Federal Interagency Committee on Indoor Air Quality (CIAQ) Meeting Minutes

February 16, 2022

Moderator: Laureen Burton, U.S. Environmental Protection Agency

Meeting Overview

- Welcome, Introductions and Announcements
- Indoor Air Quality (IAQ) Area of Interest Presentation

Evaluation of Airborne Pathogen Transport and Exposure Risks of SARS-CoV-2 in the Built Environment

Clifford K. Ho, Ph.D., Sandia National Laboratories

- Federal CIAQ Member Agency Updates (Pages 2–23)

- Post-Meeting Updates and Announcements
    - The next CIAQ meeting is scheduled for June 2022.

U.S. Environmental Protection Agency (EPA), Indoor Environments Division (IED)

COVID-19 Update

Important updates to EPA's COVID-19 indoor air content continue to be posted on the EPA website at www.epa.gov/coronavirus. This information will help the public understand the evolving science related to transmission of COVID-19 and what can be done to maximize protections indoors.

The indoor air COVID-19 content on this series of webpages is among the most visited EPA web areas and recently was updated to include information on do-it-yourself box fan air cleaners. The indoor air COVID-19 content can be found by going to www.epa.gov/coronavirus/indoor-air-and-coronavirus-covid-19.

For multilingual web content on COVID-19 and indoor air quality (as well as other indoor air environmental health issues), visit www.epa.gov/lep. EPA is continuing to add multilingual content and updating the FAQ list, so please consider checking it routinely.

Science

***National Academies Released IED-Sponsored* Indoor Exposure to Fine Particulate Matter and Practical Mitigation Approaches: Proceedings of a Workshop**

On January 26, 2022, the National Academies of Sciences, Engineering, and Medicine (NASEM) published the proceedings of the workshop *Indoor Exposure to Fine Particulate Matter and Practical Mitigation Approaches*. The proceedings are available to download for free from the National Academies Press website.

The workshop, sponsored by EPA's Indoor Environments Division, was held in April 2021 and addressed the state of the science on exposure to $PM_{2.5}$ indoors, its health impacts, and engineering approaches and interventions to reduce exposure risks, including practical mitigation solutions. More information, including recordings from the workshop, can be found on the workshop webpage or by contacting Indoor-PM@nas.edu.

The Committee on Health Risks of Indoor Exposures to Fine Particulate Matter and Practical Mitigation Solutions is conducting a companion study to this workshop that is reviewing the recent scientific literature on the health risks of exposure to fine particulate matter indoors and will offer recommendations for engineering solutions and interventions to reduce risks of exposure to it, including practical mitigation solutions to reduce exposure in residential settings. That study will be completed in early 2023. More information can be found on the study webpage.

***Webinar on Insights from* Indoor Exposure to Fine Particulate Matter and Practical Mitigation Approaches: Proceedings of a Workshop**

On January 26, 2022, IED hosted a webinar in the IAQ Science Webinar Series titled *Insights from the Indoor Exposure to Fine Particulate Matter and Practical Mitigation Approaches Workshop.* The webinar featured a presentation by Dr. Richard L. Corsi, dean of engineering at the University of California, Davis, and chair of the workshop organizing committee. Dr. Corsi summarized the results the IED-sponsored workshop hosted by the NASEM on the state of the science on exposure to fine particulate matter ($PM_{2.5}$) indoors, its health impacts, and engineering approaches and interventions to reduce exposure risks. There were 444 participants on the webinar, which was recorded and will be available on the EPA website.

IAQ Emergency Preparedness, Response and Recovery

Weather-related and man-made emergencies and disasters can damage homes and buildings and make the air indoors unhealthy to breathe. With climate change, weather-related emergencies are becoming more frequent and more severe. EPA's Emergencies and IAQ webpage provides tips on how to prepare for, respond to and recover from weather-related and man-made emergencies and disasters that affect indoor environments, including wildfires, power outages, hurricanes, flooding and more. This information is now available in multiple languages on EPA's website.

Household Energy (Cooking, Heating and Lighting in Low- to Middle-Income Countries)

Biden Administration Engagement on Cookstoves and Household Energy

In April 2021, President Biden committed to rejoin the Paris Agreement and took executive action to tackle the climate crisis in the United States and other countries. In coordination with the President's action, EPA Administrator Michael Regan also announced that the Biden Administration will resume and strengthen the U.S. commitment to the United Nations Foundation's Clean Cooking Alliance and will work with the Alliance, other country governments and partners at every level to reduce emissions from home cooking and heating that contribute to climate change and affect the health and livelihoods of almost 40 percent of the world's population.

Over the past year, EPA has been leading an effort to broaden and strengthen a whole-of-government approach to addressing this issue. At the 26th meeting of the Conference of the Parties (COP26)—more commonly known as the Glasgow Climate Change Conference—which was held in Glasgow, Scotland, in November 2021, an Energy Access event was organized by EPA and the U.S. Agency for International Development (USAID) and held at the USA Pavilion. During this event, Administrator Regan announced the United States' whole-of-government approach to address this challenge. The hour-long event is available for viewing online. EPA is working with CDC, DOE, the National Institutes of Health (NIH), states and USAID to implement this climate, health, gender and livelihood initiative.

Promotion of International Organization for Standardization (ISO) Standards

The household energy community has completed and issued important standards in recent years through the ISO process. In 2018, ISO published the international standard for laboratory testing of cookstoves, which includes protocols to test and report the emissions, efficiency, safety and durability of cookstoves in a lab setting. The new standards serve as the basis for national policies and programs on cookstoves and incentivize manufacturers and developers to improve stove quality and performance. In 2019, a second ISO household energy standard was finalized—"Guidance on Field Testing Methods for Cookstoves"—which provides a framework for testing stoves in actual use conditions.

For the past 3 years, EPA has been working with the Clean Cooking Alliance, ISO, the World Health Organization, and the Dutch and German development agencies to organize and facilitate regional workshops to encourage countries to adopt or adapt the ISO harmonized laboratory standards for clean cookstoves and clean cooking practices. EPA organized in-person, regional workshops for Asian and East African countries in 2018 and 2019; in 2020 and 2021, given COVID-19 challenges, EPA pivoted to a virtual regional workshop series for Francophone African countries and Haiti.

EPA and its partners, now including the Pan American Health Organization, are conducting virtual sessions to support the adoption or adaptation and implementation of national standards for cookstoves in Latin American countries. More than 125 stakeholders are participating from the ministries of energy, environment and health; national standards bodies; and other implementation partners from 12 countries (Bolivia, Brazil, Chile, Columbia, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay and Peru).

Advancing Sustainable Household Energy Solutions (ASHES) Initiative at Colorado State University

An EPA cooperative agreement recipient, Colorado State University, in collaboration with Berkeley Air Monitoring Group, is implementing a household energy solutions and air quality initiative called the Advancing Sustainable Household Energy Solutions (ASHES). This work includes a webinar series that focuses on disseminating the latest household energy research findings from numerous principal investigators and their organizations. ASHES webinars have highlighted World Health Organization household energy initiatives, EPA Science to Achieve Results grantees and numerous other research programs. For more information on ASHES, or to watch ASHES webinars, please go to www.ashes-csu.org.

Working With Countries to Implement Their NDCs—Nationally Determined Contributions

Every country in the world is required under the Paris Climate Agreement to submit a plan to reduce climate emissions, called their Nationally Determined Contributions (NDCs). Given that an estimated 2 percent of global CO_2 emissions come from nonrenewable wood fuels for cooking—on par with CO_2 emissions from aviation or shipping—and because cookstove/household energy emissions are the largest controllable source of black carbon emissions and include methane emissions, reducing emissions from household energy sources is an important element of national and international action on climate. EPA and its partners—the Clean Cooking Alliance, the Climate and Clean Air Coalition, Berkeley Air Monitoring Group and the United Nations Framework Convention on Climate Change—

worked during the past year to encourage countries to include references to household energy in their NDCs. Seventy-five countries have now included references to reducing emissions from household energy in their NDCs that were submitted at COP26 in Glasgow. This is a great first step for countries to acknowledge the impact that household energy has on climate and for them to begin to take steps to reduce those emissions, which will have knock-on effects on health, gender, the environment and livelihoods.

EPA is working with its consortium of partners to help countries reduce CO_2, methane, black carbon and other short-lived climate pollution (SLCP) emissions by highlighting examples already in progress, providing guidance on implementation, and developing and disseminating a harmonized approach to—and guidance on—monitoring, reporting and verification activities. This work initially will take place through webinar presentations and discussions and Berkeley Air–hosted office hours for more direct interaction with countries.

Radon

National Radon Action Month

January was National Radon Action Month. As part of National Radon Action Month, throughout January, EPA, state grantees and nongovernmental organization (NGO) partners encouraged Americans to "Test. Fix. Save a Life." The annual outreach campaign featured a national press release, social media posts, stakeholder engagement messages in English and in Spanish, new infographics, and targeted outreach by EPA. In January, views of EPA radon webpages accounted for more than a quarter of all traffic to EPA indoor air webpages. EPA's radon program plays a critical role in promoting and supporting Americans to take action on radon. Based on the most recent data, EPA estimates that more than 130,000 homes with high radon levels were mitigated in 2020, and 21 percent of all new single-family homes were built with radon-resistant features in the last year.

National Radon Action Plan (NRAP)

IED continues to support the growing national network of federal and private sector agencies, NGOs, and states to prevent lung cancer deaths through the NRAP. Along with its founding members, the American Lung Association (ALA) has brought in supporting organizations (those that have signed a declaration of support) and emerging potential partners (organizations identified to help drive progress) to increase the mitigation of existing homes and the construction of new homes with radon-reducing features. The NRAP expands on existing efforts under the Federal Radon Action Plan, going beyond federal actions.

On January 31, 2022, EPA and ALA released the *National Radon Action Plan 2021–2025: Eliminating Preventable Lung Cancer from Radon in the United States by Expanding Protections for All Communities and Buildings*. This document is the third installment of a strategy to increase action on radon and sets a goal for the nation to find, fix and prevent high indoor radon levels in 8 million buildings by 2025 and prevent at least 3,500 lung cancer deaths per year. The plan revolves around actions that will save lives by fixing existing buildings, constructing new buildings with radon-resistant features, and further developing a certified professional radon workforce. It also spotlights addressing radon as a health

equity challenge and prioritizes new strategies to reduce radon risk in underserved communities, particularly low-income populations and communities of color. For more information and to learn more about the NRAP Leadership Council's goal areas, strategies for action and target outcomes, visit NRAP|2021–2025 on RadonLeaders.org.

The NRAP Leadership Council invites leaders to join the NRAP Leadership Council who are serious about saving lives; building in health protection where we live, work and learn; eliminating preventable disease; and realizing a high return on investment in a healthier future.

State Indoor Radon Grants (SIRG)

EPA recently published the *2021 SIRG Program Activities Report*. This report highlights the important work that states, territories and tribes are undertaking across the country to advance radon risk reduction. The *2021 SIRG Program Activities Report* spotlights the recently published *National Radon Action Plan (NRAP) 2021–2025*, as well as many new grantee success stories and a strong commitment to this important public health issue. The report also spotlights EPA's efforts to expand coverage and help underserved communities, including how some state and tribal radon programs are pairing SIRG funding with other healthy housing, housing finance and/or low-income mitigation assistance program funding to expand opportunities for residents to access resources for testing and mitigating homes.

Tribal Performance Partnership Grants

EPA Performance Partnership Grants are being made more accessible to tribes, which will allow tribal grantees to combine funds from multiple environmental program grants into a single grant with a single budget and allow grantees to direct resources where they are needed most to address their environmental and public health priorities.

IED is hopeful that this action will create a pathway for additional tribes to successfully apply for and receive radon grant funds and provide additional flexibility for existing tribal radon grant recipients. EPA Regions are the lead for communicating with their states and tribal communities about the availability of funds, how to apply, conditions, limitations and how to properly use SIRG funds.

Building Codes

EPA continues to collaborate with industry and states to actively engage in efforts to promote the adoption of radon-resistant new construction practices through international, national, state and local building codes. These efforts are mandated by the Indoor Radon Abatement Act and are a key component of the NRAP.

EPA recently submitted code change proposals for Appendix F in the International Residential Code (IRC). Appendix F is an optional section of the code that contains requirements for new construction in jurisdictions where radon control methods are utilized. If a radon system is to be built, it should be built according to Appendix F. This code requirement was first passed in the 2018 IRC. EPA has received feedback from stakeholders that some portions of Appendix F could be made more prescriptive, so these proposals aim to address these issues. Changes include—

- proposals involving submembrane vent piping proper location and length
- radon vent pipe accessibility
- exemptions for aggregate layer requirements where drainage mats are used on well-drained soils

The proposals for the various changes/additions to the IRC code were submitted in January 2022 and will be presented/defended at the Committee Action Hearings in April 2022.

Radon Credentialing

EPA's work on the credentialing of radon service providers is part of the Agency's responsibility to promote and support the availability of quality radon services to the public. Professionals who provide radon testing and mitigation services play a key role in public health protection efforts. Because of the substantial risk resulting from exposure to radon, it is critical for radon service providers to possess the necessary skills to provide quality services and ensure consumer protection. Over the last several years, EPA has been working, through consultation with states, the public and industry—and in response to congressional direction—to develop a contemporary framework to guide the credentialing of radon service providers going forward. EPA remains committed to facilitating access to a qualified workforce through a national, nonregulatory framework that will help establish a quality standard for state-run and independent programs that credential radon service providers. The Agency intends to post an updated proposal online that reflects stakeholder feedback and hold an information session soon. For the most up-to-date information about EPA's proposal, visit the EPA radon website.

Asthma

Asthma Awareness Month

During Asthma Awareness Month in May, EPA will honor exceptional community-based asthma programs with the National Environmental Leadership in Asthma Management Award. EPA recognizes programs for their leadership in promoting environmental asthma management as part of comprehensive asthma care in the communities they serve. The application period for the 2022 awards is now closed. Stay tuned for the awardees to be announced in May.

AsthmaCommunityNetwork.org

During Asthma Awareness Month, outreach efforts are highlighted on AsthmaCommunityNetwork.org, an online resource that facilitates peer-to-peer engagement and action learning events. Currently, there are almost 4,700 members registered. On this site, stakeholders are encouraged to highlight their Asthma Awareness Month events. In addition, AsthmaCommunityNetwork.org features more than 600 asthma education materials in the Resource Bank and offers mentoring opportunities for registered members. You also can find more information on EPA asthma award winners and successful, sustainable financing strategies to support the delivery of home-based asthma interventions. If you are a current member, please consider updating your program profile on the Network. Any program that is not a member is encouraged to join today!

Asthma Disparities

EPA, in collaboration with CDC, the U.S. Department of Housing and Urban Development (HUD), and NIH, hosted the Asthma Disparities Workgroup Full Subcommittee meeting on October 25, 2021. The ADWG is composed of more than 60 federal stakeholders committed to coordinating activities and leveraging resources to address nationwide disparities in asthma health outcomes. The discussion topics included the Allergy and Asthma Foundation of America (AAFA) report on *Asthma Disparities in America: A Roadmap to Reducing Burden on Racial and Ethnic Minorities;* federal agencies' efforts to achieve health equity, with a focus on implications for children with asthma and identifying opportunities for collaboration; the impact of the COVID-19 pandemic on patients with asthma and asthma programs; and federal agencies' efforts on climate change with direct impact on asthma, including air pollution, pollen, disasters (wildfires, flooding/increased humidity) and understanding the indoor environment.

In October 2021, Administrator Regan, Office of Air and Radiation Acting Assistant Administrator Joe Goffman and EPA staff participated in the President's Task Force on Environmental Health Risks and Safety Risks to Children principals meeting. Principals from 17 federal departments and agencies met to reinvigorate the federal commitment to protecting children from environmental health and safety risks and to endorse future interagency actions that promote children's health and wellbeing. Three priority areas were addressed: climate, emergencies and disasters; asthma disparities; and lead exposures.

Collaboration With Partners to Promote the Environmental Management of Asthma

EPA participated in the ALA Asthma Care Coverage stakeholder meeting that was assembled in October 2021 to discuss updates to ALA's Asthma Guidelines-Based Care Coverage Project. Since 2015, ALA has been awarded funding from CDC to track coverage of and related barriers to guidelines-based asthma care, which included in-home environmental asthma interventions and in state Medicaid programs.

In November 2022, EPA participated in the USAsthma Summit hosted by the Allergy and Asthma Network. The summit included asthma programs and coalitions from across the country. Participants discussed barriers in asthma care and health equity, shared best practices and lessons learned, and addressed ways to advance guidelines-based care. EPA's 2021 National Environmental Leadership in Asthma Management Award winners shared their successful asthma care models.

Comprehensive IAQ Interventions in Homes

Indoor airPLUS: New Homes

IED's Indoor airPLUS Program (IAP) is a voluntary partnership and labeling program that helps new home builders address customer health concerns through construction practices and product specifications that minimize exposure to airborne pollutants and contaminants. IAP continued to see growth through calendar year 2021, with an 18 percent increase in new partners over 2020, which was already a record year for partner growth following a surge of interest during the height of the pandemic. With recent commitments from production builders across the country, the IAP team continues to work at onboarding and training new builders, while also preparing advancements for Version 2 of the program

requirements. The team plans to release a revised draft of those specifications for public comment in spring 2022, which will be posted on the IAP home page, www.epa.gov/indoorairplus.

The IAP team also published an update to the program's Policy Record in December 2021, including clarifications and refinements to Version 1 requirements originating from questions and feedback from stakeholders. One of the most notable changes is the opening of eligibility for multifamily properties of ALL heights, creating new opportunities for mid- and high-rise builders, as well as developers of affordable housing, to be able to earn the Indoor airPLUS label. The current Policy Record and other program documents can be found at www.epa.gov/indoorairplus/indoor-airplus-program-documents.

Indoor airPLUS: Leader Awards

IAP annually announces the Indoor airPLUS Leaders of the Year Award winners. EPA selects one Indoor airPLUS Leader of the Year in both the builder and rater categories for outstanding commitment and program performance. The award winners build and verify Indoor airPLUS–qualified homes and exhibit outstanding leadership in the promotion of the IAP program by educating homebuyers, trade professionals and allied stakeholders about the importance of enhanced indoor air quality. For 2021, the IAP Leader of the Year winners were Mandalay Homes (builder) and JKP Energy Inspections (rater). The team plans to open the 2022 award cycle in April. For additional information on IAP Leader Awards, see www.epa.gov/indoorairplus/indoor-airplus-leader-award-winners.

Indoor airPLUS: Web Content

The IAP program continues to add web content to further illustrate the role of IAP as a comprehensive, whole-building system approach to a healthier home. Recent additions include guidance on viruses, bacteria and other pathogens, as well as wildfire smoke. This content is available at www.epa.gov/indoorairplus/indoor-airplus-and-viruses-bacteria-and-mold and www.epa.gov/indoorairplus/indoor-airplus-and-wildfires.

Additional forthcoming content will include IAP and asthma and other consumer-focused resources. Sign up for the IAP mailing list for updates on this content and other IAP news: www.epa.gov/indoorairplus/forms/sign-email-updates-indoor-airplus.

Comprehensive IAQ Interventions in Schools

Indoor Air Quality, Healthy Green Cleaning and Preventive Maintenance in Schools

As a result of the COVID-19 pandemic, EPA's Schools Program is focused on the increased interest in healthy indoor environments in schools, increased urgency to respond to IAQ issues in schools, and leveraging key partnerships to expand our network of stakeholders. EPA recently participated in several key events and webinars on IAQ in schools.

On October 21, 2021, EPA hosted a webinar on *Ventilation and COVID-19 in Schools: Using a Framework to Assess, Prioritize and Plan for HVAC Upgrades and IAQ Improvements*. This webinar featured experts from the Detroit Public Schools Community District and the Michigan Board of Education who discussed

how the Detroit Public Schools Community District took action to assess IAQ, ventilation and HVAC systems (including working with consultants and contractors to perform assessments, commissioning and retro-commissioning) to help reduce the risk of COVID-19 transmission and create safe breathing environments for all students and staff. The event had a total of 1,244 registrants and 731 attendees. The webinar recording is available on-demand at Healthy Indoor Environments in Schools: Plans, Practices and Principles for Maintaining Healthy Learning Environments.

On October 29, 2021, the recipients of the American Rescue Plan–funded project titled "Schools as Community Cleaner Air and Cooling Centers" were announced. EPA's Office of Community Revitalization will provide technical assistance for the development of neighborhood cleaner air and cooling centers in public school facilities. The program has multiple goals, including improving ventilation and filtration in schools to reduce COVID-19 transmission and creating healthy learning environments through improved indoor air quality in schools.

On February 2, 2022, EPA facilitated the session "Creating a Game Plan to Reduce COVID-19 Risk and Make Lasting Improvements to IAQ in Schools" at the 2022 National School Plant Management Association (NSPMA) Conference. During the session, NSPMA members developed action plans designed to implement comprehensive IAQ management plans based on guidance from the EPA *IAQ Tools for Schools* materials and resources. NSPMA provides leadership and collaboration for facility managers in K–12 public schools throughout the country. The annual conference provides an opportunity for representatives from across the country to participate in professional development trainings and engage with a wide range of industry experts.

On February 3, 2022, EPA served as a panelist during the webinar *Classroom Air Quality Monitoring—Why It Matters*. EPA delivered remarks on IAQ CO_2 monitoring in schools and highlighted the importance of proper ventilation and healthy IAQ in schools to protect children and staff and improve educational outcomes. The webinar was hosted by District Administration, School Specialty LLC and Honeywell Corporation and was presented to school districts' local education agencies (LEAs) across the country. Speakers included representatives from a school district in San Jose, California, and the California Energy Commission. The webinar goals were to promote the benefits of improved IAQ to health and learning, to increase awareness of the related laws within California and Nevada for resident school districts and the potential for similar policies to be adopted by other states, and to recap the CalSHAPE Ventilation grant program for LEAs in the state of California.

On February 10, 2022, EPA hosted a U.S. Green Building Council (USGBC) and 21st Century Schools webinar titled *Solutions and Resources to Address COVID-19 in Schools: Establishing Lasting Improvements to Ventilation and IAQ*. Speakers from the Center for Green Schools at USGBC, 21st Century School Fund, Lawrence Berkeley National Laboratory (LBNL) and Michigan Chapter of ASHRAE examined the state of schools and how to make the case to implement building upgrades to improve IAQ, reduce the risk of COVID-19 transmission, and optimize school building energy performance. The webinar recording will be available on-demand beginning in March 2022 at Healthy Indoor Environments in Schools: Plans, Practices and Principles for Maintaining Healthy Learning Environments.

Collaboration With Federal Partners to Promote School Environmental Health

EPA and the Department of Education (ED) are working to sustain and expand a partnership on healthy infrastructure, indoor air quality investments, and health and learning in schools. This collaboration is prioritizing good indoor air quality in schools as essential for achieving learning outcomes, health and wellbeing and has a special focus on schools serving low-income communities.

EPA continues to collaborate with the DOE's Efficient and Healthy Schools campaign. The campaign aims to help K–12 schools—especially those serving low-income student populations—identify practical HVAC solutions and upgrades to improve energy efficiency while promoting healthier spaces for teaching and learning. This campaign will promote peer-to-peer learning among school participants and will recognize schools for their best practices and exemplary solutions. The campaign also will engage supporters—such as designers, engineers, consultants and program implementers—to better support schools that are investing in efficient and healthy school buildings.

EPA participates in the Federal Partners in School Health (FPSH) virtual meetings. The FPSH, coordinated by ED, is an alliance of federal agencies that assists and supports the physical and mental health of all students. The FPSH has developed a website inventorying resources promoting healthy school environments for K–12 schools, school districts, state and local education agencies: studenthealth.ed.gov.

Expanding the Reach for School IAQ Training

EPA continues to support healthy indoor environments in schools during the COVID-19 pandemic.

View IED-hosted webinars in the series Healthy Indoor Environments in Schools: Plans, Practices and Principles for Maintaining Healthy Learning Environments.

EPA also continues to promote the *IAQ Tools for Schools: Preventive Maintenance Guidance* documents to help school personnel take a holistic, proactive approach to IAQ issues. The guidance leads school personnel through the steps to develop and implement an IAQ preventive maintenance plan and offers a framework to make the case using a value proposition for an IAQ preventive maintenance plan and gain buy-in from the school community.

EPA continues to actively deliver technical assistance to the schools' community through two professional training webinar series—the IAQ Master Class Professional Training Webinar Series and the IAQ Knowledge-to-Action Professional Training Webinar Series. Since 2015, both series have had more than 22,000 views from live webinars and on-demand recordings. EPA is eager to drive even more action in school districts by spreading the IAQ Master Class Professional Training Webinar Series across more networks and platforms. Please contact us at iaqschools@epa.gov if your organization would like to use your existing training platforms and vehicles to host or link to the webinar series.

Consider Subscribing to Email Alerts on IAQ Topics

EPA offers a free subscription service for information on more than 20 indoor air topics—opt-in at public.govdelivery.com/accounts/usepaiaq/subscriber/new to receive email updates on IAQ. More than 145,000 subscribers regularly receive announcements of upcoming trainings, webinars and events, as well as practical tips and information resources to improve IAQ. Subscribers can choose among 20 topics, such as mold, air cleaners, radon, environmental asthma, air quality in schools, and IAQ emergency preparedness and response. Many topics also are presented in Spanish. Subscriptions can be canceled easily at any time.

Centers for Disease Control and Prevention (CDC)

National Center for Environmental Health (NCEH)

NCEH worked with HUD's Office of Lead Hazard Control and Healthy Homes and with EPA's IED to co-brand an infographic that shows safety considerations for use of foggers and misters. All three agencies have received many questions about the safety of such mechanisms for dispersing pesticides and disinfectants. This coordinated approach and co-branding of a single infographic reduces duplication of efforts across agencies and simplifies messages for building managers and occupants who might be exposed to chemicals through these methods. CDC worked closely with a graphic artist to develop images that conveyed complex concepts of personal protective equipment used when applying the product via fogging or misting. The graphic was approved by all three agencies, and it is now posted on each agency's website. Here is the link provided on the CDC website: Safety Tips for Using Foggers and Misters Indoors.

Division of Environmental Health Science and Practice (DEHSP)

DEHSP/Asthma and Community Health Branch

Based upon preliminary findings from a field investigation of mask use for mold cleanup in the aftermath of Hurricane Ida (December 5–15, 2021), a social media message (via Twitter) was sent by @CDCEnvironment: "Cleaning up mold after Hurricane Ida or other flooding? Be sure you wear an N95 (or better) respirator. Protect yourself from mold."

This posting garnered more than 10,000 views, as well as other reactions (metrics below):

- Impressions (views): 10,039
- Engagements (interactions): 80
- Retweets: 8
- Likes: 14

DEHSP/Water, Food and Environmental Health Services Branch

A new publication underscores the importance of water management programs to reduce *Legionella* growth in plumbing: James AE, Kesteloot K, Paul J, McMullen RL, Louie S, Waters C, et al. Potential association of Legionnaires' disease with hot spring water, Hot Springs National Park and Hot Springs, Arkansas, USA, 2018–2019. *Emerg Infect Dis.* 2022;28(1):44-50.

In summary, Legionnaires' disease has not previously been associated with hot springs in the United States. Environmental testing at Hot Springs National Park, Arkansas, revealed *Legionella* bacteria in piped spring water. These findings underscore the importance of water management programs to reduce *Legionella* growth in plumbing through control activities, such as maintaining hot water temperatures, reducing stored water age and ensuring adequate water flow.

A new column describes CDC tools to help environmental health professionals better understand how to control and manage the growth of *Legionella* in a variety of settings: Curtiss E, Hils J, Kunz J. Water management programs are key to managing Legionella growth and spread. [commentary] *J Environ Health*. 2022;84(6):30-2.

In summary, environmental health practitioners have essential expertise for responding to and preventing outbreaks of Legionnaires' disease. The authors describe CDC tools for environmental health professionals.

Agency for Toxic Substances and Disease Registry (ATSDR)

ATSDR, with NCEH collaborators, assisted with the development of the Asia-Pacific Economic Cooperation (APEC) Workshop on Nanoplastics in Marine Debris (virtual workshop, December 13–15, 2021). ATSDR and NCEH developed the framework, invited subject-matter experts, reviewed abstracts and facilitated a session on transport, exposure and health effects of microplastics. The session included airborne exposures to microplastics.

ATSDR developed a desktop application called the ATSDR SHOWER Model. The model estimates indoor air concentrations and dermal uptake from showering and bathing in contaminated water for households with up to eight people. The model also includes emissions from sinks, washers and toilets. This easy-to-use model is available to anyone by sending an email to showermodel@cdc.gov. Future upgrades will include school and occupational scenarios involving communal shower.

National Center for Emerging and Zoonotic Infectious Diseases (NCEZID)

Mycotic Disease Branch (MDB)

The branch recently posted a Broad Agency Announcement, or a solicitation of proposals for potential contracts, asking for research on fungi in health care environments, including in air. Topics include the following:

- Develop innovative methods for detection and surveillance of pathogenic fungi in health care environments.
- Quantify baseline levels of pathogenic fungi within health care environments.
- Correlate fungal quantitative data with episodes of fungal infections or transmission in patients.
- Pilot early-detection and surveillance methods for invasive mold and other fungi in patients and in the environment to guide public health efforts.
- Evaluate the feasibility and utility of different environmental sampling approaches for pathogenic fungi in health care environments.

National Institute for Occupational Safety and Health (NIOSH)

Respiratory Health Division (RHD)/Field Studies Branch (FSB)

An international collaborative study characterizing mixed exposures in school classrooms has completed the field investigation and collected more than 200 samples, including air filter, elevated surface dust, floor dust and AC filter dust from 36 classrooms in 12 schools in South Korea. The samples currently are stored in a -80° freezer in the collaborating university in Korea and will be shipped to a NIOSH laboratory for analysis. The samples will be analyzed for bacterial and fungal DNAs, endotoxin, and ergosterol to examine classroom microbiome and the associations of the microbiomes among different types of samples within classroom. In addition, Korean collaborators monitored classroom particulate matter (PM) and analyzed airborne dust for chemical composition. The association between microbial community and chemical composition in PM will also be examined.

December 5–15, 2021, NIOSH led a field investigation (Epidemiologic Assistance, Epi-Aid) of mask use for mold cleanup in the aftermath of Hurricane Ida. NIOSH and NCEH's Hurricane Ida recovery team assisted the Louisiana Department of Health with the study design, survey development and data collection efforts. In brief, the Epi-Aid was requested by the Louisiana Department of Health. The department was concerned about residents and mold-remediation workers using cloth masks or surgical masks (used to prevent transmission of SARS-CoV-2) when remediating mold damage to homes after Hurricane Ida that made landfall in Louisiana on August 29, 2021. CDC and other federal agencies recommend a higher level of respiratory protection for mold cleanup. The study team currently is analyzing data collected from the field investigation and comparing study results with a similar field investigation conducted after Hurricane Katrina in 2005.

Health Effect Laboratory Division (HELD)/Allergy and Clinical Immunology Branch (ACIB)

In November 2021, HELD completed a sub-chronic fungal exposure study (National Toxicology Program [NTP] Study #C15017: "Evaluation of the Sub-Chronic Toxicity of *Aspergillus versicolor*") in collaboration with the NTP and the National Institute of Environmental Health Sciences. This study examined the toxicological effects following the repeated inhalation of *Aspergillus versicolor*. A report is being prepared.

Division of Field Studies and Engineering (DFSE)/Hazard Evaluation and Technical Assistance Branch (HETAB)

In October 2021, DFSE published a Health Hazard Evaluation report, titled *Evaluation of Indoor Environmental Quality and Health Concerns Among Employees of a Public Elementary School*, related to indoor environmental quality (IEQ) (Health Hazard Evaluation Report 2019-0156-3382 [cdc.gov]).

National Institute of Standards and Technology (NIST)

NIST Net-Zero House

The NIST Net Zero Energy Research Test Facility (NZERTF) is a two-story, four-bedroom house incorporating energy-efficient construction, space conditioning systems and appliances, as well as solar water heating and solar photovoltaics to meet the house's energy needs. For general information on the house, view the following video: www.youtube.com/watch?v=xSzu83fyQaQ. All publications can be found at the NIST NZERTF webpage, www.nist.gov/el/nzertf. A tracer gas system that measures both SF_6 and CO_2 has been installed in the home to obtain continuous air change rate measurements and to investigate the performance of CO_2 demand control ventilation and other control approaches. An ozone monitor has been installed to record ozone in each level of the home. A CO_2 heat pump water heater has been installed, and a CO_2 geothermal heat pump will be installed this year.

Contact: Lisa Ng, lisa.ng@nist.gov

In spring 2022, the NZERTF and NIST will host the Chemical Assessment of Surface and Air research campaign. This follow-up on the HOMEChem research effort is led by Professor Delphine Farmer (Colorado State University) and Professor Marina Vance (University of Colorado). A team of up to 10 external research groups will use environmental and chemical perturbations in the NZERTF to investigate the chemistry of indoor environments. Chemical transformation induced by ozone, smoke and chemical additions will be investigated. Real-time instruments used in this campaign include a chemical ionization mass spectrometer (CIMS), two proton transfer reaction mass spectrometers (PTR-MS), an aerosol mass spectrometer (AMS), a water-soluble gas analyzer and thermal desorption aerosol gas chromatography (SV-TAG) instruments. In addition, formaldehyde, NO_X, ozone and ultrafine particles will be measured with lab-grade instruments. A range of consumer-grade sensors also will be deployed through the NZERTF during the study. In addition, a variety of surfaces will be placed in NZERTF for varying lengths of time to examine the impact of indoor air chemistry changes on surfaces and role surfaces play in impacting indoor air chemistry. These surfaces will be analyzed offsite at collaborators laboratories. Sign up for the newsletter: indoorchem.org/projects/casa.

Contact: Dustin Poppendieck, dustin.poppendieck@nist.gov

Fate and Transport of Indoor Microbiological Aerosols (FaTIMA)

In response to the COVID-19 pandemic, NIST developed an online tool to enable users to consider the effects of several factors on transmission of and exposure to airborne, virus-containing aerosols. These factors include aerosol size, emission rates and variations in these rates, deposition rates (for walls, floors, ceiling and other surfaces), pathogen inactivation rate, ventilation and filtration. The tool implements a web-based version of the CONTAM simulation engine to simulate a single, well-mixed zone for a 24-hour period. Inputs enable the definition of a source—for example, infected individual(s)—to emit aerosols both continuously (breathing) and intermittently (coughing or sneezing). Room dimensions and ventilation system characteristics also are defined, including total supply, return and fraction of outdoor airflow rate. System filters and local exhaust and in-room air cleaners also can be

included. An occupant is simulated in the room either continuously or intermittently over a user-defined occupancy period during the 24-hour simulation—for example, to simulate a caregiver intermittently checking on the infected occupant. The tool will calculate the airborne concentration, occupant exposure and surface loading over the 24-hour period and provide results both numerically and graphically. Transient charts show the time histories and integrated values for concentration and occupant exposure for the 24-hour period and the user-defined occupancy period. Summary charts provide relative percentages of aerosol fate (exited zone, filtered, deposited, deactivated and remain airborne), sources (continuous, intermittent and outdoors), deposition (floor, walls, ceiling and other), and filtration (outdoor, recirculation, air cleaner and envelope penetration). A news release and links to the tool and associated documentation are provided below.

News release: www.nist.gov/news-events/news/2020/06/nist-airflow-model-could-help-reduce-indoor-exposure-aerosols-carrying

Link to tool: www.nist.gov/services-resources/software/fatima

Link to documentation: nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.2095.pdf

Contact: W. Stuart Dols, william.dols@nist.gov

Single-Zone Simulations Using FaTIMA for Reducing Aerosol Exposure in Educational Spaces

FaTIMA was applied to a classroom, portable classroom and assembly room. NIST evaluated the relative effectiveness of various measures to reduce exposure to infectious aerosols, including masks, increasing ventilation, increasing filtration, using portable air cleaners and using exhaust fans. Multiple controls can be implemented in spaces and HVAC systems to reduce exposure as part of a broader risk-reduction strategy that might be pursued by a building owner or manager. As noted by ASHRAE, engineering and other controls should be part of a larger, layered risk reduction strategy that includes hand washing, surface cleaning, social distancing and reduced occupant density. The report can be downloaded here: doi.org/10.6028/NIST.TN.2150.

Contact: Lisa Ng, lisa.ng@nist.gov

ViPER—Virus Particle Exposure in Residence

ViPER is a new single-zone indoor air quality and ventilation analysis tool for evaluating an occupant's relative exposure to virus-laden particles exhaled by a temporary contagious visitor inside the home. It allows users to compare a baseline scenario against multiple "what-if" scenarios related to particle exposure associated with a contagious visitor in the home. ViPER also can display reductions in particle concentration. This tool was developed in collaboration with the CDC Foundation and the CDC: www.nist.gov/services-resources/software/viper-virus-particle-exposure-residences.

Contact: Lisa Ng, lisa.ng@nist.gov, and Steve Zimmerman, stephen.zimmerman@nist.gov

CDC used a subset of the residential simulations performed by NIST and developed their own web tool: www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/interactive-ventilation-tool.html. This tool has graphical representations of the reduction in particle concentration after various inputs are changed, including fan-on time, filtration, the use of a portable air cleaner and if these settings are on for an extra hour.

Contact: Ginger Chew, gjc0@cdc.gov

Introduction to CONTAM Video Tutorials

A set of six tutorials has been released and provided on the NISTube video gallery. Videos can be viewed by visiting www.nist.gov/video-gallery and searching on the "CONTAM Tutorials" keyword or accessed via the NIST Multizone Modeling website: www.nist.gov/el/energy-and-environment-division-73200/nist-multizone-modeling.

Contact: W. Stuart Dols, william.dols@nist.gov

Introduction to Building Physics Video

This video will introduce you to the physics of airflow inside buildings—particularly, the ways weather; heating, ventilating and air-conditioning (HVAC) systems; and building configuration affect building airflow. You will learn about the neutral pressure level and how buoyancy (stack effect) and wind affect air infiltration. You also will also learn about the different types of HVAC systems and how they can pressurize or depressurize a building or even do both at the same time. This video was created by Jyrteanna Teo with voiceover by Lisa Ng, lisa.ng@nist.gov. Find the video here: www.nist.gov/video/building-airflow-physics.

Coupled IAQ and Energy Analysis in Multifamily Buildings

NIST participated in the International Building Physics Conference (IBPC) 2021 in August. A presentation will be made related to the development and application of coupled IAQ and energy modeling. The presentation, titled *On the Benefits of Whole-Building IAQ, Ventilation, Infiltration and Energy Analysis Using Co-Simulation Between CONTAM and EnergyPlus*, is available on the NIST website at www.nist.gov/publications/benefits-whole-building-iaq-ventilation-infiltration-and-energy-analysis-using-co. This presentation is based on the work being performed by NIST and Boston University to model IAQ and energy in residential buildings.

Contact: W. Stuart Dols, william.dols@nist.gov

ASHRAE Standard 62.2

The committee responsible for Standard 62.2 on residential ventilation and IAQ met via a hybrid in-person and webinar in January to continue working on proposed changes that may be included in the 2022 version of the standard. Topics being addressed include changes to kitchen hood capture

efficiency, electronic air cleaners, increased required filtration level and unvented combustion appliances. The committee will meet again in June.

Contact: Steven Emmerich, steven.emmerich@nist.gov

ASHRAE Standard 189.1

The committee responsible for the ASHRAE/ICC/IESUSGBC SSPC 189.1, *Standard for High-Performance Green Buildings Except Low-Rise Residential Buildings*, is in the process of updating the 2020 version for the version to be published in 2023. This standard constitutes the technical content of the *2021 International Green Construction Code*. The committee holds monthly web meetings, which are open to all interested parties. More information on the 189.1 committee activities can be found on the ASHRAE website, where you can sign up for notifications of public reviews and other information: www.ashrae.org/resources--publications/free-resources/listserves.

Contact: Andrew Persily, andyp@nist.gov

ASHRAE Guideline 44P

The ASHRAE committee developing a guideline titled *Protecting Building Occupants from Smoke During Wildfire and Prescribed Burn Events* continues to meet by webinar monthly with a goal of publishing the guideline in summer 2022. The interim planning framework document, titled *Planning Framework for Protecting Commercial Building Occupants from Smoke During Wildfire Events*—available online from ASHRAE at tinyurl.com/yxyuqh72—was published last year and has been downloaded nearly 1,000 times.

Contact: Steven Emmerich, steven.emmerich@nist.gov

ASHRAE Guideline 45P

The ASHRAE committee developing a guideline titled *Measurement of Whole-Building Performance for Occupied Buildings Except Low-Rise Residential Buildings* has been meeting by webinar every 3 weeks. The committee is rewriting the ASHRAE *2010 Performance Measurement Protocols for Commercial Buildings* into a guideline.

Contact: Lisa Ng, lisa.ng@nist.gov

ASHRAE Position Documents

ASHRAE approved a new *Position Document on Indoor Carbon Dioxide*, which will be posted online shortly at www.ashrae.org/about/position-documents. ASHRAE also has initiated efforts to revise its Position Documents on *Infectious Aerosols* and on *Limiting Indoor Mold and Dampness in Buildings*.

Contact: Andrew Persily, andyp@nist.gov

CO_2 Monitoring Outreach

The use of CO_2 monitoring in schools and other buildings has increased in efforts to identify poorly ventilated spaces. Andrew Persily gave a talk on *Using CO_2 Monitoring to Manage Ventilation in Buildings* as part of the EPA Indoor Air Quality Science Webinar series, which can be downloaded at tsapps.nist.gov/publication/get_pdf.cfm?pub_id=933724.

Contact: Andrew Persily, andyp@nist.gov

ASHRAE Green Guide Version VI

The sixth revision of the *ASHRAE Green Guide* is scheduled to be published in spring 2022. Version VI will target more experienced building professionals, whereas the previous versions contained more introductory content. NIST took the lead editorial roles on the IEQ and Water Efficiency chapters.

Contacts: Lisa Ng, lisa.ng@nist.gov, and Tania Ullah, tania.ullah@nist.gov

ASTM: D22.05 Subcommittee on Indoor Air

The subcommittee is starting a new effort to produce a guide on an analytical method for analysis of PFAS in indoor air.

The new *D8407 Standard Guide for Measurement Techniques for Formaldehyde in Air* was highlighted at a workshop during the Healthy Buildings America 2021 conference on January 20, 2022.

Other existing standards continually undergo review and revision on a 5-year rotation.

Contact: Dustin Poppendieck, dustin.popendieck@nist.gov

The Subcommittee on Indoor Air is also in the process of revising *D6245 Standard Guide for Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation*.

Contact: Andrew Persily, andyp@nist.gov

ISIAQ Scientific and Technical Committee STC34

ISIAQ STC34 aims to continuously monitor, collect and organize information about IEQ guidelines worldwide. In 2021, STC34 created an open, integrated IEQ database that is freely accessible at www.ieqguidelines.org. Currently, the database is focused on IAQ parameters. In 2022, the committee will extend the database to include standards, regulations and guidelines related to ventilation, comfort, acoustics and lighting. The current database includes information from more than 30 countries, mostly in Asia and Europe. There are more than 70 individual indoor air pollutants in the database.

Contact: Steven Emmerich, steven.emmerich@nist.gov

U.S. Department of Energy (DOE)

Agency Point of Contact: Chris Early, 202-586-0514, chris.early@ee.doe.gov

Health in Buildings Roundtable Interagency Conference

The interagency Health in Buildings Roundtable Conference, hosted by the NIH in the past, is trying to reconvene again. The conference is looking for a new home and host. Jonathan Cohen (jonathan.cohen@ee.doe.gov) of DOE is on the planning committee. Please email him with your ideas for the conference.

First Commercially Available "Smart" Kitchen Range Hood

View the article, "Indoor Air Quality Road Map: A Smart Range Hood," by Eric Werling on September 28, 2021, at the Probuilder.com website: www.probuilder.com/indoor-air-quality-road-map-smart-range-hood. The result of a research grant from the DOE, Broan-NuTone, the largest United States manufacturer of residential kitchen range hoods, will begin producing the first commercially available "smart" range hood. This quiet, energy-efficient appliance is programmed with pollutant-monitoring sensors. The fan automatically turns on when cooking activity is detected and switches off once pollutants have returned to acceptable levels. A variable-speed fan adjusts the unit's airflow rate with cooking activity. The range hood also will be rated using a new standard for "capture efficiency," which the DOE Building America Program helped develop, setting the stage for other manufacturers to follow.

Partners included DOE's LBNL, manufacturer Broan-NuTone and Newport Partners (a company that provides analytic and technical services).

Smart Whole-House Ventilation Controls Campaign

The Residential Smart Tools for Efficient HVAC Performance (STEP) Campaign supports the use of wirelessly connected, smart diagnostic tools that can help determine whether air source heat pumps, central air conditioners and other residential HVAC equipment are installed and/or operating correctly: www.pnnl.gov/projects/residential-hvac-smart-diagnostic-tools-campaign.

The Campaign is sponsored by DOE and implemented by Pacific Northwest National Laboratory. The Campaign aims to accelerate the adoption of HVAC smart diagnostic tools by providing a platform for technical assistance and access to key resources, such as guidance on implementation best practices for contractors and installers, independent testing of available smart diagnostic tools, utility incentive programs, case studies and lessons learned.

A new case study by DOE and Pacific Northwest National Laboratory summarizes the business case for adopting smart diagnostic tools and the experiences of three HVAC contractors who have successfully integrated these tools into their business practices.

Environmental Impact Statement for New Building Code Standards for Manufactured Homes

LBNL completed simulations to quantify the impact of increasing envelope and duct air tightness on air exchange rates and indoor air pollutant concentrations for manufactured homes; the analysis was done to support an Environmental Impact Statement. LBNL wrote sections on baseline conditions and consequences of the rule on indoor air quality, wildfire protections and health risks, and it provided extensive input on mitigations and input to sections on energy, socioeconomics and environmental justice.

DOE Better Buildings Residential Network (BBRN)

The BBRN, which is a network of more than 400 members that connects energy-efficiency programs and partners to share best practices and learn from one another to increase the number of homes that are energy efficient, recently addressed IAQ in its ongoing series of webinars, which are called Peer Exchange Calls.

On August 12, 2021, the BBRN hosted a peer exchange call titled "The Cost of Cooling: Air Conditioning, Climate, and Health." The subject was heat and health. The webinar can be viewed at www.energy.gov/sites/default/files/2021-08/bbrn-peer-cooling-081221.pdf.

On October 19, 2021, the BBRN hosted a peer exchange call titled "Planning for the Future: New and Improved Pandemic Protocols" (1 hour). As building owners and operators reflect on the pandemic, they are making plans to increase preparedness, improve resilience, and enact responsive building operations that can reduce energy and scale occupancy. Improving operations during periods of low occupancy, such as temporarily decommissioning buildings, can reduce energy consumption and help building owners avoid unnecessary costs. Learn from experts in the field as they discuss changes to their own pandemic preparedness and response plans and best practices for navigating future events at betterbuildingssolutioncenter.energy.gov/events.

On January 27, 2022, the BBRN hosted a peer exchange call titled "Smart Diagnostics—New Advances in the Efficiency Field." The webinar can be watched at www.energy.gov/eere/better-buildings-residential-network/events/smart-diagnostics-new-advances-efficiency-field.

On February 24, 2022, the BBRN hosted a peer exchange call titled "It's Not About Energy, It's About Comfort—Addressing the Reality." Homeowners have spoken: They do not care that much about energy, but they do care about their comfort, their sleep and the health of their household—from newborns to seniors. Hear how efficiency programs can appeal to areas of deep personal interest to engage homeowners more effectively and highlight how home energy upgrades can deliver benefits they truly care about at betterbuildingssolutioncenter.energy.gov/events.

DOE Researchers at LBNL Continue to Contribute to IAQ Research and Knowledge Dissemination

Iain Walker of LBNL presented "Residential Applications of Smart Residential Controls" on November 23, 2021, to the meeting of the Air Infiltration and Ventilation Centre, which is the International Energy Agency's information center on energy-efficient ventilation.

Brett Singer participated in a podcast on Ventilation for Infectious Disease Risk Reduction in November 2021. The organization hosting the podcast is Soundcloud. This episode reviews the current news updates of this pandemic, as well as recently updated guidelines and medical literature. In addition, the moderator, Dr. Krystina Woods, sits down with Dr. Brett Singer of LNBL around ventilation, air circulation and air quality. They discuss recent research Dr. Singer and his team have done around indoor air and transmission; how to improve ventilation at businesses, schools, hospitals and the home; and future research in this area for the pandemic and beyond.

LBNL completed the final report *The Cost of Decarbonization and Energy Upgrade Retrofits for U.S. Homes* in August 2021. In the report, LBNL analyzes the relationship of decarbonization and indoor air quality, including technologies and costs.

"Control of Airborne Infectious Disease in Buildings: Evidence and Research Priorities" was published in *Indoor Air* in November 2021. In the article, researchers review aerobiologic and epidemiologic evidence of indoor environmental controls against transmission and present a quantitative aerosol transfer scenario illustrating relative differences in exposure at close-interactive, room and building scales. By Bueno de Mesquita, P. Jacob; William W. Delp; Wanyu R. Chan; William P. Bahnfleth; and Brett C. Singer.

"Measured Influence of Overhead HVAC on Exposure to Airborne Contaminants from Simulated Speaking in a Meeting and a Classroom" was published in *Indoor Air* in 2021. Tracer gas experiments were conducted in a 158 m^3 room with overhead supply diffusers to study dispersion of contaminants from simulated speaking in physically distanced meeting and classroom configurations. Written by Singer, Brett C.; Haoran Zhao; Chelsea V. Preble; William W. Delp; Jovan Pantelic; Michael D. Sohn; and Thomas W. Kirchstetter. https://doi.org/10.1111/ina.12917

"Chemical Changes in Thirdhand Smoke Associated With Remediation Using an Ozone Generator" was published in *Environmental Research* in July 2021. Written by Tang, Xiaochen; Noelia Ramirez Gonzalez; Marion L. Russell; Randy L. Maddalena; Lara A. Gundel; and Hugo Destaillats. https://doi.org/10.1016/j.envres.2020.110462

DOE National Virtual Biotechnology Laboratory "Report on Rapid R&D Solutions to the COVID-19 Crisis," December 2021

With funding from the Coronavirus Aid, Relief, and Economic Security (CARES) Act, DOE established the National Virtual Biotechnology Laboratory (NVBL) in March 2020 to address key challenges associated with the COVID-19 crisis. NVBL brought together the broad scientific and technical expertise and resources of DOE's 17 national laboratories to help tackle medical supply shortages, discover potential

drugs to fight the virus, develop and validate COVID-19 testing methods, model disease spread and impact across the nation, and understand virus transport in buildings and the environment. https://science.osti.gov/nvbl/NVBL-Projects/-/media/nvbl/pdf/NVBL_report.pdf