D.	College of Pharmacy University of Cincinnati
12:10 – 12:30	Closing Remarks and Program Evaluation		

## 8th Annual PRP Symposium

No.	Title	Author	University
1	Occupational Noise Exposure Assessment of South-Central Kentucky Farms	Emmanuel Iyiegbuniwe, Ph.D.	Department of Public Health Western Kentucky University
2	Urinary 1-Hydroxypyrene in Tank Workers Exposed to Crude Oil During Tank Cleaning	Nancy Hopf	Environmental Health University of Cincinnati
3	Evaluation of Adults' Perception of Slipperiness After Training Intervention	Thomas Hermann, Ed.D.	College of Allied Health Sciences University of Cincinnati
4	Numerical Modeling of Pollutant Dispersal From Exhaust Systems	Urmila Ghia, PhD	College of Engineering University of Cincinnati
5	Understanding the Relationship Between Intrusion and Health	Jason Kain	Psychology Department Bowling Green State University
6	Examining the Effect That Tailored Messages Have on Intentional Physical Activity	Tracey Yap	College of Nursing University of Cincinnati
7	The Role of Human Factors and Ergonomics in Retirement Decision-Making Behavior	Diana Schwerha, Ph.D.	Industrial and Systems Engineering Ohio University
8	New Lab-On-A-Chip Sensor for Worksite Assessment of Individual Manganese Exposure	Jin-Hwan Lee	College of Engineering University of Cincinnati
9	The Impact of Coping and Gender Role Identification on the Work-Family Interface	Erin Smith	Psychology Department Bowling Green State University
10	Genetic Differences in Response to Mn	Eric Kendig	Environmental Health University of Cincinnati
11	A Biomechanics Sensor for Measure Friction Properties in Walking	Mark Schulz, Ph.D.	College of Engineering University of Cincinnati
12	Partial Enclosures for Noise and Dust Control in Underground Longwall Coal Mining	Jeremy Slagley, Ph.D.	Department of Systems and Engineering Mgmt. Air Force Institute of Technology
13	Development of a Receptance Based Modeling Technique for Hand-Arm Vibration	Jay Kim, Ph.D.	College of Engineering University of Cincinnati
14	Chemical Analysis of Firefighter's Garment Fabric	Vesselin Shanov, Ph.D.	College of Engineering University of Cincinnati

Poster Sessions are held in the Medical Sciences Building (MSB), E Level- outside of Kresge Auditorium.

## 2006-07 AWARDEE PODIUM PRESENTATION ABSTRACTS

## Tailored Messages and Their Effect on Intentional Physical Activity

Tracey Yap and L. Sue Davis, PhD,; College of Nursing, University of Cincinnati

With more than 60 percent of US adults not engaging in the recommended amount of physical activity and 25% of adults not being active at all (Centers for Disease Control and Prevention [CDC], 1999), the sedentary lifestyle is an epidemic in the USA and is responsible for a large portion of health care costs. Engaging in regular intentional physical activity can decrease health care costs by reducing the risks of obesity, premature death, myocardial infarctions, diabetes, hypertension, colon cancer, depression, and anxiety (CDC, 1999). It has been established that if individuals are not physically fit, they are more prone to injury and illness; therefore, the purpose of this study was to design a series of theory-based tailored e-mail messages geared to increase intentional physical activity of blue collar employees in a manufacturing distribution plant. This study was undertaken because researchers often times do not make readers aware of the choices made concerning content and design of the health promotion materials. The messages were designed based on a synthesized theory using concepts from the Transtheoretical Model stages of behavior change and Maslow's Hierarchy of Needs (Yap & Davis, 2007). Using semantic differential scales, occupational health experts who work with the selected population evaluated the messages for acceptability, readability, need-level language being used, and content that matched the stage of change. Content validity index was computed, and messages were modified using feedback. Next, a series of focus groups, consisting of workers who were classified into the particular stages of change, were held to validate the messages for effectiveness in moving the worker toward the next stage of change. The focus groups were taped and transcribed verbatim and used to identify the motivational themes. Based on the findings, messages were revised to use in a larger study that will test the effectiveness and efficacy of the message as a strategy to increase intentional physical activity in employees of a manufacturing plant.

# Filtration Performance of N99 & N100 Face piece Robert Eninger and Sergey Grinshpun, PhD; Environmental Health, University of Cincinnati

NIOSH estimates that over 281,000 workplaces utilize filtering-facepiece respirators to limit occupational exposures to particulate matter. Filtering-facepiece respirators are certified by the National Institute for Occupational Safety and Health against a 300 nanometer (nm) aerosol for filtration efficiencies of 95, 99, and 99.97%. Despite their common use, only the N95 type respirators have been evaluated extensively against very small particles (ultra fine and nanoparticles, < 100 nm). We evaluated the NIOSH particulate respirator certification protocol to evaluate its effectiveness in assessing particles in the ultra fine size range. We performed a theoretical study to determine the lower boundary of particle size detected by the NIOSH certification protocol. This protocol determines filtration efficiency using two aerosol photometers to measure particle concentration before and after the respirator filter. We observed that the effective lower limit of

detection of the certification protocol is approximately 100 nm. We also evaluated the size-fractioned filtration performance of N95, N99, and P100 respirators when challenged with both inert particles (NaCl) and bioaerosols (three virions) with a significant ultrafine fraction. We observed that N-type filters--because of their elecret properties--possess a most-penetrating particle size that is less than 100 nm in diameter when tested under NIOSH protocol conditions. The results of these experiments showed that the NIOSH certification protocol as it is currently administered has limited ability to provide respirator users information about filtration efficiency of particles < 100 nm.

## A Nanotube Immunosensor for Rapid Screening of Bone Health in Occupational Safety

Mark Schulz, PhD, YeoHeung Yun; Engineering, University of Cincinnati

This study was to: (a) to test an electrochemical immunosensor with standard IgG with anti-IgG conjugation, and (b) evaluate the electrochemical immunosensor to detect bone turnover makers that indicate bone health. Preliminary work was done to develop a nanotechnology based sensor that can measure bone turnover outcomes such as N-terminal teleopeptide (N-Tx) and C-Terminal teleopeptide in test solutions. Experimentation showed that the biosensor could detect IgG and one bone marker tested, but the limit of the detection (LOD) of the sensor must be reduced to reach the sensitivity levels needed for clinical use of the sensor. Reducing the (LOD) is the subject of continuing work.

Genetic Susceptibility of Organophosphate-Induced Toxicity
Rickey Yuet-Kin Leung, PhD and Glenn Talaska, PhD, CIH; Dept of Environmental
Health, University of Cincinnati; Linda McCauley, PhD, University of Pennsylvania
Organophosphates (OPs) are organic esters of phosphorous-based acid derivatives that have
been used extensively as pesticides. Chronic Low level exposures of organophosphates (OPs) can
deteriorate our nervous system via inhibition of a signal transduction enzyme, called acetyl
cholinesterase (AChE) located between gap-junctions

of neurons, without any detectable signs of symptoms. Adverse effects on the nervous system are only expressed when OPs are accumulated to a level that exceeds certain threshold limit. Also, such threshold limits could be different from one individual to another individual. This suggests that occurrence of neurological disorders in farmers may be the result of interactions between exposure to pesticides and increased susceptibility due to functional genetic polymorphisms (affecting enzyme activity/quantity) in the pesticide metabolizing enzymes which detoxify them.

Until now, there has been no efficient and accurate way to identify pesticide related illnesses because of lack of clinical symptoms during early stage of pesticide exposure. We propose to identify functional genetic polymorphisms of crucial pesticide metabolizing enzymes (paraoxonase 1 As a result, a farmer population which is sensitive to pesticide toxicity can be identified in advance through genetic analysis and can be alerted to have more frequent health checkups and to wear more appropriate personal protective equipment. and glutathione S-transferase isoforms) that could contribute to high bioaccumulation of organophosphates and thus increase susceptibility to organophosphate induced toxicity. The following are the research aims of this study

Recruit farmers applying pesticides and control population Identify genetic polymorphisms of possible OP metabolizing enzymes (blood samples) Measure the OP metabolite levels (Dialkylphosphate levels) in urine Perform data analysis to study the effect of polymorphisms on urine metabolites In this study the influence of functional genetic polymorphisms in paraoxonase 1 (PON1) and glutathione S-transferase (GST) enzymes on the metabolism of OPs were examined. Results from this study indicates the presence of GSTO1 D140A polymorphism in the farmer group and PON1 Q192R polymorphism in the applicant group, as functional polymorphisms related to OP metabolism. From the results of this study, one can conclude that PON1 Q192R and GSTO1 D140A polymorphisms are possible target biomarkers that could be used to determine an individual's susceptibility to organophosphate toxicity.

## Understanding Strain in Teaching: Determining Age Related Differences

#### Jennifer Ellen Yugo, MA, Jennifer McInroe, Sylvia Lindinger-Stern and Charlotte Fritz, PhD; Psychology, Bowling Green State University

The responsibilities and work tasks of secondary education teachers are challenging and diverse ranging from classroom instruction to consulting with parents. Teachers must interact with a variety of different groups including students, administrators, other teachers and parents; with each which presenting a unique set of cognitive and emotional demands (Troffman & Woods, 2000). Staffing statistics reveal that more than ten percent of teachers leave the profession each year citing work stress as their reason for leaving the profession (Ingersoll, 2003). Further, research has shown that work related stress may increase with age. As growing numbers of teachers retire in the coming decade, understanding the stressor-strain relationship and what variables alleviate strain in teaching may help education policy-makers and administrators may help education policy-makers and administrators improve the work environment of teachers. The present research, a longitudinal study of stressors and strain in secondary educators, takes a first step in assessing these relationships. An additional goal is to determine what variables moderate the stressor-strain relationship, serving as buffers or exacerbating factors. Specifically, work meaning, coping and emotion regulation strategies are hypothesized moderators. These variables vary with age, permitting the present research to investigate the role of age in the stressorstrain relationship (Carver, et. al, 1989; Grandey, et. al, 2000; Wrzesniewski, et. al, 1997). Implications for future research and interventions are discussed.

## A Novel Approval to Understanding the Link between Low Back Pain and Brain Response

Lisa Lemen, PhD; Radiology, Kermit Davis, PhD and Susan Kotowski; Department of Environmental Health, University of Cincinnati; Kim Cecil, CCHMC, Cinti. Ohio Eighty percent of the working population will experience low back pain (LBP) at some point during their lifetime. Of these individuals, a staggering 85% will not receive a specific diagnosis as to the cause of their LBP. Although previous research has identified several sources of LBP - disc herniation, endplate fractures, and nerve damage, few other potential sources have been identified which may explain the underlying causes of the pain for such a large portion of the population. Although LBP is very prevalent, the pain process is not very well understood. There is no explanation as to why some individuals who are positive for clinical indicators of LBP do not show symptoms, while others who are negative for indicators have chronic, and oftentimes debilitating symptoms. Therefore, it was hypothesized that muscle inflammation, a source not typically investigated, and one not usually tested for in common clinical tests, may potentially be a source of unexplained low back pain. So, the objective of the proposed study was to delineate the role of inflammation in the muscle in the development of pain and determine whether this inflammation could be directly linked to a functional response within the brain. The study was

designed to test two hypotheses: 1) The development of pain in the lumbar musculature during a static exertion (a Biering-Sorensen test) would induce significant levels of inflammation within the muscles, changes in metabolite levels in the brain, and significant levels of perceived pain, and 2) Levels of muscular inflammation, brain metabolites, and perceived pain would be significantly different between subjects with non-specific LBP and healthy individuals. To test the above hypotheses, the following specific aims were accomplished: 1) Quantify the muscle inflammation in individuals with low back pain and individuals without low back pain using magnetic resonance imaging (MRI) at baseline (resting) and after a physically demanding task, 2) Acquire a magnetic resonance (MR) spectra scan of the anterior cortex and thalamus to determine metabolite changes between subjects with and without low back pain at baseline (resting) and after a physically demanding task, and 3) Quantify subjective pain levels of individuals with and without low back pain at baseline (resting) and after a physically demanding task. Subjects are 10 individuals, 5 males and 5 females, clinically diagnosed with chronic non-specific LBP, and ten matched healthy controls. Muscle inflammation quantification consisted of comparing calculated T2 values collected at baseline and post-exercise using MRI of the lumbar region. The response in the brain was quantified by comparing baseline and post-exercise levels of several brain metabolites. In addition, subjective pain responses were measured using a visual analog scale. Statistical analyses included repeated measures ANOVA to determine significant differences in levels of muscular inflammation, brain metabolites, and subjective pain ratings. A significant amount of pilot testing, which focused on solidifying the methodology and determining the best follow-up time point, is nearing conclusion. Preliminary pilot data based on a healthy individual scanned immediately after the exertion shows a trend of increased inflammation levels post-exertion, a positive finding since healthy individuals are expected to have smaller changes than individuals with LBP. Individuals with LBP are currently being recruited and will then be matched with a healthy control. This study is unique in that it is the first to attempt to understand the linkage between the muscles and the brain concurrently. Understanding this linkage could provide researchers with a better understanding of what causes low back pain, why some individuals recover and others do not, and better methods for treatment.

# Violence Against ED Workers in a Pediatric Hospital Gordon L. Gillespie, Donna M. Gates, RN, EdD, FAAN; Margaret Miller, RN, EdD, CNS; College of Nursing, University of Cincinnati

Violence in the healthcare setting occurs four times more often than violence in all private-sector industries. Specific violent acts against emergency department (ED) workers in a pediatric setting include punches, slaps, kicks, back injuries, and fractures. Violence can result in several negative consequences including adverse psychosocial effects, direct physical pain and injury, decreased productivity, absenteeism, and medication errors that may result in a patient death. It is important to know how experiencing or witnessing a violent act in the ED affects ED workers so that interventions can be developed to reduce the negative consequences. The multiple-case study design was used with an ecological framework with the aims of determining factors that contribute to or prevent a violent act and determining the effects of workplace violence. Sources of data included interviews with 31 ED workers; a review of institutional policies and continuing education offerings; direct observations of the ED environment; and digital pictures of physical items related to workplace violence. Interviews were audio-taped and transcribed verbatim. Field notes were generated throughout the study to record factors that aggravate and prevent occurrences of workplace violence. Data was analyzed to identify patterns that emerged from the data.

Data were organized based on an ecological framework into person factors (perpetrator and worker), workplace factors, environmental/situational factors, the negative effects of workplace violence, and potential solutions for workplace violence.

## Reducing Job Stress: A Comparison of CBT and ACT Based Work Stress Interventions

Heather Schwetschenau, MA, William H. O'Brien, Ph.D., Eileen M. Delaney, Paul W. Goetz, Jebediah J. Northern, Carmen K. Oemig; Psychology, Bowling Green State University

Work stress is a large-scale problem that is associated with many negative physical health, psychological health, and work-related outcomes. Cognitive behavioral stress management interventions have received the most empirical support for reduction in psychological symptoms associated with work stress, but there has been less support for reduction in physical symptoms or work-related outcomes. Additionally, oftentimes benefits gained from these interventions dissipate over time. A new approach to work stress, Acceptance and Commitment Therapy (ACT), has been used to treat work stress in the United Kingdom and has shown promising results. To date, there have been no published studies using ACT specifically for work stress in the United States. Therefore, the purpose of the present study is to examine the effectiveness of an acceptance and commitment approach to work stress in an occupation with documented high levels of work stress: mental health care workers who serve individuals with intellectual and developmental disabilities.

## B-Glucan Level in Sub-Micrometer Particles Released form Different Moldy Buildings

## Sung-Chul Seo and Tiina Reponen, PhD; Department of Environmental Health, University of Cincinnati

Many epidemiological studies have shown that people living or working in mold problem buildings have more respiratory symptoms and diseases than people in non-problem buildings. However, traditional assessments based on spore concentrations in mold problem buildings have not shown strong associations with health outcomes. Simultaneous release of submicrometer-sized fungal fragments (< 1.0  $\mu$ m) was discovered in earlier studies, which investigated the aero-solization of spores from moldy surfaces. Fungal fragments contain biologically active agents such as fungal antigens, mycrotoxins, and (1 $\rightarrow$ 3)-b-*D*-glucan. Thus, exposures to submicrometer-sized fungal fragments potentially contribute to adverse health effects. However, the contribution of fungal fragments to exposure and adverse health outcomes associated with these particles are poorly characterized.

The purpose of this study was to investigate the size-fractionated concentrations of particulate  $(1\rightarrow3)$ -b-D-glucan and numbers of particles aerosolized from the surface of artificially mold-contaminated materials. *Aspergillus versicolor* and *Stachybotrys chartarum* were grown on malt extract agar, ceiling tiles, and gypsum board for one to six months. Fungal particles released from these materials were collected size-selectively by a newly developed Fragment Sampling System which consists of two Sharp-Cut cyclone samplers (the 50% cut-off sizes are 2.5  $\mu$ m and 1.0  $\mu$ m, respectively) and an after filter (0.4  $\mu$ m of pore size).  $(1\rightarrow3)$ -b-D-glucan in air samples was analyzed by *Limulus* Amebocyte lysate (LAL) assay. The concentrations of  $(1\rightarrow3)$ -b-D-glucan in air

samples was analyzed by *Limulus* Amebocyte lysate (LAL) assay. The concentrations of  $(1\rightarrow 3)$ -b-D-glucan varied from 0.4 ′ 10° to 9.8 ′ 10² ng/m³ in the fragment size and from 1.0 ′ 10¹ to 4.7 ′ 10⁴ ng/m³ in the spore size range. Numbers of submicrometer-sized particles released from 6-month old cultures were always statistically significantly higher that those from 1-month old (P<0.001). This can be attributed to increased dryness on the surface of material samples and an increase in fungal biomass over time. The average fragment to spore ratios both in particle numbers (numbers of fragments divided by those of spores) and ( $1\rightarrow 3$ )-b-D-glucan mass (the amount of ( $1\rightarrow 3$ )-b-D-glucan in the fragment size range divided by that in the spore size range) were higher for S. chartarum than for A. versicolor. The results indicate that long-term mold damage in buildings may lead to increased contribution of fragments to the total mold exposure. Furthermore, the contribution of fragments may vary between species and appears to be higher for S. chartarum than for A. versicolor.

## Manganese and Hearing Loss Scott Schneider and Mary Beth Genter, PhD; Department of Environmental Health, University of Cincinnati

Based on reports of hearing loss in humans exposed to manganese (Mn), we hypothesize that Mn accumulates in the ear and is associated with hearing deficits. To test this hypothesis, we administered Mn to mice using a dosing regimen that had previously been shown to cause a 6.5-fold increase in Mn in other brain regions. Using atomic absorption spectrometry, detected an increase in Mn in the ear of both mouse strains used in the present study. Further, use of the acoustic startle response to detect hearing loss did not find hearing impairment in Mn-treated mice. Interestingly, mRNA for two metal transporters, ZIP8 and divalent metal transporter 1 (DMT1) were detected in ear tissue, and ZIP8 protein was localized to the blood vessels of the inner ear. Thus, our study shows that although metal transporters are detectable in the inner ear, Mn does not accumulate in the ear and hearing loss does not result from the Mn-treatment used in the present study.

## Energy Expenditure, Heart Rate and Perceived Physical Exertion in ER Nurses Jie Chen and L. Sue Davis, PhD; College of Nursing, University of Cincinnati

As an extended work shift, twelve or more working hours has become a concern regarding its potential harmfulness to nurses' health and patient safety. While most studies focused on the effects of extended work shifts to nurses' health and safety and quality of patient care, there are few studies comparing the differences of nurses' body response to different time lengths of the shift. The purpose of this study was to 1) compare energy expenditure (EE), heart rate (HR), and work pace (WP) between first 8 hours and rest of 4 hours during a 12-hour day shift, and 2) examine how EE, HR and WP correlate with nurses' fatigue with consideration of individual factors such as age, years of experience, percentage of body fat, sleep hours before the work and exercise.

One hundred and fifty nurses among three hospitals completed questionnaires, short diary sheet and wore a physical activity monitor for one 12-hour day shift to continuously record their heart rate and work pace, which then were translated to the value of energy expenditure. Data analysis is in process. Repeated measures analysis MANCOVA and structural equation modeling techniques are used to meet the above goals of the study. The findings will be beneficial to the opti-

## Postural Strain in Obese During Standardized Holding Task Devender Singh and Woojin Park, PhD; College of Engineering, University of Cincinnati

The rated perceived exertion (RPE) and body part discomfort (BPD) of obese and non-obese participants were empirically investigated for 84 different OWAS postures. Two obesity levels were considered: non-obese (18.5 kg/m<sup>2</sup>≤BMI≤24.9 kg/m<sup>2</sup>) and extremely obese (BMI≥ 40 kg/ m<sup>2</sup>). 10 male and 10 female participants were recruited for each obesity level. Each participant was asked to statically hold a 5 kg box (310 x 250x 205 mm) for 20 s in a randomly ordered 84 standard OWAS postures (84 postures = a combination of three arm postures, four back postures, and seven leg postures). Two different analyses were conducted to investigate the obesity effects on RPE and BPD scores. In the first analysis, an analysis of variance (ANOVA) was used to determine the effects of obesity level, gender, back postures, arm postures, leg postures and their interactions on RPE scores. In the second analysis, a series of ANOVAs were conducted for each body regions to determine the effects of obesity, gender, back postures, arm postures, leg postures and their interactions. Overall, we conclude that for most of the OWAS postures considered, the obese groups (both male and female) perceive higher levels of mean exertion and discomfort than their non-obese counterparts. It is recommended that the existing postural evaluation tools must be adjusted to reflect these differences or new postural evaluation tools should be developed which would accommodate both the obese and non-obese populations. Future studies should also be conducted with dynamic tasks in order to fully understand the obesity effects on postural strains and hence develop comprehensive guidelines to avoid any overexertion injury risks.

# A Longitudinal Study of Workplace Incivility in Hospitals Scott Hutton, RN, MSN, MBA and Donna Gates, EdD, RN, FAAN; College of Nursing; Paul Succop, PhD, Department of Environmental Health; University of Cincinnati

Workplace incivility is low level deviant behavior with ambiguous intent to harm the target in violation of workplace norms (Anderson and Pearson, 1999). Workplace incivility has been associated with decreased productivity and negative health outcomes for employees. To date there is no known research investigating whether the cause of workplace incivility is single or multifactorial. If workplace incivility is multi-factorial, then as the many factors fluctuate the level of incivility should also fluctuate. However, if workplace incivility is single factorial, then the level of incivility should remain stable until that factor is addressed. The primary aim of this longitudinal study was to assess if the level of workplace incivility changed over time in a hospital setting. A secondary aim was to assess if demographic/ employment characteristics influenced the perceived level of workplace incivility. Seventy one randomly selected employees, at a rural hospital in the Midwest, consented to participate in the study, and 77% (n=55) of randomly selected employees returned the demographic/employment survey at baseline. 87% were female, 83% were Caucasian, and 92% had at least 12 years of education. The Incivility in Healthcare Survey was distributed monthly to the consented employees. At present, data has been collected and analyzed for 6 of the 12 months. The repeated measure ANOVA showed there was a significant difference in the level of workplace incivility over time (f=5.78 p<.0000) suggesting that workplace incivility is multi-factorial. The only demographic/employment characteristic which was associated with perceived workplace incivility was hours worked (r=.31 p=.0185). This research is important because it provides support that the causes of workplace incivility are multi-factorial. With this information, future workplace incivility research can focus on interventions to attempt

# The Effects of Jet Fuel (JP-8) on Dermal absorption of Used Engine Oil Gerald Kasting, PhD; College of Pharmacy and Paul Broering; Department of Environmental Health, University of Cincinnati

Polycyclic aromatic hydrocarbons (PAHs) have been studied quite extensively with a history of being animal carcinogens when these PAHs are applied to the skin of rats or mice. A number of governmental and international agencies have also listed these same PAHs as suspected human carcinogens. A commonly tested PAH mixture used for this research is used gasoline engine oil (UGEO). Talaska et al. (1999) have shown that kerosene can act to facilitate the absorption of UGEO through the skin and lead to increased DNA adducts in the lung. This study was to determine whether other commonly used organic solvents will increase the passage of UGEO through the skin as well as re-confirm kerosene's ability to facilitate UGEO through the skin. The study specifically analyzed the effects of gasoline, jet fuel (JP-8), and kerosene on UGEO absorption through cadaver skin. Franz cells were used to create the in-vivo environment needed for this experiment. It was hypothesized that each of these organic solvents would increase the permeation rate of UGEO through the skin. This was based on the knowledge of the similar chemical structures these organic solvents shared with kerosene, which had already been identified as a UGEO facilitator through the skin. Data analysis performed via high pressure liquid chromatography (HPLC) was to identify and quantify the PAHs that have permeated through the cadaver skin.

This research was very important to the understanding of how certain solvents facilitate the absorption of PAHs. It could have led to the use of PPE and the awareness of the dermal exposure dangers of certain combinations of compounds. Future studies need to be done to verify results this type of study. The safety of employees can not be based on a one time study but must be cross checked by a number of research facilities to better determine the most accurate data and the most effective means of protection for employees. Future studies also need to accrue more data on DNA adduct levels in the lung and skin after dermal exposure to UGEO with these organic solvents, which is not evaluated in this study.



## Occupational Noise Exposure Assessment of South-Central Kentucky Farms

Emmanuel Iyiegbuniwe, PhD, Christine M. Nagy, PhD, EdS and Jack Rudolph, Jr. PhD; Department of Public Health,
Western Kentucky University

Three faculty members (two in Public Health and one in Agricultural Science) at Western Kentucky University (WKU) propose to conduct a pilot research project on occupational noise exposure assessment of South-central Kentucky farmers during a typical farming season. Hearing loss due to occupational noise exposure is a major health problem facing American farmers today. The purpose of this pilot project is to conduct a baseline assessment of occupational noise

exposure of selected farmers during normal farming activities. Exposure assessment is an essential tool for understanding, managing, controlling, and reducing risks for occupational noise. Whereas most studies of occupational noise exposures have focused primarily on noise, this study will also document the use of chemical substances of public health importance including pesticides and solvents. The project will be conducted over a period of seven days in a year during the farming seasons. All adult farmers in four or five selected farms in Warren and Allen counties in SoLIth-central Kentucky will be will be included in the study. The study will be conducted using calibrated QuestTM persona! noise dosimeters and sound level meters under different farm operating conditions. Three graduate students in the Department of Public Health at WKU will be recruited and trained to assist with field sample collection, activity documentation, and data analysis. The P1 will be responsible for project oversight, implementation, monitoring and analysis. The results of the noise survey will be analyzed to determine exposure sources and levels for hazardous noise, activities associated with individual farmer's noise exposures, and comparison with applicable noise regulations and recommended guidelines. The evaluation will focus primarily on process evaluation to assess the extent to which the program was implemented as planned compared to the timeline. Process evaluation includes the activities that occur during the planning, development and implementation of the project. Carefully conducted process evaluation provides information that allows errant strategies to be detected, alternative strategies to be developed and implemented. Discrepancies between plans and progress will be scrutinized to bring implementation back on schedule. The results of the project will eventually be disseminated to farmers and the professional community with a view to promoting hearing conservation programs and preventing noise-induced hearing loss among farmers.

## Urinary 1-Hydroxypyrene in Tank Workers Exposed to Crude Oil During Tank Cleaning

Nancy Hopf and Glenn Talaska, PhD, CIH; Department of Environmental Health, University of Cincinnati; Jorunn Kirkeleit, PhD and Bente E. Meoen, University of Bergen, Norway.

Off-shore production vessels, also called floating production, storage and offloading systems, can move from a depleted oil well to a new location. The production vessels store the crude oil in cargo tanks before it is offloaded and transported onshore. A recent study found that workers cleaning and maintaining the cargo tanks had benzene exposure. Crude oil contains, in addition to benzene, polycyclic aromatic hydrocarbons (PAHs) - a human carcinogen. Therefore it is likely that the workers are exposed to a mixture of PAHs. Workers can be exposed to PAHs through ingestion, inhalation, and though skin. Because of this, it is advantageous to use biological monitoring of PAH exposure over environmental monitoring since it estimates the internal dose from all routes of exposure. The internal dose can be measured as urinary 1- hydroxypyrene (1-OHP), which is easily accessible. 1-OHP is a metabolite of pyrene, which is one of many compounds in the PAH mixture that is always present. The pyrene metabolite 1-OHP has been extensively studied as a biomarker for PAH exposure. Samples (n=42) have already been collected in connection with another project where benzene exposure and the acute effects on the immune system were investigated. The aim of this pilot study is to quantify the internal exposure to PAHs by measuring 1OHP in urine of workers on a typical crude oil production vessel, and determine if 10HP correlates with circulating immune parameters IgA, IgM and CD4+ T helper cells already determined in these urine samples. This pilot project fits in NORA's mission of the Cancer, Reproductive, and Cardiovascular Research Program (CRC), because 1-OHP measured in workers with exposures to crude oil (carcinogens) will be a scientific approach to gather exposure

information on crude oil and their carcinogenic role in tank workers, which has not been done before. The US oil and gas extraction industry employed about 316,000 wage and salary workers in 2004, and 40% of these workers were employed directly by the oil and gas extraction companies. However, offshore workers are not included in these employment numbers, and since many Americans are employed by oil companies at locations in Africa, the North Sea, the Far East, the Middle East, South America, and countries of the former Soviet Union this number is likely higher. The proposed research will result in data that will discover whether these workers currently use sufficient personal protection for PAH exposures.

## Evaluation of Adults' Perception of Slipperiness After Training Intervention

## Thomas Hermann, EdD; Jessica Murphy, Nancy Talbot, PhD, MS, PT, College of Allied Health, University of Cincinnati

Falling, the perceived risk of falling, and alterations in gait and balance based on surface slipperiness has been the subject of numerous investigations. Little research has been done, however, to examine internal mechanisms that may prevent falls on slippery surfaces. The long term objective of this study is to determine if a program of neuro-muscular training for the lower extremity involving surfaces of different coefficients of friction will alter a subject's ability to accurately perceive the slipperiness of the surface. The specific aims of the study are: 1) to recruit 12 adult subjects to participate in a pilot study; 2) differentiate the control and experimental groups; 3) further differentiate the experimental group into weight bearing and non-weight bearing training groups; 4) to analyze the subjects perception of surface slipperiness before and after a neuro-muscular training program: and 5) to collect force plate and EMG data collected during the pre-test and post-test trials. The investigation will be a controlled experimental design involving a pre-test, an intervention and a post-test. Adult subjects who meet the inclusion criteria will be randomly divided into 3 groups. Wearing identical footwear supplied by the study, each member will move one foot in both the sagital and frontal planes across various surfaces of known friction coefficients while standing on a force platform in a protective harness. All subjects will then repeat the movements without the knowledge of the slipperiness and be asked to identify the surfaces by feel alone (pre-test). The control group will not receive any training intervention. The experimental groups will undergo an 8 session training program during which the subjects will work in sagital and frontal plane movement patterns for the lower extremity while in contact with surfaces of known slipperiness. After the training program, all subjects will return for a post-test where they will be asked to repeat the pre-test protocol. Pressure and force distribution data from the force plate and surface EMG data from the muscles controlling the active joints will be collected during all the test trials. Falling and the injuries from falls represent a considerable risk to the health of workers and the elderly. Recovering from the injuries can require extended periods of medical and therapeutic care, rest, lost productivity and loss of income. If a program can be developed that improves a person's ability to accurately perceive the slipperiness of a surface at initial contact it is possible that fall risk and falls can be reduced.

## Numerical Modeling of Pollutant Dispersal From Exhaust Systems Urmila Ghia, PhD Aravind Kishore; College of Engineering, University of Cincinnati

The broad objective of the proposed study is to develop a methodology to use Computational Fluid Dynamics (CFD) in the simulation of pollutant dispersion from exhaust systems. One such system is the under-water exhaust system of water-craft. The primary focus of this study is on

Carbon Monoxide (CO). When ejected from the under-water exhaust system of a water-craft, CO, being insoluble and lighter than water, rises to the water surface and is entrained into the watercraft cabin due to the station-wagon effect. We aim to extend the application of Computational Fluid Dynamics to problems in the Occupational Health and Safety area. In order to explore CO mitigation options, accurate concentration values of CO at water surface are required. Thus, the specific aims of the proposed study include building a CFD model accurately simulate the realworld phenomena and flow physics, predicting CO dispersal in the flow-field and, based on the results obtained, studying CO mitigation options. The incompressible Navier-stokes equations are used represent the flow. The computational model is built using Fluent, a commercially available software. The governing equations are solved using an ILES (Implicit Large-Eddy Simulation) scheme. This approach captures the large-scale flow structures that affect dispersal. The present work will involve the use of the ILES with added complexities (gravity, multiple phases) to model dispersion of CO in water. The different fluid phases involved in the flow are to be modeled a mixture, with the velocity of each phase being determined using the concept of slip velocities. NIOSH's evaluation of recreational boats recorded concentrations of CO in the watercraft cabin to be above the safe CO concentration limit. CO entrainment due to the station-wagon effect will occur on all boats similar aerodynamic configuration, be it recreational or not. The number of people who are required, by virtue of their profession, to stay on water-craft for extended periods of time (Coast Guard personnel, USNPS employees, marine workers in the fishing industry, etc.), and are affected by CO, is considerably large even though no statistics are readily available. This study aims at reducing CO exposure so it will not pose a serious occupational hazard in the future.

## **Understanding the Relationship Between Intrusion and Health**Jason Kain, Charlotte Fritz, PhD, Bowling Green State University

The negative effects of interruptions on memory, task performance, anxiety, and annoyance have been a focus on research in recent years (Bailey & Konstan, 2006; Jet, 2003; Monk, Boehm-Davis, & Trafton, 2004). Intrusions are a type of interruption defined as interactions with other people that interrupt the flow of and continued progress of work. Although untested, Jet and George (2003) note that intrusions have detrimental effects when they are frequent, unexpected, and last for long periods of time. Past research has shown that when people 's primary work tasks are interrupted by smaller less important tasks, there are many negative consequences including needing a longer amount of time to complete the primary task, making more errors in all tasks, and an increase in anxiety and annoyance (Bailey & Konstan, 2006). Because the relationship between tasks interrupting other tasks have been linked to these health outcomes, and because the outcome of both task interrupting task and intrusions are stopping the task current being worked on, it is hypothesized in the current study that intrusions will lead to similar health outcomes. Research has found that as people get older, they have decreased short-term task memory (Haarmann, Ashling, Davelaar, & Usher, 2005). Also, when primary tasks are interrupted, it takes people longer to recall what they were doing and resume the primary task (Edwards & Gronlund, 1998). Based on these findings, it would seem that since older individuals have worse short-term memory, it would take them longer to resume an interrupted tasks. Due to these findings, being older might strengthen the relationship between intrusions and health. Time pressure is a stressor that results from insufficient time to complete a job-related task. (Kinicki & Vicchio, 1994). Because people under time pressure already have insufficient time to complete a task, intrusions will only worse their situation. Due to these findings, it is expected

that the time pressure will strengthen the relationship between intrusions and health. Participants will be recruited primarily from a county government agency that has indicated interest as well as Bowling Green State University employees including faculty as well as non-academic staff. Participants will be contacted and will indicate consent through email. Incentives will be provided for each participant. The primary benefit of the current study is that it is the first known study examining the relationship between intrusions and health. Additionally, time pressure and age will be tested to see how they influence this. relationship. Finally, a new measure on intrusions will be developed that can be used in future studies.

## Examining the Effect That Tailored Messages Have on Intentional Physical Activity Tracey Yap and L. Sue Davis, PhD; College of Nursing, University of Cincinnati

A low level of physical activity is a pervasive feature of our modern lifestyle and is linked to a range of diseases, many of which are mediated through obesity. By engaging in regular physical activity, many health risks can be reduced. The purpose of this pilot research project is to evaluate the impact of tailored messages delivered by e-mail on increasing intentional physical activity. Physical activity is any bodily movement produced by skeletal muscles that results in an expenditure of energy. Intentional physical activity is a cognitive choosing to be physically active. The aims are to examine 1) the messages' effect on stage movement progression; and 2) the physical activity level in a group of workers. Two theories are used to explain the process of behavior change toward intentional physical activity: the Transtheoretical Model stages-of-change (TTM), and Maslow's Hierarchy of Needs. In the application of TTM to the phenomenon of intentional physical activity, the stages of change give an adequate view of the temporal dimension involved in behavior change. However, the decisional balance construct of TTM is too broad when addressing an individual's need for behavior change because of a plethora of Pros and Cons which may not be applicable to any one individual. Maslow's theory allows for a narrowing of the decisional balance construct so that the Pros can be geared towards a particular need which in turn motivates behavior change. A quasi-experimental design (two group, repeated measures) in which participants are in the TTM stages-of-change of either Contemplation or Preparation will be used. Two manufacturing distribution plants will serve as the study sites—both plants are part of the same multi-national company, in different locations in Kentucky. Seventy six employees will be recruited. A priori power analysis for sufficient testing of the hypothesis suggests a sample size of 32 per group (N = 64), assuming equal allocation, under hypothesis H2, for the CS correlation model, for a two-sided test at  $\alpha$ =.05, power of .80, for medium effect size ( $\Delta$  = .50) of a repeated measures design. The independent variable is either a tailored message or a sham health message, both delivered through e-mail. The dependent variables are 1) movement to a higher level of the stages of change and 2) an increase in intentional physical activity in the intervention group. Groups will be measured at baseline and three additional times.

## The Role of Human Factors and Ergonomics in Retirement Decision-Making Behavior

Diana Schwerha, PhD; Industrial and Systems Engineering, Ohio University

During the next decade, the U.S. Bureau of Labor Statistics projects that the annual growth rate of the 55 year and older labor force will be 4.1 percent, 4 times the rate of the overall labor force

(Toosi, 2005). This increase in the number of older workers has serious implications relating to the health of the older workforce, knowledge transfer, possible labor shortages, and succession planning. Companies will be in need of better methods to allow them to retain and keep their older workers healthy, and better predict retirements.

The long-term goal of the proposed study is to determine models that will guide companies in adjusting the work context so that older workers will remain healthy and interested in extending their career. The objective of this application is to perform a pilot study in two types of industry to determine perceptions about work context and its role in retirement decision-making behavior. Unlike other surveys about older workers and retirement, this study is innovative in that it will canvas both employers and employees and determine where the concurrence or divergence in opinions may occur. Specific aims are listed below:

- 1. Specific Aim 1. Determine the extent to which work related factors influence an employee's decision to retire or to delay retirement.
- 2. Specific Aim 2. Compare the influence of work related factors to general determinants of retirement, such as overall health, finances, or family commitments.

Specific Aim 3. Determine the relationship between proximity to retirement and opinions about how work context could influence an employee's decision to retire.

Specific Aim 4. Understand to what type of work employees might return after retirement and factors related to that return.

Specific Aim 5. Through a comparison of data from two different work sectors, determine whether work sector affects an employee's decision about the relationship between work context and retirement decisions.

## New Lab-On-A-Chip Sensor for Worksite Assessment of Individual Manganese Exposure

## Jin-Hwan Lee and Ian Papautsky, PhD; College of Engineering, and Erin Haynes, Department of Environmental Health; University of Cincinnati

1. Manganese (Mn) is an essential element, yet it is neurotoxic in excess. The neurological consequences of Mn exposure have a dose-related continuum. Working environments in which Mn exposure can occur are many, including welding, agricultural workers, steel production, Mn mining, Mn alloy production, and refinery. At lower levels of exposure, epidemiological studies of Mn-exposed industrial workers reveal subclinical neurological signs consistent with early manganism. At high levels of exposure, Mn can produce a neuro-logic psychiatric disorder, manganism, which resembles Parkinsonian syndrome. These extrapyramidal and neuropsychiatric symptoms progress even after cessation of exposure. Thus, it is imperative to efficiently monitor Mn in an occupational setting. Currently, whole blood is the most reliable parameter for biomonitoring Mn exposure. Air Mn concentrations have correlated well with blood Mn levels. However, costs and time delays associated with blood collection and Mn analysis are substantial. In this application, we propose to develop a low-cost disposable lab-on-a-chip for rapid point-ofcare/on-site sensing of Mn. The lab-on-a-chip will couple electrochemical sensor based on stripping voltammetry of bismuth with microfluidics, which enables precise manipulation of fluids on the microscale. We expect to develop microfabrication procedures to enable future integration of microfluidics with additional analytes, such as chromium (Cr), which is of significant occupational, public health, and environmental importance. Other heavy metal ions, such as Pb 2+, Hg 2+, and Zn 2+, could be added in the future. Ultimately, we envision a point-of-care disposable multi--analyte sensor for rapid detection and monitoring of heavy metals in blood. The utility of a proposed point-of-care disposable biological sensor for Mn is extensive. We expect it will enable industry workers to quickly and rapidly monitor their biological dose of Mn on the jobsite, ensuring worker safety. Our interdisciplinary research team is the collaboration across two colleges, namely Engineering and Medicine. Because of the complementary expertise, the research environment is especially conducive to successful completion of the proposed work.

## The Impact of Coping and Gender Role Identification on the Work-Family Interface

#### Erin Smith, Charlotte Fritz, PhD, Jennifer McInroe, Jason Kain, Marisa Adelman; Psychology Department, Bowling Green State University

Researchers have found that a person's job has significant effects on family life (Byron, 2005; Edwards, 1992). Many characteristics of a persons job (e.g., social support, interpersonal conflict, job role ambiguity) have been suggested to affect a person's life at home (e.g., family satisfaction, family conflict; Breaugh & Colihan, 1994). The aim of this project is to study the difference in how work affects family life in different populations (e.g., single parents, cohabiting parents). Research indicates that single parents are a population at risk for experiencing negative effects of work on their family life (Allen! Herst, Bruck, & Sutton, 2000). We will also be examining how factors such as personal coping style and gender influence the negative impact of work life on family life. Gender and coping are two factors that have been suggested to curb the negative spillover from work stress to family stress, and we hope to identify specific coping styles that are most beneficial to specific types of populations (e.g., single mothers! single fathers, etc.; Carver, Scheier, & Weintraub, 1989). We will administer surveys to many different types of participants and assess variables from both the work life and the family life. Participants will only be asked to complete one survey; a raffle of gift cards will provide an incentive for participation. We will recruit participants from daycare centers and elementary schools, and have already begun contacting sites to get permission to recruit.

This study is related to health outcomes in multiple ways. First, some populations may experience more negative health outcomes (e.g., psychological well-being, physical well-being, etc.) than others, making it crucial to identify the populations that are most at risk. Second, by examining gender and coping, we may identify methods to reduce negative health outcomes in each population. Certain coping styles have been found to reduce negative health outcomes in general, but we are adding to the literature by studying marital status, gender, and living situation as variables that make a person more likely to experience negative health outcomes (Krajewski & Goffin, 2005).

## Genetic Differences in Response to Mn

#### Eric Kendig and Mary Beth Genter, PhD; Department of Environmental Health, University of Cincinnati

This proposal seeks to identify a basis for genetic susceptibility to neurotoxicity in response to manganese (Mn) exposure. We will focus on metal transporters that have been demonstrated to facilitate thee transport of Mn into cells. While Mn is an essential element, too much can cause toxicity, and among the manifestations of Mn toxicity is Parkinsonism, or of the symptoms of Parkinson's disease. Preliminary data from our lab shows that the Mn symporter ZIP8 is expressed in the nasal respiratory mucosa and in olfactory nerves, which project directly from the nasal cavity and into the brain, and therefore could serve as a conduit for Mn transport from inhaled air into the brain. We will examine Mn uptake from the nasal cavity of genetically divergent

mouse strains, which we propose will model genetically divergent human populations. We will also quantitate the expression of three metal transporters (ZIP6, ZIP8, and ZIP14) in the same mouse strains. Because ZIP6 has already been found by other investigators to be expressed in the substantia nigra (one of the brain regions profoundly affected in Parkinson's disease), we will examine this same brain region for the expression of two known Mn transporters, ZIP8 and ZIP14. Successful completion of these studies will show that genetically different mouse strains will differ in their expression of Mn transporters and in their capacity to uptake Mn from the nasal cavity. This information will strengthen the case that human populations will show genetic susceptibility to development of Parkinsonism in Mn-exposed populations.

#### A Biomechanics Sensor for Measure Friction Properties in Walking Mark Schulz, PhD, Sai Lalitya Mullapudi, Yeo Heung Yun, Vesselin Shanov, PhD; College of Engineering, University of Cincinnati

The forces generated in the foot-ground interface gives us necessary data to diagnose and predict several gait and safety problems. In this seed project, the specific aim is to develop a prototype of a new type of sensor that is based on carbon nanotubes or a similar material such as carbon nanosphere chains which are lower cost. The sensor is built in order to measure the forces generated while walking. The sensor will be formed by loading carbon nanotubes or carbon nanosphere chains into an elastomer and forming a sensor wire. The sensor wire can be embedded into other elastomer types of material such as the soles of shoes to provide sensing of the strain in the material. We have all the equipment and experience needed to develop and test the new sensor material. A nanocomposite material manufacturing approach developed in our lab will be followed to make the sensor. The predominant walking forces are the normal force and the shear force which can be measured by calibrating the sensor. The data will be collected on a lab benchtop using a wireless data acquisition module that is already being used in our lab. No human testing will be needed at this stage. The wireless system is battery powered and continuously streams sensor data to a laptop computer. Thus, at the conclusion of this one year project a prototype sensor that can measure the forces of walking and compute the coefficient of friction will be developed and tested on a lab benchtop only. The sensor can be used in shoes to continuously measure and transmit walking forces and coefficient of friction information to a remote laptop computer. The data will be used in biomechanics studies to help design shoes and work places to prevent injuries. In the future, we envision adding an active friction modulator in shoes that is controlled by the friction sensor. In this way, the ideal friction coefficient for the shoe and surface are provided automatically on demand. This smart shoe could reduce injuries for workers and military/first responder personnel involved in walking or climbing on changing surfaces, e.g. dry or wet, loose or hard, and smooth or rough surfaces.

# Partial Enclosures for Noise and Dust Control in Underground Longwall Coal Mining Slagley, PhD: Department of Systems and Engineering Manageme

Maj. Jeremy Slagley, PhD; Department of Systems and Engineering Management, Air Force Institute of Technology

The overall goal of this project is to design and construct a partial enclosure to reduce noise and dust exposures to shearer operators in underground longwall coal mining. The specific aims to support this are:

- a. Assess acoustics and airflow of shearer workplace to aid in design of passive noise/dust control device.
- b. Design partial enclosure and model its effectiveness.
- c. Produce similar acoustical and dust environment at above-ground longwall laboratory.
- d. Build the partial enclosure and attach to above-ground mock shearer machine in a longwall laboratory.
- e. Take before and after measurements of dust and noise at the above-ground longwall laboratory.

Background: Although injury rates among miners have decreased steadily since 1966, mining remains one of the highest risk industries. Underground coal mining nonfatal occupational injury and illness rates for the period 1998-2002 were at 8.5 per 100 full-time equivalent workers. This exceeded the rates for all private industry for 1998-2001, which ranged from 5.7 to 6.0 per 100 workers. The two main occupational health concerns for underground mining (besides musculoskeletal disease) are noise and dust. A 1996 National Institute for Occupational Safety and Health (NIOSH) internal report stated that noise-induced hearing loss (NIHL) in miners was significantly worse than in the non-exposed population despite decades of interventions. By 50 years of age, 90% of miners have hearing impairment compared to a rate of 50% among 69-year old non-exposed people. Dust exposure in underground coal mining can result in coal- worker's pneumoconiosis (CWP). Although CWP deaths have declined from 1968-1999, CWP accounts for the largest number of deaths from all pneumoconioses during the 30-year period (1,003 deaths in 1999). The author's institution is interested in the proposed research because NIHL is a particular problem for the US military. The Institute of Medicine (2005) found that 75,000 new disability claims in 2003 for the Department of Veteran's Affairs included hearing loss, and annual disability payments in 2004 to veterans with hearing loss or tinnitus as their major disability were estimated at \$850 million. Also, the environmental and acoustic conditions encountered in underground mining are similar to some Air Force work operations. For instance, aircraft maintenance, especially depainting of aircraft, has similar noise and dust exposure conditions. Information gained will be used to solicit funding from the Air Force Office of Scientific Research.

## Development of a Receptance Based Modeling Technique for Hand-Arm Vibration

Jay Kim, PhD and Shirkant Pattnaik; College of Engineering, University of Cincinnati

Musculoskeletal Disorders (MSD) is one of the most expensive occupational diseases. Recent estimates of the cost associated with work-related MSD range from \$13 - \$54 billion annually. Exposure to excessive vibration causes the work-related MSD. Current guidelines on the HAVS limit the exposure time based on the frequency-weighted vibration amplitude. This assumes that the frequency weighting currently in use and the time-averaging associated with the frequency analysis are valid, while neither has a consensus support. It is obvious that the exposure risk to impulsive vibrations will be severely underestimated by current guidelines that do not properly account for the sharp temporal variation of the vibration. Current HAVS guidelines have been developed mainly relying on population study and empirical tests, which has been very limited because high-level exposure test is very difficult. Especially for hand and fingers, a direct animal test is not a practical option. A technique for a detailed numerical modeling is very useful for this reason in HAVS research. This research is to develop an advanced procedure and related

techniques for computational analysis of hand and arm vibration responses. Specific aims of this research are as follows. Abstract (Aim 1) Develop a finite element method (FEM) based numerical analysis model of the hand-arm: Finger tips, fingers, hand, lower and upper arms and the shoulder will be modeled independently with different degrees of freedom to be assembled later. If both the location and the mechanics of the relevant influence of vibration are known it will be possible to predict the effect of vibration from the knowledge of its transmission to the relevant part. (Aim 2) Develop a receptance-based technique to assemble the models: Use of receptance method will enable to build the model composed of a layer of sub-systems. For example, the technique will enable the finger analysis fully accounting for the effect of the hand and other body parts. The receptance technique to be developed will be very useful in human vibration analysis because it allows sub-system analysis.

## Chemical Analysis of Firefighter's Garment Fabric Vesselin Shanov, PhD; College of Engineering, University of Cincinnati

Firefighters are exposed to an extremely hazardous environment when going on a mission. Toxic gases such as carbon monoxide, phosgene and cyanides are frequently generated during the fire from burning furniture and construction materials. In addition a great amount of heat contributes to the increased stress level accumulated in the firefighters when exposed to such a harmful environment. The quality of the garment is a crucial component that protects the firefighters on the field. Frequent exposure of the garment to the fire environment causes deterioration of the fabric due to chemical and thermal destruction. The specific aim of this project is to study representative samples (patches of fabric) exposed to fire and to analyze the absorbed chemicals. The generated data are expected to provide information about the durability of the garment fabric and the deterioration mechanism caused by the absorbed chemicals in a heated environment.

## A SPECIAL THANKS TO THE FOLLOWING INDIVIDUALS FOR MAKING THIS YEAR'S PRP SYMPOSIUM A SUCCESS!

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