GEORGIA INSTITUTE OF TECHNOLOGY
HOTEL AND CONFERENCE CENTER
800 SPRING STREET NW, ATLANTA, GA 30308

PROCEEDINGS

2024 ULRI Annual Research Symposium

Protecting Health and Safety in the Modern World

September 30 – October 2, 2024

UL Research Institutes

Acknowledgments

With gratitude, we acknowledge the speakers of the 2024 Annual Research Symposium, “Protecting Human Health and Safety in the Modern World,” for their engaging, passionate, and professional commitment. We also acknowledge the general participants who attended the symposium and contributed with their knowledge and interests as key stakeholders in this open and engaging dialogue.

Preface

The following proceedings provide a summary of technical information exchanged during the on-site 2024 Annual Research Symposium, “Protecting Human Health and Safety in the Modern World,” hosted by UL Research Institutes (ULRI) in Atlanta, Georgia, September 30 – October 2. This summary is not intended to provide a complete transcription of each speaker’s presentation or participant’s specific comments. Speakers may be contacted directly for details of their presentations and subject matter expertise. These proceedings are provided to share summaries of the presentations among all stakeholders. We hope this exchange of information will enable more collaborative discussions, research, innovation, informed policy advancement, and science-based initiatives around protecting human health.

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Overview

The purpose of the annual ULRI Research Symposium is to accelerate discovery by facilitating collaboration among leaders from various organizations and fields in support of ULRI's mission. For 2024, the symposium theme revolved around "Protecting Human Health and Safety in the Modern World." Scientific and policy experts explored key topics like human exposure to consumer chemicals and disease relationships, wildfires and their chronic health impacts on communities, climate change and resiliency measures for guarding health and well-being, and new sustainable approaches for protecting health and the environment. The goal of the symposium was to share the latest science on these important societal topics and bridge pathways forward for the protection of public health.

Lifetime Achievement Award Keynote Address

Dean P. Jones, PhD, Emory University School of Medicine

The Human Exposome and Future Health

On the first morning of the ULRI symposium, Dean P. Jones, PhD was awarded the Lifetime Achievement Award in Public Health. Dr. Jones received his PhD in Biochemistry from Oregon Health Sciences University and his BS in Chemistry and Biochemistry from the University of Illinois. He also studied philosophy and found that it gave him a unique perspective in his scientific endeavors. Dr. Jones' keynote address focused on the human exposome and a few landmark experiences that shaped him and his life's work.

Dr. Jones was cared for by his grandmother, a subsistence farmer, during his early life and she instilled in him that preserving health meant protecting the earth. After years of eating fish from the rivers in Illinois, the United States Environmental Protection Agency (U.S. EPA) reported that there were only two streams in Illinois where the fish were considered safe to eat. He reflected on this news with the realization that a large portion of his diet growing up was fish that was not considered safe to eat. These experiences inspired his interest and dedication to further knowledge of the human exposome, the entirety of environmental exposures humans are exposed to throughout their lifetime.

Dr. Jones discussed his work around the study of oxidative stress and disease processes. In 2000, when his research hit a hurdle, he reevaluated his approach to this work with a philosophy mindset and published an article redefining oxidative stress. After the article was published, he consulted his colleague and dear friend, Helmut Sies, who defined oxidative stress initially. The pair discussed the initial article and wrote a follow up article on refining the definition of oxidative stress. Notably, they introduced redox signaling and redox mechanisms in terms of signaling and control. He explained when he continued this work he hit another obstacle, a flawed hypothesis, so he employed his philosophy lens again, which shifted his focus to systems biology. This led to him and Helmut Sies co-authoring an article on the redox code, emphasizing the importance to extend the concepts of the gene0tic code and its role in providing logic for information storage and transmission.

Multicellular animal life evolved in response to a dramatic increase in oxygen in Earth's atmosphere. Dr. Jones highlighted this as a major driving force for the evolution that resulted in human life. He emphasized the importance of this in terms of the environment due to the implication that all human response structures are ultimately driven by the environment. He discussed an article by Christopher Wild in which Wild defined the exposome as the complement to the genome as a lifelong determinant of health. Dr. Jones and one of his graduate students wanted to amplify this view so his student wrote an article on the exposome for high school biology teachers. The article focused on the concept of lifelong exposures including pre-conception and the exposures of parents impacting lifelong health responses.

Dr. Jones wrote an article about a decade ago on sequencing the exposome. In this article, he wrote in regard to the exposome, human genetics contribute only a relatively minor component to disease risks. He explored the idea further with an example from a study by Steve Rappaport in which genetic disease occurrence was measured in monozygotic twins (identical twins). The median was only about 21% for disease risk, inspiring Dr. Jones to explore environmental exposures as the primary risk for most human disease processes. He noted the scope and amount of work involved in sequencing the genome, but he empowered his message with a reminder: it was once unimaginable to sequence the human genome but then the right methods were developed, and it was completed in 2003.

Dr. Jones closed his speech with the message that better methods are needed in order to successfully sequence the exposome, but the methods available today can provide a start to understanding all of these complex environmental interactions.

Human Health and Environmental Pollution

MORNING, OCTOBER 1, 2024

Human Health and Environmental Pollution Panel Discussion

MODERATORS:

- **Christa Wright, PhD, Chemical Insights Research Institute (CIRI)/ULRI**
- **Judy Jeevarajan, PhD, Electrochemical Safety Research Institute (ESRI)/ULRI**

PANELISTS:

- **Christopher (Chris) P Weis, PhD, Weis Toxicology, LLC**
- **Junfeng (Jim) Zhang, PhD, Duke University**
- **Michael Caudle, PhD, Emory University**
- **Doug Walker, PhD, Emory University**

SESSION SUMMARY

Environmental factors are responsible for approximately 25% of global deaths, with exposures such as air pollution, water contamination, and chemical hazards contributing significantly to public health risks. Within this panel discussion, the increasing frequency and severity of environmental disasters, such as extreme weather events and chemical spills were presented, which emphasized the need for a systems approach to managing their health impacts. Understudied aspects of indoor air quality were presented on the rising levels of ozone pollution, linking both outdoor and indoor ozone exposure to worsened lung function, cardiovascular, and respiratory health, while challenging prior assumptions about indoor ozone's safety. Additionally, the neurotoxic effects of stress and trauma from environmental disasters were highlighted, which lead to advocacy for a deeper focus on behavioral and mental health outcomes from such exposures. Lastly, the concept of the exposome, emphasizing the importance of understanding a lifetime of environmental exposures, particularly chemicals that remain untested. Common exposome research methods and advanced instrumentation were introduced, which have evolved greatly to aid in the identification of toxic substances and their effects. Notably, the need for greater transparency and data accessibility in chemical risk assessments was recommended to improve our efforts to understand the exposome.

Panelist 1 – Christopher Weis

Chris Weis, PhD, is the Principal Science Advisor and Chief Executive Officer (CEO) of Weis Toxicology, LLC, in Bethesda, Maryland. Prior to founding his own company, he served as the Senior Science Advisor and Toxicology Liaison to the Director of the National Institute of Environmental Health Sciences (NIEHS) and the National Toxicology Program (NTP) where he represented the National Institutes of Health (NIH) on national and international committees, task forces, and ad hoc working groups. While at NIEHS, Dr. Weis conducted research and served as the President of the American Board of Toxicology. Prior to joining NIEHS, he served as the Forensic Toxicologist for the Environmental Protection Agency's (EPA's) National Enforcement Investigations Center (NEIC) in Denver, Colorado. Dr. Weis completed his PhD in Medical Physiology and Toxicology at Michigan State University in 1987 and was awarded two consecutive NIH postdoctoral fellowships at the University of Virginia School of Medicine, Department of Physiology and Molecular Biophysics.

PRESENTATION SUMMARY: According to the World Health Organization (WHO), approximately 25% of deaths worldwide are attributed to environmental factors, meaning roughly one in four deaths globally are linked to unhealthy environmental exposures, such as air pollution, water contamination, and chemical exposure. Dr. Weis began his talk by citing this WHO statistic and also noted the number of environmental disasters from 1980 2016 increased in severity and economic costs. Notably, the United States (U.S.) has experienced a rising number of environmental disasters such as extreme weather events that have caused significant amounts of damage. From 1980 to 2016, the annual average number of billion-dollar events was 5.5. For the years spanning from 2012 to 2016, the annual average was 10.6 events. Regarding chemical disasters, Dr. Weis endorsed the use of a systems approach to understanding the human health impacts of chemical pollutants. This type of approach involves planning, response operations, financial considerations, and follow-up that includes individuals and communities working together on all aspects of the threat. Weis presented examples of chemical disasters and occurrences and explained that the kinetics of toxic mixture absorption can include both acute and chronic health effects, including acute and delayed psychological impacts. One example presented was the 1996 Montana train derailment that led to massive amounts of chlorine gas being released and causing hundreds of people to experience acute lung injury and one death. The events and aftermath of the Montana train derailment are featured in a two-part book titled "Gassed Book 1: The Spill" and "Gassed Book 2: The Long Haul," by author Ron Scholl, which chronicles the physical, psychological, and financial devastation of a toxic mass chemical exposure.

Panelist 2 – Junfeng (Jim) Zhang

Dr. Jim Zhang is a Professor within the Global Health Institute at Duke University. Dr. Zhang joined the Duke faculty in fall 2013 from the University of Southern California. His prior positions include professor, department chair, and associate dean at the Rutgers School of Public Health. Dr. Zhang's research interests include developing novel biomarkers of human exposure and health effects, assessing health and climate co-benefits of air pollution interventions, and examining biological mechanisms by which environmental exposures exert adverse health effects.

PRESENTATION SUMMARY: Ozone (O_3) concentrations are increasing globally due to a rise in emissions of ozone precursors and a rise in global temperatures. O_3 is a highly reactive gas that is both a natural and a man-made product within the Earth's upper atmosphere. Studies suggest that O_3 levels today are 30-70% higher than they were 100 years ago. Indeed, O_3 pollution is accelerated by and contributes to climate change. Dr. Zhang opened his talk by revealing these staggering statistics on global O_3 levels and the work he and his research group have conducted to address this emerging environmental issue. He noted his team's recent study that aimed to examine the independent

health effects of O_3 compared to ozone-reaction products. Dr. Zhang presented data that highlighted the effects of O_3 in 43 asthmatic children and a separate study that was conducted among 89 healthy adults. He and collaborating researchers found that higher average outdoor O_3 concentrations, regardless of whether participants were outdoors or indoors, were significantly associated with worsened spirometric lung function and airway mechanics indicators. Dr. Zhang stated that the O_3 level is lower indoors than outdoors, because O_3 reacts with chemicals on indoor surfaces and terpenes in the air. These reactions generate a mixture of ozone-reaction products, including hydrogen and organic peroxides, carbonyls, dicarbonyls, hydroxy-carbonyls, and short-lived reactive intermediates such as free radicals. Using the same datasets of the asthmatic children and healthy adults, Dr. Zhang's team found that O_3 loss, a proxy of ozone-reaction products, was associated with more biomarkers of cardiovascular and respiratory pathophysiology than personal or outdoor O_3 exposure. These novel findings contradict the conventional wisdom that indoor O_3 levels are too low to cause any adverse human health effects.

Panelist 3 – Michael Caudle

Dr. Michael Caudle is an Associate Professor in the Gangarosa Department of Environmental Health at Emory University, with a joint appointment in the Neuroscience PhD program as well as the Neuroscience and Behavioral Biology (NBB) undergraduate program. His research focuses on examining the effects of exposure to environmental toxicants on the development and function of the brain that lead to neurological disorders. The overarching goal of this research is to characterize the influence of environmental pollutants on the etiopathogenesis of neurodegenerative and neurobehavioral disorders. To accomplish these goals, Dr. Caudle utilizes progressive in vitro and in vivo model systems and couples these techniques with expertise in cellular and molecular neuroscience, neuropathology, and toxicology. Additionally, he draws upon collaborations with epidemiologists and exposure scientists to establish a comprehensive understanding of the human relevance of these effects.

PRESENTATION SUMMARY: Stress and trauma brought on by environmental disasters can have neurotoxic effects on the brain. Dr. Caudle presented "Neurotoxicity of Stress and Trauma" in which the concept of stress being a biological survival function that is not inherently negative but a necessary response was introduced and discussed. Dr. Caudle indicated that chronic stress is retained in the brain and causes lasting effects on cognitive decision making and emotional processing. He introduced the idea of the influence of environmental contaminants on the stress circuit and response, and encouraged thinking of exposures in terms of stressors and mediating factors, such as duration and intensity. To date, research on the health effects of environmental stressors has rarely focused on behavioral and mental health outcomes. The discussion revealed a need for identifying and developing interventions and a call to action to explore the harmful or beneficial relationships between environmental factors and mental health from a science and policy perspective.

Panelist 4 – Doug Walker

Douglas Walker, PhD, is an Associate Professor in the Gangarosa Department of Environmental Health at Emory University. He is an environmental engineer and analytical chemist with training in metabolomics and developing exposome-wide association study (EWAS) methodologies for environmental health and precision medicine research. Dr. Walker's research focuses on the continued development and application of advanced analytical strategies for measuring the occurrence, distribution, and magnitude of previously unidentified environmental exposures and for assisting in delineating the mechanisms underlying environment-related diseases in humans. The approaches he has developed show it is possible to measure over 100,000 chemical signals, including exposure biomarkers, nutrients, and dietary chemicals,

and the associated biological response in a high-throughput and cost-effective manner, establishing a foundation for operationalizing the exposome framework for precision medicine. His ongoing research projects are now focused on using high-throughput exposome methods to establish disease-exposome atlases, and on developing methods for measuring biomarkers of complex exposures of emerging concern, including microplastics, e-waste, and polyfluorinated chemicals. Dr. Walker leads the Comprehensive Laboratory for Untargeted Exposome Science (CLUES), which was established to provide high-quality, untargeted screening of biological samples for nutrition, precision medicine, and environmental health research.

PRESENTATION SUMMARY: The exposome represents the totality of environmental exposures a person experiences throughout their lifetime, encompassing factors like diet, occupation, lifestyle, chemicals, social conditions, and physical environment. Dr. Walker presented the current landscape of exposome research and noted the role the exposome plays on health and diseases derived from the environment. To date, over 50,000 chemicals in commercial production remain unidentified and untested for their toxicological effects due to proprietary information restrictions. Dr. Walker presented methodological approaches and instrumentation including high-resolution mass spectrometers, which can assist in predicting identities of chemicals and metabolic byproducts upon exposure. He also cited the importance of data gathered from exposome analyses remaining accessible to the public. Dr. Walker spoke of recent developments within his own lab and tools used in analyzing their chemicals and samples. He noted challenges around assigning annotations and signals once they are identified and noted his database will support the rapid identification of thousands of chemicals. Many chemical databases are also being leveraged, though at a lower confidence. Dr. Walker cited a study around the discovery of chemical exposures in follicular fluids using these methods and highlighted that seven to nine exposure markers were discovered. New methods around discovering plastic exposures have been initiated and Dr. Walker noted that plastic remains a complex chemical substance that requires further examination.

MORNING, OCTOBER 1, 2024

Research Session Track #1 – Health Impacts of Environmental Pollution

Facilitator: Qian Zhang, PhD, CIRI/ULRI

SESSION SUMMARY

This session included four presentations that investigated different types of environmental pollution, such as air pollutants from indoor activities, automobiles, combustion, and other urban natural and anthropogenic sources, and watershed contamination due to urbanization and human activities. The presenters use state-of-the-art technologies to investigate the impact of pollution on environments and human beings, which include: high-resolution instruments and mobile sensors; chemical, microbiological, and toxicological analyses; satellite mapping; and advanced data analysis. This session emphasized the fact that exposure to indoor and outdoor environmental pollutants from various sources poses a health concern to people, especially vulnerable populations. It also highlighted the significance of understanding real-world human exposure by applying newly developed research methods.

RESEARCH PRESENTATIONS

Roby Greenwald, PhD, Georgia State University – *Black Carbon and $PM_{2.5}$ Personal Exposure Compared to Institutional Settings: Preliminary Results from the Air Pollution Exposure in Child Care Settings (APECCS) Study*

Dr. Roby Greenwald is a Public Health Scientist at the Georgia State University School of Public Health. His research focuses on air pollution, climate change, and the role of the built environment on exposure and emissions. He has an undergraduate degree in Civil Engineering from Clemson University and a PhD in Environmental Engineering from the Georgia Institute of Technology. Dr. Greenwald was a Post-Doctoral Fellow in Pediatric Pulmonology at Emory University School of Medicine. He has been on the faculty at Georgia State since 2014.

PRESENTATION SUMMARY: The ongoing APECCS study measures air pollution exposure in children ages three to four years and explores biological mechanisms of response using salivary metabolomics. We recruited participants at childcare centers representing Atlanta-region air quality: an urban background site and two near-road sites. We used stationery and handheld devices to measure particulate matter 2.5 micrometers or less in diameter ($PM_{2.5}$) and black carbon (BC). A rotating sub-panel of participants performed residential and transportation environment measurements for one-week periods using microsensors installed at their residence and in a backpack that accompanied the child indoors and outdoors and on major trips.

Jonna Hynynen, PhD, Research Institutes of Sweden (RISE) – *Exploring the Environmental Impact of Lithium [Li]-Ion Battery Fires: Gas, Particulates, and Extinguishing Water Contaminations*

Dr. Jonna Hynynen is a senior scientist at RISE. Her expertise lies in the field of fire safety for lithium-ion batteries (LIBs). She holds a PhD in Materials Chemistry from Chalmers University of Technology. Dr. Hynynen's research focuses on understanding battery safety and on contributing to advancing sustainable energy solutions and enhancing safety practices in battery technology.

PRESENTATION SUMMARY: RISE conducted several large-scale vehicle fire tests to investigate fire effluents from both electric vehicles (EVs) and internal combustion engine vehicles (ICEVs). Contaminants in the gas phase, extinguishing water, and particulate emissions were analyzed. This talk focused on extinguishing water contamination and its potential environmental impacts, and on how these results could be used for other battery applications.

Ethell Vereen Jr., PhD, MSEH, Morehouse College – *Man, Microbes, and a Metropolitan Watershed*

Dr. Ethell Vereen Jr. is an Assistant Professor of Biology at Morehouse College with a science, technology, engineering, and mathematics (STEM) education focus on diversity and inclusion in natural resources, Pan-African pedagogy, and Virtual Reality (VR) for teaching, learning, and assessment. His research focuses on water quality, microbial ecology, environmental health and justice, and sustainability. Dr. Vereen has been awarded over $1 million in research grants and awards from agencies, including but not limited to the National Science Foundation, Department of Education, and EPA, which has increased the research capacity at Morehouse College and provided additional training opportunities for the college's STEM students.

PRESENTATION SUMMARY: Over the last century, many streams and rivers have been subjected to rapid urbanization and anthropogenic development of their drainage basins. These inputs often negatively impact stream hydrological, physicochemical, and biological characteristics. This talk explored how microbial communities vary within an urban watershed ecosystem and the link between water quality and social inequality.

Mike Bergin, PhD, Duke University – *Improving Global Air Quality: Combining Sensors, Satellites, and Data Analytics*

Dr. Mike Bergin is the Sternberg Family Professor in the Department of Civil and Environmental Engineering at Duke University. His general research focuses on the influence of air pollution on both climate and human health as well as renewable energy production. His specific interest is particulate matter (PM), and he has done a wide range of studies on the emission, formation, deposition, and impacts of PM both in pristine regions (Greenland and the Himalayas) and hazy regions (Southeastern U.S., China, and Asia) of the world. More recently, he has been studying the influence of PM on human health with an emphasis on determining the relative contributions of both indoor and outdoor sources to acute health impacts. This research also includes looking at the combined impact of air pollution and heat exposure on human health.

PRESENTATION SUMMARY:This study investigated how the explosion of low-cost air quality sensors has greatly increased our understanding of global ambient air pollutant concentrations and public awareness of the harmful health effects of air pollutants. Combined with satellite imagery and advanced data analytics, we now have the ability to determine the sources and source regions of pollutants as well as human exposures as never before. Developing practical mitigation strategies will depend on the cooperation of key stakeholders, however, and it is still not clear how such collaborations can be fostered.

MORNING, OCTOBER 1, 2024

Research Session Track #2 – Impact of Consumer Products on Environmental Pollution

Facilitator: Vinay Premnath, MS, ESRI/ULRI

SESSION SUMMARY

This session hosted four presentations focused on environmental pollution and health impacts from the construction and use of consumer products. The consumer products discussed included electronic nicotine delivery systems (ENDS), cannabidiol (CBD) products, and LIBs. The presenters shared their research methods and latest insights on the scope and extent of these consumer products' adverse effects on the environment. For example, fires caused by thermal runaway from LIBs can impact human health beyond the burn through oxidative stress and induce heavy metal exposure. Alternative products, production practices, and consumer behaviors were suggested as means to reduce the negative effects and consequences associated with the investigated consumer products.

RESEARCH PRESENTATIONS

Maureen Meister, PhD, RD, CIRI/ULRI – *ENDS-Induced Heavy Metal Exposure and Oxidative Injury is Mediated by Vaping Behavior*

Dr. Maureen Meister is a Research Scientist in the CIRI Center of Toxicology and Human Health. Dr. Meister's research aims to integrate cellular and molecular biology with clinical research approaches to elucidate the effects of environmental and consumer product exposures on human health. Dr. Meister has a specific interest in understanding the implications that complex exposures have on cardiopulmonary functioning with a focus on developing strategies to alleviate these effects. Dr. Meister received a PhD in Chemistry from Georgia State University where she completed a U.S. Department of Agriculture-National Institute of Food and Agriculture (USDA-NIFA) Predoctoral Fellowship focused on the implications of vaping on cardiopulmonary health and the potential for dietary strategies to mitigate these deleterious effects. Dr. Meister also holds a Master of Science in Nutritional Sciences from Oklahoma State University and is a Registered Dietitian with a background in research and clinical dietetics.

PRESENTATION SUMMARY: This presentation covered a study examining the impact of ENDS, commonly known as electronic (e)-cigarettes or vapes, on heavy metal exposure and oxidative injury. Dr. Meister outlined the results of CIRI's NIH-funded human subjects research focusing on the impacts of ENDS exposure on oral and respiratory health. She discussed the experimental design, which was conducted in exclusive ENDS users, aged 18 to 35, and outlined how puffing topography was used to determine the impacts of vaping behavior on heavy metal exposure. The research found that ENDS exposure contributes to increased oxidative stress and DNA damage markers in saliva, an effect that is puff volume dependent. Furthermore, Dr. Meister discussed the characterization of ENDS firsthand, emitted from the ENDS device, and secondhand, emitted from the user, aerosol emissions. In this study, it was found that secondhand exposure produced particulates of smaller size, known to be more pathogenic, compared to first-hand exposure. The research concluded that a user's vaping behavior, puff volume in particular, drives exposure metrics and is critical in influencing health outcomes related to vaping.

Weikang Li, PhD, ExPost – *Addressing the Safety Concerns of Spent Lithium-ion Batteries from Electrochemical and Chemical Perspectives*

Dr. Weikang Li is the Chief Technology Officer of ExPost Technology, Inc., and has extensive experience in battery recycling. Before joining the company, he completed postdoctoral research at the University of California, San Diego. Dr. Li holds a PhD in Environmental Engineering from the Beijing Institute of Technology. He also has a dual bachelor's degree in environmental engineering technology and business administration. Dr. Li's research focuses on cathode synthesis, modification, mechanisms of degradation, and direct recycling. He has published more than 40 peer-reviewed articles. Dr. Li oversees several advanced battery recycling projects to enhance profitability and safety. He is the lead principal investigator of the recent grant under the Bipartisan Infrastructure Legislation (BIL) bill, entitled "Shredding and Electrolyte Removal System for Consumer Electronics Battery Transportation and Recycling," which aims to deploy a safe shredding-extraction system to address the safety concerns of spent batteries before shipment. Dr. Li is leading this collaborative effort among different universities and research institutions.

PRESENTATION SUMMARY: This presentation covered the critical safety concerns associated with spent LIBs, focusing on the electrochemical and chemical risks of LIB recycling. Dr. Li emphasized the issues of overmining, toxic waste, and domestic supply chain vulnerabilities in the context of battery production and disposal. To mitigate environmental impact, Dr. Li articulated a vision to recycle 100% of battery components, including the cathode, anode, and metals. He discussed the fire hazards associated with LIBs, noting that these batteries can catch fire due to their construction, allowing them to ignite without needing oxygen. Dr. Li introduced the "Shark" system and the Purification and Regeneration Integrated Materials Engineering (PRIME) process, which incorporates regeneration and integrated engineering techniques to enhance the recycling of LIBs safely and efficiently.

Xin Hu, PhD, Emory University – *Demystifying Safety and Quality: Plant-Derived vs. Synthetic CBD in Personal Care Products*

Dr. Xin Hu is an Assistant Professor in the Gangarosa Department of Environmental Health at Emory University. Prior to this role, she served as an Assistant Professor in the Division of Pulmonary, Allergy, Critical Care, and Sleep Medicine at the Emory School of Medicine, where she continues to hold a faculty position as a secondary appointment. Dr. Hu earned her PhD in Toxicology from the University of Iowa and completed her postdoctoral training at Emory University. Her research broadly focuses on the health outcomes of environmental exposures, with a particular emphasis on prenatal exposure and its developmental effects. Dr. Hu utilizes high-resolution mass spectrometry (HRMS) alongside various omics techniques to investigate the molecular mechanisms by which environmental factors impact human health. Her current research is centered on the adverse effects of prenatal exposure to contaminants on fetal development, particularly lung development, as well as the impact of contaminants in personal care products. Dr. Hu's research team employs an integrative systems biology approach combining exposomics, metabolomics, genomics, and molecular and computational tools to address the complexities of environmental exposure and biological responses.

PRESENTATION SUMMARY: Since the 2018 Farm Bill legalized hemp, personal care products containing hemp-derived cannabinoids, particularly CBD, have flooded the market, promising benefits like anti-inflammation and mood enhancement. Dr. Hu shared concerns about safety that have arisen due to high levels of contaminants, such as metals and pesticides, found in some products, as well as discrepancies between labeled and actual cannabinoid content. Given that the Cannabis sativa plant is prone to absorbing heavy metals and is often treated with pesticides that can end up in consumer's body, Dr. Hu explained that synthetic cannabinoids — those which are chemically

identical to their natural counterparts but produced without plants — are being considered as potentially safer alternatives. She discussed the use of HRMS to measure the chemicals present in hemp, including environmental pollutants and unwanted cannabinoid contaminants like tetrahydrocannabinol (THC). She noted that many identified environmental pollutants can disrupt estrogen receptors, raising concerns about their impact on health, particularly for vulnerable populations such as pregnant individuals.

Josh Lamb, PhD, Sandia National Laboratories – *Environmental Impact of Li-Ion Battery Energy Storage Systems (BESS) Incidents Compared to Other Fires*

Joshua Lamb joined Sandia National Laboratories in 2011, after earning his PhD in Metallurgical Engineering from the University of Nevada, Reno. He spent the first 11 years of his career working in battery safety and abuse testing, evaluating the safety performance of battery technologies for transportation, stationary, and national security applications. Dr. Lamb developed some of the earliest procedures for evaluating battery failure propagation and explored new test and diagnostic methods for the early detection of battery thermal runaway. He ultimately became the Principal Investigator for Sandia's battery safety activities, and the Safety and Reliability Thrust Lead for the Department of Energy (DOE) Energy Storage program. In 2022, Dr. Lamb accepted an Interagency Personnel Act appointment to work within the Office of the Undersecretary of Defense for Research and Engineering. There, he led the development of the Department of Defense (DOD) Battery Science and Technology Strategy providing near- to long-term targets for DOD-directed research and development in batteries and energy storage. He served as a Scientific Advisor for power and energy and deputy to the Principal Director for Renewable Energy Generation and storage. He participated in initiatives to secure the future supply chain of advanced batteries for warfighting use in collaboration with multiple DOD components and subject matter experts. Dr. Lamb returned to Sandia in 2024 and is currently supporting the technological development of multiple power source technologies.

PRESENTATION SUMMARY: This presentation examined the environmental impact of LIB energy storage system fires in comparison to other observed fires. Dr. Lamb discussed the behavior of thermal runaway in LIBs, explaining how the cathodes are composed of a mix of metals that interact with solvents to create battery energy. He highlighted the toxic emissions produced during LIB fires, specifically mentioning hydrogen fluoride as a significant concern. Dr. Lamb outlined four levels of effects resulting from LIB incidents: immediate, short-term, medium-term, and long-term impacts on air, soil, and water quality. He emphasized the need for better understanding and management of the environmental risks associated with lithium-ion energy storage systems throughout their lifetime.

Resiliency for Health and Well-Being

AFTERNOON, OCTOBER 1, 2024

Resiliency for Health and Well-Being Panel Discussion

MODERATORS:

- **Holley Henderson, Leadership in Energy and Environmental Design (LEED) Fellow, Fitwel Ambassador, WELL AP, CIRI/ULRI, H2 Ecodesign**
- **Jill Crisman, PhD, Digital Safety Research Institute (DSRI)/ULRI**

PANELISTS:

- **Maureen Lichtveld, MD, MPH, University of Pittsburgh**
- **Adele Houghton, FAIA, DrPH, LEED Accredited Professional (AP), Biositu/Harvard University**
- **Honorable Brendan Owens, U.S. DOD**
- **Matt Trowbridge, MD, MPH, University of Virginia School of Medicine**

SESSION SUMMARY

The panel discussed the importance of expanding the conversation around what resilience means, how indoor environments contribute to resilient buildings, and what it means to support human health and well-being in the built environment. Each panelist contributed unique insights and perspectives from their respective fields of academia, public health, architecture, government, and medicine. Key themes included the impact of extreme weather and the role of resilience on societal and human health, community mitigation and development opportunities, and the need for collaboration among researchers, industry professionals, and policymakers to foster advancements that prioritize resilience for human health. The panelists' presentations were followed by a panel discussion and questions from the audience.

Panelist 1 – Maureen Lichtveld

Dr. Maureen Lichtveld is a member of the National Academy of Medicine, the Dean of the School of Public Health at the University of Pittsburgh — where she also holds the Jonas Salk Chair in Population Health, and a Professor of Environmental and Occupational Health. With over 35 years of expertise, her research spans environmentally induced diseases, health disparities, climate and health, and community resilience. Dr. Lichtveld has received numerous honors for her contributions to science, including induction into the Johns Hopkins University Society of Scholars, Centers for Disease Control and Prevention (CDC) Environmental Health Scientist of the Year, and Woman of the Year of the City of New Orleans.

PRESENTATION SUMMARY: Dr. Maureen Lichtveld framed community resilience as a crucial response to global challenges such as infectious disease, extreme heat, food and water security, climate-driven migration, and poor air quality. She introduced the National Academy of Medicine's Climate Change, Human Health & Equity Grand Challenge, focusing on resilience through four pillars: strategic communication, decarbonizing the health sector, transformative roadmaps, and innovative research. These pillars are linked by a Climate Communities Network to ensure coordinated efforts across sectors. Expanding this approach through a "One Health" lens includes impacts on humans, animals, and plants, as seen in Pennsylvania's One Health Consortium, which integrates research, education, policy, and community engagement to predict, prepare, and prevent infectious agents and other harmful contaminants from spilling over to affect human health. Dr. Lichtveld stressed that true resilience requires addressing gaps in data, infrastructure, funding, human resources, and governance. She highlighted the importance of asset assessments and needs assessments in public health, and that modern resilience is a systems-driven, cross-disciplinary approach operating through science, policy, and practice, where each element informs and enhances the others.

Panelist 2 – Adele Houghton

Dr. Adele Houghton is the President of Biositu, LLC, which focuses on the intersection of buildings, public health, and climate change. A Fellow of the American Institute of Architects (FAIA), she holds a Doctor of Public Health from the Harvard T.H. Chan School of Public Health, where she also teaches. Her upcoming book, "Architectural Epidemiology," co-authored with Professor Carlos Castillo-Salgado, introduces a novel method for architectural design that integrates environmental health data and community engagement to enhance community and planetary health.

PRESENTATION SUMMARY: Dr. Houghton built on the concepts, data, and systems presented by Panelist 1, Dr. Lichtveld, and discussed how to apply them to building design. She shared an infographic from the American Public Health Association representing the complex and interacting effects of climate change on human health. She presented an approach to prioritizing architectural design strategies called "health situation analysis." By combining neighborhood data analysis with community input, designers can prioritize the "sweet spot" design strategies that will result in the greatest co-benefits for the community — including health and climate change mitigation and adaption — and minimize the risk of co-harms. Dr. Houghton demonstrated this process by sharing a case study, "The Mueller Redevelopment Project," which redeveloped a municipal airport in Austin, Texas, into a mixed income multigenerational neighborhood community.

Panelist 3 – Brendan Owens

The Honorable Brendan Owens was sworn in as Assistant Secretary of Defense for Energy, Installations, and Environment on January 26, 2023. He advises on energy, installations, and environmental matters for the U.S. DOD, overseeing millions of acres and over 500,000 buildings. With a background in consultancy, co-founding Ecountabl, and a 19-year career at the U.S. Green Building Council (USGBC), he brings extensive experience in energy management and sustainable building practices.

PRESENTATION SUMMARY: The Honorable Brendan Owens addressed the pressing challenges faced by U.S. DOD installations, particularly the risks stemming from underfunded infrastructure and its impact on the health and safety of military personnel. Managing 538 global installations, 250,000 housing units, and 650,000 buildings across 26-million acres, Owens underscored the need for resilient infrastructure to ensure military readiness. These facilities, which range from healthcare centers to airplane hangars, depend on systems providing 24/7 energy, water, and communication. He stressed that while the military's mission depends on these facilities, the surrounding communities also play a critical role, as only 30% of service members live on-site. Advocating for human-centered design, Owens emphasized the direct link between the built environment and the well-being of service members. With deferred maintenance costs reaching $140 billion, he raised concerns about recruitment, retention, healthcare, and mental health, urging investment in infrastructure improvements to enhance the physical and mental health of military personnel.

Panelist 4 – Matt Trowbridge

Dr. Matthew Trowbridge is a Physician and Associate Professor at the University of Virginia School of Medicine, specializing in the impact of architecture, urban design, and transportation planning on health. He recently served as the Chief Medical Officer at the International WELL Building Institute and led the Green Health Partnership, a collaboration focused on developing health promotion tools for global real estate investors.

PRESENTATION SUMMARY: Dr. Trowbridge emphasized the importance of integrating social responsibility and equity into resilience and the built environment. He posed the question, "Why does the built environment matter to public health?" explaining that life expectancy is more tied to one's zip code than genetic code. Public health recognizes that only 20% of health outcomes are influenced by hospital care, while the rest stem from social and environmental factors, including the built environment. While altering the built environment is challenging, it offers significant potential to improve health outcomes. He highlighted how small daily decisions and infrastructure investments impact health, especially since people spend 90% of their time indoors. He stressed the importance of addressing indoor chemical exposures, infectious disease risks, and biophilic design. In 2013, Dr. Trowbridge founded the Green Health Partnership, collaborating with the USGBC to promote health in buildings. He emphasized using metrics like LEED to drive market transformation and ensure health outcomes are incorporated into real estate practices.

AFTERNOON, OCTOBER 1, 2024

Research Session Track #1 – Impacts of Disasters and Extreme Weather

Facilitator: Betsy Gast, MA, LEED AP, CIRI/ULRI, Cantilever Instruction + Design

SESSION SUMMARY

This session included four presentations that addressed how natural disasters and extreme weather impact human health and well-being. As the climate continues to change, extreme weather and disasters are projected to grow in frequency and intensity, making them a significant public health concern. The presenters discussed how heat affects the built environment as well as vulnerable populations, how water systems are being damaged and contaminated by wildfires, and how equity challenges result in harsher outcomes for marginalized communities. Suggestions for promoting resiliency and supporting health were shared, e.g., choosing alternative roof options to mitigate the urban heat island (UHI) effect and employing damage isolation in water systems. There was a sweeping emphasis on the need to expand research efforts to better understand the breadth of these issues as well as to inform better strategies for handling them.

RESEARCH PRESENTATIONS

Alex Azan, MD, New York University – *Evaluating the Impact of Cool Roofs on Pediatric Heat-Related Health Outcomes in NYC*

Dr. Alex Azan is an Assistant Professor in the Department of Population Health and the Division of General Internal Medicine and Clinical Innovation at the Grossman School of Medicine at New York University Langone Health. He currently practices as an internist in a Federally Qualified Health Center network in Brooklyn, New York. Grounded in tenets of environmental justice, his research focuses on the impacts of climate-driven, extreme weather on urban health and health equity related to structural and intermediary determinants of health. Dr. Azan is interested in policy-oriented, translational research and contributes to health outcome evaluations of various land use and traffic-related climate resiliency policies in urban environments.

PRESENTATION SUMMARY: Dr. Azan began his presentation by highlighting the heightened vulnerability of children to extreme heat, referencing various media reports and public responses regarding New York City (NYC). He discussed his research initiative aimed at mitigating the UHI effect, which includes the implementation of green roofs, cool roofs (white, high albedo roof surfaces), and solar roofs, with cool roofs being the most widely adopted in the studied communities due to their affordability. He also indicated that his study further explores the city's infrastructure, pointing out that roofs account for approximately 20% of the land surface in NYC. Dr. Azan also shared his experiences with translating his research findings to various stakeholders.

Karema Seliem, USGBC – *Current Trends in Resilience and Health for Buildings and Communities*

Karema Saliem is an Associate Director and Resilience Subject Matter Expert on the LEED Technical Development team at USGBC in Washington, DC. She is a LEED AP with over 15 years of experience in green building and environmental policy. In her current role at USGBC, Seliem facilitates discussions amongst LEED Committees and oversees technical development of credit requirements across multiple credit categories of the LEED green building rating systems. She authors and provides technical support for social equity and resilience strategies and is the staff point person managing the LEED Resilience Working Group and LEED Equity Working Group. Seliem began her career working as a space planner and project architect at the University of Pennsylvania's School of Engineering and closed out her experience in Philadelphia working at the Penn Sustainability office. She holds a Bachelor of Science in Interior Design from Drexel University and a Master of Environmental Studies from the University of Pennsylvania, with a concentration in Environmental Policy.

PRESENTATION SUMMARY: Karema Saliem presented an overview of LEED certification, which is now recognized in all 50 states and over 186 countries and territories. She referenced various surveys indicating that employees working in LEED-certified green buildings report higher levels of happiness, health, and productivity, emphasizing the significance of resiliency efforts. Seliem discussed resilience and health challenges in relation to equity issues, focusing on marginalized communities' vulnerability to climate change and energy poverty experiences as well as the importance of designing accessible spaces. She reviewed the evolution of resilience and health within the LEED framework, highlighting recent developments in LEED, version 5. Saliem provided an overview of the development timeline for this version, which introduces two new prerequisites: a Human Impact Assessment and a Climate Resilience Assessment.

Andrew Whelton, PhD, Purdue University – *Mitigation of Wildfire Damage to Drinking Water Systems*

Dr. Andrew Whelton is an internationally recognized environmental engineer with more than 20 years of experience in the infrastructure and public health disciplines. He has often been called into nationally significant disasters to provide executive level support. Some disasters include the Freedom Industries Chemical Spill, Camp Fire, Marshall Fire, Maui Wildfires, and fuel contamination in Hawaii, among others. At Purdue, Dr. Whelton founded and leads the Center for Plumbing Safety, an industrial consortium, and several multi-institution research efforts. His expertise has been sought by President Biden's Administration, Canadian communities, and the Ministry of Health.

PRESENTATION SUMMARY: Public and private drinking water systems are increasingly being damaged and chemically contaminated by wildfires, posing immediate and long-term health risks. These include both regulated public water systems as well as private property systems for residences and businesses. Dr. Whelton emphasized the significance of research on this topic, highlighting that prior to 2021 there were no publicly available studies on wildfire-related contamination of drinking water wells. During his study, he identified the presence of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) in debris collected near wells. Dr. Whelton further noted that these contaminants were also detected within the wells themselves. He shared a series of recommendations for future research and actions. For water utilities, he advised implementing defense measures, including but not limited to buffer zones, storage solutions, bypass systems, automatic shutoff mechanisms, and training. Dr. Whelton also emphasized the importance of response strategies, including damage isolation, mutual aid agreements, and correct water testing support practices. For households and businesses, he urged seeking assistance when needed. Dr. Whelton called on elected officials to actively listen, support, and fund necessary actions. Lastly, he recommended conducting research to better understand several critical areas, including the fate of contaminants in water systems and plumbing, exposure risks at fixtures, the relationship between water system impacts and household health and economic resilience, and the effects of agricultural water systems on animal and crop health.

Zach Calhoun, PhD Candidate, Duke University – *Matching Heat Maps to Health Outcomes: Urban Heat Stress and Opportunities to Intervene*

Zach Calhoun is a PhD Candidate at Duke University, advised by Professors Mike Bergin and David Carlson. Zach's research leverages machine learning, spatial statistics, and remote sensing to explore the profound effects of urban heating on air pollution exposure, human health, and energy. Passionate about innovation, Zach is pioneering new methods to utilize citizen-collected weather data for precise heat exposure estimation at high spatiotemporal resolution. His recent publications explore the application of causal inference techniques to estimate the efficacy of UHI interventions and further demonstrate that environmental monitoring itself is an environmental justice issue. Zach advocates for passive interventions to reduce heat stress, so that we may reduce cooling demand, lower carbon emissions, and make cities healthier, more equitable, and resilient. Prior to his PhD, Zach earned his Bachelor of Science at the University of Virginia, then worked as a supply chain technology consultant in New York City. He is a proud native of Atlanta, Georgia.

PRESENTATION SUMMARY: Zach Calhoun presented on the topic of urban heat stress and opportunities for intervention. He provided an overview of the context of extreme heat and the formation of UHI, followed by a discussion of urban heat data and modeling techniques used to analyze these issues. A significant challenge for understanding the impact of heat on human health and energy systems is a lack of high spatiotemporal resolution temperature data. Without this granularity of data, it is difficult to characterize neighborhood-level heat stress. Calhoun also examined the health outcomes associated with urban heat stress and proposed potential intervention strategies. He focused primarily on vegetation and cool roof interventions and demonstrated how machine learning could be used to understand the efficacy of these interventions on reducing urban temperatures. Lastly, Calhoun identified key areas for future research that could enhance understanding and action in this field. His presentation emphasized the importance of: interventions aimed at mitigating the impact of urban heat on public health and energy systems; exploring the relationships between urban heat, health, and energy consumption; and the data and models used to study urban heat dynamics.

AFTERNOON, OCTOBER 1, 2024

Research Session Track #2 – Addressing Health and Well-Being

Facilitator: Sean McGregor, PhD, DSRI/ULRI

SESSION SUMMARY

This session explored the complex and growing world of artificial intelligence (AI) technology and its use in supporting human health and well-being. With backgrounds in medicine/healthcare, education, AI technology, and social science, the presenters shared their unique experiences with AI technology and its application in equitable healthcare education, privacy protection in healthcare, improved healthcare experiences and outcomes, and social services. While there are many benefits to employing AI technology in these cases, the presenters also discussed critical challenges they face and their approach to addressing them to mitigate harmful consequences.

RESEARCH PRESENTATIONS

Francisco Iacobelli, PhD, MSCS, Loyola University, Chicago – *Purposeful AI Design for Low-Literacy Latinas*

Dr. Francisco Iacobelli is an Associate Professor with a dual appointment to the Departments of Health Informatics and Data Science and to the Department of Surgery at Loyola University, Chicago. Prior to that, for over 12 years, he taught at Northeastern Illinois University, a minority serving institution. Dr. Iacobelli is affiliated with the Center for Advancing Safety of Machine Intelligence (CASMI) and the Medical Association for Latino Advancement (MOLA). His research focus is at the intersection of human-computer interaction, equitable AI, and health disparities. Dr. Iacobelli received his PhD in Computer Science from Northwestern University, a Master of Science from DePaul University, and his undergraduate degree from the Universidad Diego Portales in Santiago, Chile. Throughout his career, he has been purposefully integrating students from diverse backgrounds in his research, always with an eye toward helping generate a tangible impact in Chicago communities to bridge health disparities.

PRESENTATION SUMMARY: This presentation focused on the intersectionality of low-literacy populations and the consumption of information through technology. Dr. Iacobelli started by talking about equity in relation to literacy levels of U.S. adults. He explained his work in the application of AI in interfaces, such as tutoring systems and virtual agents, that are purposefully designed for low-literacy Latina populations. This research involves language models specifically designed to be culturally appropriate for minority populations. The goal of his current efforts is to develop culturally appropriate Intelligent Tutoring Systems (ITS), AI-infused systems, for health education of low-literacy minorities. Creating effective educational materials like ITS for breast cancer patients and survivors in marginalized communities can create a better healthcare experience. Dr. Iacobelli discussed the initial challenges he faced while creating this AI system, highlighting the need to adapt the technology to meet the unique needs of low-literacy individuals. He emphasized the importance of addressing biases in representation and noted solutions that work for some populations may not be effective for others. To enhance the user experience, he adapted the system to allow low-literacy individuals the time to complete their sentences, ensuring that the AI captures the full context of their communication.

Abel Kho, MD, MS, FACMI, Northwestern University – *Data Privacy as an Enabler of Health Insights*

Dr. Abel Kho is an Internist and Professor of Medicine and Preventive Medicine in the Northwestern University Feinberg School of Medicine where he is the Founding Director of the Center for Health Information Partnerships (2015) and the Institute for Artificial Intelligence in Medicine (2020). His research focuses on integrating diverse data (e.g., electronic health records, administrative data, geospatial data) for a range of health applications, including computational phenotyping, estimating population level disease burden, and quality improvement. Dr. Kho has received funding for his research from the NIH, National Science Foundation (NSF), Defense Advanced Research Projects Agency (DARPA), Patient-Centered Outcomes Research Institute (PCORI), CDC, Centers for Medicare and Medicaid Services (CMS), Office of the National Coordinator for Health Information Technology (ONC), and Agency for Healthcare Research and Quality (AHRQ) as well as from several Foundations. He has published extensively and mentored numerous students and trainees. Dr. Kho is an internationally recognized expert in privacy-preserving record linkage, having published the first large scale real-world application of this method for which he was assigned a patent. He co-founded a startup that was subsequently acquired by Datavant. Dr. Kho is an elected Fellow of the American College of Medical Informatics and recipient of the Donald A.B. Lindbergh Award for Innovation in Informatics.

PRESENTATION SUMMARY: Personal and institutional data privacy concerns are crucial considerations when handling health data. Advances in privacy-enhancing technologies and attention to the practical challenges in implementing these technologies can help address privacy concerns. Over the last decade, researchers in Chicago have advanced the practical implementation of privacy-preserving record linkage and distributed analyses to enable population health insights. Dr. Kho emphasized the correlation between socioeconomic status and healthcare quality, highlighting the need for equitable access to health insights. He introduced the Chicago Area Patient-Centered Outcomes Research Network (CAPriCORN) initiative and the non-profit Medical Research Analytics and Informatics Alliance (MRAIA), which serves as the honest data broker for CAPriCORN. Dr. Kho also described the creation of VaultDB, a system designed to enhance data privacy. VaultDB reveals only the necessary data while eliminating the need for a middle honest broker, thus safeguarding sensitive information. He explained that this privacy-enhancing technology allows for the analysis of geospatial location data with health information across institutions, enabling hospitals to assess and provide probabilities of health risks more effectively.

Nick Judd, PhD, DSRI/ULRI – *Measuring Hazards in Health-Related Applications of Large Language Models*

Dr. Nick Judd is a computational social scientist currently evaluating the capabilities and impact of AI technologies. At DSRI, Dr. Judd leads an interdisciplinary research team that refines methodologies, benchmarks, and data for AI system evaluation. Dr. Judd's research interests also include methodologies for evaluating the social and societal impact of AI systems. While at Twitter, Dr. Judd and his colleagues released Birdwatch (now called Community Notes) — a first-of-its-kind, community-based approach to addressing misinformation with the help of volunteer contributors and a human-in-the-loop machine learning system. Dr. Judd led research on the impact of Birdwatch on individual users and the Twitter platform. The Birdwatch algorithm is now cited in a growing number of prospective mechanisms for distributed governance of AI systems. Dr. Judd received his PhD in Sociology from the University of Chicago. Before becoming a researcher, Dr. Judd was Managing Editor of the widely read news site techPresident. While there, he led an editorial team that covered the 2010 and 2012 U.S. elections, Occupy Wall Street, and the role of Internet technologies in global politics and international development.

PRESENTATION SUMMARY: Health applications are a promising area for applications of large language models (LLMs). Many well-known LLM pathologies, however, raise critical questions about whether any individual LLM-based system is suitable for health-related purposes. Dr. Judd introduced methodologies for measuring the likelihood that an LLM-based system would present hazards in health-related, consumer-facing applications through automated and reproducible assessments. He described the potential risks and benefits of chatbot-based systems, which are known often to include factually inaccurate results in their outputs, in healthcare settings. Dr. Judd presented assessment results showing that many consumer-grade foundation models frequently offer incorrect responses to straightforward yes-or-no health inquiries.

Kenneth Holstein, PhD, Carnegie-Mellon University – *Designing for Complementarity in AI-Augmented Work*

Dr. Ken Holstein is an Assistant Professor at Carnegie Mellon University's Human-Computer Interaction Institute, where he directs the CoALA (Augmentation, Learning, & AI) Lab. His research focuses on enabling more participatory, worker-centered, and community-driven approaches to AI design and evaluation. Towards this goal, researchers at the CoALA Lab develop new methods and tools to incorporate diverse human expertise across the AI development lifecycle. Their research has received awards at top-tier venues in human-centered AI and has been featured by news outlets such as the Public Broadcasting Service (PBS), The Guardian, Wired, Forbes, and The Boston Globe.

PRESENTATION SUMMARY: AI systems are increasingly used to augment human work in complex social contexts, including social services, education, and content moderation. Dr. Holstein asserted that today's worker-facing AI systems often represent missed opportunities to meaningfully complement and enhance human workers' abilities. He took attendees through a real-world case study on the integration of AI systems in government processes, particularly in the context of identifying potential cases of child abuse through child welfare screening. Through this study, Dr. Holstein discussed the challenges associated with creating the optimal AI for social decision-making, including establishing a "ground truth," noting that socially constructed concepts can often be subjective and difficult to quantify. He raised critical questions regarding the ethical implications of using AI in these sensitive areas and the need for ongoing evaluation and oversight in government applications of AI technology. Dr. Holstein shared his research efforts to overcome these challenges, targeting various points across the AI project lifecycle — from the earliest problem formulation stages to the design of AI system evaluations and the development of worker-AI interfaces.

2024 Symposium Keynote Address

Joel Tickner, ScD, University of Massachusetts-Lowell/Change Chemistry

From Assessing Problems to Scaling Solutions: Preventing Toxic Chemical Risks Through Safer Chemicals and Materials

The second morning of the symposium started with a keynote address by Joel A. Tickner, ScD from UMass Lowell and Change Chemistry. Dr. Tickner presented strategies for mitigating toxic chemical risks by promoting the use of safer chemicals and materials. He emphasized the need for a shift from merely assessing problems related to toxic substances to actively scaling solutions that can prevent these risks. Dr. Tickner outlined four different lenses to consider when assessing safer alternatives: research and strategic engagement; supply chain needs and applications and innovation policy; adoption in industry; and building multi-disciplinary science and practice.

In 2023, the United Nations Environment Programme (UNEP) published a report on the risks posed by chemicals found in plastic. More than 13,000 chemicals have been identified as associated with plastics and plastic production and, of those, only 7,000 chemicals have been assessed for their hazardous properties. The report shared that more than 3,200 of the studied chemicals were identified as substances of potential concern. Dr. Tickner noted chemicals of concern and their impacts cannot be properly addressed without safer alternatives at scale. Studying the chemicals and their issues without focusing on alternatives as a solution can make changes take longer as well as lead to the implementation of regrettable substitutes.

Dr. Tickner offered the process of alternatives assessment as a means to support substitution efforts. This assessment leverages toxicology and exposure science insights to identify and better understand safer alternatives to chemicals of concern and their trade-offs. The objective is to foster an informed consideration of the positive and negative aspects of alternatives. He emphasized the alternatives assessment is not a safety assessment, a risk assessment, or a sustainability assessment. The goal of this approach of informed substitution is to minimize the probability of unintended consequences and empower the decisionmaker to take action with the best information available. There are more than 20 alternatives assessment frameworks to reference; some guides contain more resource intensive sections, and some have more components but there are many aspects in common between them. The general steps for alternatives assessment are to develop scope, identify alternatives, assess hazards and exposure, assess performance and economic feasibility, compare alternatives and make decisions, and then implement.

If scientists determine that a safer alternative does not currently exist, they need to work to develop alternatives quickly using the tools of green chemistry. Finding or synthesizing a safer alternative and adopting it, however, are two distinct goals. Identifying an alternative is an important step in mitigating risk but it needs to be adoptable in the marketplace, working for professionals and consumers alike, to actually create change and protect health. In the adoption phase it is important to determine unexpected trade-offs, reduce the amount of possible regrettable substitutions, address hindrances to substitution, and provide companies without knowledge or expertise support in the process. One of the common barriers to implementation is related to the incumbency of the existing chemicals that are optimized, capitalized, and lower cost.

The alternatives assessment seems like an optimal answer to handling chemicals of concern, but because there are more growth deterrents than drivers and accelerators, adoption rate is slow. Dr. Tickner highlighted the importance of collaboration among stakeholders in industry, academic, and regulatory bodies to accelerate growth. He emphasized the significance of proactive measures in chemical management to enhance public health and environmental sustainability.

Sustainable Advances in Materials and Technologies

MORNING, OCTOBER 2, 2024

Sustainable Advances in Materials and Technologies Panel Discussion

MODERATORS:

- **Cristi Bell Huff, PhD, CIRI/ULRI**
- **Stuart Miller, PhD, Materials Discovery Research Institute (MDRI)/ULRI**

PANELISTS:

- **William Paddock, MBA, WAP Sustainability**
- **Dawn Haynie, PhD, American Society of Interior Designers (ASID)/Georgia State University**
- **Heather McKenney, MPH, ChemFORWARD**
- **David Carlson, PhD, Duke University**

SESSION SUMMARY

The focus of this panel was to build on what was heard from Panels 1 and 2 on the first day of the ULRI Research Symposium. From their different backgrounds and perspectives, the experts for this panel helped the audience explore the intersections of their work as they discussed both how materials and technologies can impact human health and how advances in materials and technologies can protect human health. Much of what was discussed in this session integrated well with the previous panels related to the impacts of environmental pollution and human health as well as to resiliency for health when considering solutions to these impacts. The panelists discussed innovative practices and research in the field. Each panelist contributed insights on their respective areas of expertise, highlighting the importance of sustainable materials and the technologies that support their development and application. Key themes included the role of sustainability in design, the impact of regulatory frameworks on material safety, and the integration of new technologies in creating safer, more sustainable materials. The panelists' presentations were followed by time for questions from the audience and for panel discussion. The panel emphasized collaboration among researchers, industry professionals, and policymakers to foster advancements that prioritize sustainability and health.

Panelist 1 – William Paddock

William Paddock is the Founder and Managing Director of WAP Sustainability, a leading provider of sustainability services. He is also an Adjunct Professor at the Institute for Sustainable Practice at Lipscomb University. William serves as an EcoSystem Partner for the International Living Future Institute — Living Product Challenge, and is the current Chair of the LEED Materials and Resources Technical Advisory Group. He is also a Board Member of the Carbon Leadership Forum and supports the Health Product Declaration Collaborative as a member of its Technical Committee.

PRESENTATION SUMMARY: Manufacturers are challenged to meet sustainability expectations, but this can be improved through full life-cycle product assessments, carbon management, and comprehensive chemical ingredient transparency. WAP Sustainability has integrated these approaches in the optimization of materials selection. This allows for the use of a decision matrix framework in sustainable materials selection. This framework was developed to understand trade-offs between cost, returns, and impacts with dimensions resulting from competitor and consumer analyses, regulatory contexts, input pricing uncertainties, emerging technologies, and green financing mechanisms.

Panelist 2 – Dawn Haynie, PhD

Dr. Dawn Haynie offers a distinctive, interdisciplinary approach to design, with extensive experience across urban design, interiors, architecture, and graphic design. As a Research Fellow with ASID, she manages their internal and external research on the interior design industry. As an Adjunct Professor at Georgia State University, Dr. Haynie inspires undergraduate and graduate students with her interdisciplinary approach, encouraging them to explore new ideas, test established boundaries, and become more critical, creative, and collaborative. She is also the Founder of Detailed Designs.

PRESENTATION SUMMARY: Extreme weather events and evolving environmental conditions are impacting building materials and increasing risks to human health. An increase in warmer temperatures and changes in precipitation have increased VOCs, SVOCs, PM, and ground ozone, mold, and pathogens, adversely impacting indoor air quality (IAQ). Designers and manufacturers have an opportunity to raise greater awareness, reduce indoor pollution, use materials that minimize risks, drive market transformation, and collectively move the industry toward healthier spaces with greater building resiliency. ASID has published an Impact of Design Brief that provides designers with background information on emerging issues related to IAQ, climate change, and resilience. This document also explores the connection between interior design, human health, and building resilience offering guidance and a framework for decision making for interior designers seeking to improve building resiliency.

Panelist 3 – Heather McKenney

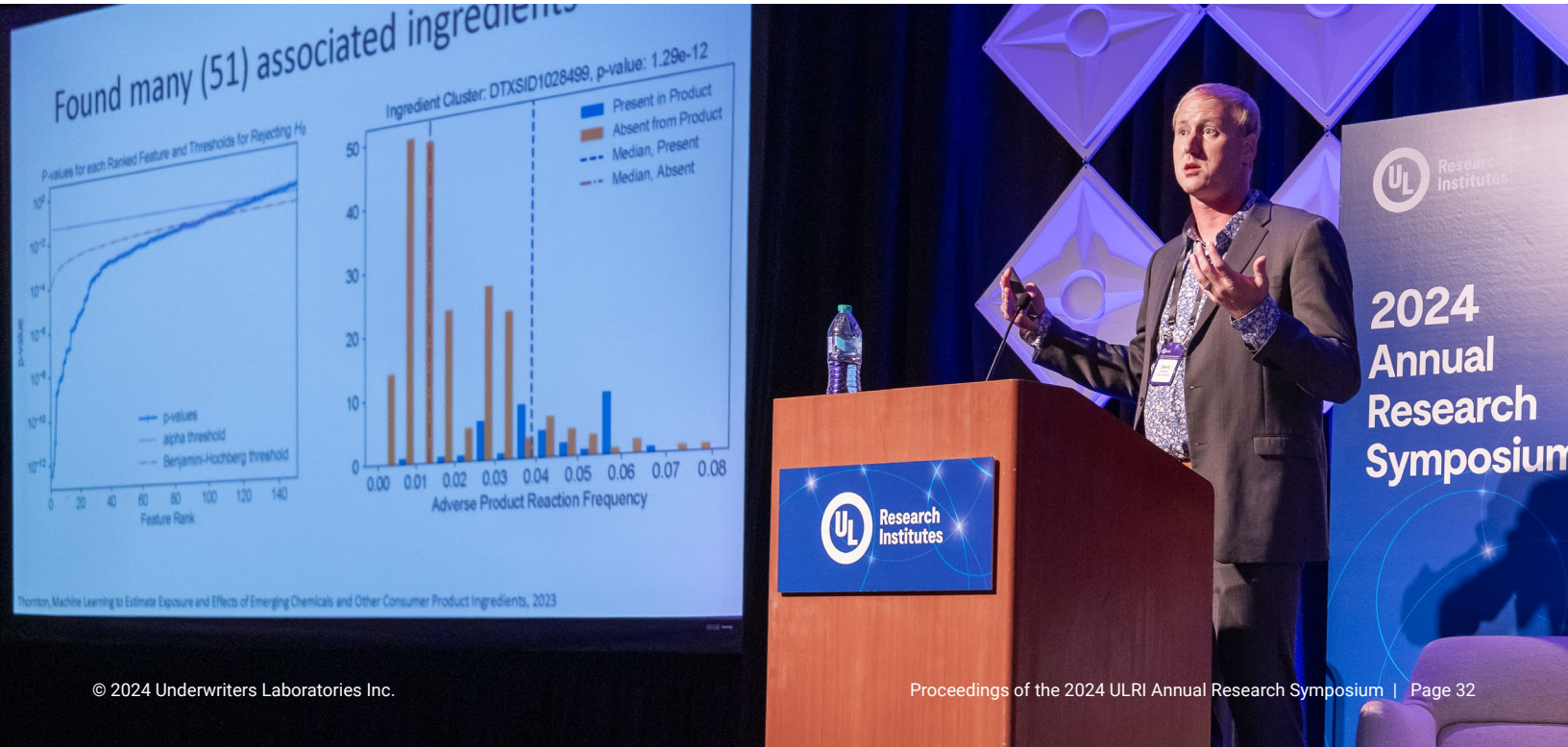
Heather McKenny is the Science and Safer Chemistry Lead at ChemFORWARD, where she is responsible for the strategy and execution of the Science Team's efforts to scale access to chemical hazard data and identify safer chemistry. She has a Master of Public Health and a background in the consumer-packaged goods (CPG) industry leading toxicology and product safety teams for formulated consumer products.

PRESENTATION SUMMARY: Regulations indicate what chemicals not to use, but the next question is what to use instead. Without robust, high-quality data, this question cannot be answered and everyone in the value chain is vulnerable to regrettable substitution. The Chemical Hazard Data Trust is managed by ChemFORWARD and designed to simplify access to chemical hazard data from many sources; curate, maintain, and improve the data; and harmonize the information for actionable decision support that will accelerate global transition to safer chemistry. The lack of cost-effective, high-quality, chemical hazard data has been a barrier for companies in the transition to more sustainable materials. ChemFORWARD's work in the area of chemical hazard assessment facilitates proactive identification and monitoring of chemicals used at the product formulation stage. By conducting and sharing comprehensive chemical hazard assessments on these chemicals, the introduction of high hazards into the ecosystem can be proactively avoided.

Panelist 4 – David Carlson, PhD

Dr. David Carlson is an Associate Professor at Duke University, with appointments in the Departments of Civil and Environmental Engineering, Biostatistics and Bioinformatics, and Computer Science. His research focuses on developing machine learning methods to advance data-driven science, particularly through probabilistic and deep learning approaches. His methods have been applied in various fields across engineering and health, including environmental health and the development of novel treatments for brain disorders in animal models.

PRESENTATION SUMMARY: Currently, very few chemicals undergo comprehensive safety testing. Hazard assessments are often done by extrapolating from information on related chemicals, and human health impacts are often interpreted based on those relevant to different species or simpler biological systems. In addition, there are new substances constantly emerging and a lack of data on complex mixtures that are more representative of real use applications. Machine learning can help bring a better understanding of the risk resulting in safer products; however, as these AI systems are developed, there are gaps in human health response data that can be used to inform the models. Borrowing from public health fields that leverage online text data, Dr. Carlson's research seeks to use product review data related to adverse reactions to inform chemical safety. By training and using modern AI tools over large product datasets, connections can be made between adverse reactions and product ingredients. This has the potential to scale to many kinds of products and inform safer, more sustainable product development.



MORNING, OCTOBER 2, 2024

Research Session Track #1 – Advances in Materials

Facilitator: Debra Harris, PhD, Baylor University/RAD Consultants

SESSION SUMMARY

The proper selection of materials to accomplish decarbonization, lower climate impact, sustainability, and better IAQ for human health has become more important in recent years. Fulfilling these goals involves investigating embodied carbon in building materials and furnishings, declaring materials' environmental impact, substituting biobased and green feedstocks, and potentially changing current third-party certifications to include temperature variability in the indoor environment. The speakers in this breakout session discussed the advances in these types of materials and the goal of increasing awareness of climate-related issues in relation to the built environment.

RESEARCH PRESENTATIONS

Lance Davis, FAIA, LEED Fellow, MSU Fellow, Federal Employee – *The Federal Government Advances Material Decarbonization and Equity*

Lance Davis is the sustainability architect for a Federal Agency in Washington, DC, where he leads the development of sustainable policy, performance, and tools. He has a Bachelor of Architecture from Mississippi State University where he is a Fellow. He is also a Fellow of the American Institute of Architects and USGBC. He chaired the LEED Steering Committee for the development of LEED version 5, and was on the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Decarbonization Task Force focusing on carbon sequestration. He is appointed to President Biden's Climate Smart Infrastructure Working Group, co-authored "Sustainability Matters," and is featured in the book, "The Rise of Living Architecture."

PRESENTATION SUMMARY: Material decarbonization and the promotion of environmental and human equity that is necessarily involved in its advancement involves four key themes: whole-building modeling, low materials, alternative means to material decarbonization, and biomimetic, regenerative, and ethical sourcing of materials. Among the many sustainable federal regulations that federal buildings must comply with, building projects must incorporate one LEED BD+C credit for life-cycle impact reduction. A target of 20% reduction in the whole building's embodied carbon from materials could be satisfied by choosing low embodied carbon materials, such as bamboo, hempcrete, sheep's wool, or straw-bale, as opposed to concrete or gypsum board, for instance. Additional options for embodied carbon reduction in the federal government's modernization or completely new construction building projects include reuse alone, which could present an 87% decrease in embodied carbon. Compared to a baselined brand-new replacement building, which can be approximated as 19.7 million kg CO_2e, an adaptive reuse design would only represent 2.6 million kg CO_2e. The subtractive effect of improving material selection using the examples given above would further reduce the building's environmental impact. Increasingly, thousands of environmental product declarations (EPDs) published in material categories since 2022 are driving the glass and steel market to yield competitive advantages as well as enhancing the profile of buying clean across building sectors. Finally, those purchasing agents sourcing materials in federal buildings have begun to identify novel utilizations such as biomimetic and regenerative materials. Salvaged materials and diverted construction and demolition waste can also be assessed for existing buildings.

Scott Steady, UL Solutions – *Environmental Product Declarations and Product Carbon Footprint Verification: Tools for Selecting Lower Impact Materials*

Scott Steady is a highly accomplished Business Development Manager at UL Solutions, with a passion for helping manufacturers understand the impact of their products on health and the environment. With a Bachelor of Science in Chemical Engineering from Louisiana State University, Scott possesses a deep understanding of product development and its potential effects on the world around us. Throughout his career, Scott has played a pivotal role in the development and implementation of various sustainability initiatives. Notably, he was instrumental in developing the GREENGUARD Certification program for low emitting products. This program has become a widely recognized and trusted standard for ensuring the safety and sustainability of indoor environments. In addition to his work with GREENGUARD, Scott has also been a driving force behind UL's establishment of standards and programs related to circularity and carbon footprint. His expertise in these areas brings value to manufacturers as they work towards more sustainable practices and reducing their environmental impact.

PRESENTATION SUMMARY: Many countries, and subsequently businesses, have committed to carbon neutrality and are pursuing ambitious net zero goals by target years as soon as 2030. When looking at a producer's total carbon emissions, it is important to keep in mind three different scopes of those emissions. Scope 1 is the direct impact on carbon emissions from sources such as company facilities and vehicles. Scope 2 includes indirect emissions from capital goods, transportation and distribution, generated waste, travel, commuting, and purchased electricity, heating, and cooling. Additionally, Scope 3 emissions are indirect and include downstream activities like processing of products, use of sold products, end-of-life treatment, and franchises, for example. A business can investigate these emission sources when deciding to declare their emissions as a step toward net zero carbon. The different options for tracking and communicating carbon emissions as a step in reduction comprise four methods: lifecycle assessment (LCA), product category rule (PCR), EPD, and product carbon footprint (PCF). All these tools are interrelated and help manufacturers, purchasers, suppliers, and distributors evaluate a product's impact.

Sam Jackson, PhD, HudsonAlpha – *Advanced Biobased Materials for a Low Carbon Future*

Dr. Sam Jackson is Director of Greening the Southeast, an NSF Engine program at the HudsonAlpha Institute for Biotechnology. The program supports the advancement of the biobased economy in the region, specifically biobased products derived from perennial grass crops for use in the automotive, construction, and packaging industries. Dr. Jackson is nationally recognized for his work to develop economical and sustainable biomass feedstock supply chains for bioenergy and bioproducts, particularly working with researchers and farmers to pioneer the establishment and management of dedicated energy crops as bioenergy feedstocks for use in sustainable downstream products. He also has extensive experience in biomass processing and conversion and in technoeconomic and life-cycle analysis of bioproducts. Prior to HudsonAlpha, Dr. Jackson was a Cofounder of Genera, a molded fiber products manufacturer, where he spent 15 years growing the business. He received his PhD in Natural Resources from the University of Tennessee Institute of Agriculture.

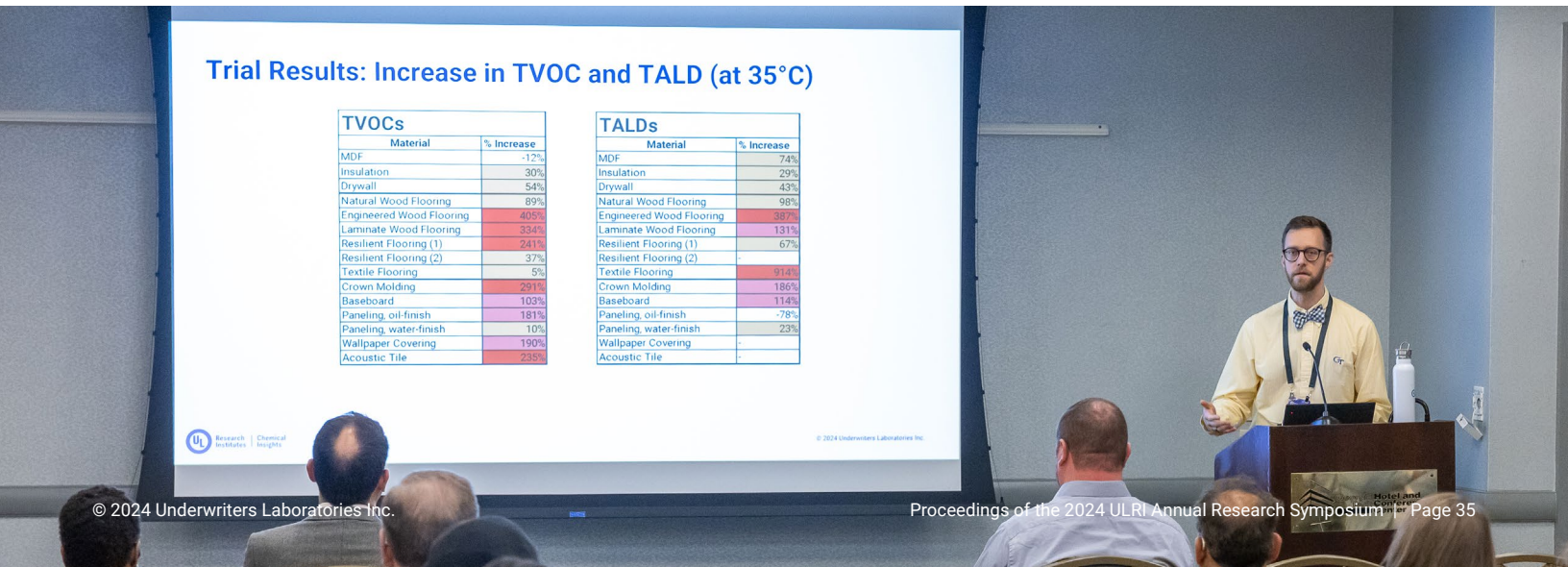
PRESENTATION SUMMARY: Using advanced biobased materials for a low carbon future involves converting carbon neutral crops to sustainable consumer goods while building a diverse agriscience workforce and reviving rural economies. Three specific industries — packaging, automotive, and construction materials — are the focus of this work. The example crops used to demonstrate the concept were switchgrass and miscanthus, agricultural grasses that contain 35% cellulose, 28% hemicellulose, 20% lignin, 12% extractives, and 5% inorganics, all of which can be

used in diverse downstream products such as packaging, coatings, additives, binders, and building products. The program's research on these materials focuses on integrated feedstock systems, product performance, life span carbon reduction, and end-of-service-life solutions like compostability. The impacts of using biobased materials to reduce carbon impact on our environment include use-inspired product development, education across workforce sectors, economic growth in rural areas, and expanded production of feedstocks for low carbon commercial products. The manufacturing process could produce circularity in local economies by including all feedstocks, sustainable manufacturing, reuse, and community outcomes within a localized region. This would improve the outlook not only of the specific region, but also of larger processes and economies.

Patrick Chepaitis, MS, CIRI/ULRI – *Climate Change and Indoor Material Emissions*

Patrick Chepaitis is a Research Scientist in the Center for Advanced Measurements at CIRI. His research focuses on investigating chemical emissions from household products and emerging technologies such as electronic cigarettes and 3D printing. Patrick utilizes analytical chemistry instrumentation to identify and quantify chemical exposure and its impact on human health. He holds a Master of Science in Chemistry from Georgia State University and was a forensic chemist for seven years prior to joining CIRI.

PRESENTATION SUMMARY: As the climate begins to warm, not only our outdoor environments, but also our indoor environments are affected, so additional scrutiny of the sources of indoor air pollution is warranted. There are more choices than ever for designers, developers, and consumers to choose from among modern building materials. And, while we spend much of our time indoors, the materials that occupy our spaces have not been given full investigation within the scope of IAQ and human health related to rising global temperatures. Indeed, about a third of homes in the U.S. lack air conditioning and many more may have suboptimal systems in deteriorating housing conditions. As high-heat events become more frequent, the materials we are most exposed to may have an outsized impact on our health. In this study, 18 building materials of varying classifications were chosen to investigate the effect of elevated indoor temperatures on chemical emission profiles. Among all the materials, the emissions of 78% increased at higher temperature. The high surface area materials represented the greatest portion of statistically greater emissions at elevated temperature. Additional VOCs, greater than 50% more than were emitted at room temperature in some materials like carpet and mineral-based acoustic tile, were produced at the higher temperature point. Chemicals present in more than half of the samples included diethyl phthalate, phenol, decanal, and hexanal. Significant increases in formaldehyde concentrations were produced among the wood flooring samples, which reflect concerns for human health. Among the other chemicals of concern being emitted from these materials included those classified as respiratory irritants, metabolic antagonists, and ones that adversely affect microbiomes. Mitigation strategies for lessening exposure to chemical emissions from building materials at both room temperature and moderately elevated temperature were also discussed.



MORNING, OCTOBER 2, 2024

Research Session Track #2 – Advances in Pollution Management

Facilitator: David Kalafut, CIRI/ULRI

SESSION SUMMARY

The focus of this track was on the different developments made in pollution management with a focus on e-waste streams and complications in recycling electronics, upcycling, and delivering clean potable water in arid equatorial areas.

RESEARCH PRESENTATIONS

Richard (Rick) Neitzel, PhD, CIH, FAIHA, University of Michigan – *Informal Electronic Waste Recycling Exposures and Impacts*

Rick Neitzel is a Professor of Environmental Health Sciences and Global Public Health at the University of Michigan School of Public Health. Global in nature, his research has evaluated hazardous workplace and community exposures and associated health impacts in the U.S., Sweden, Thailand, Chile, Ghana, and Kuwait. He has created a free, publicly accessible job-exposure matrix for occupational noise exposures in the U.S. and Canada (http://noisejem.sph.umich.edu/), serves as the principal investigator for the ongoing, nationwide Apple Hearing Study (https://sph.umich.edu/applehearingstudy/), and directs the Center for Occupational Health and Safety Engineering (http://cohse.umich.edu/). He serves as Chair of the American Conference of Governmental Industrial Hygienists (ACGIH®) Threshold Limit Values for Physical Agents (TLV®-PA) Committee, is a Fellow of the American Industrial Hygiene Association, and has been a Certified Industrial Hygienist since 2003.

PRESENTATION SUMMARY: As consumers, we rarely think about what happens to our electronic devices after we have discarded them, and about the challenges associated with converting our “e-waste” into profit. The recycling of e-waste is tedious, laborious, and a time-consuming process with small profit margins. Because of these constraints, most of our e-waste is recycled by workers in low- and middle- income countries who use rudimentary tools and processes to do this work, oftentimes in their home. These unique conditions can lead to several adverse health conditions ranging from musculoskeletal injuries, exposures to heavy metals, harmful chemicals, and admixtures, psychosocial stressors, and economic instability. We can improve our e-waste recycling capabilities by creating a more transparent and consistent supply chain and by developing the tools to recycle our electronics most efficiently.

Timur Islamoglu, PhD, MDRI/ULRI – *Porous Material Development towards Atmospheric Water Harvesting*

Dr. Timur Islamoglu is a Lead Research Scientist at the Materials Discovery Research Institution in Skokie, Illinois, where he spearheads the In(organic) and Hybrid Materials Group. His team is developing innovative materials aimed at addressing critical environmental challenges. Their work spans a range of eco-remediation projects, including atmospheric water harvesting, carbon capture, and water purification, among others. Dr. Islamoglu's expertise lies in the realm of porous materials, with a particular focus on metal-organic frameworks (MOFs), porous polymers, and zeolites. These materials are pivotal in creating solutions for sustainable environmental practices. Dr. Islamoglu received his PhD from Virginia Commonwealth University.

PRESENTATION SUMMARY: The growth and development of the world's population is limited by the amount of drinkable freshwater available on the planet. As humans, we have taken advantage of most of the immediately available freshwater and will need to find other sources if we plan on continued growth as a species. The most readily available and cost-effective form of water in equatorial dry, arid areas comes in the form of water vapor. Current technologies in water vapor harvesting are inefficient and costly. By using a combination of metal-organic frameworks (MOFs), zeolites, and porous organic polymers, we can create a much more porous, tunable adsorbent bed to enhance the water harvesting efficiency. This off-grid technology is ideal for arid areas without water resources or areas with contaminated water, enhancing water security and supporting environmental sustainability.

Konstantinos (Kostas) Goulas, PhD, Oregon State University – *Hydrodechlorination of Polyvinyl Chloride to Value-Added Hydrocarbon Waxes*

Kostas Goulas received his Diploma in Chemical Engineering from the Aristotle University of Thessaloniki, and received his PhD from the University of California, Berkeley, investigating the upgrading of fermentation products to diesel fuel precursors via tandem dehydrogenation-aldol condensation reactions. Dr. Goulas worked as a postdoctoral researcher at the Catalysis Center for Energy Innovation at the University of Delaware, focusing on the development of fundamental structure-activity relations for hydrodeoxygenation reactions. Since 2018, he has been an Assistant Professor of Chemical Engineering at Oregon State University. Research in his group focuses on using operando spectroscopy to understand the fundamental drivers of selectivity and activity in metal and oxide catalysis and on combining kinetics and spectroscopy with catalyst development for environmental applications as well as for the upgrading of biomass and waste polymers.

PRESENTATION SUMMARY: Upcycling is the process of converting waste materials into products of greater quality or value. The upcycling of waste polymers has seen rapid growth over the last few years and significant progress has been made, but polyvinyl chloride (PVC) has provided unique complications to the upcycling process. PVC is a hard to upcycle compound and its presence in waste streams complicates the upcycling of other compounds (polyolefins). Through combining a dechlorination process with a hydrogenation process and the introduction of a few bulkier alkylamines, we can convert PVC to a hydrocarbon wax and a salt.

Beth Koigi, MA, Majik Water – *Majik Water: Using Technology to Solve Global Challenges*

Beth Koigi holds a Master of Arts in Project Planning and Management from the University of Nairobi and a Bachelor Science in Community Development from Chuka University, Kenya. She also has a post graduate Certificate in Exponential Technologies for Global Grand Challenges from Singularity University, California. In 2014, Koigi founded her first social enterprise as part of her undergraduate course work where she built a filter using activated carbon to filter water. Over two years, she distributed over 5,000 filters to communities around Kenya. Later, in 2017, Koigi co-founded an award-winning social enterprise (Majik Water) that aims to provide clean drinking water to communities in water-scarce areas (arid and semi-arid regions) using air to water technologies also known as Atmospheric Water Generators. Majik Water was awarded several prizes, such as the EDF Pulse Award Africa and the Massachusetts Institute of Technology (MIT) Water Innovation Prize. Koigi is working with academics, practitioners, and key industry stakeholders to develop a report on water management and purification technologies. They aim to put together recommendations to heads of states in Africa regarding existing and emerging technologies that allow maximizing public benefit and minimizing adverse effects.

PRESENTATION SUMMARY: Water is a required basic building block of any society and is central to achieving a larger sense of security, sustainability, development, and human well-being. Water is required for food and energy production, industry, transport, tourism, and the lack of water security can lead directly to social and political unrest and mass migration events. In the sub-Saharan portion of Africa, water is a scarce resource, and this technology can help alleviate water shortages in remote areas by removing atmospheric vapor and condensing it down into drinkable water.

Wildland-Urban Interface (WUI) Fires

AFTERNOON, OCTOBER 2, 2024

Wildland-Urban Interface (WUI) Fires Panel Discussion

MODERATORS:

- **Mark Wilson, MSPH, PhD, CIH, CIRI/ULRI**
- **Steve Kerber, PhD, Fire Safety Research Institute (FSRI)/ULRI**

PANELISTS:

- **Olorunfemi (Femi) Adetona, PhD, Ohio State University**
- **Ilona Jaspers, PhD, University of North Carolina**
- **Kenny Fent, PhD, CIH, National Institute for Occupational Safety and Health (NIOSH)**
- **Diana Hamer, PhD, National Network of Public Health Institutes (NNPHI)**

SESSION SUMMARY

The focus of this panel was to highlight the relevance, complexity, and data gaps associated with occupational and community-level exposures to WUI emissions and residues. The panel consisted of occupational health professionals and public health scientists who shared their points of view related to the state of knowledge around the WUI.

Much of what was discussed in this session focused on the theme of complexity. Topics that were covered included the complexities of exposure, emissions, health impacts, and communities. Each panelist contributed insights on their respective areas of expertise, highlighting the importance of recognizing the data and knowledge gaps associated with the WUI along with challenges associated with attempting to meaningfully address them. The panelists' presentations were followed by questions from the audience and by panel discussions. The panel emphasized the need for trans-discipline collaboration and recognition of the limitations of existing literature focused on either wildland or structural fire emissions and how they are important but cannot address the specific concerns associated with WUI scenarios.

Panelist 1 – Olorunfemi (Femi) Adetona, PhD

Dr. Femi Adetona is an Associate Professor in the College of Public Health at The Ohio State University. His doctoral and postdoctoral research training is in toxicology, exposure assessment, and environmental and occupational epidemiology. He conducts research to characterize and mitigate the adverse health effects of combustion emissions with a major focus on the occupational health of firefighters. With funding from NIOSH and the U.S. EPA, his ongoing research includes the evaluation of changes in vascular health and molecular alterations in the respiratory airways consequent upon wildland firefighting and health risk communication about smoke emissions from prescribed wildland burns. Dr. Adetona recently became a member of the National Academies of Sciences, Engineering, and Medicine's Committee on the Chemistry of Urban Wildfires and on the International Agency for Research on Cancer's Monograph 132 for the evaluation of the carcinogenicity of occupational exposure as a firefighter.

PRESENTATION SUMMARY: The WUI is the area where undeveloped land meets or intermixes with man-made structures. This area is rapidly growing, and there are over 43 million households that are in areas that fit the definition of the WUI. Wildfires are environmental disasters that are increasing in terms of both frequency and intensity, and WUI areas are heavily impacted when wildland fires encroach into these areas. There are significant unknowns associated with the chemical makeup of emissions and residues from WUI fires. There is, however, relevant information that can be inferred from the existing literature on structure and wildland fires, but it is important to recognize the data gaps that still exist associated with WUI fires. For example, wildland fires have a fuel mix that is primarily biomass, while WUI fires contain a highly variable fuel load that includes internal combustion and electric vehicles, household chemicals (e.g., pesticides, paints, solvents, cleaning products), synthetic building materials and furnishings, and appliances. The fuel composition is a significant predictor of the types of contaminates released during a fire as well as the types of chemical hazards present in the fire residues left after the fire has been extinguished. Typical structural fires burn from the inside out, while WUI fires destroy structures from the outside in. This different burn order may change the chemical nature of emissions and residues in WUI fire scenarios compared to typical structural fires. It is also important to note that structural fires are typically limited to one or a few individual buildings, while WUI fires may impact many structures all at once. In addition to the complexities associated with fire fuels, emissions, and residues, there is also a lack of information on best practices for measuring exposures to fire-related chemicals in both occupational and community settings. The length of time that WUI fire emissions and residues have been in the environment is also an important consideration. For example, the aging of a smoke plume in the atmosphere can lead to very different chemical signatures in the near- versus far-fields. While inhalation is the most thought of route of exposure to WUI fire emissions, it is also important to consider additional routes, such as ingestion and dermal transfer of chemicals from dusts, and additional matrices, such as potential impacts on drinking water quality. A final point is that, while there is occupational epidemiological data on structural and wildland firefighter exposures, there is a distinct lack of knowledge associated with the potential exposures for non-firefighting outdoor workers. There are many data gaps associated with WUI fire emissions and residues, and their recognition is a critical first step in filling those gaps.

Panelist 2 – Ilona Jaspers, PhD

Dr. Ilona Jaspers received her PhD in Environmental Health Sciences from New York University and is a Professor in the department of Pediatrics, with joint appointments in Microbiology and Immunology as well as in Environmental Sciences and Engineering, at the University of North Carolina (UNC)-Chapel Hill. She has worked for UNC-Chapel Hill in a variety of roles, most recently as the Director of the Center for Environmental Medicine, Asthma, and Lung Biology where she works closely with investigators from the U.S. EPA. Dr. Jaspers is also the training program director for the School of Medicine's Curriculum in Toxicology and Environmental Medicine, as well as Associate Director of Scientific Development for the Children's Research Institute and has additional leadership roles in the Center for Environmental Health and Susceptibility as well as the Institute for Environmental Health Solutions in the Gillings School of Global Public Health. For over 20 years, she has studied the respiratory health effects of inhaled toxicants, including ambient air pollutants, military burn pit smoke, wildfire smoke, tobacco products, and cannabidiol vaping products.

PRESENTATION SUMMARY: Ozone, cigarette smoke, diesel exhaust, and wildfire/WUI smoke represent respiratory hazards presented in rank order of increasing chemical complexity. Ozone is a single chemical that can be linked directly to adverse respiratory health outcomes. Cigarette smoke is a complex but well-defined mixture of chemicals that are known to negatively impact cardiorespiratory health and increase the risk of lung cancer. Diesel exhaust is also a complex mixture of chemical hazards, but the most toxic constitutes of the mixture have been identified through analytical chemistry, toxicology, epidemiology, and clinical investigations. Wildfire/WUI smoke is a complex chemical mixture for which there is very little information on the association of health risks and exposure to this mixture. Although fuel mix is an important determinate of the types of chemicals present in WUI fires and emissions, it is also important to consider the impact of burn temperature. Incomplete smoldering combustion and flaming efficient combustion create emissions and residues with different chemical profiles that may impact different target organs. Large-scale WUI fires can impact air quality hundreds of miles from the fire. When areas with preexisting air quality issues are impacted, distant wildfire/WUI events can add a new layer of chemical complexity to exposures and health risks in areas that already experience poor air quality. The exposure-response relationship between non-respiratory health impacts and this uncharacterized mixture are not frequently considered in epidemiological studies. The SARS-CoV-2 pandemic in 2019 led to the collection of robust spatially resolved epidemiological surveillance of disease rates nationwide. In 2020, with the pandemic and epidemiologic surveillance ongoing, wildfires impacted large areas of the mainland U.S. When the smoke-impacted areas were visualized on the disease transmission map, an interaction was apparent, which indicates that exposure to wildfire or WUI smoke may have important implications for disease transmission. Volunteer human subjects who are exposed to simulated wildfire smoke in a controlled setting show an increase in inflammatory biomarkers in males but not in females. This could have important implications for the occupational health impacts among firefighters who are predominately male. Computational toxicology methods are currently being employed to elucidate the broad classes and to identify specific chemicals as candidates for drivers of toxicity. Currently, a standardized mixture of materials for the laboratory-scale evaluation of simulated WUI fires is under development, which will assist with the discovery of mechanisms of toxicity and biomarkers of exposure and effect.

Panelist 3 – Kenny Fent, PhD, CIH

Dr. Kenny Fent is a Research Industrial Hygienist and the Manager of the Firefighter Health Program and National Firefighter Registry (NFR) for Cancer at NIOSH. The NFR for Cancer is the only nationwide voluntary registry of U.S. firefighters that aims to track and understand their risk of occupational cancer. Dr. Fent has spent over 15 years studying firefighters' exposures and health effects and has published over 80 scientific articles and reports. His research findings have provided evidence to support a variety of control measures to reduce carcinogenic exposures in the fire service. Dr. Fent actively serves on several first responder health and safety committees and advisory boards, including the U.S. Fire Administration (USFA) Comprehensive Cancer Strategy Workgroup and the National Emergency Response Information System (NERIS) Advisory Committee. In 2022, Dr. Fent also served as a co-chair on the WHO committee that classified the occupation of firefighting as a Group 1 known human carcinogen. He is also a Captain in the U.S. Public Health Service and has responded to public health emergencies and disasters in the U.S. and abroad, including the 2014 Ebola epidemic in West Africa and the 2023 Maui Wildfires.

PRESENTATION SUMMARY: "Imagine deep sea diving with no scuba gear." The thought of being in a hazardous environment without protection is unpleasant. Although there is an existing respirator standard for wildland firefighters, many often find themselves in this situation due to their job durations and locations. This can be a significant problem when firefighters equipped and trained to deal with wildfires cross over into a WUI fire event. On the morning of August 8, 2023, firefighters in wildland gear were responding to a brush fire on the hills above the town of Lahaina on the Hawaiian island of Maui. Strong winds pushed the fire from the hills into the town leading to a massive urban fire that immediately became the focus of the firefighting efforts. These firefighters struggled to control and extinguish the blaze for over two days. Standard structural firefighting supplied air breathing apparatuses, even if available to these firefighters, would not be practical to use over this type of timescale. During the event and in the immediate aftermath, many firefighters shifted from firefighting to search and rescue. This not only extended the already long timeframe of active work for these firefighters, but also increased the possibility of additional inhalation and dermal exposures arising from disturbing the residual materials. It is critical that the concept of exposure among these firefighters is not reductively conceived as only related to chemical hazards. Rather, exposure should be thought of as the interaction of chemical exposures and the stressful mental toll that accompanies being involved in this work. Exposure assessment during a WUI event is difficult. Traditional industrial hygiene and environmental monitoring equipment is difficult to deploy and measuring biomarkers of chemical exposures in post-shift firefighters often lacks a baseline value for comparison. Furthermore, many combustion-related biomarkers are non-specific. Therefore, it is difficult to attribute the presence of a combustion biomarker to a wildfire or WUI event as it may originate from other sources such as the consumption of smoked meat or the use of tobacco products. Environmental monitoring equipment that is deployed days, weeks, or months after the event do not provide accurate information about the environment during the event as many toxic chemicals of concern have short half-lives that dissipate quickly in the environment. This means the presence of acute health hazards with short half-lives are often not represented in post-fire environmental sampling but pose significant risk to firefighters during a response to a fire event. Occupational exposures to firefighters are broad and very complex. Little is known about the long-term health impacts of dealing with WUI fires. The NFR for Cancer is a NIOSH-supported, voluntary occupational cohort study that seeks to address these unknowns. This registry is a collaborative effort between federal occupational health professionals, clinicians, and researchers. It is the only occupational cohort that is designed to track cancer and chronic disease risk prospectively over time and how other relevant variables, such as biological sex, may impact disease risk. The NFR for Cancer continues to enroll participants and is using modern molecular tools to identify pre-disease biomarkers of exposure to specific classes of chemicals associated with chronic disease and cancer risk.

Panelist 4 – Diana Hamer, PhD

Dr. Diana Hamer received her PhD from Tulane University's School of Public Health and Tropical Medicine and her Master of Science in Molecular Biology from Erasmus University Medical Center. Her dissertation research concentrated on environmental health, particularly environmental modifications and vector disease control as well as health care access and utilization. Dr. Hamer is currently the Director for Climate and Crisis Preparedness at the National Network of Public Health Institutes (NNPHI) where she oversees the continued growth of projects related to building public health capacity for all hazard disaster response, emergent and infectious pathogens, and climate and health issues at the state and local level.

PRESENTATION SUMMARY: NNPHI is an organization that provides technical assistance, education, evaluation, and stakeholder convenings to improve population health. With over 50 members, it provides services and programs across all 50 states and territories. Sanitation and environmental health monitoring have historically laid the foundation for critical public health policies, such as the Safe Drinking Water Act (SDWA) and the Clean Air Act (CAA). There has been a trend in public health education over the last decade to move away from building discipline specific expertise in public health science, such as toxicology, environmental monitoring, and exposure assessment. This trend impacts the public health workforce in a real way as the expertise to fill these historically critical roles is often lacking among many early-career public health workers. When public health surveillance and management is working well, it is not something that you typically hear about. When it is not working well, everyone hears about it. A key role that NNPHI plays is to link public health officials and workers in specific geographic areas to projects and resources that aid in managing and responding to environmental health threats like natural disasters, such as WUI fires. It is critical to understand the chemical complexity of WUI fire emissions and residues and the intricacies associated with exposure evaluations in these complex and dynamic events. It is also critical to understand the complexities in and between communities and to realize that there can be no one-size fits all approach to public health disaster response. NNPHI is currently engaged with public health training centers, primarily associated with universities, that focus on effective crisis communication and the development of micro-training that deals with specific scenarios. This is a step to begin to address the problems associated with the one-size-fits-all model of training and education. There is, however, still a need for public health practitioners to interpret scientific literature and data in meaningful ways.

AFTERNOON, OCTOBER 2, 2024

Research Session Track #1 – Community Impacts and Risk Management

Facilitator: Birgitte Messerschmidt, MSc, National Fire Protection Association (NFPA)

SESSION SUMMARY

As global temperatures rise and weather patterns become more unpredictable, wildfires and WUI fires are not only becoming more frequent, but also more severe. The four speakers in this session shared their research insights on community impacts and risk management involving a combination of preparedness, proactive mitigation, and post-fire health exposure assessment.

RESEARCH PRESENTATIONS

Timothy Nurkiewicz, PhD, West Virginia University – *Characterization of WUI Fire Emissions Created in a Novel Combustion Generator*

Dr. Timothy R. Nurkiewicz is the E.J. Van Liere Endowed Professor in the Department of Physiology, Pharmacology & Toxicology in the School of Medicine at West Virginia University. He is also the Director of the Center for Inhalation Toxicology (iTOX). Dr. Nurkiewicz's research program characterizes systemic microvascular effects of inhaled particles from two perspectives: 1) environmental air pollution PM; and 2) engineered nanomaterial exposures. Most recently, his research interests have expanded into identifying the health effects of inhalation exposures to combustion emissions, most notably, military burn pit emission exposures and WUI exposures.

PRESENTATION SUMMARY: WUI fires pose significant risks to both human health and the environment, particularly through inhalation exposure to smoke and toxic gases. Dr. Nurkiewicz presented his research on the characterization of WUI fire emissions using a novel combustion generator to identify toxicant profiles and levels from the WUI emissions. A pellet stove was modified to combust custom formulated wood pellets to model common constituents of WUI fires from geographically distinct regions of the U.S. Emissions were assessed in real-time and off-line for particles (size distribution, concentrations, and morphology), and gases (total and speciation). Subtle differences in the aerosol size distribution were observed among wood types, but a greater than 30% upward shift in diameter was observed with vinyl flooring pellets and in mixes. He discussed the development of a thermal chamber for future studies and introduced a method for the collection and isolation of respirable floor ash.

Rawad Saleh, PhD, University of Georgia – *Linking Smoke to Fire: The Effect of Burn Conditions in Wildland Fires on Smoke Production and Atmospheric Processing*

Dr. Rawad Saleh is an Associated Professor in the College of Engineering at the University of Georgia. His research group employs techniques based in fundamental theory, laboratory experiments, as well as large-scale computer modeling to study the impact of aerosols (or PM) on air quality and the climate system. His current focus is on emissions from various combustion sources, including wildland fires. Prior to joining the University of Georgia, Dr. Saleh was a Research Scientist in the Center for Atmospheric Particle Studies at Carnegie Mellon University. He holds a PhD in Environmental Engineering from Duke University, Master of Science in Mechanical Engineering from the American University of Beirut (Lebanon), and Bachelor of Science in Mechanical Engineering from the Middle East Technical University (Turkey).

PRESENTATION SUMMARY: Dr. Rawad Saleh presented his research on how the differences in combustion conditions encountered in drought-induced wildfires and prescribed fires affect smoke emissions. He discussed how fire radiative power can be used to parameterize the production rates of gaseous and particulate carbon, aerosol optical properties, and secondary organic aerosol formation. These parameterizations will ultimately enhance the ability of models to predict the air quality and climate impacts of wildland fire smoke.

Cynthia Choo, PhD, CIRI/ULRI – *Field to Lab: Assessing Direct and Indirect Emissions from Wildland-Urban Interface Fires*

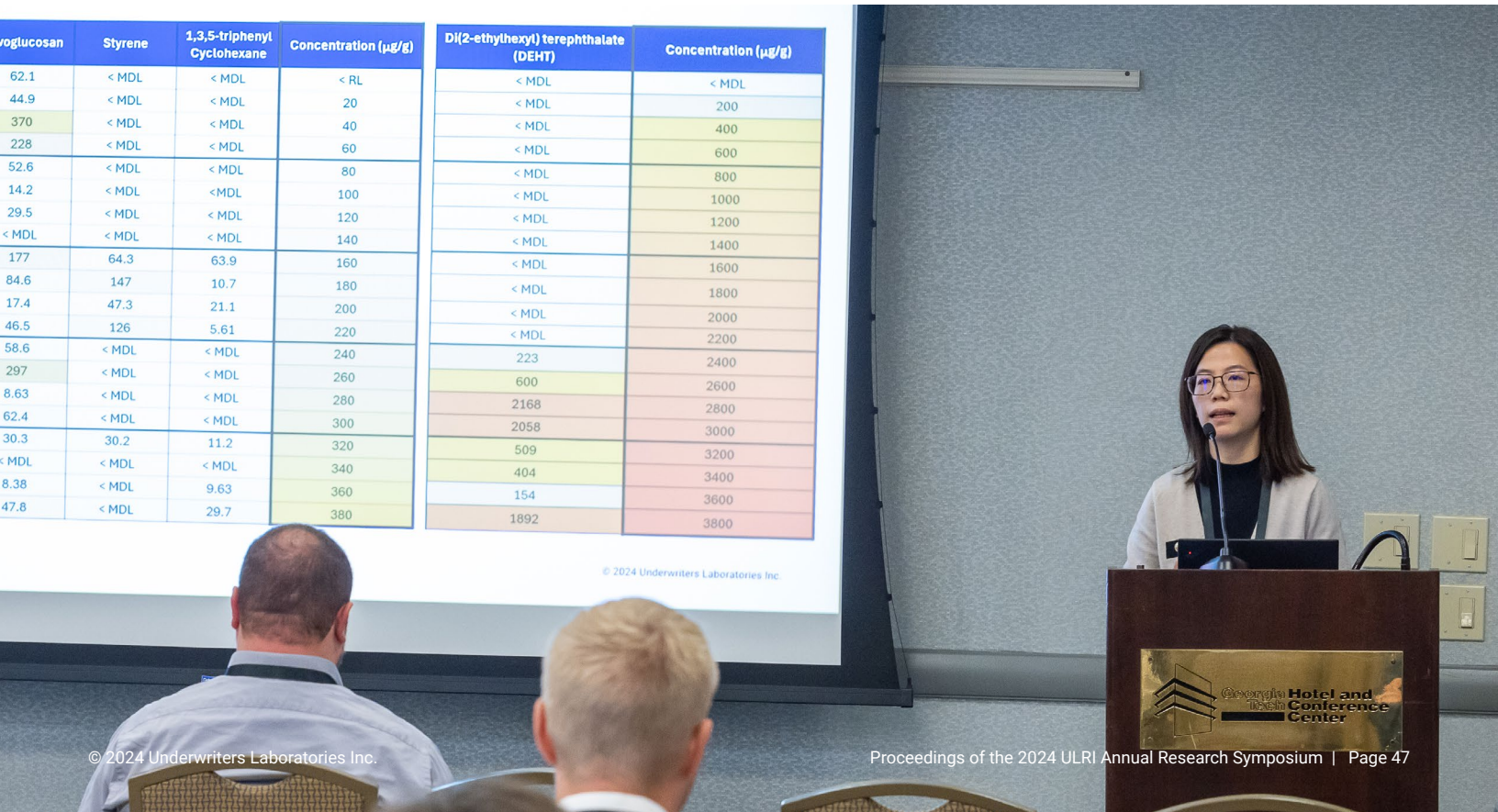
Dr. Cynthia Choo is a Research Scientist in the Center for Exposure Science at CIRI. Her work aims to better understand and reduce human exposure to VOCs and SVOCs in the indoor environment. Dr Choo's research focuses on chemical characterization of the post fire residue from wildland or WUI fires and exposure modeling to assess corresponding human exposure through inhalation, ingestion, and dermal exposure. Using advanced analytical instrumentation like gas chromatography-mass spectrometry (GC-MS), Dr. Choo implements green analytical methods for the analysis of VOCs and SVOCs in different matrices.

PRESENTATION SUMMARY: WUI fire ash from combustion of building materials, such as wood, plastics, and other synthetic substances from the contents of modern homes, may contain heavy metals, VOCs, and SVOCs. Ashes can be carried by wind and infiltrate the indoor environment. When compounds are retained in dust, ingestion and dermal exposures are possible through hand-to-mouth activity by toddlers and young children and by absorption through the skin. Post WUI fire ash poses a significant environmental and societal challenge, with repercussions for air quality, ecosystem health, and human health. Dr. Choo presented an analytical method that allows for analysis of VOCs and SVOCs like polyaromatic hydrocarbons (PAHs) in fire residues. Collected ash samples are weighed into a stainless-steel desorption tube and analyzed by direct thermal desorption-gas chromatography-mass spectrometry (TD-GC-MS). Dr. Choo reported that preliminary results show high levels of styrene and plasticizers (phthalates and phthalates-related compounds) in the ash from laboratory scale combustion of synthetic building materials.

Debra Harris, PhD, Baylor University/RAD Consultants – *Practical Strategies to Deploy Before, During, and After WUI Fires*

Dr. Debra Harris is a researcher, product developer, designer, and educator. She serves as a Professor of Interior Design in the College of Health and Human Science at Baylor University. An advocate for evidence-based design, Dr. Harris promotes the integration of interventional evidence to inform design decisions, thereby enhancing the built environment and its impact on occupants. Her interdisciplinary research delves into factors influencing user experience and outcomes, with particular emphasis on health and wellness, sustainability, productivity, safety, and the cost implications of the built environment. Dr. Harris's research on the influence of materials on health examines the transmission of microbial and chemical contaminants within built environments. Dr. Harris oversees the Environmental Forensics and Material Science Laboratory, which offers environmental material testing and specimen preparation for product lifespan, durability, simulation, and performance assessments. Her practical expertise is centered on designing sustainable, healthy environments that promote well-being, utilizing evidence-based design and focusing on indoor environmental quality factors that affect occupants.

PRESENTATION SUMMARY: The WUI has rapidly expanded across the U.S., now encompassing over 32 percent of all housing nationwide. When structures within the WUI burn, they release harmful toxins from household materials like plastics, chemicals, and treated wood, leading to acute and long-term health risks. These toxins can elevate the risk of heart attacks, strokes, hypertension, and other illnesses. In Dr. Harris' presentation, she shared practical strategies to mitigate health risks associated with WUI fires, addressing measures to take before, during, and after such events.



AFTERNOON, OCTOBER 2, 2024

Research Session Track #2 – Impacts on Community and Firefighter Health

Facilitator: Gavin Horn, PhD, FSRI/ULRI

SESSION SUMMARY

This session included four presentations that examined the exposure risks and health impacts from wildfires in the WUI. Wildfire smoke and ash can include toxic materials, such as PM, metals, and VOCs, which affect IAQ and put human health at risk even after a fire is extinguished. The presenting experts shared their current research insights including the damaging effects on water quality, resulting toxicity and health issues, and the compared efficacy of air filtering methods to increase air quality and protect health. Additionally, recommendations for safeguarding health as an affected community member and firefighter were also discussed.

RESEARCH PRESENTATIONS

Alexandra Noël, PhD, Louisiana State University – *Impact of Wildfire Smoke on Pulmonary Health*

Dr. Alexandra Noël received her bachelor's degree in biomedical sciences, her master's in occupational and environmental health, and her PhD in Public Health — with a specialization in Toxicology and Risk Assessment, all from the Faculty of Medicine of the University of Montreal (Quebec, Canada). She is an Associate Professor in the Department of Comparative Biomedical Sciences at LSU. She conducts in vitro and in vivo inhalation toxicology studies on cardiopulmonary effects resulting from in utero and adult exposures to second-hand smoke, electronic-cigarette aerosols, nanoparticles, and particles from air pollution. Dr. Noël is the leader of the Inhalation Toxicology Core of the LSU Superfund Research Program. She is a counselor for the Inhalation and Respiratory Specialty Section (IRSS) of the Society of Toxicology (SOT) and the co-Chair of the Membership Committee of the American Thoracic Society (ATS). Dr. Noël is also a member of the NIH Advisory Committee on Research on Women's Health and an Associate Editor for the American Journal of Respiratory Cell and Molecular Biology.

PRESENTATION SUMMARY: Dr. Noël shared her latest research on the pulmonary effects of wildfire smoke WFS exposures and how WFS exposure conditions impact cellular toxicity. In the U.S., the annual health impact of wildfires translates into 4,000 premature deaths. Furthermore, increasing epidemiological evidence demonstrates that respiratory morbidities are one of the main health effects associated with WFS exposures. Recent hospitalization data show a clear association between WFS exposures and asthma. The pulmonary toxicity mechanisms of WFS, however, are still poorly understood. Dr. Noël highlighted that wildfire smoke contains not only PM, but also trace metals and PAHs, which can significantly affect health outcomes. She discussed the role of atmospheric transport and physicochemical aging of smoke, explaining how these processes can create effects that extend beyond geographic borders. Dr. Noël emphasized the cellular toxicity of wild and prescribed fire smoke extracts. Since wild and prescribed fires occur under different exposure conditions, she concluded her presentation by highlighting the importance of considering key factors (e.g., physiochemical aging, type of fuels, characteristics of the landscape) when evaluating wildland fire smoke toxicity. Furthermore, her findings showed differential in vitro lung cell toxicity of wildland fire emissions based on exposure conditions (wild vs. prescribed and fresh vs. aged).

Zhanghua Chen, PhD, University of Southern California – *The Effects of Using HEPA Purifiers on Indoor Air Pollution and Cardiometabolic Health*

Dr. Zhanghua Chen is an environmental epidemiologist and biostatistician with multidisciplinary expertise in environmental health, biostatistics, epidemiology, and clinical medicine. Her research interests include cardiometabolic diseases, children's growth, COVID-19, omics biomarkers, lifetime disease risk of environmental pollution, air pollution interventions, and data science. She has been the principal investigator and co-investigator on 14 environmental health studies supported by the NIEHS and other non-profit research institutes. Dr. Chen received her PhD in Biostatistics from the University of Southern California. Her accomplishments in environmental health research have received wide media attention from national and international news agencies, e.g., Reuters, U.S. News, and Xinhua News Agency.

PRESENTATION SUMMARY: Dr. Zhanghua Chen presented her research on the impact of high efficiency particulate air (HEPA) purifiers on indoor air pollution and cardiometabolic health. She discussed findings that indicate HEPA filtration can effectively reduce blood pressure and systemic inflammation. Dr. Chen highlighted an ongoing study comparing the effects of sham filters versus HEPA filters. The research focuses on measuring indoor air conditions and pollution levels that participants aged 65 to 84 years were exposed to as well as on tracking biomarkers and vital statistics. The purpose of this study is to determine whether filtration systems can decrease the likelihood of developing Type 2 diabetes as individuals age. It also aims to provide valuable insights into the health benefits of HEPA purifiers in mitigating indoor air pollution and promoting better cardiometabolic outcomes.

CDR Catherine Beaucham, PhD, CIH, RS/REHS, DAAS, NIOSH – *Biomonitoring of Firefighters: Application During the 2023 Maui Wildfires*

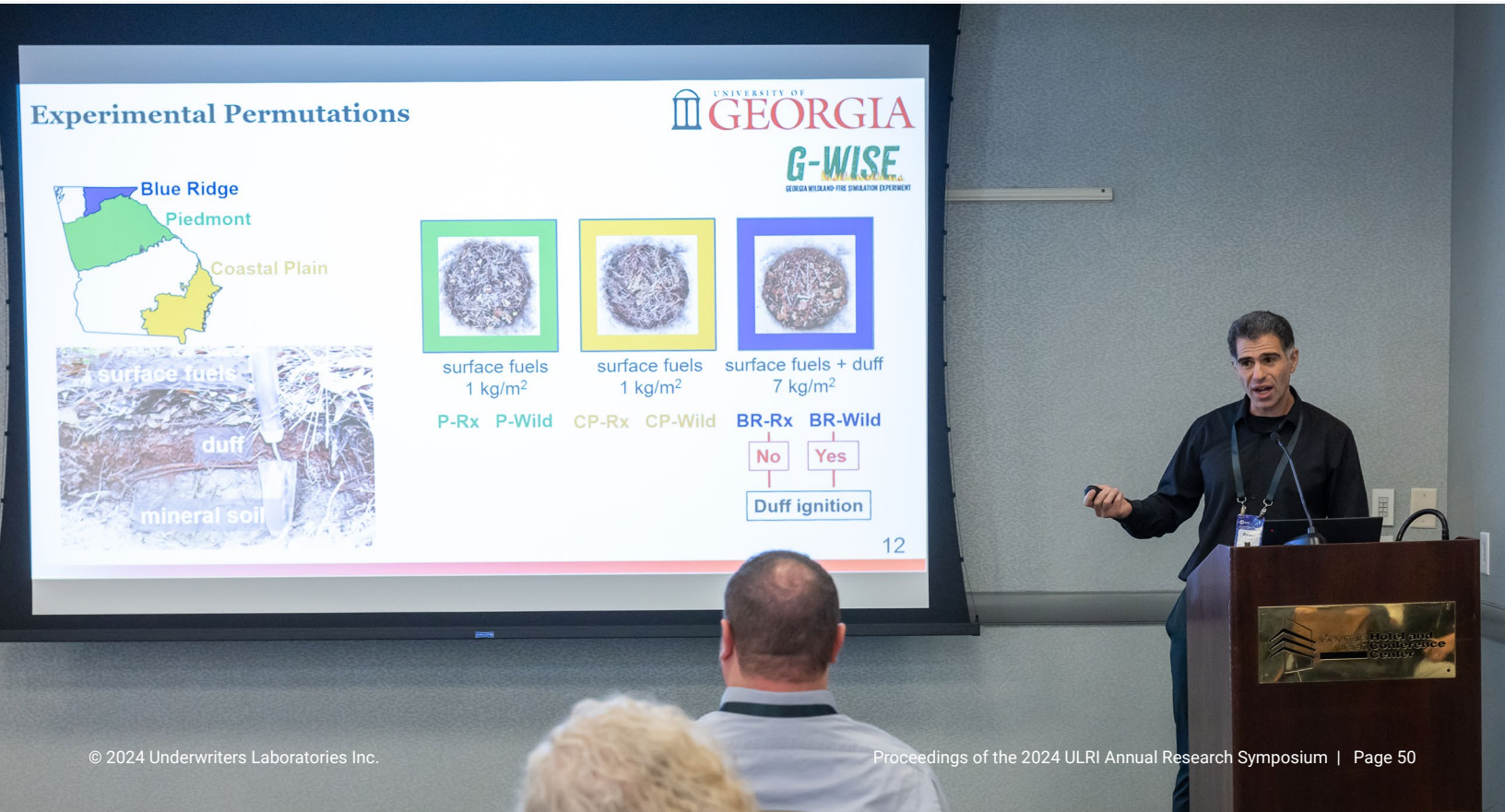
Dr. Catherine Beaucham is a Commander in the U. S. Public Health Service. She completed her undergraduate degree in Industrial Hygiene from Ohio University in 2003, her Master of Public Health from The Ohio State University in 2008, and her PhD in Epidemiology from the University of Cincinnati in 2022. She is a Certified Industrial Hygienist and a Registered Sanitarian/Registered Environmental Health Specialist. She has worked for NIOSH since 2008 and is fluent in Spanish. Her primary research interests include wildland firefighters, flame retardants, and disaster epidemiology.

PRESENTATION SUMMARY: In early August 2023, a series of wildfires burned parts of the island of Maui in the state of Hawaii. Firefighters from the Maui County Fire Department were part of the initial response and were involved in fire suppression, structure protection, life safety actions, and were imbedded with the Urban Search and Rescue (USAR) teams. Dr. Catherine Beaucham explained that, even after the fires were extinguished, there were still concerns about exposure risks during search and rescue operations from ash and smoldering material. She highlighted that firefighting is classified as a Group 1 carcinogenic occupation. NIOSH assembled a multidisciplinary team experienced in biological monitoring and exposure assessment and developed a biomonitoring plan based on anticipated contaminations from previous firefighter research. Dr. Beaucham explained the findings indicated that some of the participants had inorganic element exposure levels above relevant reference values for chromium, selenium, arsenic, manganese, and nickel, and that as expected, almost all participants had detectable levels of per- and polyfluoroalkyl substances (PFAS), poly-brominated diphenyl ethers, and organophosphate esters. She also noted that PFAS levels were higher among firefighters, especially in those with longer tenures in the field. Dr. Beaucham emphasized the importance of firefighters and other first responders following best practices to protect themselves from exposure risks during and after wildfire events.

Nicholas Dow, MS, FSRI/ULRI – *Pilot Study on Fire Effluent Condensate from Full-Scale Residential Fires*

Nicholas Dow has worked for FSRI for over five years. Prior to joining the team, he earned his Master of Science at Penn State and his Bachelor of Science at Rowan University, both in Mechanical Engineering.

PRESENTATION SUMMARY: Studies related to effluent produced by structure and vegetation fires often focus on the gas phase or the solid condensed phase, with limited treatment of liquid condensate generated as smoke cools to ambient temperatures. Recent post-fire human health concerns related to contamination of water distribution systems after WUI fires and systemic human exposures to fire smoke can be informed by understanding the chemical composition of liquid condensate resulting from large-scale fire experiments. Dow presented on his pilot study in which fire effluent (smoke) samples were continuously drawn from five different full-scale room-and-contents fire experiments from which condensate was collected as the effluent cooled. His research aims to enhance understanding of these pathways and inform strategies for protecting drinking water supplies in wildfire-affected areas.



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