

CHILDREN'S HEALTH AND WILDFIRE SMOKE EXPOSURE WORKSHOP

WORKSHOP SUMMARY

MAY 5–6, 2021

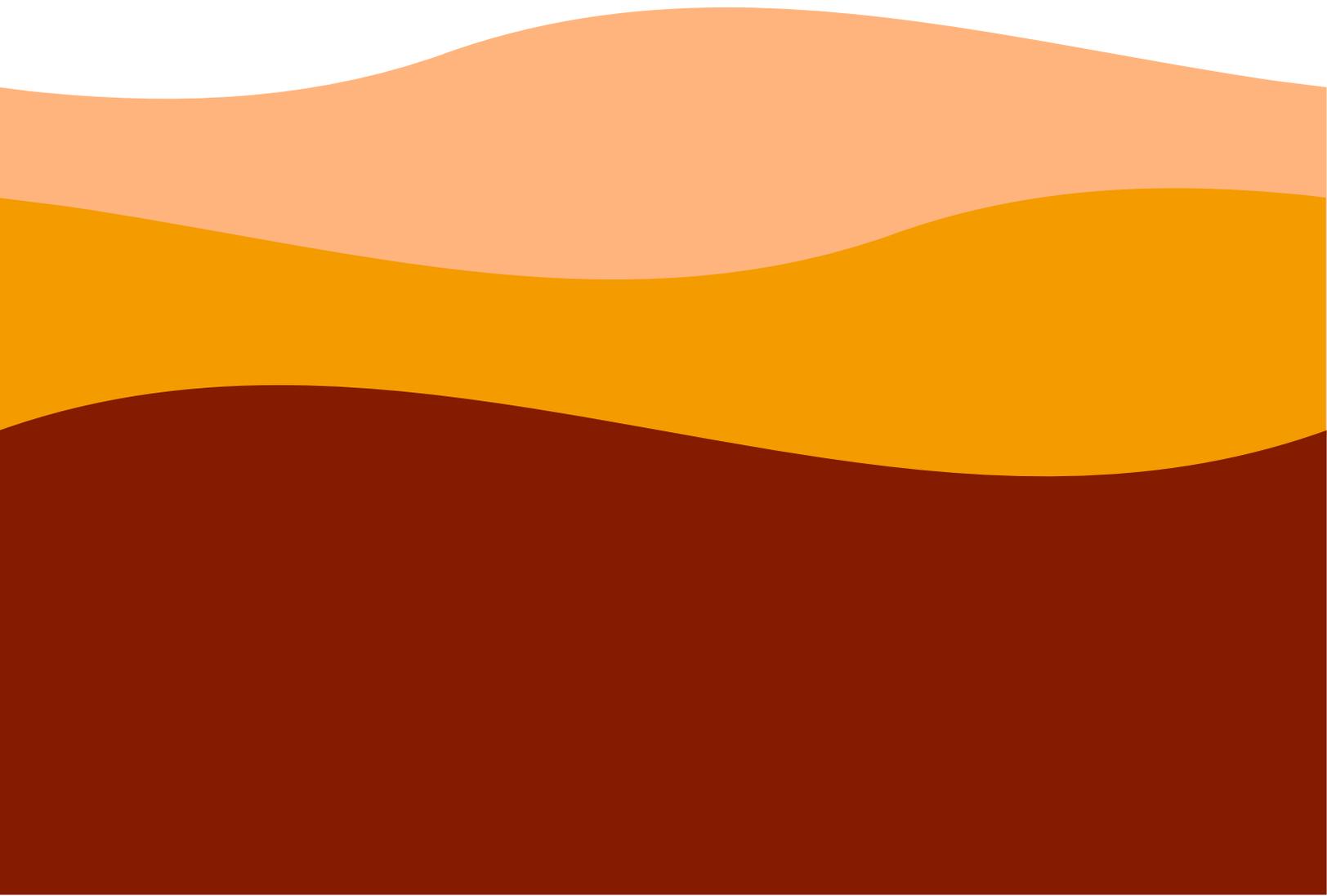


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MEETING SUMMARY

DAY 1: WEDNESDAY, MAY 5, 2021

Welcome and Opening Remarks

Jeanne Briskin, U.S. EPA Office of Children's Health Protection
Erika Sasser, U.S. EPA Office of Air and Radiation

Ms. Jeanne Briskin recognized the work put into the workshop. She highlighted the time and space available during the workshop to focus on respirators, air quality monitors, school activity guidelines, and indoor air quality (IAQ) in schools. This collaboration will help develop best methods for helping to protect children from exposure during wildfire smoke events. Wildfire smoke has outsized effects on the health of children, and Ms. Briskin recognized the inevitability of wildfire events. She emphasized the importance to continue to work together to protect children, and because there would be remaining issues after the workshop, she informed the participants that the President's Task Force on Environmental Health Risks and Safety Risks to Children is one possible way for federal agencies to work together to protect children in wildfire situations. Another opportunity to build on the questions from this workshop is the Children's Health Protection Advisory Committee (CHPAC). Ms. Briskin noted that the U.S. Environmental Protection Agency (EPA) hopes to continue the collaboration with individuals in the public health community to better promote child health.

Dr. Erika Sasser welcomed workshop participants and thanked them for their input and feedback. Wildfire smoke is a present and growing issue around the country and the investment in children's health and wildfire research is important. Children's risk is higher because their bodies are still developing, and Dr. Sasser noted that we have learned from studying the science that exposure to wildfire pollutants can affect children long-term. Wildfire smoke is an important contributor to children's asthma and has other impacts on the respiratory system. These impacts are important to the public, as reducing exposure can have several benefits. EPA's current principal tool is the Air Quality Index (AQI), which provides location-specific air quality and guidelines for individuals to reduce exposure. One way of reviewing AQI is through the AirNow website and the AirNow phone application. The goal is to enhance underlying science and research, while also examining ways to communicate effectively with the public and provide actionable information for individuals to protect themselves in various exposure situations. Dr. Sasser explained that EPA worked with the Centers for Disease Control and Prevention (CDC) to develop a web course that provides information on health effects associated with wildfire smoke and actions that patients can take before and during wildfires. The course offers a continuing education credit for physicians, nurses, and educators. We are also in discussion with Pediatric Environmental Health Specialty Units (PEHSUs) and CDC about a medical course specifically for pediatricians and children's healthcare professionals. Along with federal and state partners, EPA also has a comprehensive guidance document and fact sheets on several different air quality topics.

Overview of State of the Research White Paper (Health Effects in Children)

Health Effects of Wildfire Smoke in Children and Public Health Tools: A Narrative Review (Overview of the White Paper)

Stephanie Holm, California EPA and Western States Pediatric Environmental Health Specialty Unit

Dr. Stephanie Holm provided an overview of the white paper (<https://www.nature.com/articles/s41370-020-00267-4>) and an update of work that has been published since then. She described the scope of the problem as large populations exposed to wildfire smoke. Dr. Holm provided a National Oceanic and Atmospheric Administration (NOAA) map that estimates the risk of very large fires in the mid-21st century compared to the end of the 20th century. She noted that it is expected that this problem will continue to worsen, so creating mitigation strategies now is important. Research has shown consistent relationships with respiratory illnesses, hospitalizations, and clinical visits with wildfire smoke exposure. However, smoke effect research has mostly been on adults. Dr. Holm explained that children are more vulnerable than adults because of their differences in physiology. The unique windows of development in childhood make disruptions during this time prone to causing lifelong effects. Children's behaviors and preferences, such as being outside and active, also increases their exposure of wildfire smoke. She then previewed upcoming topics that are noted in the white paper such as mask or respirator use, IAQ in schools, school activity guidelines, and sensor use.

Topic Overviews

Moderators:

- Stephanie Holm | *California EPA and Western States Pediatric Environmental Health Specialty Unit*
- Catherine Karr | *University of Washington and Region 10 Pediatric Environmental Health Specialty Unit*

Respirator Use by Children

Respirator Use by Children

John Balmes, University of California San Francisco

Dr. John Balmes discussed respirator use by children and acute health impacts of short-term community wildfire smoke exposures. He highlighted the strong evidence of the association between wildfire smoke and respiratory health in adults and growing evidence of a link between wildfire smoke and respiratory infections in adults and children. Emerging evidence from ecological studies demonstrate that fine particulate pollution increases risk of infection and Coronavirus Disease 2019 (COVID-19). He provided a detailed overview of the study on fine particles in wildfire smoke and pediatric respiratory health in California. The study strongly suggests that wildfire smoke is more toxic for children than non-wildfire particulate matter. He suggested several approaches to reducing children's exposure to wildfire smoke, such as keeping children indoors, using central ventilation, using portable high-efficiency particulate air (HEPA) filters, and using a respirator if a child with asthma must go outside. He described the differences between cloth masks, medical masks, and respirators. NIOSH (National Institute for Occupational Safety and Health)-approved N95 respirators are not made for children in the United States and most children can wear a small adult N95. Evidence to date is that N95s are safe for most people with pre-existing heart and lung disease, and ongoing work will further investigate for whom N95s may have the most benefit and risk.

Workgroup Synopsis

Mark Miller, California EPA and Western States Pediatric Environmental Health Specialty Unit

Dr. Mark Miller discussed guidance for mask and respirator use by children and pregnant women during wildfire smoke events. He stated there was a working group that met several times to develop key messages for public health officials. Public health officials should consider respirator and mask use during wildfire smoke events for children and pregnant women when the AQI is greater than 100 and encourage respirator and mask use when the AQI is greater than 150 or if smoke is making a child or pregnant woman cough. Dr. Miller noted that local challenges or conditions should be considered when interpreting local conditions. Mask or respirator use is encouraged for children if they must spend time in an area where the AQI level is in the orange range (100) or higher. It is discouraged to increase a child's activity just because they seem to be protected by a mask or respirator. He provided an overview of the developed messages for public health officials on different types of masks and respirators. Dr. Miller recommended the audience to use products that are NIOSH certified.

Indoor Air Quality in Schools

Improving School Indoor Air Quality During Wildfire Smoke Events

Wanyu Rengie Chan, Lawrence Berkeley National Laboratory

Dr. Wanyu Rengie Chan discussed the role of filtration and ventilation control in schools, and key challenges and opportunities to improve their air quality. She provided an overview of several factors affecting IAQ in schools. With a focus on particulate matter, she discussed air cleaning and the difference between filtration and ventilation. Dr. Chan noted the opportunity to modernize schools to move from pandemic-mode to wildfire mode. She described the scientific approach for a study completed in two California schools to evaluate energy and indoor environmental quality performance of heating, ventilation, and air conditioning (HVAC) systems. She stressed the importance for schools to have a plan to maintain HVAC systems, upgrade to Minimum Efficiency Reporting Value (MERV)-13 or higher efficiency air filters and have HVAC controls to enable prompt response to changing conditions. Dr. Chan provided a brief overview of portable air cleaners and their effectiveness for creating a clean room or space. For schools to be better prepared, she emphasized that it would take more capital investments and near-term improvements.

School Indoor Air Quality During Wildfire Smoke Events: Workgroup Recommendations

Alison Clune, U.S. EPA

Ms. Alison Clune provided a brief overview of the workgroup recommendations for school IAQ during wildfire smoke events. The guidance started with a recommendation to assemble a team and create an IAQ plan. Minimizing intrusion of outdoor air, ensuring adequate ventilation and filtration, avoiding activities that could add to indoor air pollution, considering respirator use or changes to school activities to reduce smoke exposure, and accommodating the needs of sensitive groups are all important in preparing and responding to wildfire smoke. In facilities served by an HVAC system, adequate ventilation and filtration may be achieved by using a higher-efficiency filter (i.e., MERV-13 or higher, if the system can accommodate it) while operating the HVAC system to maintain positive pressure in the building. For spaces not served by an HVAC system or where additional filtration is needed, portable air cleaners that are the appropriate size for the space, do not produce ozone, and meet requirements for noise and cost should be considered. There are also additional considerations such as extreme heat, cleaning up after wildfire smoke events, and COVID-19.

Sensors

Air Monitoring using Low Cost Sensors

Charles Pearson, California Air Resources Board, Incident Air Monitoring Section

Mr. Charles Pearson discussed air monitoring using low-cost sensors. He stated that sensors are appealing because they make monitoring more accessible to the public, and the public is starting to purchase and deploy sensors more. He discussed the difference between regulatory networks and sensor networks and stated the AirNow fire and smoke map includes corrected, hourly averaged low-cost sensor data on the map. Mr. Pearson demonstrated how smoke sensing networks are developed. He provided an overview of an indoor air case study where PurpleAir-II sensors were deployed. In summary, Mr. Pearson stated that wildfire smoke monitoring with sensors has expanded the monitoring network. Applying adjustments can significantly improve accuracy of sensors and AQI estimations and sensors can be used to track benefits from indoor air intervention measures.

Guidance on Using Air Sensors to Understand Air Quality During Wildfire Smoke Events

Amara Holder, U.S. EPA

Dr. Amara Holder discussed how to best choose an air sensor. She described how to understand sensor data quality and quality control. Sensor quality control requires frequent data review to identify problems because many sensors do not have status indicators. Dr. Holder noted that the workgroups recommended comparing redundant measurements to ensure matching trends, using a source such as a match or candle to ensure the sensor is responding, completing a periodic co-location as a sensor health check, or if necessary, cleaning suspect data and considering replacing the air sensor. Interpretating sensor data can be accomplished by identifying trends, diagnosing issues with building sealings or HVAC systems, and ensuring air cleaners are the correct size and are functional. She noted that sensors should be placed near vulnerable or sensitive groups, where outdoor activities might take place, and generally where exposure might be greatest. She reviewed the recommendations for using air sensors to monitor school IAQ during wildfire smoke events.

School Activity Guidelines

Exposure and Health Consequences of Chronic Wildfire Smoke

Rima Habre, Keck School of Medicine, University of Southern California

Dr. Rima Habre stated that wildfires are increasing in frequency, duration, and intensity due to climate change, land use changes, and an increase in wildland-urban interface. Acute health effects have been well documented, but chronic exposure patterns and health effects are less researched. Dr. Habre noted that ultimately, in health studies, we are trying to understand how to mitigate that issue. The chemical composition of wildfire smoke depends on what is burned, and wildfire smoke varies in size distribution. She stated that vertical profiles are important when tracking wildfire smoke. She provided examples of exposure models such as two maps of long-term exposure patterns.

Guidance on Children's Physical Activity During Wildfire Smoke Events: Workgroup Recommendations

Susan Stone, U.S. EPA

Ms. Susan Stone discussed guidance on children's physical activity during wildfire smoke events. The guidance highlighted important considerations for use by schools and childcare facilities to make decisions about children's activities, both indoors and outdoors during wildfire smoke events. Factors affecting the inhaled dose of pollution, or exposure, during outdoor or indoor activities include: concentration of the pollutant, activity level, and duration of the activity. Reducing any of these three factors will reduce the inhaled dose of pollution. She provided example modifications for outdoor activities and calculations of the expected reductions in exposure based on these modifications. Recommendations included additional exposure reductions measures for children at greater risk, such as children with lung or cardiovascular disease or younger children, and for prolonged or repeated smoke events. The importance of having a communication plan in place before fire season to keep parents informed of exposure reduction measures was emphasized.

Day 1 Closing

Erik Svendsen, Centers for Disease Control and Prevention

Dr. Erik Svendsen thanked the presenters and moderators. He noted that discussing children's health issues during unfortunate wildfire circumstances is important. He provided a brief overview of what his CDC division focuses on as a non-regulatory agency. Dr. Svendsen explained that CDC helps to inform best practices and guidelines across public health. Within the National Center of Environmental Health (NCEH), there is a strong focus on protecting individual's health from air and drinking water. He stated that CDC examines the length between environmental factors and health, develops tools and guidance, and builds partnerships to support decision-making. NCEH primarily focuses on supporting the local environmental health network to prepare for, respond to, and recover from wildfire smoke events.

DAY 2: THURSDAY, MAY 6, 2021

Welcome to Day 2 – Introduction

Lauren Zeise, California EPA Office of Environmental Health Hazard Assessment

Dr. Lauren Zeise welcomed workshop participants and thanked them and the organizing committee. She explained that the guidance for public health officials was written over two decades ago. The guide has developed since then due to the increasing evidence and research on air pollution and heat exposure. After wildfire events at the primate center at the University of California Davis, immune and respiratory effects were discovered that continued to persist in offspring years later. Dr. Zeise noted that there is now emerging evidence of wildfire smoke effects in humans and the severity of these effects. She stated "there is a new normal," with NOAA releasing new temperatures recently. She looked forward to continued discussions so that schools and communities are better equipped to protect individuals from wildfire smoke exposure.

Translation Successes and Challenges

Moderator: *Melanie Marty | California EPA*

Framework for Decision-Making

How to Develop School Emergency Operations Plans to Address Wildfires

Janelle Hughes, Readiness and Emergency Management for Schools Technical Assistance Center
Alison Curtis, Readiness and Emergency Management for Schools Technical Assistance Center

Mrs. Janelle Hughes discussed how to develop school emergency operations plans (EOP) to address wildfires. The Readiness and Emergency Management for Schools (REMS) Technical Assistance Center helps direct efforts in prevention, protection, mitigation, and recovery. She noted that the REMS Technical Assistance Center supports all aspects of preparedness including activities before, during, and after a wildfire smoke event. Developing an EOP is about creating structure that helps develop and engage children in possible incidents that could happen, by giving them ideas of

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possible scenarios. There is a six-step planning process that is cyclical and ongoing to create, implement, and continuously enhance a schools EOP. She provided examples of several different possible goals to set for before, during, and after an event.

- **Step 1:** Include a core planning team.
- **Step 2:** Understand the situation, such as conducting site assessment to better understand the locations vulnerabilities.
- **Step 3:** Determine goals and objectives.

Ms. Alison Curtis reviewed Steps 4–6.

- **Step 4:** Plan development which includes identifying courses of action.
- **Step 5:** Plan preparation, review, and approval. This is a possible approach and not a required format. She described the basic plan, functional annexes, threat annexes and hazard specific annexes.
- **Step 6:** Plan implementation and maintenance.

Ms. Curtis provided resources and tools to help with wildfire support work. The wildfire fact sheet that integrated information from the guides with school information. There are also free plan generator tools that will help to develop and revise plans. EOP ASSIST Interactive Workbook and the free mobile application are two additional tools for record keeping and developing improvements for smoke events.

Schools

Planning Ahead: How to Prepare your School Community for a Wildfire or Smoke Event

Steve Herrington | Sonoma County Office of Education

Dr. Steve Herrington discussed planning ahead and preparing schools for wildfire smoke events. He provided a brief overview of Sonoma County's wildfire history. When a fire approaches a suburban community, there is a different level of toxic ash. He described the evacuation issues that can cause trauma for children. In 2018, there was no state guidance for wildfire smoke and schools. Balancing the negative impacts of children missing school with the negative impacts of wildfire smoke is a huge challenge. Dr. Herrington mentioned that building partnerships is important. He discussed how agencies can assist schools with decision-making, and decision-making should be collaborative between schools, health officers, and air quality districts. School leaders should defer to scientists to help establish air-quality thresholds. Lastly, he provided an overview of how schools can prepare for wildfires or smoke events in advance.

Responding to Wildfire Smoke with Schools in Washington

Nancy Bernard, Washington State Department of Health

Ms. Nancy Bernard discussed responding to wildfire smoke with schools in Washington. In 2012, there was a large fire in eastern Washington after the start of school in September. In the Cashmere School District, PM_{2.5} was exceeding 900 µg/m³ and CO₂ measured 30 ppm in classrooms. She discussed different tools used to help respond to the emergency – the *Wildfire Smoke Guide for Public Health Officials*, guidance on choosing safe and effective portable HEPA air cleaners, improving mechanical ventilation, and upgrading to MERV 13 filters. Washington developed new guidance: *Improving Ventilation and Indoor Air Quality during Wildfire Smoke Events: Recommendations for Schools and Buildings with Mechanical Ventilation* and the *Air Pollution and School Activities Guide*. The guide was rapidly adopted by schools, sports teams, and superintendents. Since 2012, the Washington State Department of Health and our local health jurisdictions continue to provide education and training for schools on preparing for and responding to wildfire smoke. Clean Air Methow in Okanogan County is a leading example of partnership with schools to prepare for and respond to wildfire smoke.

School Closure Guidance for Wildfire Smoke Events

Julie Fox, Washington State Department of Health

Dr. Julie Fox presented on school closure guidance for wildfire smoke events. She provided an overview of how the Washington State Department of Health (DOH) makes decisions. One of the main roles at the state level is to provide support for local health jurisdictions (LHJs). One of the first priorities they determined was the need for school closure guidance. Dr. Fox explained that Washington state formed a workgroup consisting of 10 members from state agencies and LHJs. They identified the objective for a Washington State DOH publication that would inform wildfire smoke decisions for public health before the 2019 wildfire season. They found that they did not have the evidence needed for the

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timeline they proposed, and the next step was to review existing guidance. There was guidance provided in the Washington Air Quality Advisory (WAQA) and Washington Comprehensive Emergency Management Plan. The workgroup selected between two action levels for closures and cancellations. The Washington Department of Health leadership discussed and created the goal to create the best actionable recommendation. The updated recommendations were added in July 2019. She then discussed factors to consider with school closures.

Communities

Let's Talk About Becoming Smoke Ready

Kris Ray, Confederated Tribes of the Colville Reservation

Mr. Kris Ray discussed measures to take to be smoke-ready. He defined smoke ready as all sources of smoke that affect our health, yearly smoke exposure, prevention of health problems, education and outreach, mitigation actions, and coordination with partners. Smoke ready is community based, and he noted that communication is the more important aspect of pre-smoke event planning. Mr. Ray provided an overview of actions to take during some events, and tips for managing buildings to have cleaner air. He emphasized the importance to make individuals aware of the smoke. Smoke ready is not selective to wildfire smoke; it also includes wood stove smoke and residential debris burning smoke.

Protecting Children from Wildfire Smoke at Home

George Conway, Deschutes County

Dr. George Conway discussed ways to protect children from wildfire smoke at home. He noted the importance to be prepared with a few weeks' supply of food, water, and children's medications. He described several equity concerns, including recent housing shortages and rapid increase in cost. He provided an overview of local lessons learned as a result of smoke and COVID-19. Dr. Conway outlined how COVID-19 precluded the opening of public buildings as clean air spaces during smoke events, as there was a lot of public messaging about protecting yourself, checking AQI, and the overall visual impression of AQI.

Shared Decision Making and Communication

Bridging Public Health and Community Needs

Kalie Bonomo, California Air Pollution Control Officers Association

Ms. Kalie Bonomo discussed the California Air Pollution Control Officers Association (CAPCOA) and its initiatives. She described prescribed burning as the intentional use of fire to reduce wildfires, clear land, and restore natural ecosystems. Ms. Bonomo stated that wildfires have grown to be a large concern in California, and the responsibility for clean air is shared among federal, state, local agencies, and communities. CAPCOA is part of a Smoke Communications Workgroup that works to make infographics describing wildfire smoke and prescribed burning.

Communicating with the Public About Wildfire Smoke Health Risks

Sarah Coefield, Missoula City-County Health Department

Ms. Sarah Coefield discussed communicating with the public about wildfire smoke health risks. In 2017, when there was a month and a half of the worst smoke Montana had ever seen, the standard message was to "go inside." She explained that, when you have hazardous air quality for months, going inside is not sufficient advice. Extra advice on mental health resources and how to clean indoor air was needed, so the standard messaging was updated. There is a multi-pronged approach to Missoula County smoke messaging; the information is distributed during both pre-smoke seasons and smoke season. Ms. Coefield explained that daily updates are comprehensive and posted on all social platforms, including information about current air quality, where the smoke is coming from, where the smoke is going to, places nearby that have clean air, and how to stay protected from the wildfire smoke.

Research Needs and Policy Issues

Moderator: Ambarish Vaidyanathan | *Centers for Disease Control and Prevention*

Panel Discussion: Research Needs

Moderator: Ambarish Vaidyanathan, Centers for Disease Control and Prevention

Kimberly Gray, National Institute of Environmental Health Sciences

John Balmes, University of California San Francisco

Jason Sacks, U.S. EPA

Dr. Kimberly Gray thanked the organizers for their work to prepare the workshop. She stated there are several research needs, but explained that the National Institutes of Health (NIH) can be supportive in the role of translation. The intersectionality between the wildfire crisis, equity issues, schools dealing with multiple issues, and the underlying stress during these crises are all reoccurring issues of discussion. Dr. Gray noted that the group should examine the health effects of vulnerable populations during crises.

Dr. John Balmes outlined his involvement with an application for research funding for wildfire smoke for children and adults. Considering that many wildfires that have occurred in the western United States have included the wildfire urban interface, he emphasized the need to better characterize the exposures and outcomes and be concerned about the effects exposure to wildfire smoke has on children's development. Dr. Balmes explained the limited data on these effects. He stressed the importance of having further data on the interactive effects of environmental exposure, specifically wildfire smoke, and psychosocial stressors on asthma.

Mr. Jason Sacks stated that our understanding of the health effects of wildfire smoke exposure is grounded in the decades of research on fine particulate matter (PM_{2.5}). Currently, we have a relatively good understanding of the health effects due to short-term (24-hour average) exposures to wildfire smoke (i.e., over a few days), but we have yet to fully grasp the health implications of other exposure durations such as less than 24-hour average, repeated exposures to high concentrations over multiple days, and longer-term exposures (i.e., over multiple months or multiple fire seasons). Although epidemiologic studies have consistently reported associations with a number of health effects, across studies there is variability in the indicator used to represent smoke exposure (e.g., total PM_{2.5}, wildfire-specific PM_{2.5}, smoke plume), which complicates the comparison and interpretation of results between studies.

Presentations: Policy Issues

U.S. Respirator Landscape and Policy Needs

Maryann M. D'Alessandro, National Institute for Occupational Safety and Health

Dr. Maryann D'Alessandro discussed the National Personal Protective Technology Laboratory (NPPTL) mission regarding personal protective equipment and NPPTL's responsibilities focused on research needs, outreach, and communications. She discussed current respirator authorities, nationally recognized authorities, and research considerations.

Dr. D'Alessandro emphasized that the current NIOSH approval process does not require a fit test for N95 respirators.

The Future of Schools as Healthy Environments

Michael Brauer, The University of British Columbia and University of Washington

Prof. Michael Brauer discussed several adaptation responses for wildfire smoke in pre-season preparation, during episodes, and interventions. Interventions included clean air shelters and portable HEPA filters. The location matters in these events. Prof. Brauer also described ways to address community disparities.

Selected Other Issues for Children's Health

Moderator: Jeanne Briskin | U.S. EPA Office of Children's Health Protection

Other Wildfire Issues for Children's Health – Flash Talks

Research on Pregnancy and Prenatal Practice

Marya Zlatnik, University of California, San Francisco and Western States Western States Pediatric Environmental Health Specialty Unit

Dr. Marya Zlatnik discussed maternal risk from air pollution. Pregnant women have changes to their immune system, which make them more susceptible to certain infections. They are also susceptible to several adverse effects of health pollution, as well as other high-risk individuals with asthma or other chronic lung disease, COVID-19, and structural vulnerabilities. Air pollution, more broadly, is linked to preeclampsia and hypertension in pregnancy, and she noted that there are some studies that have looked at child outcomes. Dr. Zlatnik provided a high-level overview of a University California San Francisco study and stressed the need for more wildfire smoke research.

Wildfire Issues for Children's Health: Mental Health Findings

Stephen E. Brock, California State University, Sacramento

Prof. Stephen E. Brock discussed mental health findings related to wildfires. He offered that school is the one place where many of our nation's youth are objectively safe and basic needs are met. Consequently, when schools are forced to close negative consequences are often the result (thereby compounding the trauma generated by wildfire and resulting smoke). He also acknowledged the intersection among wildfire, wildfire smoke, and the unique needs of the community when making school closure decisions (some communities are more negatively affected by school closure than others). He asked that public health officials keep these variables in mind when considering the need to close schools. He also shared a sampling of research demonstrating the negative consequences for youth exposed to natural disasters in general, and wildfire and wildfire smoke in particular. Specific recommendations for meeting the mental health needs of youth affected by wildfire smoke were offered. They included (a) attending to school staff member needs so that they can be effective caregivers, (b) returning students to as typical a school environment/experience as soon as possible, (c) paying particular attention to youth who had pre-existing vulnerabilities, (d) appreciating that traumatic stressors of all sorts have a cumulative effect, and (e) that a system's preparedness to respond to disasters will reduce an events traumatic impact. Finally, Prof. Brock referenced the National Association of School Psychologists' April 1, 2021, resolution acknowledging the impact of climate related disasters. More specifically, this resolution acknowledges that reduced air quality, an increase number of wildfires (which of course is the cause of wildfire smoke) results in childhood illness and disease. The resolution also stated that contaminated air results in increased rates of cognitive and psychiatric disorders; and increased extreme weather events attributed to climate changes (such as wildfires) contribute to rates of posttraumatic stress disorder, anxiety, and depression.

The Mental Health Effects of Multiple Traumas on Adolescents: Contagion, Retraumatization, and Non-Recovery

Hannah Pazderka, University of Alberta

Dr. Hannah Pazderka discussed three major effects to consider in collective trauma: contagion, non-recovery, and retraumatization. Mental health in adolescents in the wake of collective trauma is an area being extensively studied. Contagion is defined as not being exposed to the trauma, but being impacted simply by spending time with others that have been. The Alberta team found that children who were not present during the wildfire were just as likely to show symptoms of anxiety, depression and PTSD as those who were actually present. In fact, being present at the fire made children *less* susceptible to suicidal thoughts, perhaps because imagining what could have happened is scarier than remembering what actually did. Dr. Pazderka also reported that their recent research demonstrated that over the ensuing three years there was little recovery, which is counter to what one would normally expect to see following trauma. Generally, the effects of PTSD are thought to wane over time; repeated testing of the victims of the Ft. McMurray wildfire did not show that. One possible reason is retraumatization, as the town population then experienced both flooding and economic calamity and unemployment. The effects of retraumatization have most recently been tested with this population. Adolescents who reported the wildfire as being their worst trauma were compared to those who reported a worse trauma prior to the wildfire. Those with a trauma history were more likely to experience depression and PTSD in the

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wake of the wildfire. These results suggest that when you experience cumulative traumas, children may be less likely to recover.

Responding to COVID-19 and Wildfire Smoke Simultaneously

Eva Smith, K'ima:w Medical Center, an Entity of the Hoopa Valley Tribe

Dr. Eva Smith discussed the air quality guide for particle pollution. During the Megram Fire in 1999, there was no information about wildfire smoke available. She noted that they knew they had to communicate with the communities, so they posted daily messages. EPA proposed tribal communities buy massive amounts of ozone filters, so they purchased HEPA filters and did their best to distribute them to the community. Respiratory related visits were measured against the past years' numbers, and CDC spent some time retrospectively examining results. In 1999, they had to relocate 200 individuals to cleaner air locations. Transitioning to COVID-19, Dr. Smith noted that they asked CDC epidemiology unit to assist, and they reviewed the first 50 cases, many of which were young people. Different age groups were studied, and presented symptoms were documented. The results of these studies were further described by Dr. Smith as cough and sinus congestion.

Day 2 Closing and Thank You

Dave Rowson, U.S. EPA

Jeanne Briskin, U.S. EPA Office of Children's Health Protection

Mr. Dave Rowson thanked the participants and presenters for the work during the virtual workshop. He thanked Ms. Berger, Ms. Clune, Ms. Stone, Dr. Holm, and Dr. Miller for their work to make the event possible. He discussed the significant impacts that wildfire smoke can have indoors in homes, schools, and other indoor environments. These concerns are relevant to EPA's Indoor Air Quality Program. The program addresses some of the highest public health risks in the EPA portfolio. EPA's Indoor Air Quality Program is robust and non-regulatory, and aims to reduce exposure in homes, schools, and commercial buildings. He explained that the program has been directly involved with responding to the COVID-19 pandemic and has noted growing public awareness of indoor air quality issues. EPA's indoor air program and resources provide critical research and guidance on an array of indoor air issues. Mr. Rowson emphasized that the outcomes from the workshop will make an important contribution to work on protecting children's health during wildfire smoke events.

Ms. Jeanne Briskin thanked the workshop participants, speakers, and moderators that contributed to the content of the workgroup. She then thanked the workgroup co-chairs and planning committee for their efforts in putting together the workshop over the course of 2021–2021. She appreciated everyone's attendance and stated that she looked forward to the work that will happen in the future because of this workshop.

AGENDA

DAY 1: WEDNESDAY, MAY 5, 2021

Time (EDT)	Topic and Presenter
12:00 PM	Welcome and Opening Remarks Jeanne Briskin <i>U.S. EPA Office of Children's Health Protection</i> Erika Sasser <i>U.S. EPA Office of Air and Radiation</i>
12:20 PM	Overview of State of the Research White Paper (Health Effects in Children) Health Effects of Wildfire Smoke in Children and Public Health Tools: A Narrative Review (Overview of the White Paper) Link: https://www.nature.com/articles/s41370-020-00267-4 Stephanie Holm <i>California EPA and Western States Pediatric Environmental Health Specialty Unit</i>
Topic Overviews Moderators: <ul style="list-style-type: none">Stephanie Holm <i>Western States Pediatric Environmental Health Specialty Unit</i>Catherine Karr <i>University of Washington</i>	
12:45 PM	Respirator Use by Children Respirator Use by Children John Balmes <i>University of California San Francisco</i> Workgroup Synopsis Mark Miller <i>California EPA and Western States Pediatric Environmental Health Specialty Unit</i>
1:15 PM	Indoor Air Quality in Schools Improving School Indoor Air Quality During Wildfire Smoke Events Rengie Chan <i>Lawrence Berkeley National Laboratory</i> School Indoor Air Quality During Wildfire Smoke Events: Workgroup Recommendations Alison Clune <i>U.S. EPA</i>
1:45 PM	BREAK
2:00 PM	Sensors Air Monitoring using Low Cost Sensors Charles Pearson <i>California Air Resources Board, Incident Air Monitoring Section</i> Guidance on Using Air Sensors to Understand Air Quality During Wildfire Smoke Events Amara Holder <i>U.S. EPA</i>

Children's Health and Wildfire Smoke Exposure Workshop
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Time (EDT)	Topic and Presenter
2:30 PM	School Activity Guidelines Exposure and Health Consequences of Chronic Wildfire Smoke Rima Habre <i>Keck School of Medicine, University of Southern California</i> Guidance on Children's Physical Activity During Wildfire Smoke Events: Workgroup Recommendations Susan Stone <i>U.S. EPA</i>
3:05 PM	Crosscutting Questions Moderator: Catherine Karr <i>University of Washington</i>
3:35 PM	Day 1 Closing Erik Svendsen <i>Centers for Disease Control and Prevention</i>
3:40 PM	DAY 1 ADJOURNS

DAY 2: THURSDAY, MAY 6, 2021

Time (EDT)	Topic and Presenter
12:00 PM	Welcome to Day 2 – Introduction Lauren Zeise <i>California EPA Office of Environmental Health Hazard Assessment</i>
Translation Successes and Challenges Moderator: Melanie Marty <i>California EPA</i>	
12:05 PM	Framework for Decision-Making How to Develop School Emergency Operations Plans to Address Wildfires Janelle Hughes and Alison Curtis <i>Readiness and Emergency Management for Schools Technical Assistance Center</i>
12:35 PM	Schools Planning Ahead: How to Prepare your School Community for a Wildfire or Smoke Event Steve Herrington <i>Sonoma County Office of Education</i> Responding to Wildfire Smoke with Schools in Washington Nancy Bernard <i>Washington State Department of Health</i> School Closure Guidance for Wildfire Smoke Events Julie Fox <i>Washington State Department of Health</i>
1:20 PM	Questions and Answers: Schools Moderator: Melanie Marty <i>California EPA</i>
1:35 PM	BREAK

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Time (EDT)	Topic and Presenter
1:50 PM	Communities Let's Talk About Becoming Smoke Ready Kris Ray <i>Confederated Tribes of the Colville Reservation</i> Protecting Children from Wildfire Smoke at Home George Conway <i>Deschutes County</i>
2:15 PM	Shared Decision Making and Communication Bridging Public Health and Community Needs Kalie Bonomo <i>California Air Pollution Control Officers Association</i> Communicating with the Public About Wildfire Smoke Health Risks Sarah Coefield <i>Missoula City-County Health Department</i>
2:40 PM	Questions and Answers: Communities and Shared Decision Making and Communication Moderator: Melanie Marty <i>California EPA</i>
Research Needs and Policy Issues Moderator: Ambarish Vaidyanathan <i>Centers for Disease Control and Prevention</i>	
2:55 PM	Panel Discussion: Research Needs Long-term high exposures, repeated exposures, extremely high exposures, and other issues Moderator: Ambarish Vaidyanathan <i>Centers for Disease Control and Prevention</i> Kimberly Gray <i>National Institute of Environmental Health Sciences</i> John Balmes <i>University of California San Francisco</i> Jason Sacks <i>U.S. EPA</i>
3:25 PM	Presentations: Policy Issues U.S. Respirator Landscape and Policy Needs Maryann D'Alessandro <i>National Institute for Occupational Safety and Health</i> The Future of Schools as Healthy Environments Michael Brauer <i>The University of British Columbia and University of Washington</i>
3:55 PM	BREAK

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Selected Other Issues for Children's Health

Moderator: Jeanne Briskin | *U.S. EPA*

4:10 PM Other Wildfire Issues for Children's Health – Flash Talks

Research on Pregnancy and Prenatal Practice

Marya Zlatnik | *University of California, San Francisco, Western States Pediatric Environmental Health Specialty Unit*

Wildfire Issues for Children's Health: Mental Health Findings

Stephen Brock | *California State University, Sacramento*

The Mental Health Effects of Multiple Traumas on Adolescents: Contagion, Retraumatization, and Non-Recovery

Hannah Pazderka | *University of Alberta*

Responding to COVID-19 and Wildfire Smoke Simultaneously

Eva Smith | *K'ima:w Medical Center, an Entity of the Hoopa Valley Tribe*

5:10 PM Day 2 Closing and Thank You

Dave Rowson | *U.S. EPA*
Jeanne Briskin | *U.S. EPA*

5:25 PM DAY 2 ADJOURNS

WORKGROUP PARTICIPANTS

Workgroup 1: Recommendations for Mask or Respirator Use by Children and Pregnant Women During Wildfire Smoke Events

John Balmes (<i>Co-chair</i>)	Alison Clune Savage	Tung Le
Stephanie Holm (<i>Co-chair</i>)	Maryann D'Alessandro	Nicole McCoullough
Mark Miller (<i>Co-chair</i>)	Scott Damon	Scott Needle
Kimberly Bartels	Philip Harber	Andrea Nick
Nancy Beaudet	Jessica Hauge	Susan Lyon Stone
Geoff Betsinger	Lyz Hoffman	Barbara Weller
Camden Byrd	Bonnie Holmes-Gen	Marya Zlatnik
Kevin Chatham-Stephens	Kaitlyn Kelly	

Workgroup 2: School Indoor Air Quality During Wildfire Smoke Events

Alison Clune Savage (<i>Co-chair</i>)	Sarah Coefield	Karen Riveles
Jeffery Williams (<i>Co-chair</i>)	Chip Dehnert	Brett Singer
Marcy Ballman	Nektarios Hagler	Orly Stampfer
Claire Barnett	Maryam Hajbabaei	Kathleen Stewart
Kimberly Bartels	Lyz Hoffman	Gretchen Stewart
Nancy Bernard	Stephanie Holm	Susan Lyon Stone
Camden Byrd	Jason Mandly	Pat Wong
Rengie Chan	Mark Miller	
Kevin Chatham-Stephens	Michelle Muska	

Workgroup 3: Using Air Sensors to Understand Air Quality During Wildfire Smoke Events and Recommendations on Children's Physical Activity During Wildfire Smoke Events

Catherine Karr (<i>Co-chair</i>)	Walter Ham	Michael Ogletree
Susan Lyon Stone (<i>Co-chair</i>)	Ann Hobbs	Charles Pearson
Nancy Bernard	Amara Holder	Kris Ray
Melissa Brymer	Stephanie Holm	Karen Riveles
Camden Byrd	Mary Hutson	Edmund Seto
Kevin Chatham-Stephens	Melanie Marty	Orly Stampfer
Alison Clune Savage	Mark Miller	Jeffery Williams
Julie Fox	Maria Mirabelli	
Rima Habre	Andrea Nick	

