23rd Pilot Research Project Symposium

OCTOBER 20-21, 2022

PROGRAM BOOKLET

University of Cincinnati Education and Research Center (ERC) Supported by the National Institute for Occupational Safety and Health (NIOSH) Grant # T42-OH008432

2022 Pilot Research Project (PRP) Symposium
University of Cincinnati NIOSH Education and Research Center
October 20-21, 2022
University of Cincinnati, College of Nursing, Procter Hall & Graduate Cincinnati Hotel

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About the ERC and PRP

Welcome to the University of Cincinnati Education and Research Center's (ERC) **23rd Annual Pilot Research Project (PRP) Symposium** on October 20-21, 2022 held at the University of Cincinnati, College of Nursing, Procter Hall and Graduate Cincinnati Hotel. 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 and Dr. Gordon Gillespie, research proposals are solicited and peer-reviewed annually by qualifying faculty and graduate students from the **University of Cincinnati and the following PRP partnering institutions – Air Force Institute of Technology, Bowling Green State University, University of Toledo – Health Science Campus, Central State University, Purdue University, University of Kentucky, Western Kentucky University, Eastern Kentucky University, Murray State University, Ohio University and Kentucky State University.**

At this symposium, the 2021-22 awardees will be presenting the results of their research and the 2022-23 awardees will make poster presentations of their proposed work. The keynote speaker on Thursday, October 20, 2022 is **Dr. Tiina Reponen, Professor Emerita at the University of Cincinnati, presenting on "Bioaerosol Research in the Nexus of Public and Occupational Health."**

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

Since 1999, the PRP program has allocated over $1.6 million to support 273 pilot research projects. These projects have served as a catalyst in bringing over $43 million in additional research support to the region from sources independent of the PRP program, such as, the National Institute for Occupational Safety and Health (NIOSH), National Institutes of Health (NIH), United States Department of Agriculture (USDA), National Science Foundation (NSF), and the Centers for Disease Control and Prevention (CDC). Additionally, the PRP has brought 65 new investigators from other fields of expertise to the area of occupational safety and health research.

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Thursday, October 20, 2022

8:30am-12:30pm	**Careers Workshop** *Kettering Lab, G23*	Lab tours and Q&A meeting with current ERC graduate students. Workshop is for students interested in learning about and pursuing UC ERC graduate programs.

Symposium Start

11:30am	**Welcome Reception** *Procter Hall 3rd Floor Atrium*	
1:00pm	**Welcoming Remarks** *Graduate Cincinnati Hotel*	Alex Lentsch, PhD, Sr. Associate Dean and Acting Chair of the Department of Environmental and Public Health Sciences
1:10pm	**Introduction of Education and Research Center** **Introduction of Keynote Speaker** *Graduate Cincinnati Hotel*	Amit Bhattacharya, PhD, CPE, ERC & PRP Program Director *University of Cincinnati, Environmental and Public Health Sciences*
1:15pm	**Bioaerosol Research in the Nexus of Public and Occupational Health** *Graduate Cincinnati Hotel*	Tiina Reponen, PhD *University of Cincinnati, Environmental and Public Health Sciences*
2:00pm	**Synthesis and Fabrication of Group III-V Doped Carbon Nanotube-based Biosensors** *Graduate Cincinnati Hotel*	Anuptha Pujari *University of Cincinnati, Mechanical and Materials Engineering*
2:20pm	**Workplace Violence Among Young Black Workers Ages 18-24 in Southcentral Kentucky** *Graduate Cincinnati Hotel*	Edrisa Sanyang and Shwe Win *Western Kentucky University, Public Health*
2:40pm	**Poster Session 1 and Break** *Procter Hall 3rd Floor Atrium*	*See page 3 for poster titles*
3:20pm	**Poster Session 1 Q&A** *Graduate Cincinnati Hotel* *Moderator: Dr. Gordon Gillespie*	Dania Abu-Alhaija, Elizabeth Keller, Guoyang Zhou, Kavitha Joseph, Aaron Vissman
3:50pm	**Work Stress, Poor Recovery, and Burnout in Nurses** *Graduate Cincinnati Hotel*	Grayson Sturgis *Bowling Green State University, Psychology*
4:10pm	**Occupational Safety and Health in the Wake of Drones** *Graduate Cincinnati Hotel*	Hoda Rahmani *Ohio University, Industrial and Systems Engineering*
4:30pm	**Carbon Nanotube-based Chemical Deactivation Membrane for Air Filtration** *Graduate Cincinnati Hotel*	Megha Chitranshi *University of Cincinnati, Electrical Engineering and Computer Science*
5:00pm	**Networking Dinner** *Procter Hall 3rd Floor Atrium*	

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Friday, October 21, 2022

7:15am	**Breakfast and Networking** *Procter Hall 3rd Floor Atrium*	
8:00am	**Welcoming Remarks and Introductions** *Graduate Cincinnati Hotel*	Gordon Gillespie, PhD, DNP, RN, PRP Deputy Director *University of Cincinnati, Nursing*
8:10am	**Assessment of Phase Change Material based Enhanced Cooling Helmets for the Firefighters** *Graduate Cincinnati Hotel*	Navaneeth Chandran and Nabin Khanal *University of Cincinnati, Mechanical and Materials Engineering*
8:30am	**Investigation of Occupationally-related Stress of At-risk Workers During COVID-19** *Graduate Cincinnati Hotel*	Thomas Gerding *University of Cincinnati, Environmental and Public Health Sciences*
8:50am	**Pressure to Attend Work when Unwell: Health and Safety Consequences among Nurses** *Graduate Cincinnati Hotel*	Lindsey Freier *Bowling Green State University, Psychology*
9:10am	**Poster Session 2 and Break** *Procter Hall 3rd Floor Atrium*	*See page 3 for poster titles*
9:50am	**Poster Session 2 Q&A** *Graduate Cincinnati Hotel* *Moderator: Dr. Gordon Gillespie*	Mahnoosh Khosravifar, Michaela Keener, Sukanta Bhattacharya, Vamsi Kondapalli, Je-Hyeong Bhak
10:20am	**Break & Vote for Favorite Poster and Presenter** *Graduate Cincinnati Hotel*	Voting link is in the Whova app and at the registration desk
10:30am	**Panel Discussion of the Podium Presentation Topics** *Graduate Cincinnati Hotel* *Moderator: Dr. Gordon Gillespie*	Ellen Wells, Aaron Vissman, Kermit Davis, Tom Huston, Amit Bhattacharya *Purdue University; University of Cincinnati*
11:30am	**BEST Award Presentations** *Graduate Cincinnati Hotel*	Amit Bhattacharya, PhD, CPE, ERC & PRP Program Director *University of Cincinnati, Environmental and Public Health Sciences*
11:50am	**Closing Remarks and Program Evaluation** *Graduate Cincinnati Hotel*	Amit Bhattacharya, PhD, CPE, ERC & PRP Program Director *University of Cincinnati, Environmental and Public Health Sciences*

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2022-23 PRP Awardee Posters & Invited Posters

#	Title	Presenter	Program
1	Factors and Strategies Influencing Chemotherapy Safety among Oncology Nurses	Dania Abu-Alhaija	*University of Cincinnati, College of Nursing*
2	Evaluating Stress and Wellbeing Trends in U.S. Correctional Nurses	Elizabeth Keller	*University of Cincinnati, College of Nursing*
3	Real-time Lifting Risk Prediction Using Tactile Gloves	Guoyang Zhou	*Purdue University, School of Industrial Engineering*
4	Carbon Nanotube-based Thermoelectric Fabrics Providing Thermal Comfort and Power Generation for Firefighters	Je-Hyeong Bahk	*University of Cincinnati, Mechanical and Materials Engineering*
5	Flexible and Wearable Supercapacitors for Fire Fighters and First Responders	Kavitha Joseph	*University of Cincinnati, Mechanical and Materials Engineering*
6	Nitrogen-doped Three-dimensional Graphene as a Sensor for Heavy Metals	Mahnoosh Khosravifar	*University of Cincinnati, Mechanical and Materials Engineering*
7	Multi-sensor Occupation Specific Energy Expenditure Models for Race Riders	Michaela Keener	*University of Kentucky, Rehabilitation and Health Sciences*
8	Evaluating Microbiome as Biomarkers in Firefighting Associated Stress	Sukanta Bhattacharya	*University of Cincinnati, Environmental and Public Health Sciences*
9	Cool Helmet for First Responders Based on Nano Carbon Composite and Thermoelectrics	Vamsi Kondapalli	*University of Cincinnati, Mechanical and Materials Engineering*
10	Needs and Capacity of the Open Access Withdrawal Management Model: Occupational Perspectives on Clinically Managed Residential Detox in southern Ohio	Aaron Vissman	*University of Cincinnati, Environmental and Public Health Sciences*

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Important Links

Whova app instructions

- App includes speaker bios, agenda, abstracts, locations/maps, and all other event information
- If you registered ahead of time, use the email you registered with to access the event in the Whova app
- If you did not register in advance you can download the app in your app store and use the code **"ulxk9ld7aa"** to access the event
- Access the desktop version of the event here

Voting for favorite poster and presenter
Program Evaluation
Speaker webpage
PRP Agenda webpage
ERC upcoming events

Continuing Education

Attendees are eligible for the continuing education options below, certificates will be emailed after completing the post-event evaluation.

- Meets BGC criteria for IH/CIH professionals; https://gobgc.org/
- Meets BCSP criteria for professional development conference CSP recertification points; https://www.bcsp.org/recertification/

Social Media

Twitter

- Follow us on Twitter @uc_erc
- Use **#23PRP** in all of your PRP related comments and questions so they will be displayed in the event feed

Facebook

- Follow and like us on Facebook at University of Cincinnati NIOSH Education and Research Center

CERKL

- Subscribe to our CERKL pages at CERKL.com to get email newsletters about ERC program events, alumni news, job opportunities and more
- Subscribe to one or all of the ERC CERKL pages to receive updates via email: UC Education and Research Center, UC Environmental & Industrial Hygiene, UC Occupational Health Nursing, UC Occupational Medical Residency, UC Occupational Safety and Health Engineering

Instagram

- Follow us on Instagram @uofcincy_erc

Sponsors

Thank you to the Ohio Association of Occupational Health Nurses
For more information about OAOHN visit their website

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2021-22 PRP Awardee Podium Abstracts

Synthesis and Fabrication of Group III-V Doped Carbon Nanotube-based Biosensors

Anuptha Pujari (PI) and Mark Schulz
University of Cincinnati, Mechanical and Materials Engineering

In the medical industry there is always a never-ending substantial need for point – of care devices, tailored medicines, and cheaper tools for diagnosis. Due to the increasing demand for such devices the need for the development of Biosensors with new materials has become vital in modern day healthcare. One of the major challenges faced during the designing miniature electrochemical biosensors is establishing a faster transfer of electrons between the electrochemical transducer and the active site of the enzyme. Carbon nanotubes provide excellent electrical conductivity for biosensor applications. The main focus of this project is to improve the electrical conductivity of CNTs by doping with group III -V compounds. Carbon nanotube structures consist of highly stable nanotube shells which have a high specific surface area and a large aspect ratio. However, the methods currently used for the manufacturing of CNTs cannot be scaled up to produce higher outputs of CNTs. As part of this project, we have also scaled up and the process to producer larger sheets of CNTs. About 25 CNT sheets were made with improved electrical conductivity.

Workplace Violence Among Young Black Workers Ages 18-24 in Southcentral Kentucky

Edrisa Sanyang (PI), Ritchie Taylor, Gretchen Macy, and Jacqueline Basham
Western Kentucky University, Public Health

Workplace violence and work-related attacks may go unnoticed, but this important public health problem can affect populations across the lifespan. However, young black workers are at a higher risk, not only because they are a minority, but also disadvantaged due to age-related psychological development. They are also commonly left out in occupational health databases because they are not thought of as workers.

This study includes young black workers ages between 18 and 24 years in Southcentral Kentucky. Participants identified themselves as victims of workplace violence by completing a recruitment survey. The survey was distributed via social media posts including sharing recruitment YouTube video on the Western Kentucky University (WKU) Student Support Services (SSS) TRIO program and Intercultural Student Engagement Center (ISEC) Instagram. It was also share via email feeds of majority black associations or other groups. Data is being collected using Key Informant Interviews (KIIs). Participants discuss risk factors and characterize workplace violence, describe the relationship of perpetrators to the workplace, supports received from the employer, and how the violent event was resolved. Participants also described the effects of the violent event on their education and employment. The data collection is ongoing. Interviews are expected to end in September 2022.

Work Stress, Poor Recovery, and Burnout in Nurses

Grayson Sturgis (PI)[1], Clare Barratt[1], Seth Brooks[1], and William O'Brien[2]
[1]Bowling Green State University, Industrial/Organizational Psychology; [2]Bowling Green State University, Clinical Psychology

Purpose: Examine how nurses engage in stress recovery and the potential effects of specific recovery behaviors on overall well-being (i.e. physical and psychological health).
Design: Longitudinal daily diary design (2 daily online surveys for 14 days) with a sample of approximately 200 full-time nurses.
Methods: Analysis will be conducted via hierarchical linear modeling and descriptive statistic comparisons.

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Results: Data collection still in progress; currently launching a second wave of collection to increase N; data, discussion, and conclusion will be presented at the 2023 conference.
We expect, however, to find that recovery experiences moderate the relationship between stress and well-being such that the positive stress x burnout relationship is buffered by recovery experiences.
Conclusion: See above

Occupational Safety and Health in the Wake of Drones

Hoda Rahmani (PI)[1], Gary Weckman[1], and Darrell Binnion[2]
[1]Ohio University, Industrial and Systems Engineering; [2]Texas Commercial Aerial, Solar Panel Inspection

The body of research examining the integration of drones into various industries is expanding rapidly, particularly in construction, mining, agriculture, and public safety. Despite progress made in addressing the cybersecurity concerns for commercial drones, knowledge deficits remain in identifying potential occupational hazards and risks of drone use to employees' well-being and health in the workplace. This creates difficulty in determining key approaches to risk mitigation strategies, and thus reflects the need for raising awareness among employers, safety professionals, and policy makers about workplace drone-related accidents. The purpose of this study is to examine the prevalence of drone-related mishaps and identify possible risk factors associated with flying drones in different industries. Understanding these factors through evidence-based practices will help address the pressing knowledge gaps in current literature and extend human performance in safe and fulfilling ways.

Carbon Nanotube-based Chemical Deactivation Membrane for Air Filtration

Megha Chitranshi (PI)[1], Mark Schulz[2], Sergey Grinshpun[3], and Marc Cahay[1]
[1]University of Cincinnati, Electrical Engineering and Computer Science; [2]University of Cincinnati, Mechanical and Materials Engineering; [3]University of Cincinnati, Environmental and Public Health Sciences

This project was to synthesize carbon nanotube (CNT) sheet for particulate matter filtering applications. The pilot grant was used to produce CNT filtering sheet using the floating catalyst chemical vapor deposition synthesis method. A composite filter was fabricated using CNT filtering layer and other conventional filtering material. The composite filters were tested for filtration efficiency and pressure drop. The funds were used to purchase materials for making CNT filter layer and supplies such as process gases used in the research. The data obtained from the project is also being used toward publication of paper and for one chapter in my doctoral dissertation.

The goal of this research was to manufacture a CNT based composite PM air filter. This research provides the engineering pathway and technology hardware to successfully integrate desirable metals in the CNT matrix in a scalable process for multiple novel applications.

Assessment of Phase Change Material based Enhanced Cooling Helmets for the Firefighters

Navaneeth Chandran (PI), Nabin Khanal, and Rupak Banerjee
University of Cincinnati, Mechanical and Materials Engineering

Firefighters, miners, construction workers and people working in high temperature environment are subjected to high thermal stress conditions during their work which can lead to heat related adverse health effects. Regulation of body as well as brain temperature is critical for their health. Regulation of brain temperature can be achieved by external cooling of head. A portable head cooling system that can be used in firefighting, mining, and working in high temperature in general is currently unavailable. Experimental model of portable head cooling system was designed and studied in our

lab previously. This study proposes an optimized computational model of portable head cooling device which can actively cool the head temperature during firefighting. The model consists of a heater which mimics the head of the firefighter, a heat exchanger which contains Phase Change Material (PCM) that will help to cool the head temperature, a pump and two valves which will assist to maintain the constant flow within the loop. The study was done in two parts: 1) Creation of computational model mimicking and validating the performance of the experimental study, 2) Optimizing the device by increasing the duration of cooling using PCM and taking external temperature as variable. This computational model is optimized for varying heat load representing the rest to exercise conditions (20 W – 40 W) with varying flowrate (0.25 l/min – 0.65 l/min). The model shows that the head cooling device can cool the head temperature for 136 min for 40 W which is the highest load condition in the study with flowrate of 0.65 l/min. The results suggest that the portable head cooling system can assist in the thermoregulation of brain temperature and can optimize the duration of cooling to increase the safe duration for workers in the elevated heat stress conditions.

Investigation of Occupationally-related Stress of At-risk Workers During COVID-19

Thomas Gerding (PI)[1], Jun Wang[1], and Peggy Zoccola[2]

[1]University of Cincinnati, Environmental and Public Health Sciences; [2]Ohio University, Psychology

Chronic stress has been associated with a range of health disparities, but examination of occupational stress, especially in the wake of COVID-19, has been minimal for many career fields. A novel methodology involving work stress diaries and collection of salivary cortisol was employed to determine correlations between occupations, occupational stressors, and how well these are related to the physiological response to stress exposure, the release of cortisol within the body. While cortisol levels tended to follow typical circadian rhythm based on sampling times, cortisol levels also followed the subjective stress levels listed in the work stress diaries following linear regression analysis using the pooled study population data ($p = 0.042$). When comparing the stressors between the studied careers, the participants who worked in the healthcare industry accounted for one-third of the total participants, but accounted for nearly half (42%) of the more severe occupational stressors listed in the diaries. Finally, the most commonly listed emotional reactions to exposures listed included feelings of stress, frustration, anger, anxiety, or overwhelm. As the workplace progresses from the pandemic, the opportunity to reduce occupational stress exposures in the workplace is at hand. Companies that work towards minimizing the stress faced by their workforce would have a healthier and more relaxed workforce. This study helps to lay the foundation of correlating occupational stress experienced with physiological response (i.e., cortisol fluctuation).

Pressure to Attend Work when Unwell: Health and Safety Consequences among Nurses

Lindsey Freier (PI)[1], Melissa Albert[1], Susannah Huang[1], Samuel McAbee[1], Claire Smith[1], Michael Valigosky[2], and Susan Batten[3]

[1]Bowling Green State University, Industrial/Organizational Psychology; [2]University of Toledo, School of Population Health; [3]University of Toledo, College of Nursing

Purpose: The purpose of this study was to investigate how presenteeism pressure among nurses affects their health and safety engagement, including the mitigating or exacerbating effects of supervisor support and job design characteristics.

Design/Methods: This study used a time-separated survey design in a sample of 127 registered nurses who reported on their levels of presenteeism pressure, presenteeism behavior, burnout, safety behaviors, and supervisor support and job design characteristics.

Results: Findings suggest that presenteeism pressure predicts presenteeism behavior and burnout, but not safety behaviors. Supervisor support and job design characteristics did not interact with presenteeism pressure in predicting these outcomes.

Conclusion: Organizational pressure to work when unwell (presenteeism pressure) predicts engagement in presenteeism behavior and burnout, but more research is needed to investigate further outcomes and boundary conditions.

Impact Statement: In attempts to limit nurses' absenteeism, organizations may be inadvertently pressuring nurses to attend work when unwell, driving high burnout rates in this occupation.

2022-23 PRP Awardee Poster Abstracts

Factors and Strategies Influencing Chemotherapy Safety among Oncology Nurses

Dania Abu-Alhaija (PI), Gordon Gillespie, Elaine Miller
University of Cincinnati, College of Nursing

Exposure to chemotherapy drugs is a serious occupational hazard affecting oncology nurses. It could result in genetic mutations, miscarriages, reproductive problems, and a higher risk to develop cancer. About 14% of 1,814 oncology nurses who responded to a survey indicated that they were exposed to chemotherapy through skin or experienced chemotherapy spills in the previous week. Evidence from the literature indicates that some essential measures to protect nurses against chemotherapy exposure are not adopted in oncology settings. Also, nurses show less than the recommended levels of adherence to the guidelines when handling chemotherapy. The purpose of this proposal is to describe the factors that affect chemotherapy exposure among oncology nurses and strategies to foster chemotherapy safety by eliciting the perspectives of nurses and nurse managers. Involving people at the leadership level in addition to oncology nurses will help in providing richer and more comprehensive insights on the problem and possible solutions. This study employs a sequential exploratory mixed method design. There are two specific aims for this proposal. Aim 1: describe the factors that influence chemotherapy exposure among oncology nurses and strategies to foster chemotherapy safety from the viewpoints of nurses and nurse managers. We will conduct qualitative interviews with oncology nurses (n=15-20) and oncology nurse managers (n=10) through phone. Findings from the interviews will help in identifying the factors affecting chemotherapy exposure among oncology nurses and strategies to foster chemotherapy safety. Also, it will assist in refining the previously developed Oncology Nurses' Health Behaviors Determinants Scale (ONHBDS), so it would serve as a more comprehensive measure of the phenomenon. Aim 2: assess the psychometric properties of the revised ONHBDS on a sample of oncology nurses. This will be accomplished by administering the surveys 1) Chemotherapy exposure knowledge 2) Revised Hazardous Drugs Handling Questionnaire and 3) the Revised Oncology Nurses' Health Behaviors Determinants Scale to a sample of oncology nurses (n=162) using a cross-sectional design.

Evaluating Stress and Wellbeing Trends in U.S. Correctional Nurses

Elizabeth Keller (PI)[1], Beverly Hittle[1], Gordon Gillespie[1], Samantha Boch[1], Kermit Davis[2], Joshua Lambert[1]
[1]University of Cincinnati, College of Nursing; University of Cincinnati, [2]Department of Environmental and Public Health Sciences

Despite the U.S. maintaining the largest correctional system in the world, little is relatively known about the health and wellbeing of the employees that uphold and work in this system. Unfortunately, even less is known about the health and wellbeing of correctional nurses. The purpose of this study is to comprehensively evaluate organizational characteristics,

job stress, and wellbeing levels among correctional nurses and predict wellbeing levels based on their environmental factors. If left unmanaged, job stress can negatively affect employees and their families, along with organizational, and patient outcomes. We will employ a descriptive correlational, cross-sectional, survey using convenient based methods. A goal of 270 correctional nurses across the United States will complete the survey, sampled through social media, the American Correctional Nurses Association (ACNA) webpage, and emails available from the National Commission on Correctional Health Care (NCCHC). The Job Demands-Resource Theory has guided the development of a conceptual model, informing the variables of interest that will be measured in the survey. Such variables of organizational characteristics, job stress, and wellbeing, will be evaluated with validated and reliable tools: Health & Safety Executive Management Standards Indicator Tool; the Perceived Stress Scale (PSS-10); and the Nurse Wellbeing Index. Demographic moderators of age, sex, race, and ethnicity, will be determined with questions adapted from the Behavioral Risk Factor Surveillance System Survey (BRFSS), with additional questions of nursing licensure, environment type, U.S. state, and time spent in correctional role, based on the Agency for Healthcare and Research Quality (HRQ) Hospital Survey on Patient Safety Culture Database. Descriptive statistics will be used to summarize the characteristics of the sample. Multiple linear regression modeling will be used to explore the relationships between organizational characteristics and wellbeing, mediated by job stress. Results will provide a national snapshot and understanding for the wellbeing of correctional nurses and serve as baseline data because limited data exists. Results will also inform the development of future studies with this population that enhance worker wellbeing.

Real-time Lifting Risk Prediction Using Tactile Gloves

Guoyang Zhou (PI), Denny Yu
Purdue University, School of Industrial Engineering

Lifting tasks remains one of the leading causes of workplace injuries. Assessing the lifting risk at workplaces is essential for reducing the injuries caused by lifting tasks. Although tools have been developed to evaluate the lifting risk, their implementation at workplaces is challenging because the lifting weight cannot be observed and estimated, and practitioners cannot widely adopt the intrusive sensors or computer vision techniques. A reliable and convenient tool is needed for assessing the lifting risk at workplaces. The proposal proposes using tactile gloves with deep learning techniques to predict the lifting index, a well-validated indicator of lifting risk determined by the NIOSH Lifting Equation. Specifically, this work plans to develop a software that takes a raw recording of the tactile gloves as input and predicts the lifting index of each lifting action lying in the raw recording. Since the raw recording of the tactile gloves can be untrimmed and contains various hand actives not associated with lifting, a lifting action detection module will be embedded in the software to locate the start and end of each lifting action lying in the raw recording. The proposed tool utilizing tactile gloves with deep learning techniques can provide an alternative and reliable method for practitioners to evaluate workers' injury risk in lifting without being too intrusive to workers.

Carbon Nanotube-based Thermoelectric Fabrics Providing Thermal Comfort and Power Generation for Firefighters

Je-Hyeong Bahk (PI), Vesselin Shanov
University of Cincinnati, Mechanical and Materials Engineering

The aim of this proposal research is to develop thermoelectric (TE) fabrics woven from carbon nanotube (CNT) fibers for use in firefighter suits to perform both power generation and temperature control for firefighters. Long CNT fibers spun from CNT arrays by the dry spinning process will be selectively doped into n-type (negatively charged) and p-type (positively charged) sections and then woven into a fabric. This CNT fabric will be embedded in the thermal barrier layer of a firefighter suit to utilize the maximum temperature difference available while maintaining the structure of the

existing fabric. Based on the thermoelectric effects, CNT fabrics can convert heat input driven by the temperature difference between the outside and the inside of the suit to electricity. This power-generating TE fabric can potentially replace batteries to power sensors and electronics equipped in next-generation smart firefighter suits, eliminating the need for frequent battery recharging and replacement. Furthermore, the same fabric can be used to keep the temperature inside the suit at a comfort level for firefighters by active cooling. For the cooling operation, an electric current is injected into the fabric to induce heat transfer from the inside to the outside of the suit by the Peltier effect, thus achieving cooling inside the firefighter suit. We will fabricate several small fabrics with varying fiber diameter, density, and CNT doping level and fully rest both power generation and cooling performance within the firefighter suit fabric structure.

Flexible and Wearable Supercapacitors for Fire Fighters and First Responders

Kavitha Joseph (PI), Vesselin Shanov
University of Cincinnati, Mechanical and Materials Engineering

The research project proposes the design and fabrication of flexible and wearable supercapacitors and their incorporation into the fabrics of firefighters and first responders. Flexible and wearable electronic devices have gathered significant attention due to their vast potential in applications like healthcare monitoring systems, environmental monitoring systems, military equipment, safety, and construction areas. However, the greatest challenge for such wearable devices is the lack of power supply that is equally flexible, lightweight, durable, biocompatible, and strong. Traditional energy storage devices are hard, heavy, and bulky and unable to be integrated into humans and other portable devices. Therefore, the need for thin, lightweight, and deformable supercapacitors which can be conveniently integrated into the fabrics. This project is based on lightweight and flexible supercapacitors based on carbon nanotube and its composites. The unique properties of carbon nanotubes like high surface area, low density, superior electrical and mechanical properties, high mesoporosity, and electrochemical stability make them the best candidates for this application.

Nitrogen-doped Three-dimensional Graphene as a Sensor for Heavy Metals

Mahnoosh Khosravifar (PI), Vesselin Shanov
University of Cincinnati, Mechanical and Materials Engineering

This proposal focuses on developing highly sensitive sensors for heavy metal sensors like Pb2+ and Cd2+ in water based on three-dimensional graphene structure. Carbon-based nanomaterials and particularly graphene, have received increased interest as sensors due to their outstanding properties such as low density, interconnected porous structure, fast electron transfer rate, large specific surface area, mechanical stability, and flexibility. The incorporation of active materials such as nitrogen has proven to increase the electrochemical performance of graphene-based structures. The detection of Pb2+ has been done successfully using our nitrogen-doped three-dimensional graphene (N3DG) in our previously funded project by PRP; however, we are seeking a lower limit of detection down to pM as well as investigating the Cd2+ sensing with this structure. The improvement in the limit of detection will be implemented by optimizing the sensor-making process to get the best result by Square-Wave Anodic Stripping Voltammetry (SWASV) method.

Multi-sensor Occupation Specific Energy Expenditure Models for Race Riders

Michaela Keener (PI)[1], Kimberly Tumlin[2], Nicholas Heebner[3]
[1]University of Kentucky, Rehabilitation and Health Sciences; [2]University of Kentucky, Department of Epidemiology, College of Public Health; [3]University of Kentucky, Sports Medicine Research Institute

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Jockeys are non-standard, independent contractors with variable work patterns and strict weight restrictions for Thoroughbred jockeys resulting in dangerous weight-making strategies, including restricted calories, long-term fasting, and self-induced vomiting. There are currently no occupational-specific energy expenditure estimations for galloping activities including training on live horses and horse simulators. Pilot data show that riding a galloping simulator's upper body movement patterns increase heart rate disproportionately to oxygen consumption. Oxygen consumption is the gold standard for calculating caloric expenditure. These findings suggest the need to include movement (kinematic) data to heart rate and respiration rate (kinetic data). Identifying occupational-specific energy expenditure is the first step to create future training and diet regimens to move away from jockeys using dangerous weight-making habits. Therefore, the aims of this study are 1) to develop a multi-sensor system to predict reliable energy expenditure through kinetics and kinematics data of race riders and kinematic data of the horse while exercising live horses, and 2) to advance a multi-sensor system from existing pilot data to predict energy expenditure through kinetics and kinematics data of race riders while training on a mechanical simulator. A multidisciplinary team with comprehensive expertise in equestrian sports, sports medicine, and occupational assessment has been assembled to accomplish this pilot project. The results of the pilot data align with previous research suggesting a combination of kinematic and kinetic data is optimal for more precise caloric expenditure prediction. The proposed study builds on this existing data to integrate new wearable technology and accurately evolve the current methodology to measure VO2 during galloping activities. The proposed research results will inform the racing community and health specialists working with race riders to create healthier training and diet regimens to shift away from current weight-making practices causing decrements in mental and physical health.

Evaluating Microbiome as Biomarkers in Firefighting Associated Stress

Sukanta Bhattacharya (PI), Jagjit Yadav
University of Cincinnati, Environmental and Public Health Sciences

First responders, particularly firefighters, are subjected to various forms of physical stress as well as chemical exposures at the workplace. Epidemiological studies in firefighters have linked these occupational stress factors to various systemic illnesses including but not limited to respiratory and cardiovascular diseases, immune dysfunction, and cancers. Firefighters are subjected to continuous work shifts of multiple days resulting in chronic sleep deprivation (SD). They are also exposed to various chemicals which include the toxicants like perfluorooctanoic acid (PFOA) present in the fire extinguishing foams. Independent human and animal studies have linked SD to an altered immune function, cardiovascular diseases, and hypertension, among others. Immune function is also impacted by the human exposure to PFOA. Studies on animal models have confirmed a suppressed immune system as well as linked different types of cancer to PFOA exposures. Independent epidemiological studies have also linked altered microbiome to various human systemic diseases such as hyperglycemia (blood sugar), hypertension (blood pressure), inflammation, cancer, among others. Continued stress may induce microbiome perturbations which may serve as biomarkers as well as interact with other prevailing environmental stress factors thereby increasing the risk for occupational diseases. This initial study therefore focuses on investigating the impact of co-exposure to SD induced stress and PFOA on the microbiome as a apart of our long-term goal to study the role of occupational chronic stress in inducting microbiome dysbiosis and underlying occupational health conditions in firefighters. We propose to perform these studies using a mouse model of sleep deprivation without or with co-exposure to PFOA. Completion of the study will open up ways to provide insights into the role of sleep deprivation and PFOA exposure-induced chronic stress in causing microbiome dysbiosis. These studies will eventually help understand the etiological factors and biomarkers of occupational health risks in firefighters.

Cool Helmet for First Responders Based on Nano Carbon Composite and Thermoelectrics

Vamsi Kondapalli (PI), Kyle Brittingham, Vesselin Shanov
University of Cincinnati, Mechanical and Materials Engineering

The proposed project focuses on developing a prototype of a "Cool Helmet" with active cooling to help first responders and particularly firefighter`s to get relief from heat stress and hyperthermia. The helmets utilize an in-house developed active cooling system comprising of a thermoelectric cooler and Compressed 3D Graphene (C3DG) and copper coated or uncoated CNT sheet composite. These nano–carbon-based materials are employed as heat spreaders to keep "the cool" within the space between the helmet and the firefighter`s head. Properties including lightweight, flexibility, high thermal conductivity, and high tensile strength make C3DG composites very good alternatives for metals to transfer heat. Further, the use of thermoelectric cooling eliminates the requirement for moving used in a traditional convection cooler. The "Cool Helmet" will be tested rigorously in terms of mechanical strength, rigidity, and cooling performance. Ultimately, we will design and develop a prototype capable of keeping the firefighter`s helmet cool when in use in a hot environment.

Additional Poster Abstracts

Needs and Capacity of the Open Access Withdrawal Management Model: Occupational Perspectives on Clinically Managed Residential Detox in Southern Ohio

Aaron Vissman (PI) and Kermit Davis
University of Cincinnati, Environmental and Public Health Sciences, Targeted Research Training Program

There has been increased state-level adoption and implementation of the American Society of Addiction Medicine (ASAM) level-of-care criteria. Few studies have reported on Level-3 (residential) withdrawal management or opioid detoxification service models where clonidine, naltrexone, buprenorphine and other comfort drugs and induction services may be administered along with residential stabilization services. This study explored year-one patient outcomes and occupational perspectives from a novel public-access service center model for clinically managed residential withdrawal management (CM-WM Level 3.2) in a U.S. epicenter. Research included administrative record abstraction and in-depth semi-structured interviews of individuals (n<30) who represented collaborating agencies (n<10) and experiences of nurses, social workers, resident advisors, and patient/peer navigators. Participants delivered CM-WM services (ASAM Level 2-WM, 3.1, 3.2 WM, and 3.5) and linkages (referral/transfer/discharge) to hospitalization, treatment-supportive housing, ambulatory care, and other services in Greater Cincinnati. Results are limited to overlapping (triangulated) accounts from a small network of healthcare workers and clinical/program directors (n=16 "insiders", and n=8 "outsiders") who cooperated in service center research during Oct-Dec 2019. Results of thematic analysis include perceived competencies from same-day enrollment and extending length-of-stay needed for successful discharge. Results and discussion address different occupational exposures and experiences during acute withdrawal management, residential stabilization activities, and the ways cognitive and environmental conditions may affect CM-WM selection processes and health outcomes. Discussion includes an overarching open-access model for interagency workforce-development and occupational health and safety research in state-certified residential CM-WM settings (e.g., <30-bed, <30-day detox units) and independent home healthcare settings where potential biases, cumulative toxicological risk, and long-term household-level exposures may be further addressed.

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2022 Pilot Research Project (PRP) Symposium
University of Cincinnati NIOSH Education and Research Center
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University of Cincinnati, College of Nursing, Procter Hall & Graduate Cincinnati Hotel

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