5/28/20  This information was developed before the COVID-19 health emergency. Please supplement this information with the latest advice from state, local, Tribal and federal agencies, including the EPA website https://www.epa.gov/coronavirus and CDC webpage https://www.cdc.gov/coronavirus/2019-ncov/index.html
WILDFIRE SMOKE: A GUIDE FOR PUBLIC HEALTH OFFICIALS
ACKNOWLEDGEMENTS

The Wildfire Smoke Guide for Public Health Officials, first published in 2002, was developed in part as a result of a workshop held at the University of Washington in June 2001, under the auspices of the U.S. Environmental Protection Agency, Region X, and the Department of Environmental Health, School of Public Health and Community Medicine of the University of Washington. It was written by Harriet Ammann (Washington Department of Health); Robert Blaisdell and Michael Lipsett (California Office of Environmental Health Hazard Assessment), Susan Lyon Stone (U.S. Environmental Protection Agency); and Shannon Therriault (Missoula, MT County Health Department), with input from individuals in several other state and federal agencies, in particular Jed Waldman (California Department of Health Services) and Peggy Jenkins (California Air Resources Board).

The 2008 version of this document was written by Michael Lipsett and Barbara Materna (California Department of Public Health); Susan Lyon Stone (U.S. Environmental Protection Agency); Shannon Therriault (Missoula, MT County Health Department); Robert Blaisdell (California Office of Environmental Health Hazard Assessment); and Jeff Cook (California Air Resources Board), with input from individuals in several other government agencies and academia.

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.

For More Information
Project Lead: Susan Lyon Stone, stone.susan@epa.gov

Chapter 1 Health Effects: Jason Sacks, sacks.jason@epa.gov

Chapter 2 Air Quality Impacts: Peter Lahm, peter.lahm@usda.gov

Chapter 3 Exposure Reduction Strategies: Alison Clune, clune.alison@epa.gov

Respirators: Lewis Radonovich, mto5@cdc.gov and Maryann D’Alessandro, bpj5@cdc.gov

Chapter 4 Air Quality Communication: Miki Wayland, wayland.michelle@epa.gov

Chapter 5 Public Health Actions: Maria Mirabelli, zif7@cdc.gov

Photos: Front cover, back cover, and Chapter 2 title page courtesy of the U.S. Forest Service. Chapter 4 title page courtesy of Robert Elleman, U.S. Environmental Protection Agency.

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.
# TABLE OF CONTENTS

Team, Authors, Contributors, Reviewers ................................................................. viii

Executive Summary ................................................................................................. 1
  Health Effects of Wildfire Smoke ......................................................................... 1
  Wildfire Smoke and Air Quality Impacts ............................................................... 1
  Specific Strategies to Reduce Exposure to Wildfire Smoke .................................... 2
  Communicating Air Quality Conditions during Smoke Events ............................ 2
  Recommendations for Public Health Actions ...................................................... 3

I. Health Effects of Wildfire Smoke ......................................................................... 4
  At-risk lifestages and populations ....................................................................... 6
  Summary ............................................................................................................... 9

II. Wildfire Smoke and Air Quality Impacts ............................................................. 11
  Composition of wildfire smoke .......................................................................... 12
  Characteristics of wildfires ................................................................................. 13
  Wildland fuels ...................................................................................................... 14
  Meteorology and smoke ....................................................................................... 15
  Wildland fire management ................................................................................... 15
  Incident Management Teams ............................................................................. 16

III. Specific Strategies to Reduce Exposure to Wildfire Smoke ............................... 17
  Stay indoors ......................................................................................................... 18
  Reduce activity ..................................................................................................... 19
  Reduce other sources of indoor air pollution ....................................................... 19
  Use air conditioners and filters .......................................................................... 19
    Central air systems ............................................................................................ 20
    Swamp coolers .................................................................................................. 21
    Ductless mini-split systems .............................................................................. 21
  Use room air cleaners .......................................................................................... 22
    Choose an air cleaner appropriate for the size of the indoor environment ........ 22
    Choose an air cleaner that effectively removes particles without producing ozone 23
    Place and operate the air cleaner to maximize particle removal ....................... 23
    Air cleaners for gases and odors ....................................................................... 23
    Do-it-yourself box fan air cleaners ................................................................... 23
  Avoid ozone generators ....................................................................................... 24
  Humidifiers ......................................................................................................... 24
  Create a clean room at home .............................................................................. 25
  Cleaner air shelters and cleaner air spaces ......................................................... 25
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaner air shelters</td>
<td>25</td>
</tr>
<tr>
<td>Cleaner air spaces</td>
<td>25</td>
</tr>
<tr>
<td>Inside vehicles</td>
<td>26</td>
</tr>
<tr>
<td>Respiratory protection for wildfire smoke and ash</td>
<td>26</td>
</tr>
<tr>
<td>Children and respirator use</td>
<td>27</td>
</tr>
<tr>
<td>Who may need to wear a respirator</td>
<td>27</td>
</tr>
<tr>
<td>Choosing the correct respirator</td>
<td>28</td>
</tr>
<tr>
<td>How to use a tight-fitting respirator</td>
<td>28</td>
</tr>
<tr>
<td>Possible risks from wearing a respirator</td>
<td>28</td>
</tr>
<tr>
<td>Certain “masks” do not provide protection</td>
<td>29</td>
</tr>
<tr>
<td>Handling respirator shortages</td>
<td>29</td>
</tr>
<tr>
<td>Respiratory protection resources</td>
<td>29</td>
</tr>
<tr>
<td>Avoiding smoky periods</td>
<td>30</td>
</tr>
<tr>
<td>Closures</td>
<td>30</td>
</tr>
<tr>
<td>Evacuation</td>
<td>30</td>
</tr>
<tr>
<td>Summary of strategies to reduce smoke exposure</td>
<td>31</td>
</tr>
</tbody>
</table>

IV. Communicating Air Quality Conditions during Smoke Events          | 32   |
| Air Quality Index                                                    | 33   |
| AirNow                                                               | 33   |
| Interagency Wildland Fire Air Quality Response Program and Air Resource Advisors | 35   |
| New monitoring and air quality estimation technologies – a caution   | 36   |
| Using visual range to assess smoke levels in the interior western United States | 37   |
| Basic Approach:                                                      | 37   |

V. Recommendations for Public Health Actions                          | 39   |
<p>| Public advisories and protective measures                            | 40   |
| Protecting children                                                 | 40   |
| Protecting other at-risk groups                                     | 41   |
| Protecting outdoor workers                                          | 41   |
| Prolonged smoke events                                              | 42   |
| Protecting pets and livestock                                       | 43   |
| Air quality cautionary statements and recommended public actions     | 43   |
| Public service announcements                                         | 47   |
| General recommendations to the public                               | 47   |
| Recommendations for people with chronic diseases                    | 48   |
| Use social media to raise awareness                                 | 48   |
| Preparedness                                                        | 49   |
| Recommended steps for public health officials before fire season    | 49   |
| Build strong partnerships                                           | 50   |
| Putting together a wildfire smoke team                              | 50   |
| Cleaning up after the fire                                          | 51   |</p>
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>References</td>
<td>53</td>
</tr>
<tr>
<td>Additional Resources and Links</td>
<td>56</td>
</tr>
<tr>
<td>Active Wildfire Information</td>
<td>56</td>
</tr>
<tr>
<td>Satellite Images of Fires and Smoke</td>
<td>56</td>
</tr>
<tr>
<td>Weather</td>
<td>56</td>
</tr>
<tr>
<td>Information about Wildfire Smoke and Health Effects</td>
<td>56</td>
</tr>
<tr>
<td>Appendix A</td>
<td>A-1</td>
</tr>
<tr>
<td>Available Factsheets as of March 2019</td>
<td>A-1</td>
</tr>
<tr>
<td>Appendix B</td>
<td>B-1</td>
</tr>
<tr>
<td>Identification and Preparation of Cleaner Air Shelters for Protection of the Public from Wildfire Smoke</td>
<td>B-1</td>
</tr>
<tr>
<td>Appendix C</td>
<td>C-1</td>
</tr>
<tr>
<td>Technical Wildfire and Smoke Resources</td>
<td>C-1</td>
</tr>
<tr>
<td>Accessing Information about Active Wildfires</td>
<td>C-1</td>
</tr>
<tr>
<td>Seeing Smoke from Space</td>
<td>C-2</td>
</tr>
<tr>
<td>AirNow-Tech</td>
<td>C-2</td>
</tr>
<tr>
<td>U.S. Forest Service/Interagency Wildland Fire Air Quality Response Program Tools</td>
<td>C-3</td>
</tr>
<tr>
<td>Particulate (PM_{&lt;2.5}) Monitoring Website Tool</td>
<td>C-3</td>
</tr>
<tr>
<td>BlueSky Daily Smoke Model Runs</td>
<td>C-5</td>
</tr>
<tr>
<td>Appendix D</td>
<td>D-1</td>
</tr>
<tr>
<td>Guidance on Protecting Workers in Offices and Similar Indoor Workplaces from Wildfire Smoke</td>
<td>D-1</td>
</tr>
<tr>
<td>Using the HVAC System(s) to Protect Building Occupants from Smoke</td>
<td>D-1</td>
</tr>
<tr>
<td>Other Actions to Protect Employees from Wildfire Smoke</td>
<td>D-2</td>
</tr>
<tr>
<td>Appendix E</td>
<td>E-1</td>
</tr>
<tr>
<td>Hazards during Cleanup Work Following Wildfires from National Institute for Occupational Safety and Health</td>
<td>E-1</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1. Fine, inhalable particulate matter (PM$_{2.5}$) is the air pollutant of greatest concern to public health from wildfire smoke because it can travel deep into the lungs and may even enter the bloodstream. ................................................................. 12

Figure 2. Wildfire rate of spread, fuel consumed, smoke produced, and duration are all influenced by vegetation type. ........................................................................................................ 13

Figure 3. Strong winds can cause rapid fire spread and move smoke into communities far from a wildfire. 14

Figure 4. Two types of N95 disposable particulate respirators. Note the presence and placement of the two straps above and below the ears. ........................................................................ 27

Figure 5. A one-strap paper mask is not a respirator and provides little or no protection from smoke particles. Photo courtesy of the California Department of Public Health ......................... 29

Figure 6. A surgical mask is designed to capture infectious particles generated by the wearer, is not a respirator, and provides little or no protection from smoke particles. .................... 29

Figure 7. Overall concept of the NowCast ......................................................... 33

Figure 8. Sample AirNow current air quality data, map, and AQI values ............ 34

Figure 9. Sample AirNow Fires: Current Conditions map ......................................................... 34

Figure 10. Elements of the Wildland Fire Air Quality Response Program supporting an Air Resource Advisor assigned to an Incident Management Team responding to a wildfire. ............... 35

Figure 11. Example smoke outlook (partially shown) produced by an Air Resource Advisor assigned to the 416 Fire ................................................................. 36

Figure C1. Smoke from many large fires creating haze across the western and central United States. Red dots are satellite fire hot spot detections. ............................................................. C-1

Figure C2. Smoke plumes from NOAA Hazard Mapping System. See more about the NOAA HMS here: https://www.ospo.noaa.gov/Products/land/hms.html ........................................ C-2

Figure C3. AirNow-Tech Navigator .................................................................... C-2

Figure C4. PM$_{2.5}$ monitoring web tool display example. Current fine particulate NowCast conditions are shown on the map ..................................................................................... C-3

Figure C5. BlueSky daily smoke model run for the Continental United States (CONUS) shown in the web viewer version ........................................................................................................ C-4

Figure C6. BlueSky hourly average surface smoke predictions at 1am on 8/19/2018 at 3 grid resolutions: (a) 1.33 km, (b) 4 km, and (c) 12 km in north central Washington. ................................................. C-4
**LIST OF TABLES**

Table 1. Summary of lifestages and populations potentially at-risk of health effects from wildfire smoke exposures. ................................................................. 10
Table 2. Particle size efficiency for select MERV ratings. ..................................................... 21
Table 3. Visual range and actions to take to reduce smoke exposure when wildfire smoke is in the air. .... 38
Table 4. Health effects and cautionary messages for at risk populations for each
AQI category  ........................................................................................................ 44
Table 5. Recommended actions for consideration by public health officials ......................... 46
TEAM, AUTHORS, CONTRIBUTORS, REVIEWERS

Team Members

Susan Lyon Stone MS, Senior Environmental Health Scientist, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. Project Lead


Cory R. Butler MS, Occupational Safety and Health Specialist, Western States Division, National Institute for Occupational Safety and Health, U.S. Centers for Disease Control and Prevention, CO 80215.

Wayne E. Cascio MD, Director, National Health and Environmental Effects Research Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.


Scott Damon MAIA, Health Communication Lead, Asthma and Community Health Branch, National Center for Environmental Health, U.S. Centers for Disease Control and Prevention, Atlanta, GA 30341.

Phillip G. Dickerson BS CPE, Supervisory Environmental Protection Specialist, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

Paul Garbe DVM, Retired, Air Pollution and Respiratory Health Branch, National Center for Environmental Health, U.S. Centers for Disease Control and Prevention, Atlanta, GA 30341.

William E. Haskell MS, Retired, National Personal Protective Technology Laboratory, National Institute for Occupational Safety and Health, U.S. Centers for Disease Control and Prevention, MA 01810.

Sumi Hoshiko MPH, Research Scientist, Environmental Health Investigations Branch, California Department of Public Health, Richmond, CA 94804.


Barbara Materna PhD, CIH, Chief, Occupational Health Branch, California Department of Public Health, Richmond, CA 94804.

Maria C. Mirabelli PhD, MPH, Senior Service Fellow, Asthma and Community Health Branch, National Center for Environmental Health, U.S. Centers for Disease Control and Prevention, Atlanta, GA 30341.


Karen Riveles PhD, MPH, Staff Toxicologist & Emergency Response Coordinator, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Sacramento, CA 95812.


Michelle Wayland BSE, Environmental Engineer, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.
John E. White BSM, Environmental Protection Specialist, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

Jeffery R. Williams PhD, Air Pollution Specialist, Research Division, California Air Resources Board, Sacramento, CA 95812.

Authors
Susan Lyon Stone MS, Senior Environmental Health Scientist, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. Project Lead, health, health communication, public health policy.

Laura Anderko PhD, RN, Director, Mid-Atlantic Center for Children's Health and the Environment, School of Nursing and Health Studies, Georgetown University, Washington DC 20057. Children’s health.


Cory R. Butler MS, Occupational Safety and Health Specialist, Western States Division, National Institute for Occupational Safety and Health, U.S. Centers for Disease Control and Prevention, CO 80215. Occupational health.


Scott Damon MAIA, Health Communication Lead, Asthma and Community Health Branch, National Center for Environmental Health, U.S. Centers for Disease Control and Prevention, Atlanta, GA 30341. Health communication.

Paul Garbe DVM, Retired, Air Pollution and Respiratory Health Branch, U.S. Centers for Disease Control and Prevention, Atlanta, GA 30341. Health, epidemiology.

Marissa Hauptman MD, MPH, Pediatric Environmental Health Fellow, New England Pediatric Environmental Health Specialty Unit, Boston Children's Hospital, Boston, MA 02115. Children's health.

William E. Haskell MS, Retired, National Personal Protective Technology Laboratory, National Institute for Occupational Safety and Health, U.S. Centers for Disease Control and Prevention, MA 01810. Personal protective technology.

Sumi Hoshiko MPH, Research Scientist, Environmental Health Investigations Branch, California Department of Public Health, Richmond, CA 94804. Health, epidemiology.


Barbara Materna PhD, CIH, Chief, Occupational Health Branch, California Department of Public Health, Richmond, CA 94804. Occupational health, respirators.

Maria C. Mirabelli PhD, MPH, Senior Service Fellow, Asthma and Community Health Branch, National Center for Environmental Health, U.S. Centers for Disease Control and Prevention, Atlanta, GA 30341. Chapter 5 Lead, health, epidemiology.

Narasimhan (Sim) Larkin PhD, Climate Scientist, Air Fire Team, U.S. Forest Service, Pacific Northwest Fire Station, WA 98103. Air quality, smoke emissions, smoke forecasting.


Karen Riveles PhD, MPH, Staff Toxicologist & Emergency Response Coordinator, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Sacramento, CA 95812. Smoke, ash, school closure, toxic air contaminants, risk communication.


Jeffery R. Williams PhD, Air Pollution Specialist, Research Division, California Air Resources Board, Sacramento, CA 95812. Chapter 3 Lead, indoor air, filtration, portable air cleaners, personal exposure, asthma, cleaner air shelters, ozone.

Contributors

Sarah Coefield MS, MA, Air Quality Specialist, Missoula City-County Health Department, Missoula, MT 59802.

Maryann M. D’Alessandro PhD, Director, National Personal Protective Technology Laboratory, National Institute for Occupational Safety and Health, Pittsburgh, PA 15236.

Gayle S.W. Hagler, PhD, Environmental Engineer, Office of Research and Development, U.S. Environmental Protection Agency, Research Triangle Park, NC 27709.

Laura Kolb, Office of Radiation and Indoor Air, Indoor Environments Division, U.S. Environmental Protection Agency, Washington, DC, 20460.

Lewis Radonovich MD, Chief of Research, National Personal Protective Technology Laboratory, National Institute for Occupational Safety and Health, U.S. Centers for Disease Control and Prevention, Pittsburgh, PA 15236.

Reviewers
California Air Resources Board: Peggy L. Jenkins; Lori Miyasato, PhD; Hye-Youn Park, PhD; Charles Pearson; Feng-Chiao Su, PhD; Barbara Weller, PhD;

California Department of Industrial Relations, Division of Occupational Safety and Health: Eric Berg MPH; Amalia Niedhardt MPH.

California Office of Environmental Health Hazard Assessment: Rupa Basu, PhD, MPH; Heather Bolstad, PhD; Dharshani Pearson, MPH; Xiangmei Wu, PhD.

U.S. Centers for Disease Control and Prevention: Josephine Malilay PhD, MPH; Kanta Sircar PhD, MPH.

U.S. Environmental Protection Agency: Kirk Baker PhD; Pat Dolwick MS; Janice Dye DVM; Michael P. Firestone PhD; Benjamin Gibson MPP; Joanna Gmyr MEM; Elizabeth D. Hilborn DVM, MPH, Dipl. ACVPM; Stacey Katz MPH; Laura Kolb; Gail Robarge; Karen Wesson MS.

U.S. Forest Service: Melanie Pitrolo MS; Leland Tarnay PhD.

U.S. National Park Service: Mark Fitch MS.
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](https://airresources.ca.gov) 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](https://www.airnow.gov) (AQI; available on [AirNow](https://www.airnow.gov)), visual range scale, or other approaches. The [Current Conditions Map](https://www.airnow.gov) 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](https://www.airnow.gov) 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](https://www.airnow.gov)
**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](https://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.