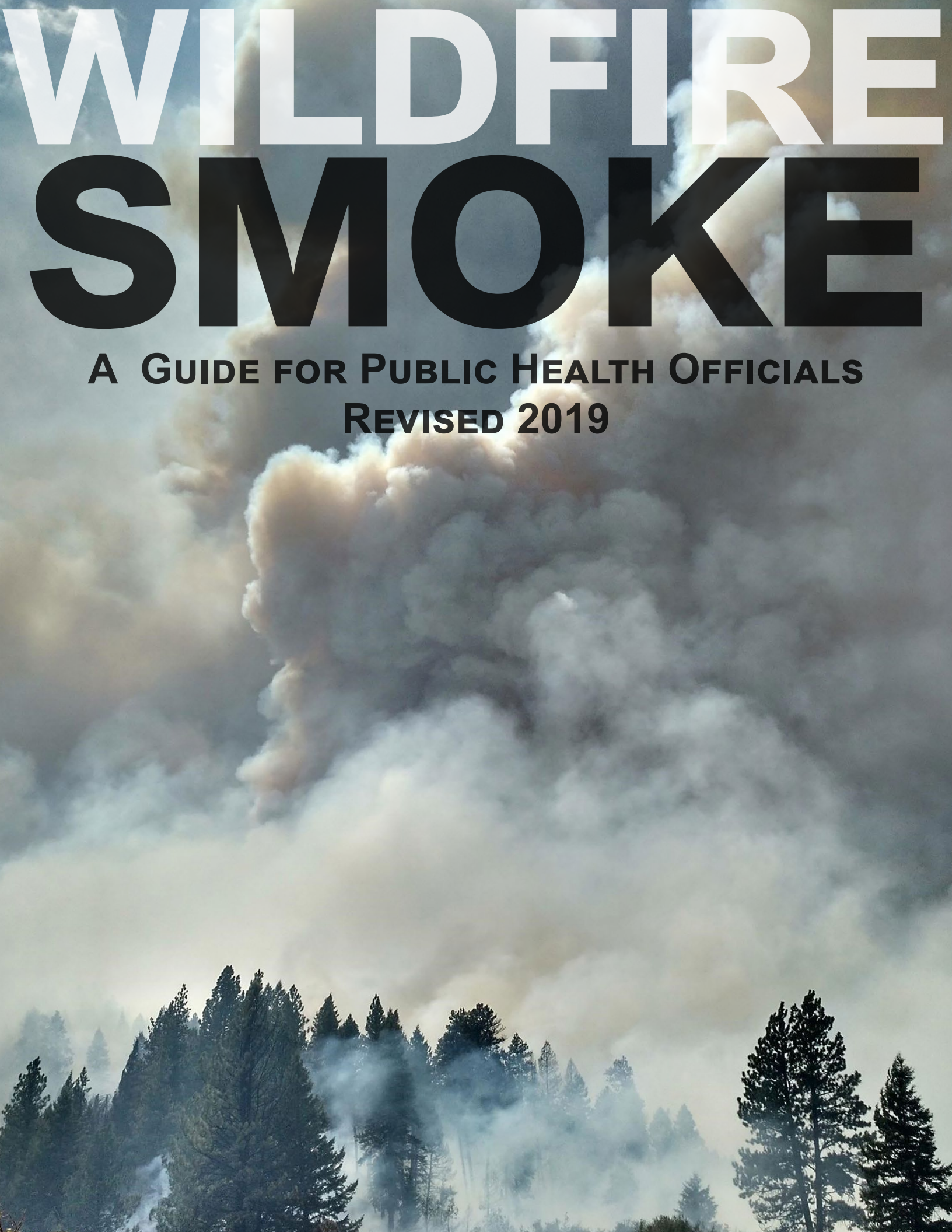

WILDFIRE SMOKE

A Guide for Public Health Officials

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WILDFIRE SMOKE: A GUIDE FOR PUBLIC HEALTH OFFICIALS

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The 2016 version of this document was updated by a team of experts from the same agencies that developed the current, 2019 version. The goal of the 2016 revision was to quickly update the 2008 version by incorporating the expanded scientific evidence base, and then take more time expanding the Guide by adding new sections and fact sheets. Since 2016, eight factsheets have been developed, with links available in Appendix A. More will be coming, including translations of the currently available ones, so watch for them.

This 2019 version of the Guide is the product of an inter-agency collaboration that includes: California Air Resources Board; California Office of Environmental Health Hazard Assessment; U.S. Centers for Disease Control and Prevention; U.S. Forest Service; and U.S. Environmental Protection Agency. Team members, authors, contributors and reviewers are listed below.

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Disclaimer: The viewpoints and policies expressed herein do not necessarily represent those of the various agencies and organizations listed. Mention of any specific product name is neither an endorsement nor a recommendation for use.

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EXECUTIVE **SUMMARY**

Wildfire smoke events can occur without warning – but we can be prepared. This Guide is intended to provide state, tribal, and local public health officials with information they need to be prepared for smoke events and, when wildfire smoke is present, to communicate health risks and take measures to protect the public. Although developed for public health officials, the information in this document could be useful to many other groups including health professionals, air quality officials, and members of the public. The document is divided into five Chapters and five Appendices. Guide authors and contributors will post up-to-date guidance, documents, and other new evidence-based information here between revisions for use by public health officials.

Health Effects of Wildfire Smoke

Wildfire smoke is a mixture of air pollutants of which particulate matter is the principal public health threat. The initial basis for understanding wildfire smoke health effects was derived primarily from studies of ambient air pollutants, specifically particulate matter. Extensive scientific evidence has demonstrated health effects in response to short-term (i.e., daily) particulate matter exposure ranging from eye and respiratory tract irritation to more serious effects, including reduced lung function, pulmonary inflammation, bronchitis, exacerbation of asthma and other lung diseases, exacerbation of cardiovascular diseases, such as heart failure, and even premature death. Recent studies examining the health effects of wildfire smoke provide evidence of health effects consistent with those reported for particulate matter. However, there is only limited evidence about the potential health impacts due to cumulative exposures from repeated, multi-day wildfire smoke exposures or multiple, consecutive fire seasons.

Although a large population can be exposed to smoke during a wildfire event, most healthy adults and children will recover quickly from wildfire smoke exposure. Certain lifestages and populations may, however, be at greater risk of experiencing health effects, including people with respiratory or cardiovascular diseases, children and older adults, pregnant women, people of lower socioeconomic status, and outdoor workers.

Wildfire Smoke and Air Quality Impacts

The science of wildfire behavior and management is complex and highly technical. Wildfire smoke produced from combustion of natural biomass contains thousands of individual compounds, including particulate matter, carbon dioxide, water vapor, carbon monoxide, hydrocarbons and other organic chemicals, nitrogen oxides, and trace minerals. Wildfires can move into the wildland urban interface (WUI), burning homes and structures and thereby consuming man made materials in addition to natural fuels. More research is needed to understand potential health impacts of breathing this complex mix of natural and man made material emissions.

Wildfire behavior will vary depending on natural fuel type; fires in forest fuels can range from mild to severe and can spread very slowly or extremely rapidly depending on weather and fuel conditions. Wildfires in forests can last for weeks or months and are often the type that results in the most severe and longest duration air quality impacts. Smoke levels in populated areas can be difficult to predict.

Most of the tens of thousands of wildfires in the United States are suppressed when they first start. Those that continue past the initial suppression attempt can become large, of long duration, and a significant source of smoke. On these types of fires, an Incident Management Team (IMT) is usually

engaged, which is then guided by the land owner/manager/agency administrator and pre-existing land management plans.

Specific Strategies to Reduce Exposure to Wildfire Smoke

In areas where the public is experiencing wildfire smoke, public health and air quality agencies should provide advice on strategies to limit exposure, which include staying indoors; limiting physical activity; reducing indoor air pollution sources; effectively using air conditioners and air filters or cleaners; creating cleaner air shelters; and using respiratory protection appropriately.

The most common advisory during a smoke episode is to stay indoors, where people can better control their environment. Whether at home or in a public space, indoor environments that have filtered air and climate control can provide relief from smoke and heat. High-efficiency heating, ventilation, and air-conditioning (HVAC) filters (rated MERV 13 or higher) in systems that can accommodate them can help reduce particle concentrations indoors.

Appropriately sized room air cleaners can also reduce particle concentrations in individual rooms. It is important to choose a room air cleaner that produces little or no ozone. The California Air Resources Board provides a list of air cleaners that meet the ozone emissions limit. High-efficiency filters and room air cleaners are more effective with more frequent operation. Individuals can use a room air cleaner in a designated room in the house to create a protected environment called a "clean room" at home. Public cleaner-air shelters and spaces can provide relief from smoke for individuals who do not have adequate air filtration or cooling equipment at home. When traveling between indoor locations with cleaner air, people can reduce particle levels in vehicles by keeping windows and vents closed and operating the air conditioning in "recirculate" mode.

Properly wearing a NIOSH-certified N95 or P100 particulate respirator that fits closely to the face can help reduce personal exposure to wildfire smoke and ash. Adults who must remain outdoors in unhealthy air for extended periods due to work or other factors may particularly benefit from using this strategy. People should avoid using masks that do not provide proper protection, such as single-strap dust masks or surgical masks. Respirators are not made to fit children and will not protect them from breathing wildfire smoke.

Smoke levels can vary throughout the day, so people may be able to plan necessary trips outside during times when the air is less smoky or minimize their time in smoke impacted areas. Smoke outreach and forecasting tools can help people make decisions about when and where they can go to minimize their smoke exposures. When smoke levels are especially high, local officials may take actions such as closing schools or canceling public events. Where evacuation is necessary because of fire danger, public health officials should consider appropriate strategies to reduce smoke exposure during the evacuation, at evacuation centers, and after allowing evacuees to return home.

Communicating Air Quality Conditions during Smoke Events

The goal of air quality monitoring during a wildfire smoke event is to relay information to the public in a timely manner so people can make decisions about how to protect their health. Tools for measuring and estimating air quality conditions and conveying them to the public include the Air Quality Index (AQI; available on AirNow), visual range scale, or other approaches. The Fire & Smoke Map provides a one-stop place for the public on current wildfire and air quality information. School-focused guidance addresses outdoor activities, and the Air Quality Flag Program uses a visual flag alert for schools and organizations to take health protective actions. When requested by the land manager responding to a large wildfire, the Interagency Wildland Fire

Air Quality Response Program will deploy an Air Resource Advisor (ARA) to the IMT. These technical specialists are trained to monitor air quality, analyze smoke impacts, model future smoke impacts, and provide smoke outlooks for impacted communities which will help public health officials in advising the public.

Areas without continuous PM monitors may be able to get temporary, portable monitors through their federal, state, tribal, or local air quality agencies or the U.S. Forest Service, especially when associated with a wildfire incident with an assigned ARA. Emerging technology has expanded sources for air quality information, including miniaturized $PM_{2.5}$ sensors, mobile air quality monitoring systems, and data fusion products. However, there are many unknowns regarding their precision, accuracy, and reliability, especially under wildfire conditions. Therefore, sensor data and data fusion products should be considered supplemental information, but they need to be put into context with the help of nearby regulatory monitors or short-term monitors, AQI estimates, satellite data, and daily ARA Smoke Outlooks.

Recommendations for Public Health Actions

Communications planning for recommendations should address not only messages and actions during a wildfire event, but preparations to make before fires occur and as well as guidance for cleaning up after a fire. Many factors must be considered, so these recommendations should be adapted to each specific situation. Areas with established air quality programs typically have a communication plan for wildfire smoke events. One approach used by states and most communities across the country is to refer the public to the AirNow website (www.airnow.gov).

In areas where fires are likely to occur, state and local public health agencies should consider running pre-season PSAs or news and social media announcements to advise the public on preparing for the fire season. During smoke periods, public advisories based on air quality levels should address special needs of at-risk lifestages and populations (in the Air Quality Index, the term "sensitive groups" is used), including people with heart or lung disease, older adults, children, pregnant women, and people of lower SES. Other concerns include advisories for outdoor workers, prolonged smoke events, and protections for pets and livestock.

Preparation is key. Recommendations to the public at risk for smoke exposure include advising preparations in advance of wildfire season, e.g. maintaining nonperishable groceries not requiring cooking. People with chronic diseases should check with their health care provider about precautions ahead of smoke events and have an adequate supply of medication available; asthmatics should have a written asthma action plan.

Recommended steps for public health officials to take before fires start include: check fire risk in monthly outlooks at National Interagency Fire Center (NIFC) website and, especially if high, communicate risk to the public; consider how to implement the recommended actions in the Guide; prepare a communication plan; and form partnerships with important partners or stakeholders (e.g., air quality agencies, local health providers, the media).

Even after the worst of the fire and smoke is over, exposure to lingering smoke and ash from a wildfire can cause significant health effects in both healthy and at-risk populations, such as respiratory irritation, heat-related illness and emotional stress, as well as physical stress or injuries from cleanup activities. In post-fire situations in which air quality is poor due to smoke and ash residue in or near affected structures, ventilation and other protective measures are advised during cleanup.