University of Cincinnati Education and Research Center (ERC)
Supported by the National Institute for Occupational Safety and Health (NIOSH)

Sixth Annual

Pilot Research Project Symposium

October 20 & 21, 2005

Abstract Booklet

Presentations by

2004 and 2005 Awardees

Kehoe Auditorium

Kettering Laboratory

University of Cincinnati

Thursday 10/20/05 1:00 p.m. — 5:30 p.m.

5:30 p.m. – Picnic Sponsored by the Academy of Kettering Fellows

Friday 10/21/05 8:30 a.m. — 12:30 p.m.

0.5 ABIH (IH) CM Points Per Day

UNIVERSITY OF Cincinnati

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Abstract Booklet

Pilot Research Program Overview

The University of Cincinnati's Education and Research Center (ERC) which is housed within the Environmental and Industrial Hygiene Division of the Department of Environmental Health, has been sponsored by the National Institute of Occupational Safety and Health (NIOSH) for the past 27 years. The Pilot Research Program (PRP) was instituted 6 years ago under the auspices of the ERC's graduate training program. The overall goal of PRP is to train and provide competitive research grant funds to graduate students, doctoral students and junior faculty members. Under the auspices of PRP, there are 9 other institutions in the region that participate with the University of Cincinnati. They are Central State University, Bowling Green State University, Eastern Kentucky University, Medical College of Ohio, University of Kentucky, Purdue University, Kentucky State University, Murray State University and Western Kentucky University. Each year the PRP Symposium is held as a means to showcase the research funded by the program and to make available the opportunity for students, researchers and professionals in the industry to network. Dr. C. Scott Clark serves as the director for both the Environmental and Industrial Hygiene Division and the ERC . Dr. Amit Bhattacharya, serves as the director of the PRP training program.

Recent accomplishments

The Pilot Research training Program (PRP) five year grant application was competitively reviewed by NIOSH in March 2005 and it received an outstanding review and has been funded through 2010. During the first five years of its operation, the PRP program has funded eighty-three projects from a total of 94 proposals from the participating institutions. Collectively, the PRP awardees have already produced a total of 41 peer-reviewed articles and conference presentations directly resulting from their PRP pilot research grant activities. During the last 5 year period, PRP awarded a total of $ 382,289 to eighty three awardees and the data collected (and the experience gained by the awardees) in the pilot grants resulted in grant awards totaling about $2,894,386 million from various sources other than PRP such as NIOSH, USDA, CDC, etc. This reflects a return on the investment equaling 8:1. Furthermore, PRP also allowed bringing in 15 new investigators from other fields of expertise to the area of occupational safety and health research.

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

University of Cincinnati Education and Research Center (ERC)
Supported by the National Institute for Occupational Safety and Health (NIOSH)

Keynote Speaker for Thursday, October 20, 2005

Jean Grassman, PhD
Associate Professor and Deputy Chair-Health
Health and Nutrition Sciences
Brooklyn College-CUNY
e-mail: grassman@brooklyn.cuny.edu

Jean Grassman is an Associate Professor in the Department of Health and Nutrition Sciences at Brooklyn College in Brooklyn, New York. She currently teaches occupational and environmental health to both graduate and undergraduate students. Grassman directs the MPH Program and is the deputy chair of the school's graduate program in health. She previously worked with the Molecular Epidemiology Program at NIEHS and the Environmental Science Program at Columbia University. In 1994, Grassman was selected as an AAAS Science and Engineering Fellow where she served at the EPA in Washington, DC.

Grassman attended the University of California-Berkeley School of Public Health where she studied environmental health sciences, specializing in industrial hygiene. She received her Master's degree in 1989 and her doctorate in 1992. As an undergraduate, she attended the University of Wisconsin where she received degrees in Anthropology and Zoology in 1982. She has been a member of the American Industrial Hygiene since 1986 and has served as Chair of both the Social Concerns and the Biological Monitoring Committees.

Grassman chairs the Brooklyn College chapter of her union's health and safety committee and is active in CUNY-wide health and safety activities.

Her research program investigates the effect of dioxins in human populations. Her current activities include investigating the impact of PBDE's on human cells and an ongoing study of the impact of dioxin exposure in Russian firefighters.

She is married and lives in Brooklyn. When she has time, she enjoys running, bird-watching and studying dance.

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Abstract Booklet

Keynote Speaker for Friday, October 21, 2005

Linda McCauley, PhD, FAAN, RN
Nightingale Professor of Nursing, and Associate Dean for Nursing Research
University of Pennsylvania School of Nursing
email: lmccaule@nursing.upenn.edu

Dr. McCauley's current research includes a community-based intervention and research project targeted at reducing pesticide exposures among minority farm workers. This work aims to identify culturally-appropriate interventions to decrease the pesticide exposures of farm workers and their children. The epidemiological approach used in these investigations incorporates survey questionnaires on exposure, biomarkers of exposure to organophosphate pesticides and assessment of neurobehavioral function. A major goal of this research project is to disseminate the findings in ways that are understandable and meaningful to migrant and seasonal farm workers. She also integrates molecular epidemiology into her research studies. She is currently investigating developmental vulnerability among adolescent farm workers who are exposed to pesticides, incorporating state-of-the-art measures of biomarkers of oxidative stress and DNA damage in her study protocols. Using an interdisciplinary community-based research design she has studied extensively cultural differences in perceptions of work safety and worker protection. Culturally appropriate translation of research findings to the affected communities is an integral part of her research program. In her investigations of environmental exposures and health effects, Dr. McCauley has become increasing aware of the role that genetic susceptibility plays in the risk of acquiring disease. Because of the rapidly advancing discoveries in genetic science and her interest in immigrant populations, Dr. McCauley has recently begun a new project that aims to bring together genetic scientists and communities, particularly disinfranchised populations to increase our understanding of the ethical, legal, and social implications of research on genetic susceptibility and environmental exposures.

Thursday, October 20, 2005
Platform Presentation Schedule

Time	Page#	PI Name	(University)(Award Year)	Title
1:10 – 1:40		**Keynote Lecturer Dr. Jean Grassman, PhD**		
		"A Different Kind of Biomarker: Changes in Gene Expression After Exposure to Dioxins"		
1:45 – 2:05	7	Mingming Lu, PhD	(UC)(1)	Composition identification of Odorous in Anima
2:05 – 2:25	7	Setenay Tuncel Richard Shell, PhD & Judy Jarrell, Phd	(UC)(1)	Customized Integrated Intervention for Injury Prevention
2:25 – 2:45	8	Anthony Arment, PhD	(CSU)(1)	Use of E-Beam Technology to Produce Silver-Fabric Bactericidal Composites
2:45 – 3:45		**Refreshments & Poster Session (Kettering Lobby)**		
		Platform Presentations		
3:45 – 4:05	9	Mustafa Al-Zoughool & Glenn Talaska, PhD	(UC)(1)	Glucuronidation in Arylamine-Induced Breast Genotoxicity
4:05 – 4:25	10	Ashley Guidroz, Jennifer Burnfield, Olga Clark & Heather Schwetschenau	(BGSU)(1)	An investigation of the Impact of Incivility Among Nurses
4:25 - 4:45	10	Mark Knezovich, Fan Xu James McGlothlin, PhD	(PU)(1)	Evaluation of Ergonomic Controls for the Preparation of Footers in Post-Frame Building Construction
4:45 - 5:05	11	Jay Vietas Glenn Talaska, PhD	(UC)(1)	In-Vivo Effects of Arsenic Speciation on BaP

Friday, October 21, 2005
Platform Presentation Schedule

8:30—8:35 **Opening Remarks**

8:40—9:15 **Keynote Lecturer: Dr. Linda McCauley, Phd, FAAN, RN**
"Closing the Research Link: Farmworker Pesticide Exposure, Biomarkers and Neurobehavioral Effect"

9:15 – 9:35	11	Olga Clark Steve Jex, PhD	(BGSU)(1)	Predicting Compliance with Universal Precautions
9:35 – 9:55	12	Dianne M. Felblinger, EdD, MSn, WHNP-C, CNS & Donna M. Gates, EdD, MSPH, MSN	(UC)(1)	Domestic Violence Screening and Treatment in the Workplace
9:55 – 10:15	13	Woojin Park, PhD	(UC)(1)	Obesity Effects on Lifting/Lowering Movement Pattern

UC = University of Cincinnati
CSU=Central State University
PU = Purdue University
MUO=Medical University of Ohio
BGSU = Bowling Green State University
(1) = Funding Period 8/15/04 — 6/30/05
(2) = Funding Period 8/01/05 — 6/30/06

Abstract Booklet

Time	Page#	PI Name	(University)(Award Year)	Title
10:15 – 11:15		Refreshments (Lobby) & Poster Session (Kettering Atrium)		
		Platform Presentations		
11:15 – 11:35	14	Chunhui He, Kermit Davis, PhD	(UC)(1)	Body Type Impact on Whole Body Kinematics During Manual Handling
11:35 – 11:55	15	L. Jean Whingther, Christopher J. Cunningham & Steve Jex, PhD	(BGSU)(1)	Understanding the Work-Family Consequences of Shiftwork

Poster Presentations (Both Days)

Poster No.	Page#	Name	University	Title
1	15	Jennifer Gillespie	BGSU	Health and Safety Training for Direct Care of People with Dementia
2	16	Woojin Park, PhD	UC	Obesity Effects of Postural Stability During Standing
3	16	Scott Hutton Donna Gates, EdD	UC	Workplace Incivility Among Nursing Staff and Losses in Productivity
4	17	Janet Wray, PhD	UC	Personal Safety, Violence and Hospital-Based Psychiatric Nurses and Workers
5	18	Susan Kotowski Kermit Davis, PhD	UC	The Ergonomics of Electronic Medical Records
6	18	Jennifer Yugo	BGSU	Predicting Youth Farm Injury: A Psychosocial Perspective
7	19	Devender Singh Woojin Park, PhD	UC	Evaluating the NIOSH Lifting Equation for Obese Workers
8	20	Yulia Iossifova	UC	Comparison of Two Methods for Measurement of Fungal (1-3) - p-d-glucan
9	20	Chunhui He Kermit Davis, PhD	UC	Physical and Psychosocial Demands on Day and Night Shift in Nursing Homes
10	21	Sheryl Milz, PhD	MUO	Evaluating Vapor Intrusion from Gasoline Underground Storage Tanks

Platform Presentations

Composition Identification of Odorous Compounds in Anima

Mingming Lu, PhD
University of Cincinnati

The odorous emissions from confined animal feeding operations (CAFO), such as wine, poultry and dairy farms, are the main cause of community complaints, but are not well characterized due to the absence of legislations and the limitations in sampling and instrumentation techniques. This proposal is aimed at the innovative use of high volume sampling with sorbent cartridges to collect the odorous emissions from CAFO farms at representative locations.

The sorbent was custom designed to take into consideration of the potential compounds that can exist in a dairy farm. It has also been tested with the artificial odor from the swine manure for feasibility. The individual compositions of the odor have been identified using GC-MS and HPLC. The carbon fraction has been analyzed for the particulate matter collected at select locations. The preliminary data on the organize odor compositions has been obtained, and indicated that the sampling and analysis can be greatly improved with lower costs. This will be helpful to better health risk assessment, and the development of more effective control technologies.

Customized Integrated Intervention For Injury Prevention

Setenay Tuncel
University of Cincinnati

Lower back disorders (LBDs) are the number one cause of disability in workers under the age of 45 (National Institute of Neurological Disorders and Stroke, 2004), causing Americans to spend at least $24 billion each year on direct medical costs (Lahad et al. 1994). Due to the severe impact of LBDs on the life of individuals and the economy of the country, extensive research has focused on the etiology, prevention and treatment of the lower back. Winkel and Mathiassen (1994) categorized possible risk factors under three groups: individual, biomechanical, and psychosocial. Cumulative or combined effects (Johanning, 2000) of these risk factors led to increased complexity of the solution to the problem, pointing out a need for designing intervention that address different risk factors of LBDs simultaneously. Selecting the correct set of risk factions to be addressed in an intervention is critical for success of the intervention. Thus a detailed workplace assessment which addresses both physical and non-physical work environments to identify the risk factors for a specific workplace is critical. Even though, at some point, expert knowledge and management participation is required to pinpoint precautious for the reduction of the LBD's prevalence in a specific workplace, an automated process could greatly reduce necessary time and effort.

Based on need of workplace assessment, Robertson and Courtney (2004) adapted the systems analysis model originally proposed by Mosard (1982) to solve health and performance problems. Even though they integrated both microergonomic and macroergonomic aspects of the work environment as a list of potential problematic areas in health problems, and used this list for improvement, their workplace assessment is limited to office systems. Another popular approach is adapting proven business approaches into the area of safety and health. For example, based on the connection between ergonomics problems and quality deficiencies (Eklund 1999), Rahimi (1995) integrated safety and health planning into a Total Quality Management system. Similarly Ketola and coworkers (2002) applied Malcolm Baldrige Criteria for Performance Excellence to assess and improve occupation safety and health management. However, these efforts are far from providing a read-to-use tool for the assessment of work environments. Although Ramsauer (2001) provided a survey as a ready-to-use assessment tool to

identify issues in the workplace, because the process is not automated, the decision-making process to prioritize improvement areas requires extensive expert knowledge. On the other hand, Cagno et al. (2001) developed an algorithm to prioritize safety improvement areas based on risk assessment and business constraints. Even though the algorithm includes automation, it does not offer an assessment tool. Mattila (1987) provides a survey as an assessment tool and an algorithm for prioritization; however the number of risk factors is quite limited to assess both physical and non-physical environments in detail. Genaidy and Karwowski (2003) proposed the *Work Compatibility* concept: the work environment may replenish a worker's energy as an *energizer*, or it may deplete the worker's energy as a *demand*. Work Compatability Level (WCL) is defined as the degree of balance between energizers and demands. Low WCL indicates the imbalance between energizers and demands, i.e., a poor work environments, which may lead to adverse health effects. Their ready-to-use assessment tool enables works to evaluate an extensive number of physical and non-physical work environment variables. Effective use of computer programming is required to reduce the time and effort spent by experts and management to design intervention.

Use of E-Beam Technology to Produce Bactericidal Silver-Fabric Composites

Anthony Arment, PhD

Central State University

Silver has a long, historical use as a bactericidal metal; as early as 550BC, according to the writings of Herodotus (silverinstitute.org), silver was used for beverage storage during long voyages. Silver nitrate has been used medically in podiatry to treat neonatal conjunctivitis; legislation from 1909-1959 required this treatment in newborns, resulting in a decrease in infant blindness from 24% to 0.3% as measured by admissions to schools for the blind (Tortora et al., 2004). Other silver salts have been used as disinfectants and in the treatment of various infections such as moniliasis (candidiasis) and trichomoniasis. Silver Sulfadiazine is used as an antibiotic and antifungal topical, particularly in burn cases where nosocomial infections (*Staphylococcus* and *Pseudomonas*) are a high-risk.

Silver exerts its antimicrobial effects oligodynamically that is to say from the action of relatively few molecules. It functions as many of the other heavy metals do against microbes, effecting membrane stability, inhibiting DNA replication, and interacting with thiol groups in proteins to denature them (Matsumura et al., 2003). However, the use of colloidal silver as a treatment is hotly debated between traditional and alternative medicine (van Hessalt et al., 2004; silvermedicine.org).

Silver is being tested in various industrial applications as a coating compound to retard or prevent bacterial growth and biofilm formation (Cowan et al., 2003). The application of silver salts to fabric to control the presence of odor-causing bacteria in socks and sports clothing has become commonplace. Silver-impregnated nylon (X-static) has been tested for its ability to retard and prevent bacterial growth among a large number of bacterial genera (MacKeen et al., 1987). Nylon fibers were incubated in bacterial cultures then evaluated for CFU reduction potential; these fibers were active because of the slow release of silver salts from fabric.

With the advent of e-beam technology, it is possible to go from beyond impregnating metal slats into fabrics for slow release to bonding the two substances into a composite. Central State University (CSU) maintains collaborative research ties with Kent State University (KSU). KSU maintains a 150 kW, 5 MeV electron accelerator in partnership with Mercury Plastics, Inc. (MPI) as part of their joint Program on Electron Beam Technology

(PEBT); the joint facility is the NEO Beam Alliance Ltd.. Faculty at PEBT has expressed interest in developing collaborative research projects with CSU. This proposal marks the first project geared towards this collaboration. This project impacts the NORA Research Agenda in two important areas: Emerging Technologies (e-beams) and Control Technology and Personal Protective Equipment.

The primary goal of the project is to evaluate the usefulness of e-beam technology in creating bacteriostatic lab coats using silver as a means of bacterial control. Within this goal lie the following specific aims to:

1. Test different e-beam treated synthetic fabrics used in lab coats for effectiveness in retarding bacterial growth.
2. Distinguish differences in resistance between different bacterial genera.
3. Test the longevity of treated fabrics to withstand repeated exposure as measured by repeated washing.
4. Optimize e-beam treatment and silver concentrations for maximum effectiveness.

Glucuronidation in Arylamine-Induced Breast Genotoxicity

Al-Zoughool Mustafa Hussein
University of Cincinnati

The breast is the most important incident site for cancer in women and the second leading cause of their cancer deaths. Only 50% of cases can be understood in terms of know risk factors. Environmental causes are assumed to contribute significantly to the remainder, but their impact is unknown. Tobacco smoking has been shown to contribute to breast cancer, but the elevated risk associated with smoking in all women appears modes. Aromatic amines are major carcinogenic components in tobacco smoke and are also the best characterized occupation carcinogens. If only a sub-group of women smokers are at elevated risk due to the way the metabolize aromatic amine procarcinogens in tobacco smoke, their risk my be diluted toward the background when all women smokers are considered. Women are known to be slow glucuronidators when compared to men and a wide distribution in the rates of glucuronidation of women has been seen using substrates such as cotinine.

The focus of this research is to conduct the first investigation of the role of procarcinogen glucuronidation phenotype may play in human breast carcinogenesis. Our hypothesis is that the ability of breast tissue samples to glucuronidate a specific aromatic

An Investigation of the Impact of Incivility Among Nurses

Ashley Guidroz, Jennifer L. Brunfield, Olga L. Clark and Heather M. Schwetschenau
Bowling Green State University

This study was a pilot study of a measure of incivility. A general measure of incivility was tailored for the healthcare setting in order to identify that nurses may experience at work. Focus groups were conducted to learn more about the experience of incivility at a hospital and to gather information about what behaviors would be considered uncivil or rude. These results helped to create a tailored measure title the Nursing Incivility Scale. This scale measures incivility experienced in the general work environment as well as from nurses, supervisiors, physicians and patients. Followng the focus groups, surveys were mailed to nurses working at a large hostipal in the Mid-West. Results indicated good rliability and validity. However, there was not enough statistical power to conduct item-level analysis to verify the factor structure of the scale. Future efforts will be directed at

collecting more data to run these analyses.

A Pilot Field Study Involving the Evaluation of Ergonomic Controls for the Preparation of Footers in Post-frame Building Construction

Mark Knezovich, Fan Xu, James McGlothlin, PhD

Purdue University

A footer preparation process of a post-fram building construction crew was examined as part of an ergonomic intervention study involving an alternative tool and a newly developed tool (N=5 pre– and 4 post-intervention sites). Data from the pre-intervention process was compared to data from the post-intervention process in order to determine the effect on physical work demand. Measured tasks of interest in the pre-intervention phase of the study included the use of a standard post-hole tool for removing excess soil from pre-drilled holes, the manually lifting and drompoping of concrete footer pads weigh in between 44 and 66 lbs., and the shoveling of unearthed soil both away from and back into the footer holes. The measured tasks for the introduction of an phase of the study were the same as the pre-intervention tasks except for the introduction of an altered commercially available alternative post-hole digging tool and a concrete footer pad lift and drop device designed for this study. In the absence of an ergonomic control, the shoveling tasks were examined for instances of irregular patterns of recovery in heart rate between each hole. Measurement methods for various parameters of crew-member work exposure included: time synchronized heart rate monitoring with Polar Vantage NV™ heart rate monitoring system used with a standard video camera, ratings of perceived exertion (RPE) using the aBorg RPE scale, biomechanical analysis using the University of Michigan's 3D Static Strength Prediction Program™ v.5.0.0., and time cycle analysis from video review. ANCOVA (SAS® v.9.1) was used to determine the effect of the independent intervention variables.

The introduction of the two intervention appeared to have no significant effect on measurements of both heart rate and ratings of perceived exertion for the single subject performing the work (p-values>0.05). The introduction of the alternative post-hole digging tool appeared to have no significant effect on the post-hole cycle (p-value>0.05). The introduction of these concrete footer pad lift and drop device had a significant negative effect on the task cylce times (p-value<0.05). However, both intervention showed decreasing trends in cycle times over the post-intervention study sites, implying that a possible learning effect may have been occurring. Likewise, a decreasing trend was also noticed in the mean perceived exertion scores for the use of the concrete footer pad lift and drop

device, which may be due to a general trend in improving ground conditions or also to the possible occurrence of a learning effect. An estimation of the range of compressive force in the L$/L% vertbral region resulting from the manual lifting of force in the same area of the back when lifting pads with the intervention mechanism is between 158 and 172 lbs. Future research should focus on the introduction of the concrete footer lift and drop device to a larger number of subjects and work sites in order to further investigate the trend of decreasing cycle times and rating of perceived exertion. Further research should also attempt to better validate the mechanism as a viable alternative to manual lifting of concrete pads.

Co-Exposure Of Arsenite And Benzo(a)pyrene: Effect Of Glutathione On DNA Adduct Levels

J. Vietas, G. Talaska, PhD
University of Cincinnati

Humans are considered the most sensitive species to arsenic exposure with increased risk to skin, lung and bladder cancer. Epidemiologic studies of workers simultaneously exposed to benzo[a]pyrene (BaP) and arsenite (As) report additive to multiplicative effects. These studies are supported by both in vitro and in animal studies demonstrating an increase in BaP DNA adduct levels when co-treated with BaP and arsenite than when treated with BaP alone. Glutathione, the major thiol compound responsible for maintaining redox homeostasis, may provide cellular protection against arsenite's ability to increase the likelihood of DNA damage. We characterized the effect of modulating glutathione levels, through the use of buthionine sulfoximine (BSO) and glutathione ethyl ester (GSHEE) treatment as well as by using glutathione deficient knockout mice, on the formation of DNA adduct levels after co-exposure to arsenite and benzo(a)pyrene. Lung and skin tissues were analyzed for DNA adducts using ^{32}P-postlabeling. Arsenic cotreatment increased average BaP adduct levels in both lung and skin; the increase was statistically significant in the lung ($p=0.048$). A reduction in glutathione level increased BaP adduct levels, although only significantly in the skin of mice treated with BSO ($p=0.028$). Treatment with GSHEE reduced adduct levels, although not significantly ($p > 0.05$) in any tissue measured. These results are consistent with previous in vitro and in vivo findings and suggest that glutathione plays a minor role in arsenic's ability to potentiate BaP DNA adduct formation.

Predicting Compliance With Universal Precautions

Olga Clark, Steve Jex, PhD
Bowling Green State University

This research is directly related to occupational safety and health. Specifically, it is aimed at reducing occupational injury and illness associated with exposure to bloodborne infections. Accidental exposure to blood-borne pathogens is a serious occupational hazard for thousands of health care workers. It inflicts a tremendous toll in terms of human and economic costs. The population at risk includes thousands of health care workers who have contact with patients and patient specimens in hospital and laboratory settings. Universal precautions are safe work practice guidelines that were developed by the Centers for the Disease Control and Prevention. Universal Precautions (UP) are effective at preventing accidental exposure. However, according to surveillance evidence, the level of

compliance with universal precautions among health care workers is often low. The investigators integrated two distinct areas of research: occupational safety and industrial/organizational psychology, to identify organizational and individual factors that influence compliance with universal precautions. The aim of this study was to explore the psychological processes involved in adhering to safer work practices. The results of this study may tell us under what conditions health care workers are less likely to follow universal precautions and what could be done to increase compliance. The results of this exploratory study may also inform future research efforts and help improve work practices by guiding the development of a training program.

Domestic Violence Screening and Treatment in the Workplace

Dianne M. Felblinger, EdD, MSN, WHNP-C, CNS & Donna M. Gates, EdD, MSPH, MSN

University of Cincinnati

The purpose of this study was to survey members of the American Association of Occupational Health Nurses (AAOHN) regarding their beliefs about their ability to screen for and treat domestic violence (also called intimate partner violence) in the workplace. The specific research aims were: (1) Identify the educational training that Occupational Health Nurses receive about workplace screening for and treatment of domestic violence. (2) Describe the Occupational Health Nurses' beliefs about their ability to complete workplace screening for and treatment of domestic violence. (3) Identify the relationship between the educational training, demographics and work experiences of Occupational Health Nurses and their perceived ability to complete workplace screening and treatment of employees who experience domestic violence. A total of 458 AAOHN direct care providers or case managers throughout the United States anonymously completed the mailed instrument "Occupational Health Nurses' Survey on Screening for Domestic Violence in the Workplace." Results of the study showed that although Occupational Health Nurses consider domestic violence screening and treatment to be components of their nursing role, they do not believe that they have had adequate training to competently and comfortably complete the screening and treatment aspects of domestic violence care. The Occupational Health Nurses also did not perceive that there were existing policies in their workplace to assist them in dealing with domestic violence cases. This study provided baseline information about screening and treatment for domestic violence by Occupational Health Nurses in the workplace and addressed a priority of both the NORA and AAOHN research agendas. Information from the study can be used to serve as the foundation for future policy development and intervention research that benefits multiple stakeholders, including employees, employers, nurses and academicians.

Obesity Effects on Lifting/Lowering Movement Pattern

Woojin Park, PhD

University of Cincinnati

Obese workers represent a significant portion of the workforce in today's industry. A recent statistics by Flegal et al. (2002) reported that nearly one third (30.5%) of U.S. adults are obese and predicted that obesity will continue to increase rapidly in the United States. Obesity may be a risk factor for work-related musculoskeletal disorders (WMSDs) from manual materials handling (MMH), as heavier body mass may subject obese workers to higher biomechanical stresses than non-obese workers.

Body mass affects biomechanical stresses during MMH. Also, motion pattern (joint angle-time trajectories) adopted by a worker also affects them (Hsiang et al., 1997; van Dieën et al., 1999). When performing a MMH

task, obese workers may move differently than non-obese workers to compensate for heavier body mass and reduce biomechanical stresses in certain body areas. In other words, obese workers may adopt more self-protective motion strategies than non-obese workers. Recently, DeVita and Hortobagyi (2003) and Sibella et al. (2003) identified self-protective motion strategies associated with obesity for walking and sit-to-stand movement, respectively.

Despite the prevalence of obesity and its potential importance as a risk factor for WMSDs, movement patterns of obese individuals during MMH have not been extensively studied. At present, it is largely unknown whether or not there exist significant differences between motion patterns of obese and non-obese individuals during MMH and how such potential differences would affect biomechanical stresses.

Testing differences between motion patterns of obese and non-obese individuals during MMH has practical importance. If it is found that motion patterns of obese workers are not significantly different from those of non-obese workers, then obesity can be established as a risk factor for WMSDs that increases biomechanical stresses by excess body mass. Practical implications of such finding would be as follows: 1) it may be necessary to slightly modify existing ergonomic design guidelines (e.g., NIOSH lifting index) to adequately protect the obese worker population, 2) existing posture/motion simulation models (Faraway, 1997; Park et al., 2004) and kinematic motion databases (Chaffin, 2001) mainly based on data from non-obese individuals can be used for computerized ergonomic design for the obese worker population, without any modifications or additional data collection, and 3) self-protective movement techniques may be developed in the future studies to reduce biomechanical stresses for the obese worker population. If obese workers are found to indeed adopt more self-protective motion strategies than non-obese workers, then the obesity effects cannot be regarded as simple increase in body mass. Implications of such finding would be as follows: 1) comprehensive empirical studies will be needed to accurately define hazardous and non-hazardous working conditions for the obese worker population and further develop new MMH task design guidelines for obese workers, 2) special posture/motion simulation models will need to be developed for computerized ergonomic design for the obese worker population, and 3) self-protective movement strategies of obese workers may be further studied to elicit their biomechanical principles and utilized as safer movement techniques for the general worker population such that even non-obese workers can benefit by adopting them.

To gain a better understanding of biomechanical effects of obesity and further provide a basis for establishing future research directions, the objective of the proposed research was to test differences between non-obese and obese individuals in their motion patterns during whole-body lifting and lowering and identify how such differences affect biomechanical stresses in body areas. Lifting and lowering were selected because they are common in many industries and also known as primary risk factors for low back injuries.

Low Back Biomechanics & Workplace Stress Laboratory

Chunhui He, MS, Kermit Davis, PhD
University of Cincinnati

Obesity is one of several factors that have been associated with the development of low back pain (LBP). One potential mechanism for such an association is differences in mechanical disadvantage with respect to weight distribution, in that, how the weight is distributed may physically alter the way an obese individual moves. The

distribution of body weight in obese individuals falls into three body types: apple-shaped, pear-shaped, and tube-shaped with the two later being most common. The objective of this study was to investigate the whole-body kinematics of individuals in the two most prevalent body type groups (pear and tube) while performing manual material handling tasks. The participants performed symmetric and asymmetric lifting of boxes (weighing 4.5 and 9.1 kg, with and without handles) from mid-shin and knee to elbow height. The angular angles, velocities, and accelerations of the major joints: ankle, knee, hip, shoulder, and elbow were attained using the Peak Motus motion capturing system. The pear-shaped individuals lifted with greater angles and faster motion in the hips (about 6^{o} in posture and 15^{o}/s in velocity) but with slower motions for the ankles and elbows (between 15 and 30^{o}/s in velocity) in comparison to tube-shaped individuals. The difference in kinematic responses was magnified at the lower origin height and when lifting without handles. Similar results were found for lowering tasks. The study provided a preliminary evaluation of whether weight distribution impacts how an individual lifts. From the results, it is apparent that biomechanical alterations occur that may place certain obese individuals at more risk of LBP. The results allude to a potential increase in risk of LBP development for pear-shaped obese individuals and may need to be compensated through engineering controls. Future research will need to determine the biomechanical loading that results from these kinematic differences to truly understand the impact of weight distribution.

Understanding the Work-Family Consequences of Shiftwork

L. Jean Whinghter, Christopher J. L. Cunningham & Steve M. Jex, PhD

Bowling Green State University

The antecedents and consequences of occupational health and safety problems associated with shiftwork are not domain-specific. For this reason, study of these issues as they relate to shiftworkers should not be limited to the workplace. The present study explored a topic related to two of NORA's 21 priority areas of study: Organization of work and Special populations at risk. Data were collected from both shiftworkers and their significant others in an effort to qualify and quantify the work- and family-related consequences of working swinging shifts. Strengths of the present study included the attention to multiple components of stress (e.g., psychological, physical and environmental factors), as well as multiple perspectives beyond just the individual shiftworker (i. e., significant others). Data were also collected over three stages, allowing the researchers to give initial consideration to change over time as well as avoiding many of the limitations associated with simple cross-sectional studies.

Results showed shiftworking tenure was negatively associated with most health and nonwork difficulties. Work-to-family conflict (WFC) was more prevalent than family-to-work conflict (FWC), with time-based WFC the most problematic type of conflict. In addition, WFC was linked to job stress, job satisfaction and life satisfaction; however, the direction and magnitude of correlations differed somewhat among phases and respondents. The results of this study contribute to the existing shiftwork literature by examining the influences of multiple components of stress (e.g., psychological, physical and environmental factors), as reported from multiple stakeholder's perspectives (e.g., the shiftworker and his/her significant other). Implications and plans for future research are discussed.

Poster Presentations

Poster#1 Health and Safety Training For Direct Care Providers of People with Dementia

Jennifer Gillespie
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Our objective is to conduct an education and training intervention for direct care providers of people with dementia that will increase the health and safety of both parties. Our specific aims are to develop, execute, and assess such an intervention. This research falls within the Intervention Effectiveness Research (IER) priority area under NORA guidelines, as it addresses the goals outlined by the NORA IER team.

Direct care providers of people with dementia will be recruited to participate through the co-investigators' many contact with nursing homes, hospitals, and assisted living facilities in 24 nearby counties. Some will participate in the intervention, and all will be asked to complete pre– and post-intervention surveys. Survey responses along with more objectives indicators of health and safety will be used to assess the intervention.

The two-component intervention will focus on effective care-giving relationships, which occur when the direct care provider effectively maintains the safety and health of both parties. The first component concerns Person-Centered Care (PCC), which is the new paradigm of dementia care (Kitwood & Benson, 1995). The second concerns emotional labor (EL), or the act of displaying appropriate emotion on the job (Hochschild, 1983). EL is relevant to occupational health in that health care jobs rank among the highest in terms of EL demands (Glomb, et al., 2004). EL is a work stressor (Grandey & Brauburger, 2002) and some forms of EL have been linked to all-cause mortality as well as to the incidence of coronary heart disease, hypertension and related risk-factors (Mauss & Gross, 2004). Some forms of EL are healthier than others (Gross, 2001), so, in addition to learning PCC techniques, direct care providers will become equipped to manage emotionally evocative situation so as to maximize the health and safety of care-giving relationships.

With the baby boom's retirement fast approach, dementia is a key public health concern. It is one of the most serious disorders affecting the elderly and is among the most feared of all later life conditions. Thus, increasing the health and safety of those affected and of their care-givers is important to public health.

Poster #2: Obesity Effects of Postural Stability During Standing

Woojin Park, PhD

University of Cincinnati

Obesity may be a risk factor for postural instability and hence loss of balance. Due to heavier body segment weight and abnormal body mass distribution, but limited strength, postural control may be inherently more difficult for obese individuals than non-obese individuals. Also, higher biomechanical muscle loadings due to heavier body weight may induce fatigue more rapidly for obese workers during prolonged manual work, which in turn may compromise postural stability more quickly.

Despite the prevalence of obesity, its effects on human balance maintenance ability during occupational tasks have not been extensively studied. No quantitative, empirical studies can be found in the ergonomics and the biomechanics literature that investigate effects of obesity on postural stability. This lack of knowledge limits our understanding of obesity as a risk factor for balance loss and fall accidents, and hampers attempts to develop methods for protecting obese workers from falls. Therefore, the purpose of this pilot study is to examine effects of obesity on postural stability during manual work. More specifically, non-obese and obese individuals will be compared in degradation of postural stability measured by postural sway during a prolonged static standing task. A prolonged static standing task is chosen, as it is a common occupational task across many different trades.

A balance assessment experiment will be conducted to accomplish the research goal. The experiment will be conducted at the Occupational Safety Motion Research (OSMR) Laboratory at University of Cincinnati (Room 414 Old Chemistry Building). 10 non-obese (18.5 kg/m^2 < Body Mass Index (BMI) < 25 kg/m^2) and 10 obese (BMI > 40 kg/m^2) subjects of similar stature (170~175cm) will be recruited as subjects. Subjects will perform quiet upright standing with their feet together for one-hour. A force plate (FP4060-08, Bertec Corp., Columbus, Ohio) will be used to record the center-of-pressure (CoP) position over time. The one-hour period will be divided into sixty one-minute intervals. For each interval, several CoP-based postural sway measures will be computed based on the CoP-time trajectory data: mean distance, RMS distance, mean velocity and peak velocity in both the medio-lateral (ML) and the anterior-posterior (AP) direction. Also, the CoP sway area will be computed as a postural sway measure. For each time interval and for each dependent postural sway measure, a t-test will be performed to compare the obese and the non-obese subject group. Linear regression analyses will be performed to evaluate changes in dependent postural sway measures with respect to time, and the significance of the slopes will be determined (^{1}0). Significance of all statistical tests are accepted when P£0.05.
The proposed pilot study, when completed, will provide an initial estimate of obesity effects on postural stability during prolonged standing task. Such preliminary data will provide a basis for further investigating obesity effects for various prolonged occupational tasks in the construction, manufacturing, and service industries.

Poster #3 Workplace Incivility Among Nursing Staff and Losses in Productivity

Scott A. Hutton & Donna Gates, EdD

University of Cincinnati

The financial cost of workplace violence is estimated to be 4.2 million dollars a year. Workplace violence is often started by a minor incident such as workplace incivility that spirals out of control. Workplace incivility, known as a low-intensity, deviant behavior with ambiguous intent to harm, may initiate a spiral that for one thousand

people a year ends in death at work. If an initial minor incident such as incivility could be mitigated, then the financial and human capital that could be realized is astounding. Direct care staff are at particularly high risk of being victims of workplace incivility. This increase in risk is because of the lack of trained staff, increased acuity of hospitalized patients, increased use of part time/ temporary/ agency staff and generalized loss of environmental control. The purpose of this cross sectional study is to examine the incivility experienced by direct care nurses in their workplaces. The specific research aims are 1) describe the extent of incivility experienced by nurses at their workplaces from patients, visitors and co-workers, 2) identify if demographics or employment characteristics are related to experiences of incivility by nurses, 3) determine if there is a relationship between incivility and work limitations due to absenteeism and impaired performance while at work (presenteeism) and 4) cost out losses in productivity to the healthcare organization when incivility is present. Three survey instruments will be used in this study 1) demographic and employment characteristics 2) the Work Limitation Questionnaire (WLQ) and 3) the incivility in Healthcare Survey (HIS). The WLQ will be used with direct care staff to assess losses in productivity. The IHS will assess direct care staff perceptions of incivility in the healthcare work environment. The surveys will be distributed to all direct care nursing staff at Christ Hospital and Saint Elizabeth's (North) Hospital. Data analysis will include descriptive statistics, frequencies, percentages, means and standard deviations. Bi-variate analysis will be done to identify relationships between employee variables and incivility experienced. Regression analysis will be conducted to identify relationships between incivility and productivity in direct care staff. The information obtained will serve two purposes. First, it will be shared with the hospitals in aggregate form to provide information for planning changes. Second, it will provide a base for further research into intervention studies to manage incivility.

Poster #4 *Personal Safety, Violence and Hospital Based Psychiatric Nurses and Workers*

Janet Wray, PhD
University of Cincinnati

The threat of violence in the workplace is an increasingly recognized concern for all nurses, with the level of threat to nurses in emergency and psychiatric settings being the most documented. Violence by hospitalized mentally ill patients against psychiatric care workers is a pervasive, long-standing, and well documented occupational health problem (Lanza, 1992). As a result, many violence prevention strategies and training interventions have been developed. However, there have been few data based evaluations of these strategies. Published research about perceived personal safety risks in psychiatric care provide little documentation about how individual, organizational, educational, and training factors enhance or impede the personal safety of mental health staff. The topic addressed in this research proposal is responsive to the NORA priority *Organization of Work.*

The purpose of this study is to describe psychiatric nurses' and workers' experiences of violence and aggression and how, individually and/or collectively, they go about ensuring their own safety and providing a safe environment for others.

The specific aims of this study are:

1. To investigate the experiences of psychiatric-nurses and other psychiatric hospital workers with aggression and violence from hospitalized psychiatric patients.
2. To promote a better understanding of the needs of psychiatric nurses and other psychiatric hospital workers who have experienced aggression and/or violence in the workplace.
3. To explore how psychiatric nurses and other psychiatric hospital workers go about ensuring their own

safety and the safety of others in the workplace.

4. To explore how to balance staff security with therapeutic regard and kindness toward patients.
5. To provide an understanding of how perceived threats to personal safety may influence psychiatric patient care and patient outcomes.

Poster #5 *The Ergonomics of Electronic Medical Records*

Susan Kotowski, & Kermit Davis, PhD

University of Cincinnati

With advances in technology, health care facilities are beginning to embrace Electronic Medical Record (EMR) technology for numerous reasons including: ease of information sharing, reduced expenses, increased user and patient satisfaction over conventional paper record methods, increased productivity, and decreased medical errors. While numerous studies on EMR technology have examined satisfaction by users and patients, compatibility between the user and the interface (software), and economic impact of the technology; there has been a failure to investigate the potential ergonomic issues associated with implementation of EMR technology. Potential ergonomic issues include adaptability of the user to the technology (e.g. computer savvy individuals vs. individuals not as familiar with computers), issues with an aging healthcare workforce (e.g. declining vision, decreased dexterity), musculoskeletal discomfort associated with use of the technology (e.g. repetition during information input, and postures associated with using the device), and issues unique to the specific type of EMR input device (e.g. tablet, desktop, or laptop). There are two hypotheses for the proposed study. *First, it is hypothesized that musculoskeletal strain for EMR users will be prevalent in body regions different than those in the current paper and pen record keeping method.* It would be expected that how the nurses and doctors interact with the recording method would be significantly different and potentially stressful to different parts of the body. *Secondly, there will be ergonomic risk factors unique to each type of input device (tablet, desktop, laptop).* The size of the EMR will have a direct influence into how users interact with the devices, potentially resulting in different musculoskeletal stress. The proposed study will provide the first extensive ergonomic stress evaluation to determine the nuances of the interaction between the used and EMR.

Poster #6 *Predicting Youth Farm Injury: A Psychosocial Perspective*

Jennifer Yugo

Bowling Green State University

Youth farm workers are exceptionally vulberable to work injuries and illnesses because of two risk factors: age and industry. Farming consistently ranks among the nations most dangerous occupations, with high risks for fatal and non fatal injuries as well as chronic health conditions such as hearing loss, skin diseases and certain cancers.

The overarching goal of the proposed pilot study is to complete a holistic assessment of the predictors of injury to youth workers on farms. More specifically, while past research has looked at specific demographics, farm characteristics or psychosocial variables in isolation, the proposed research will analyze a multitude of these predictors in a comprehensive longitudinal design. To strengthen the causal validity of the results, this study will have a longitudinal design with participants completing measures three times at two month intervals. This research will take place in the summer and fall months, when youth farm labor is most prevalent. Results of this

pilot study will illuminate which predictors of injury generalize across all subareas of agriculture as well as predictors that are especially pernicious in a particular area. In the long term, this grant will serve as the foundation to create or enhance existing interventions for youth farm workers.

Youth farm injury is a compelling issue to industry, parents, adolescents, the medical community and farm organizations. Research in this area can inform these stakeholders on how to increase safety and reduce injury. As farms are often grouped together in certain areas, knowledge of the predictors of youth farm injury can be disseminated and interventions targeted at local levels.

Poster #7 Evaluating the NIOSH Lifting Equation for Obese Workers

Devender Singh & Woojin Park, PhD
University of Cincinnati

Studies have shown that obese individuals constitute a significant portion of the workforce today. Obese people, because of their heavier body mass due to excess body fat, may experience higher biomechanical stresses/loadings (e.g., spinal compressive forces) at the low back spine area than non-obese workers during common lifting activities.

Despite the prevalence of obesity and the potential LBD risks associated with it, currently, no ergonomic MMH evaluation/design tools exist, which are proven to be able to identify LBD risks for the obese population. The lack of MMH evaluation/design tools proven to be accurate for the obese population is problematic, because it represents a difficulty in protecting the emerging obese population from LBD risks.

Therefore, the objective of this pilot study is to determine whether a widely used lifting task evaluation/design tool, the 1991 NIOSH lifting equation, is capable of determining the safe load weight limits for the obese population, and thus, identify a need for modifying the NIOSH lifting equation for the special population of the obese individuals in future studies. In order to accomplish the research objective, the proposed research will biomechanically estimate static low back spinal compression forces experienced by obese individuals during various lifting tasks (non-repetitive) with NIOSH Recommended Weight Limits (RWLs), and compare them with the NIOSH Action Limit (AL) of spinal loading (3400 N). If static spinal compression forces experienced by obese individuals during lifting tasks with RWLs exceed the NIOSH AL, then it indicates that the biomechanical criterion that was used for the development of the NIOSH equation is violated, and the current NIOSH equation is not able to accurately quantify LBD risks for the obese individuals, at least, in light of its own biomechanical criterion. Thus, the Hypothesis to be tested is: Static spinal compression forces experienced by obese individuals during non-repetitive, one-time lifting tasks with RWLs (Lifting Index, LI=1) are equal to or less than the NIOSH action limit (3400 N).

A motion capture experiment will be conducted to accomplish the research goal. 40 obese individuals (20 moderately obese [30 kg/m^2 <BMI<40 kg/m^2] and 20 morbidly obese [BMI>40 kg/m^2]) will participate in this experiment. In each obesity classification, we will consider 10 male and 10 female. Each subject will perform 16 different lifting tasks (2 H x 2 V x 2 D x 2 A) with the corresponding RWLs. Therefore, a total of 480 (30 subjects x 16 tasks) motions will be performed. Time trajectories of the positions of the optical markers will be obtained by the

VICON motion capture system with a sampling frequency of 120 Hz. Joint angles will be computed based on the VICON marker position data according to the joint angle definitions of the 3DSSPP. Static low back spinal compression forces experienced by obese individuals while performing various lifting tasks (non-repetitive) with NIOSH recommended weight limits (RWL) will be computed using a biomechanical analysis software program (3DSSPP). A t-test will be used to investigate if the calculated mean L5/S1 spinal disc compression force is statistically less than NIOSH action limit (3400N). Significance of the statistical test will be accepted when $p \leq 0.05$.

Poster #8 *Comparison of Two Methods for Measurement Of Fungal (1-3)-p-d-glucan*

Yulia Iossifova

University of Cincinnati

Exposure to fungal (1-3)-β-D-glucans in the workplace is of increasing concern, but methods of assessing that exposure are not well defined. Currently there are two methods used for the analysis of (1-3)-β-D-glucans in the environment– the *Limulus Amebocyte* Lysate (LAL) assay, based on specific enzyme activation, and the inhibition Enzymatic Immunoassay (EIA), based on an antigen-antibody reaction. So far little is known on how these two methods compare, and data on their reliability as pure mold exposure surrogates are scarce and controversial. Thus this study will evaluate the sensitivity and specificity of two methods for assessing exposure to (1-3)-β-D-glucans in workplaces. This will be accomplished by comparing LAL and EIA analyzed (1-3)-β-D-glucan types and concentrations via samples spiked with known concentrations of linear (1-3)-β-D-glucan, and branched (1-3)(1-6)- and (1-3)(1-4)-β-D-glucan standards. (1-3)-β-D-glucans are of diverse structures and can cause a variety of biological reactions in vivo and in vitro experiments. Thus in order to explain the different health effects observed in occupational environments it is important to investigate the content and structure of (1-3)-β-D-glucans in the most common fungal species found in occupational organic dust and workplace indoor environments. This will be done by LAL/EIA analysis of selected indoor fungal species against linear (1-3)-β-D-glucan, and branched (1-3)(1-6)- and (1-3)(1-4)-β-D-glucan standards of known concentrations. This will help explain the various health effects observed after exposure to different types of mold , as well as to determine the most sensitive and specific assay for the analysis of (1-3)-β-D-glucan in occupational samples. These data can be used in future large-scale population-based studies to assess occupational mold exposures. The results from this study will also be used as the basis for an NIH grant application on the use of (1-3)-β-D-glucan as a measure of mold when investigating the mold-related respiratory health effects.

Poster #9 *Physical and Psychosocial Demands On Day and Nigh Shift in Nursing Homes*

Chunhui He & Kermit Davis, PhD

University of Cincinnati

Health care workers are experiencing increasing numbers of occupational injuries and illnesses. National data compiled by the Bureau of Labor Statistics (BLS) show that the rate of work-related injury or illness requiring medical treatment or lost work was 8.8 per 100 fulltime hospital workers, and 13.5 per 100 among nursing home workers in 2001. In addition to the highly involved physical demand, the nursing aids have extra stress from working extended hours (12 hours work days), dealing with life and death situations, high mental demands, less of social activities (shift work) and potential violent acts from residents. These demands may be directly related

to the shift that the nurse works (e.g. more demanding physically during day shift). Since better understanding of nurses' physical and psychological demands in nursing homes may help in designing interventions or policy development to decrease injury rate and turnover. Therefore, the objective of this study is to differentiate and quantify the physical and psychosocial demands among nurses working on day and night shift, as well as to investigate any musculoskeletal disorders among day and night shift nursing assistants working in nursing homes.

Poster #10 Evaluating Vapor Intrusion from Gasoline Underground Storage Tanks

Sheryl A. Milz, PhD
Medical University of Ohio

Vapor intrusion is the movement of volatile chemicals from contaminated soil into buildings and their airspace. Gasoline releases result in petroleum constituents contaminating soil. The overall goal of this pilot project is to evaluate the potential for exposure from vapor intrusion of workers within operating establishments surrounded with petroleum contaminated soil from previously leaking underground storage tanks. The volatile petroleum constituents of interest are benzene, ethyl benzene, toluene, and xylenes. Specific aims of the project will be to systematically characterize the airborne concentrations of the volatile petroleum constituents of interest, to determine the proportion of the airborne concentrations attributed to vapor intrusion, and then to compare the measured airborne concentrations with the results from the USEPA vapor intrusion model. To accomplish these aims area air sampling will be conducted over a 24-hour period both inside and outside of three sites with a prior gasoline release. Measured subsurface contaminant levels along with geologic conditions and hydrogeologic conditions will also be obtained for the three participating facilities through Freedom of Information Act requests in order to utlize site specific information in the USEPA vapor intrusion model. Statistical analylsis will be used to compare the results from the area air sampling and the vapor intrusion model at each of the three sites.

The National Institute for Occupational Safety and Health (NIOSH) and its partners established the National Occupational Research Agenda (NORA) in 1996 to guide research in 21 priority areas. The four areas addressed by this pilot project are indoor environments and mixed exposures, under the work environment and workforce grouping, and exposure assessment methods and risk assessment methods, under the research tools and approaches grouping.

NOTES

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Education and Research Center
Pilot Project Research Program

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Participating Universities

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Kentucky State University
Medical University of Ohio
Murray State University
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