UNIVERSITY OF Cincinnati

University of Cincinnati
Education and Research Center

22nd Pilot Research Project Symposium

OCTOBER 21-22, 2021

PROGRAM BOOKLET

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

2021 Pilot Research Project (PRP) Symposium
University of Cincinnati NIOSH Education and Research Center
October 21-22, 2021
Virtual Event – Whova app

Contents

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About the ERC and PRP

Welcome to the University of Cincinnati Education and Research Center's (ERC) **22nd Annual Pilot Research Project (PRP) Symposium** on October 21-22, 2021 held as a virtual event using the Whova event app. 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 2020-21 awardees will be presenting the results of their research and the 2021-22 awardees will make poster presentations of their proposed work. The keynote speakers on Thursday, October 21, 2021 are **a panel of NIOSH employees and UC ERC alumni celebrating the 50th anniversary of NIOSH and discussing the future of occupational safety and 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. Tiina Reponen 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 264 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 64 new investigators from other fields of expertise to the area of occupational safety and health research.

Keynote Panel

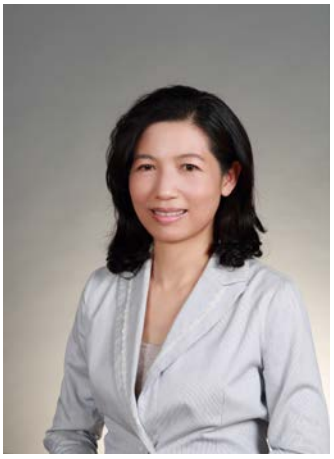
This year's symposium will feature a keynote panel celebrating the 50th anniversary of NIOSH. The panel will discuss how the ERC trained the panelists to resolve NORA specific issues, the educational and career experiences of occupational safety and health (OSH) professionals, emerging trends in OSH fields, and the future of OSH professionals. All panelists are UC ERC alumni and now work in different roles at NIOSH. Included are brief bios for each of the panelists.

CAPT Lisa Delaney, *Associate Director, Emergency Preparedness and Response, NIOSH*

CAPT Lisa Delaney, MS, CIH joined the National Institute for Occupational Safety and Health (NIOSH) in 1999 after graduating with a Master of Science degree in Environmental Health and Industrial Hygiene from the University of Cincinnati. CAPT Delaney currently serves as the Associate Director for Emergency Preparedness and Response at NIOSH where she coordinates NIOSH's response to emergencies, ensures federal response plans incorporate occupational safety and health protection measures, and, promotes research in the area of protecting first responders during emergencies. CAPT Delaney directs deployment of NIOSH staff providing disaster technical assistance and leads EPRO staffing, budget, project planning and reporting, and program evaluation activities. She also serves as a senior-level technical reviewer and co-author of Institute responder safety and health policy, plans, training and exercise documents.

CAPT Delaney has responded to nearly every major domestic emergency beginning with the September 11th attacks and most recently the 2018 hurricane responses. CAPT Delaney has specialized in biological emergency responses with a focus on understanding the role the environment plays in disease transmission and protecting workers during these responses. She led NIOSH's response to the 2014-2016 Ebola epidemic and deployed to Sierra Leone as the CDC Safety Officer. She has served as the Pandemic Influenza Coordinator for NIOSH since 2006. CAPT Delaney is a leading expert in environmental assessment of Bacillus anthracis and serves as team lead within CDC's Anthrax Management Team. She has co-authored a range of anthrax guidance documents related to worker protection, sample collection procedures, and interagency sampling strategies.

Dr. Sharon Chiou, *Health Scientist/Scientific Program Officer, Office of Extramural Programs, NIOSH*



Dr. Sharon Chiou is a Scientific Program Officer for NIOSH's Office of Extramural Programs. She is certified in federal grants management and currently oversees NIOSH-funded research grants and cooperative agreements. She manages the NIOSH extramural portfolios for program areas of Traumatic Injury, Musculoskeletal Health, Construction, and Robotics, with her primary focus being the National Center for Construction Safety and Health. From 2017-2020, she managed the annual NIOSH Intramural Research Competition, which is the institute's internal research funding process. Prior to joining the Office of Extramural Programs in 2015, Dr. Chiou was a Health Scientist in NIOSH's Division of Safety Research for 16 years, where she conducted research in the areas of construction safety and ergonomics, slips and falls, and personal protective technology. She currently serves on steering committees of four NIOSH sector and cross-sector programs, as well as the NIOSH Science Lead Team. She holds a master's degree in Industrial Hygiene and a Ph.D. in Occupational Ergonomics, both from the University of Cincinnati.

Dr. Mamadou Niang, *Research Industrial Hygienist, Division of Field Studies and Engineering, NIOSH*

Mamadou Niang PhD, MPH, MS is an industrial hygiene researcher at CDC/NIOSH Division of Field Studies and Engineering. Having earned a master's degree in Biology specializing in parasitology and immunology at University of Dakar, Senegal. Dr. Niang came to the United States in 2008 to pursuit his education. Upon his arrival, he enrolled at Xavier University to learn English and then at Cincinnati State Technical and Community College to gain familiarity with English medical terminology, in furtherance of his goal of being admitted into an American PhD program. From June 2011 to December 2014, Dr. Niang worked as Volunteer Research Assistant at the Biological Department at University of Cincinnati before starting the Master of Public Health (MPH) at the University of Cincinnati. After completing his MPH in August 2016 with a concentration in epidemiology, Dr. Niang was admitted into the PhD program in biological monitoring. Dr. Niang graduated from University of Cincinnati in August 2020 with a PhD in industrial hygiene. His dissertation research is focused on assessing the basis for increased illness in biosolids exposed occupations by investigating the risk of co-exposure to antibiotics and microbial pathogens in the biosolids that may contribute to the incidence of illness in wastewater treatment workers.

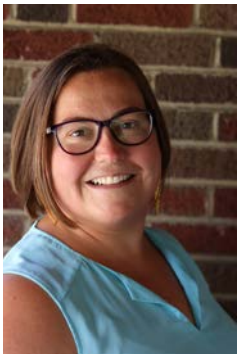
Dr. Jay Vietas, *Chief, Emerging Technologies Branch, NIOSH*

Jay Vietas is the Chief, Emerging Technologies in the Division of Sciences Integration at the National Institute for Occupational Safety and Health. He leads a team of scientists in the study of emerging technologies on worker health and practical application of this knowledge. This includes research on the use of advanced materials, synthetic biology and biomanufacturing, and artificial intelligence.

Prior to joining NIOSH in 2020, Jay served as a senior medical leader in the United States Air Force, developing policy in support of operations for 2,400 allied health officers delivering care in 75 treatment facilities.

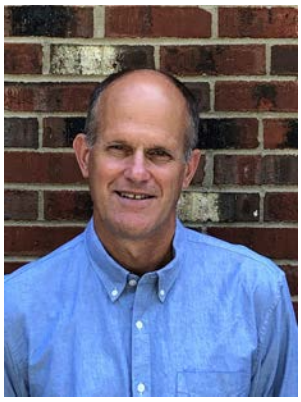
Jay obtained his PhD from the University of Cincinnati in Environmental Health, graduate degrees in environmental health and engineering from Colorado State University, and an undergraduate degree in Chemistry from the United States Air Force Academy. Jay is a Certified Industrial Hygienist, a Certified Safety Professional and a member of the American Industrial Hygiene Association.

Dr. Megan Lobaugh, *Research Health Physicist, Division of Compensation Analysis and Support, NIOSH*



Megan Lobaugh graduated with her PhD in Nuclear Engineering from the University of Cincinnati in December 2013. During her graduate studies, she received a NIOSH OSHE Fellowship and enjoyed participating in the UC NIOSH ERC activities. Her most memorable ERC activity was the Historical Perspectives on Occupational Safety and Health Trip in June 2009, because it combined learning, travel, and fun. Currently, she is a Research Health Physicist in the Division of Compensation Analysis and Support at NIOSH. Her previous experience includes: radiation safety project management at the International Atomic Energy Agency and radiation protection including emergency preparedness at Lawrence Livermore National Laboratory. Megan credits the NIOSH OSHE and participation with the ERC for helping open the door for many of the opportunities she has had in her career.

Dr. Douglas Trout, *Medical Officer, Office of Construction Safety and Health, NIOSH*



Dr. Douglas Trout has a degree in Industrial Hygiene and is an Internal Medicine and Occupational Medicine physician. Dr. Trout worked for CDC's National Institute for Occupational Safety and Health (NIOSH) since 1992 in several roles. He is currently a Medical Officer in the NIOSH Office of Construction Safety and Health and a member of the NIOSH Construction Sector Council. Dr. Trout was active in many roles during the CDC COVID-19 response.

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Thursday, October 21, 2021

8:30am-12:30pm	**Virtual Careers Workshop**	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

1:00pm	**Welcoming Remarks and Introductions**	Amit Bhattacharya, PhD, CPE, PRP Program Director *University of Cincinnati, Environmental Health*
1:05pm	**Introduction of Education and Research Center**	Tiina Reponen, PhD, CIAQP, ERC Director *University of Cincinnati, Environmental Health*
1:10pm	**Introduction of Keynote Panel**	Amit Bhattacharya, PhD, CPE, PRP Program Director *University of Cincinnati, Environmental Health*
1:15pm	**Keynote Panel of ERC Alumni Working at NIOSH to Celebrate the 50th Anniversary of NIOSH** Moderator: Gordon Gillespie, PhD, DNP, RN	Megan Lobaugh, Sharon Chiou, Mamadou NIang, Jay Vietas, Douglas Trout, and Lisa Delaney
2:30pm	**Home Healthcare Workers' Exposure to Bacterial and Fungal Bioaerosols**	Yao Addor *University of Cincinnati, Environmental and Public Health Sciences*
2:50pm	**A Computer-Vision Technique to Predict Type/Level of Force Exertions**	Guoyang Zhou on behalf of Hamed Asadi *Purdue University, Industrial Engineering*
3:10pm	**Break**	
3:25pm	**Poster Session 1 – Gather Town app**	*See page 8 for poster titles*
4:10pm	**Break**	
4:20pm	**A Novel Wearable Carbon-Based Material to Shield Aircrews from Cosmic Radiation**	Devika Chauhan *University of Cincinnati, Mechanical and Materials Engineering*
4:40pm	**CNT Hybrid Fabric Facemask to Filter and Deactivate Virus**	Megha Chitranshi *University of Cincinnati, Electrical Engineering and Computer Science*
5:15pm	**Virtual Trivia**	Last Call Trivia

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Friday, October 22, 2021

8:00am	**Welcoming Remarks and Introductions**	Gordon Gillespie, PhD, DNP, RN, PRP Deputy Director *University of Cincinnati, Nursing*
8:10am	**Flexible and Low-voltage Carbon Nano Tube Heaters to Combat Cold Weather -- For Fire Fighters and First Responders**	Kavitha Joseph *University of Cincinnati, Mechanical and Materials Engineering*
8:30am	**Wearable Carbon Monoxide Sensor for Firefighters Based on Copper Doped Graphene-Polymer Composite**	Vamsi Kondapalli and Kyle Brittingham *University of Cincinnati, Mechanical and Materials Engineering*
8:50am	**Real-Time Automated Vehicle Crash Detection and Reporting System**	Oyindamola Omotuyi *University of Cincinnati, Mechanical Engineering*
9:10am	**Understanding Nurse Turnover: The Cyclical Role of Understaffing**	Mohsin Sultan *Ohio University, Psychology*
9:30am	**Break**	
9:45am	**Poster Session 2 – Gather Town app**	*See page 8 for poster titles*
10:30am	**Break & Vote for Favorite Poster and Presenter**	
10:40am	**Panel Discussion of the Podium Presentation Topics** Moderator: Gordon Gillespie, PhD, DNP, RN	Cynthia Betcher, Amit Bhattacharya, Jagjit Yadav, and Mark Schulz
11:30am	**BEST Award Presentations**	Jessica Bloomer *University of Cincinnati, Environmental and Public Health Sciences*
11:50am	**Closing Remarks and Program Evaluation**	

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2021-22 PRP Awardee Posters & Invited Posters

#	Title	Presenter	Program
1	**Optimization of Phase Change Material Based Enhanced Cooling Helmets for the Firefighters**	Navaneeth Chandran	*University of Cincinnati, Mechanical and Materials Engineering*
2	**Synthesis and Fabrication of Group III-V Doped Carbon Nanotube-based Biosensors**	Anuptha Pujari	*University of Cincinnati, Mechanical and Materials Engineering*
3	**Pressure to Attend Work when Unwell: Health and Safety Consequences among Nurses**	Lindsey Freier	*Bowling Green State University, Psychology*
4	**Workplace Violence Among Young Black Workers Ages 18-24 in Southcentral Kentucky**	Edrisa Sanyang	*Western Kentucky University, Public Health*
5	**Carbon Nanotube based Chemical Deactivation Membrane for Air Filtration**	Megha Chitranshi	*University of Cincinnati, Electrical Engineering and Computer Science*
6	**Work Stress, Poor Recovery and Burnout in Nurses**	Grayson Sturgis	*Bowling Green State University, Psychology*
7	**Investigation of Occupationally-Related Stress of At-Risk Workers During COVID-19**	Thomas Gerding	*University of Cincinnati, Environmental and Public Health Sciences*
8	**Occupational Safety and Health in the Wake of Drones**	Hoda Rahmani	*Ohio University, Industrial and Systems Engineering*
9	**Advocacy for Occupational Safety and Health Policy and Practices to Address Stressors and Workplace Violence in Home Health Care Workers (HHCW)**	Trevor Holtz	*University of Cincinnati, College of Nursing, Targeted Research Training Program*

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 **"aprth"** to access the event

Gather town instructions

- The poster sessions will be in Gather Town – the link is available in the Whova agenda under the poster sessions
- You can also access the poster space early here if you'd like to explore the space and view the posters in advance

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.

- ABIH (IH) CM hours, www.abih.org
- Meets BCSP criteria for professional development conference CSP recertification points, www.bcsp.org

Social Media

Twitter

- Follow us on Twitter @uc_erc
- Use **#22PRP** 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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2020-21 PRP Awardee Podium Abstracts

Home Healthcare Workers' Exposure to Bacterial and Fungal Bioaerosols

Yao Addor (PI)[1], Nicholas Newman[2], and Tiina Reponen[1]

[1]*University of Cincinnati, Environmental and Public Health Sciences;* [2]*Cincinnati Children's Hospital Medical Center*

Purpose: In the present study, we assessed indoor and outdoor bioaerosols at a residential site during the late and after COVID-19 shutdown periods from July through September 2020 to compare their characteristics and trends, as well as to compare the traditional bioaerosol measurement methods, including cultivation, microscopy count, real-time quantitative polymerase chain reaction (qPCR), and next-generation sequencing (NGS) with the direct-reading fluorescent-based Wideband Integrated Bioaerosol Sensor (WIBS-5/NEO; DMT, Longmont, CO).

Design and Methods: Indoor and outdoor air were monitored and sampled for bioaerosols using the direct-reading WIBS-5/NEO and three different traditional methods, including the Button sampler (SKC, Eight Four, PA) for qPCR and NGS, the Allergenco-D spore trap (Eurofins EMLab P&K, Phoenix, AZ) for fungal spore microscopy counting, and the two-stage Andersen impactor (Thermo Fisher Scientific, Franklin, MA) for bacterial and fungal culture on tryptic soy agar (TSA) and malt extract agar (MEA) plates, respectively. As statistical analyses, indoor and outdoor bioaerosol levels, types and size distributions were compared through t-test and variants, and the correlation between the direct-reading and the traditional methods was investigated by performing Spearman's correlation test.

Results: Preliminary results show that: 1) There was no significant difference between late and after the COVID-19 shutdown periods; 2) Bioaerosol levels were significantly higher indoors than outdoors ($p < 0.001$); 3) Type A fluorescent particles were significantly dominant indoors, and were higher indoors than outdoors ($p < 0.001$); 4) Most fluorescent particles sized on average 2 µm indoors and 3 µm outdoors; and 5) There were positive correlations between the WIBS fluorescent types and each of the traditional methods, but not consistently. Also, genera such as *Cladosporium, Ganoderma* and *Aspergillus/Penicillium* were commonly found with the traditional methods, including NGS.

Discussion: High bioaerosol concentration indoors could be due to various human activities that generate and/or resuspend particles. Based on previous laboratory-based studies, type A fluorescent particles, which dominated indoors, are mostly bacteria; for fluorescent particle types dominating outdoors, type B particles are mostly fungi, whereas types BC and ABC are mostly pollen. The absence of the COVID-19 shutdown effect could be due to the timing; as the complete shutdown was ordered back in March 2020, most business activities had gradually resumed by the time we conducted our air monitoring. We also found that the fluorescent particle types behave differently, indicating that they belong to different categories. The high level of bacteria indoors suggests that they would have been generated mostly by humans. The particle size distribution also showed that the majority of the fluorescent particles were mostly $PM_{2.5}$, alerting that they possess a high potential of causing respiratory health issues in humans. The inconsistency in the correlation between the WIBS fluorescent types and the traditional methods reflects the fact that each of the traditional methods detects a different fraction of biological particles.

Conclusion: In this study, the total bioaerosol levels were higher indoors and dominated by bacteria compared to outdoors. Their size range suggests that they were mostly of $PM_{2.5}$ category and, as such, have a high potential of causing harmful respiratory and cardiovascular health issues in humans. Positive correlations were observed between the direct-reading WIBS fluorescent types and the different traditional methods, but not consistently. Finally, some most common genera in the NGS profile were shared across the traditional methods.

Impact statement: Exposure to bioaerosols has not yet been studied among HHCWs. We used cutting-edge technologies such as metagenomics with next-generation sequencing, and the WIBS system to characterize for the first time the microbial profile at a residential site which could be a typical workplace for home healthcare workers. The findings of this study, including the high levels of indoor $PM_{2.5}$ and bacteria along with other types of bioaerosol like fungi, will provide a ground for other studies to gain an insight on HHCWs' exposure to bioaerosols in homes and anticipate potentially harmful health outcomes. By gaining such understanding, policymakers can make informed and sound decisions in establishing guidelines or standards to protect this category of workers.

A Computer-Vision Technique to Predict Type/Level of Force Exertions

Hamed Asadi (PI), Guoyang Zhou, and Denny Yu
Purdue University, Industrial Engineering

Exposure to high and/or repetitive force exertions can lead to musculoskeletal injuries. However, measuring worker force exertion levels is challenging, and existing techniques can be intrusive, interfere with human–machine interface, and/or be limited by subjectivity. Our overall hypothesis was that computer vision-based techniques could provide an innovative solution for tackling the challenge of widely and systematically identifying type/level of exposures in workplaces. A controlled study setup was designed to collect data and developed the targeted algorithm in different levels of pull/push exposures. Force exertions were measured in different amounts of effort (0% (baseline), 30%, 50%, 75%, and 100%MVC) and at different exertion types of push and pull. The developed algorithms classified the demanding tasks by the worker using information available in videos, e.g., facial and postural kinematics.

The presented work is introducing an approach to estimate the type/level of force exertions from videos, which is less distracting to workers, easier to implement by practitioners, and could potentially be used in a wide variety of workplaces. This method could be widely used in different occupations to predict forces automatically to better understand the exposures that cause workplace injuries. New technologies such as automated observation analysis are highlighted as an efficient approach that could be scalable to larger populations and workers with more varied work.

A Novel Wearable Carbon-Based Material to Shield Aircrews from Cosmic Radiation

Devika Chauhan (PI), Henry Spitz, and Mark Schulz
University of Cincinnati, Mechanical and Materials Engineering

This project investigates the radiation shielding properties of a wearable carbon nanotube-boron-metal composite material to reduce cosmic radiation exposure to US aircrews. Boron is integrated into the carbon nanotube matrix by mixing boron hydroxide in the fuel for chemical boron integration. For physical integration, boron carbide mixed with latex solution is used for CNT densification during CNT synthesis. Bismuth metal is integrated into the CNT matrix using the solvothermal method. The material is characterized using SEM and EdXS characterization techniques. Upon radiation shielding testing, it is observed that higher boron loading is needed. Due to the low concentration of boron in the sample, the presence of boron was not detectable in the sample.

CNT Hybrid Fabric Facemask to Filter and Deactivate Virus

Megha Chitranshi (PI)[1], Mark Schulz[2], Sergey Grinshpun[3], and Ashley Kubley[4]
[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; [4]University of Cincinnati, Design, Architecture, Art, and Planning

This project was to synthesize carbon nanotube (CNT) sheet for facemask filtering applications. The pilot grant was used to produce CNT sheet samples used as a filtering layer in the facemask. Facemask samples were tested for filtration efficiency and pressure drop. The funds were used to purchase materials for making CNT filter layer, facemask samples

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testing with Dr. Sergey Grinshpun, 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.

Flexible and Low-voltage Carbon Nano Tube Heaters to Combat Cold Weather -- For Fire Fighters and First Responders

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

The goal of the project is to fabricate highly efficient and flexible Carbon Nanotube (CNT) heaters and integrate them into the boots and gloves of the firefighters and first responders, thus helping them to combat cold weather during their missions. Here the unique properties of carbon nanotube such as low density, electrical conductivity, and strength are made use for designing light, flexible, and low-voltage heating material. The CNT sheet was made from a spinnable CNT array synthesized by the CVD process. The sheet was characterized by SEM for structural morphology, the quality assessed by Raman spectroscopy and the resistivity was determined from sheet resistance. The fabrication of the heater was accomplished by electrodeposition of copper on the sheet and the heating efficiency of the heater was assessed by thermal imaging technique using an Infrared camera (FLIR). Taking into advantage the effect of the number of layers in determining the heater efficiency, 40 and 80-layer CNT heater was fabricated. 80 - layer heater was found to perform remarkably well at conditions of low voltage, low power with faster response. It can reach the desired temperature of 400C in a few seconds at 1.1 V and 0.5 W. In the long run, this project will break new ground in the wearable electronic heater sector based on CNT heating elements and their advanced versions with the ability of automatic temperature control and real-time activity tracking feedbacks. This approach can be eventually expanded to other components of the first responder`s gears including garments.

Wearable Carbon Monoxide Sensor for Firefighters Based on Copper Doped Graphene-Polymer Composite

Vamsi Kondapalli (PI)[1], Kyle Brittingham[2], and Vesselin Shanov[1,2]
[1]University of Cincinnati, Mechanical and Materials Engineering; [2]University of Cincinnati, Chemical and Environmental Engineering

The proposed project focusses on developing a wearable sensor to detect one of the most poisonous gases, carbon monoxide (CO), released during house fires. According to an article published in the Journal of Emergency Medical Services, every year around 50% of the firefighter's deaths are due to cardiovascular diseases caused by CO poisoning during fire suppression. Existing CO sensors carried by firefighters, work on catalytic combustion. They are portable and sensitive, but they suffer from sensor poisoning and require regular maintenance and calibration. Carbon nanomaterials like graphene and CNT have been explored as efficient alternative gas sensing materials as they are lightweight and can adsorb a wide range of gases causing a response that can be acquired. However, the CNTs and graphene suffer from low surface area and poor selectivity. The proposed sensor uses a novel 3D shaped 3D Graphene (3D2G) to enhance the surface area where the deposited PANI-Cu (I) ensures the selectivity towards CO over various other common gases like CO2 released during house fires. Cu (I) plays a crucial role in enhancing selectivity via chemisorption where pi-complexations are formed rather than Van der Waal attractions as in adsorption. The operational principle of the proposed sensors is based on the change of composite`s electrical conductivity due to the chemisorption of CO molecules on its surface. This eliminates the requirement for high operating temperatures and combustion making the device much simple to develop and use. It also lowers the necessity for the battery to provide high voltage and power density.

Real-Time Automated Vehicle Crash Detection and Reporting System

Oyindamola Omotuyi (PI), Rumit Kumar, and Manish Kumar
University of Cincinnati, Mechanical Engineering

The signalized intersections are a key component in road transportation system. One of the major causes of traffic congestion is vehicular crashes which can cause a halt in traffic operations at these intersections. In [1], about 40% of the reported accidents in the United States are due to intersection-related crashes. More so, broad range of crash configurations results from the varying nature of intersection geometries and the number of vehicles [2]. According to the World Health Organization (WHO) [3], the number of deaths caused by road traffic crashes is approximately 1.35 million people around the world each year and between 20 and 50 million people with non-fatal injuries. A faster rescue response has the potential to not only save lives but also result in faster clearing of accidents and lesser traffic congestion. Recent advances in IoT (Internet of Things) devices and associated Artificial Intelligence for fast, accurate data processing provide a unique opportunity to develop an efficient system for detecting and reporting crashes at traffic intersections. This will minimize the response time of the authorities, including first responders and firefighters for restoring the traffic operations after vehicular crashes. We have developed a low-cost crash detection system using video and audio data. A Convolutional Neural Network (CNN) was developed for the audio system to identify crashes using microphone sounds mounted at the traffic intersections. The proposed system achieved a recognition rate of 100% and false positive rate of 2.74-5.50% on Mivia Road event dataset. Also, a robust crash detection system using Convolutional Neural Network (CNN) and kinematic time-series analysis on video data was developed and it achieved an accuracy of 86.2% and false positive rate of 16.5% for the intersection traffic videos in the Cincinnati, Ohio region.

Understanding Nurse Turnover: The Cyclical Role of Understaffing

Mohsin Sultan (PI), Ryan Johnson, and Rachel Clift
Ohio University, Psychology

Purpose: To explore burnout as a potential linking mechanism between perceptions of understaffing and both organizational and occupational turnover intentions among nurses. Potential methods to alleviate such consequences due to understaffing are also examined.

Design: This study consists of two time points separated by a three-month lag, all participants complete an online questionnaire at each time point. Time 1 data consisted of 449 full-time nurses who were employed as part of a larger organization, turnover intentions data were collected during time 1, and actual turnover data are collected during the second time point of the study. Data collection for the second time point is currently ongoing.

Methods: All participants completed self-report measures, in which the focal variables of the study were, understaffing, burnout, coworker support, organizational support, organizational turnover intentions, and occupational turnover intentions.

Results: Burnout partially mediates the relationships between understaffing and both forms of turnover intentions, and neither form of support were found to have a moderating role in the relationship between perceptions of understaffing and burnout.

Conclusion: Understaffing remains a pervasive workplace stressor with multiple consequences, and traditional forms of support may not be sufficient for alleviating such consequences.

Impact Statement: The results of this study demonstrate that understaffed work environments may be a source of burnout for nurses, regardless of the support they receive at work, and ultimately play a role in whether they leave their jobs or the nursing profession altogether.

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2021-22 PRP Awardee Poster Abstracts

Optimization of Phase Change Material Based Enhanced Cooling Helmets for the Firefighters

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

Regulation of the brain temperature is critical for managing heat stress related adverse events. It can be achieved by external cooling of the head. Head cooling systems that are lightweight, portable, and suitable for active work scenarios such as firefighting, mining, and construction work scenarios are currently unavailable in the market. During firefighting activities, the firefighters experience increased heat buildup in their bodies as a result of increased metabolism. This increase in metabolism causes a rise in the core body temperature. The rise in core body temperature if unchecked, can lead to various ailments such as heat stroke, brain damage, and impaired thermal regulation. Firefighters can also experience unconsciousness or cardiac arrest. The above mentioned reactions or a combination of the same could prove fatal to the lives of the firefighters. The closed-loop bench-top working model of the device has been manufactured in our lab previously which comprises of a novel active head cooling system that a) uses phase change material for thermal storage and b) designed for portability. The system consists of two heat exchangers: a water-cooled heat exchanger combined with a heater to emulate heat generation from the head, and a helical tube heat exchanger surrounded with chamber containing ice to act as the cooling system. These heat exchanges are interconnected by tubing for water circulation. The system performance is assessed by cooling duration that depends on mass of ice used and heat transfer rate. The above experimental research, done previously, was limited in scope, focusing on assessing the proof-of-concept.

The long-term goal of this research is to optimize for longer and safer working period for firefighters during firefighting activities. The central objective of this project is to use numerical-computational approach to optimize the thermal response of the cooling system and firefighters during firefighting activities. We hypothesize that the effect of phase-change material (PCM), used as thermal storage medium, does not have a linear dependency on the material property of the PCM because of the difference in melting point of the materials and also due to the heat loss to the environment. To test the hypothesis the specific aims are to determine the time period of safe operation by optimizing different variables, such as Aim 1) PCM used as heat sink. The PCM such as ice-water, salt hydrates and polymers will be assessed; and Aim 2) environmental temperature. The rationale is that the accurate estimation of the thermal response of the human body will help in devising better cooling techniques. This will permit in limiting the heat-induced stress to the body. It is expected that this optimization research will not only improve the head cooling proposed in earlier study but also would determine a viable option for practical usage of portable design. The optimized head cooling system will be helpful for firefighters to elongate the safe duration and avoid adverse exposure to thermal stress during firefighting activities.

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

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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. Although CNTs have reasonable electrical properties,

there is still a need for faster electron transfer when considering CNTs for biosensor applications. Proposed here is a carbon hybrid material with increased electrical conductivity formed by doping of carbon nanotubes with group III -V compounds. This increase electrical conductivity across the nanotube junctions thereby promoting faster electron transfer. Carbon nanotube structures consist of highly stable nanotube shells which have a high specific surface area and a large aspect ratio. These carbon shells consist of a hollow inner cavity which can be filled and wet by other materials and nanoparticles without affecting the stability of the nanotubes. We also propose a process of filling of the inner cavity of nanotubes offering a potential possibility for nanoinjectors, targeted drug delivery, imaging, phototherapy.

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

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Nurses play a crucial role in the health and safety of their patients (Calabresi et al., 2019). To best care for their patients, however, nurses must also have the opportunity to care for their own health. Unfortunately, nurses attend work when feeling unwell at alarmingly high rates (Rainbow et al., 2019; Shan et al., 2021); this behavior is called presenteeism. The prevalence of presenteeism among nurses poses urgent threats to productivity (Gustafsson & Markuland, 2021), employee engagement (Burton et al., 2017), nurses' own health (Ruhle & Sub, 2019), and patient safety (Letvak et al., 2012).

A growing research literature delineates the damaging consequences of nurse presenteeism, but less is known about why nurses engage in presenteeism behaviors (Karakika-Murray & Biron, 2020), limiting efforts to reduce it. We pose that many nurses feel expected or pressured to engage in presenteeism by their employer. Specifically, 'presenteeism pressure' reflects an employee's perception that their employing organization or its members expect them to attend work when their health would reasonably excuse absence (Albert et al., 2020, June; Huang et al., 2019, April). We argue that presenteeism pressure is an important but, thus far, unexamined contributor to nurse's presenteeism behavior and related health and safety outcomes.

The proposed study will test whether presenteeism pressure not only drives nurse presenteeism behavior but also nurse burnout and safety performance (i.e., safety compliance and safety participation). Additionally, we will test whether various job characteristics (e.g. autonomy to schedule work, perceived significance of work, and supervisor support) provide a buffering effect against negative health and safety outcomes. We will also test whether supervisor's distrust of health-related absences exacerbates the negative effects of presenteeism pressure on nurses' health and safety. Survey data will be collected from the 250 nurses across two time points, and hypotheses will be tested using multiple linear regression.

Our research agenda aims to establish presenteeism pressure as an important avenue through which to reduce the negative effects of presenteeism behaviors on health and safety in nurses. The proposed study would be a first step to building interventions targeted at organizational policies, leadership training, and organizational culture that create unhealthy presenteeism pressure among nurses.

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

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Workplace violence and work-related attacks may go unnoticed but can have far reaching consequences on a person's education and employment. 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 due to age-related psychological development. Western Kentucky Center for Environmental and Workplace Health (CEWH) research team previously identified risk for violence in the general population, workplace injury and violence, workplace health in America, barriers in providing health promotion in the workplace, and workplace physical and chemical hazards. However, little is known about workplace violence in the young workers, especially blacks in the rural United States.

This priority focused study will identify and characterize workplace violence and document the effects of such violence on the education and employment of young black workers. This will include assessing violent victimization, physical injuries suffered (regardless of severity), the relationship of the perpetrator to employees and the business, violence prevention training received, as well as the effects of these events on employment and education outcomes among young black workers. The research team will recruit forty subjects who have experienced workplace violence within 12 months prior to the study to participate in the focus group discussions.

This priority focused study aligns with the National Institute for Occupational Safety and Health (NIOSH) long standing focus on young worker health and minority workers. IT also aligns well with the National Occupational Research Agenda (NORA) on traumatic injury, occupational injuries and death related to workplace violence, and occupational safety equity in the worker populations.

Results from this study will be used to develop a collaborative competitive research agenda. They will also be used to develop infographics and other educational materials to be distributed in schools. Ultimately, the project team will develop best practices that will contribute to protecting young black workers and improve their education and employment. These data will also help to inform workplace injury and violence prevention.

Carbon Nanotube based Chemical Deactivation Membrane for Air Filtration

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Air pollution has become environmental health risk hence it is important to address those adverse effects and find solutions to ensure a healthy life and a sustainable environment. Proposed here is a filter that can capture and deactivate gaseous contaminants in the air. The filter uses carbon hybrid material (CHM) composed of a membrane of carbon nanotubes and graphite cone structures with integrated fine metal nanoparticles (NPs). The membrane captures chemicals and particles from the air by adsorption onto the carbon materials and by chemical bonding to the metal NPs which have a huge surface area/volume ratio. The NPs acts as catalysts to deactivate or convert toxic chemicals to various safe compounds. The main feature of this filter is that it can be used in both indoor and outdoor environments and can also integrate into the textile for wearable applications. The lightweight and mass-producible filter can reduce the exposure of the particulate matter and can reach the high-efficiency criterion.

Work Stress, Poor Recovery and Burnout In Nurses

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Although extended exposure to stress is universally harmful, healthcare workers, particularly nurses, face enormous mental and physical stressors at work. In the past year, COVID-19 has placed an additional burden on nurses as they deal with high levels of sickness while worrying about their own personal health. Occupational stress in nursing has been linked to both negative organizational outcomes (e.g., absenteeism, task errors; Hall et al., 2016) and negative employee outcomes (e.g., burnout, musculoskeletal injuries; Ngan et al., 2010; Kath et al., 2012; Salyers et al., 2017). In an effort to reduce such negative outcomes, scholars have devoted extensive research to examining the predictors of stress in healthcare. Common sources include environmental stressors (e.g., role ambiguity, organizational constraints) and social stressors (e.g., interpersonal conflict, poor leadership; Hemingway & Smith, 1999; Hofmann & Stetzer, 1996). Although research has identified common sources of stress, due to the nature of the job, not all sources of stress can be reduced or eliminated. Stressed workers can protect their health, however, by engaging in stress recovery or the process of recuperation and replenishment following stress at work (Sonnentag, Venz, & Casper, 2017). Both work stress and poor recovery have been shown to contribute to the development of burnout and lower overall well-being. However, the role of recovery as a mediating mechanism that links work stress to well-being has not been sufficiently addressed in research, especially in high-risk and high-stress occupations such as nursing.

This study will utilize a daily diary method to assess between- and within-person effects in the relationships between work stressors, stress recovery, and physical and psychological well-being. Participants will complete an initial electronic survey, providing trait measures of occupational stress, workplace stressors, recovery activities, and physical and psychological well-being. Participants will then complete daily electronic surveys for a period of two weeks, providing state measures of daily work stress, recovery activities, and physical and psychological well-being. Data will be analyzed using hierarchical linear modeling. We hope to gain valuable insights regarding the relationships between work stress, stress recovery, and well-being to help can guide stress interventions in healthcare.

Investigation of Occupationally-Related Stress of At-Risk Workers During COVID-19

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Occupational stress may be experienced due to the responsibilities, atmosphere, and co-workers/supervisors within the workplace and can result in anxiety, low productivity, and a variety of health issues such as a suppressed immune system, increased risk of diabetes, ulcers, and ulcerative colitis, and psychological illnesses such as neuroses, depression, and schizophrenia. Occupational stress is a common public health issue, further worsened by the ongoing COVID-19 global pandemic, especially to those who work in various at-risk industries such as first responders (i.e., firefighting, policing), those working from home (WFH), and healthcare professionals, specifically home healthcare workers which are one of the fastest-growing, more vulnerable and understudied segments of the healthcare workforce. Health issues associated with stress may not only impede a worker's ability to perform on the job, but may also make them more susceptible to diseases they might encounter due to immune system suppression. Work-related stress in on-campus healthcare workers has been well documented in recent years, but has not yet specifically focused on those employed in the home health care sector. Studies correlating work-related stressors with fluctuations in cortisol levels are especially relevant for understanding health disparities within certain work sectors compared to others. Due to daily work responsibilities, healthcare workers, WFH workers, and first-responders may easily encounter occupational stress on a

daily basis. The goal of this proposal is to investigate the validity of relating daily stressor experiences with fluctuations in self-administered salivary cortisol sampling using a small cohort (n = 15) of at-risk workers within the Greater Cincinnati area. To achieve this goal, we will: 1) investigate work-related and other factors that contribute to stress, especially among the aforementioned work sectors through qualitative research involving digitally distributed surveys and 2) Conduct a longitudinal study of daily stressors using self-recorded daily diaries and salivary cortisol, a biomarker of stress. Through this study, the findings associated with self-perceived working conditions and work organization in the completed surveys will be correlated with fluctuating patterns in salivary cortisol levels which will be sampled at multiple times throughout the three-day sampling period. This study design will allow for a short-term, longitudinal analysis of the data, correlating occupational stressor events with increases and declines in the workers' respective salivary cortisol levels. Findings in this study will provide a foundation for further evaluation of this understudied work sector which will lead to workplace intervention so as to reduce unneeded occupational stress."

Occupational Safety and Health in the Wake of Drones

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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 determining 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, and possible risk factors for drone-related mishaps by comparing the application of drones in construction with manufacturing 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.

Additional Poster Abstracts

Advocacy for Occupational Safety and Health Policy and Practices to Address Stressors and Workplace Violence in Home Health Care Workers (HHCW)

Trevor Holtz

University of Cincinnati, College of Nursing, Targeted Research Training Program

Home Health Care Workers (HHCW) work alone in the isolated environment of patient homes and may encounter risks from unique work stressors including workplace violence. To advance the occupational health of HHCW, the long-term goals of this research are to promote worker advocacy and involvement in developing pragmatic occupational safety and health policies and practices to address common stressors. The purpose of the first phase of a mixed methods research project will be to explore home healthcare workers' experiences of common stressors and violence encountered in the work environment. In addition, HHCW will be asked to describe current policy and practices within their work organizations used to guide their response to common workplace stressors to better understand the role current policy plays in addressing stressors and violence experienced as part of their HHCW job/position. This exploratory qualitative phase will be completed by conducting in-depth individual interviews with 25 HHCWs. Interviews will explore topics such as common stressors and WPV experienced by HHCW, HHCW's perceptions of current policies/practices, attitudes and beliefs about HHCW role in policy development, and reasons why HHCW would get involved in policy/practice development. Individual interviews will be approximately 45 minutes long and interviews will be audio-recorded to

facilitate analysis of verbatim interview transcripts. Each participant will receive a $40 gift card as compensation for their time. Recurring themes amongst the attitudes and beliefs of participating healthcare workers will be identified through thematic analysis of transcribed interview data. Qualitative results will be used to inform the development of an educational intervention that promotes HHCWs to advocate for effective policies and practices to address common stressors and workplace violence in the home environment.

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