# UC San Diego Health

# Clinician Information Sheet: Health Impacts of Wildfire Smoke

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RESOURCES FOR PATIENTS		
<u>Americares</u> Climate Resilience Toolkit	<ul> <li><u>Wildfire Tip Sheet</u></li> <li><u>Wildfire Action Plan</u></li> </ul>	
<u>CDC</u>	<ul> <li><u>Preparedness for Wildfire Smoke</u></li> <li><u>Guide for Staying Safe</u> <u>During Wildfire</u></li> </ul>	
<u>Cal Air</u> <u>Resources Board</u>	<u>Air Quality Index and</u> <u>Filtration Resources</u>	
<u>EPA</u>	<u>Smoke Ready Toolbox for</u> <u>Wildfires and Wildfire Smoke</u>	
UC Center Climate Health and Equity	• Wildfires & Health Education Hub Educational infographics available for wildfire and health in English, Spanish, and Chinese	

# I. BRIEF BACKGROUND

The impacts of short-term exposure to wildfire smoke pollutants include temporary effects such as irritation of the eyes, nose, skin, and throat, to breathing difficulties, cough, chest tightness, and wheezing to more serious health effects such as asthma and COPD exacerbations as well as lung and heart problems requiring hospitalizations. The long-term effects of wildfire smoke particulate matter (PM), the main pollutant of concern from wildfire smoke, can persist and can even induce different illnesses including chronic respiratory illnesses, cancers, neurological diseases, and death. Educational information for patients on health effects of wildfire can also be found here: UC Center for <u>Climate Health and Equity</u>.

#### Figure 1: Short term and long-term health effects of PM2.51



# **II. HEALTH IMPACTS OF WILDFIRE SMOKE**

The primary health hazard posed by wildfires is smoke exposure. Wildfire smoke, carries numerous toxicants derived from the materials burned. This **smoke typically consists of acrolein, a lung irritant, polyaromatic hydrocarbons known for their carcinogenic and neurotoxic properties, oxides of nitrogen that irritate the lungs, and particulate matter**. In the United States, wildfire-generated PM with a diameter less than 2.5 microns (PM2.5) is linked to approximately 6300 deaths annually, along with an estimated 1300 to 5900 emergency department visits.

#### Particulate Matter (PM 2.5) Exposure

- Particles from smoke with diameters of 2.5 micrometers or less can get into the bloodstream.
- Oxidative stress and systemic inflammation<sup>2</sup> are the primary mechanisms that are associated with how PM2.5 increases the risk of cardiovascular diseases.
- A study<sup>3</sup> found that wildfire PM instilled directly into rodent lungs generated a more robust oxidative stress and inflammatory response compared to other sources of instillation of PM.

Health Condition	Exacerbated Symptoms During Wildfire Smoke
Respiratory Illnesses	Breathing difficulties
(COPD, Asthma)	Coughing
	Wheezing
	<ul> <li>Increased medication usage and presentation to ED setting<sup>4,5,6</sup></li> </ul>
Cardiovascular Disease	Greater incidence of ischemic events
	Worsening heart failure
	Arrhythmias
	<ul> <li>Increased presentation to ED setting and hospital admission<sup>7,8</sup></li> </ul>
Chronic Kidney Disease	Notable mortality risk to dialysis patients
	Decreased renal function
	<ul> <li>Progression to end-stage renal disease<sup>9,10</sup></li> </ul>
Occupational Health	- Outdoor workers especially firefighters have increased vulnerability and prolonged exposure "
Pregnancy	<ul> <li>Wildfire smoke exposure linked to low birthweight and preterm birth<sup>12</sup></li> </ul>

# III. MANAGEMENT OF ACUTE SMOKE INHALATION, ADAPTED FROM <u>AMERICAN</u> <u>BURN ASSOCIATION</u> (REFER FOR COMPLETE TREATMENT GUIDELINES)

Initial Assessment	Remove exposed clothing material
	<ul> <li>Assess patient's airway, breathing, and circulation</li> </ul>
	Obtain any relevant information regarding comorbidities
Securing the airway	<ul> <li>Anesthesiologist, intensivist, surgeon, and/or critical care physician decides on the optimal airway management method (endotracheal intubation or tracheostomy placement</li> <li>Mechanical ventilation for patients with inhalation injury should commence with low tidal volumes (6 to 8 mL/kg), with adjustments made according to the patient's condition, compliance, airway resistance, tolerance, etc)</li> <li>Patients not needing intubation should be administered humidified 100% oxygen through a face mask to effectively displace carbon monoxide</li> </ul>
Disposition	<ul> <li>Hospitalization is recommended for patients with the following:</li> <li>History of closed space entrapment</li> <li>History of syncope</li> <li>Carbonaceous sputum</li> <li>Arterial PaO<sub>2</sub> &lt;60 mmHg</li> <li>Metabolic acidosis</li> <li>Carboxyhemoglobin levels &gt; 15 percent</li> <li>Bronchospasm/wheezing</li> <li>Facial burns</li> </ul>
Supportive Care	<ul> <li>Monitor for complications. ARDS can develop days after exposure</li> <li>Bronchodilators for wheezing and airway clearance</li> <li>Administer aerosolized mucolytic agents and alternate with chest PT</li> </ul>

# IV. STRATEGIES TO REDUCE RISKS TO SMOKE EXPOSURE

Indoors	Outdoors		
<ul> <li>Patients who have a home HVAC system should close the intake or set the system to recirculate mode. The HVAC system can be upgraded to a filter rated MERV<sup>13</sup> or higher for smoky periods. Patients can set the fan to run continuously to maximize the filter's effectiveness.<sup>14</sup></li> <li>Create a clean room in the home. Choose a room with no fireplace and as few windows and doors as possible and use a portable air cleaner* in the room. Portable air cleaners* fitted with high efficiency filters may reduce indoor particle concentrations by as much as 45%<sup>14</sup>.</li> </ul>	<ul> <li>Wear a respirator. Paint masks, dust masks, or surgical masks do not prevent breathing in fine particles from smoke.</li> <li>For patients temporarily sheltered in their vehicles, close windows and vents, and set the car's air conditioner to run in recirculate mode.</li> <li>HEPA filters can also be installed in vehicles</li> </ul>		
<ul> <li>Avoid activities that add to indoor particle levels.</li> </ul>			

\*The University of Washington Center for Exposures, Disease, Genomics and Environment provides instructions on how to build a low-cost DIY air filter.

# V. ADDITIONAL INFORMATION ON VULNERABLE POPULATIONS

#### Figure 2. Wear N95 Masks correctly (California Air Resources Board)



#### Wildfire Smoke and Pregnancy

- Pregnant individuals are especially susceptible to the adverse health effects of air pollution due to the increased respiration and cardiovascular output in pregnancy.
- Elevated PM2.5 exposure has been associated with preterm birth.<sup>13,15</sup>
- Wildfire smoke exposure during pregnancy has been linked with gestational hypertension.<sup>13</sup>
- Pregnancy during the 2003 Southern California wildfires was associated with reduced average birth weight by 7.0 g when the wildfire occurred in the third trimester, 9.7 g less when it happened in the second trimester, and 3.4 g lower in the first trimester.

#### **Relevant Links for Wildfire Smoke and Pregnancy**

- » UC Climate Center Infographic on Wildfire and Pregnancy
- » CDC Guidelines for Pregnant Patients During Wildfires
- » <u>American Public Health Association Wildfire Preparedness</u> <u>for Pregnant Women</u>
- » How to Clean, Sanitize, and Store Infant Feeding Items
- » Neonatal Resuscitation Program Skills Videos
- » Infant and Toddler Nutrition
- » American Red Cross Child and Baby CPR
- » Disaster Housing Coalition Member List

#### Wildfire Smoke and Lung Health

- Wildfire smoke causes an increase in breathing difficulties and respiratory symptoms, greater medication usage, emergency department visits, and hospital admissions.
- Spirometry testing has shown decreased lung function status in populations frequently exposed to wildfire smoke.
- There was a strong correlation between peak smoke periods and increased medical encounters during the 2007 San Diego wildfires.<sup>16</sup>
- Patients with existing chronic lung illnesses such as COPD, pulmonary fibrosis, or lung cancer patients are at greater risk. PM from wildfire smoke is thought to affect the lungs by contributing to oxidative stress, inflammation (IL-6 and IL-8), and cell toxicity.<sup>17</sup>
- Occupationally exposed workers such as firefighters are at most risk with both short term and long term effects.

#### **Relevant Links for Wildfire Smoke and Lung Health**

- » <u>UC Climate Center Infographic on Wildfire Smoke and</u> <u>Lung Health</u>
- » <u>American Lung Association Recommendations during</u> <u>Wildfire Smoke</u>
- » Box Fan DIY Air Filtration Video
- » Create a Clean Room and How to Build Air Filter Fans
- » Asthma and Outdoor Air Pollution
- » Protect Your Lungs from Wildfire Smoke and Ash

#### Wildfire Smoke and Cardiovascular Health

- The largest time series study on the effect of wildfire smoke PM2.5 exposures included 15 million cardiovascular deaths from over 40 countries between 2000 to 2016.<sup>18</sup>
- Relative risk of cardiovascular mortality was higher by 1.9% per each 10 μg/m<sup>3</sup> increase in the 3-day moving of PM2.5.
- Ambient exposures to PM2.5 from forest fires are associated with short-term elevations in blood pressure. Controlled clinical exposure studies replicated comparable results with woodsmoke in humans<sup>19</sup> and murine models<sup>20</sup>. Sun<sup>21</sup> showed an association between PM2.5 exposure and development of more vulnerable atherosclerotic plaques via inflammatory mechanisms. The gaseous components

of smoke (SO<sub>2</sub>, NH<sub>4</sub>, NO<sub>x</sub>, and CO) are significant factors in atherosclerotic response and stability.<sup>22</sup> Plaque destabilization leads to acute cardiovascular events, including stroke or acute coronary syndrome.

#### Relevant Links for Wildfire Smoke and Cardiovascular Health

- » <u>UC Climate Center Infographic on Wildfire Smoke and</u> <u>Heart Health</u>
- » AHA CPR Instructional Video
- » Environmental Protection Agency (EPA) Healthy Heart Toolkit
- » CDC guidelines on Wildfire Smoke and Chronic Conditions
- » Heart Disease, Stroke and Air Pollution

## Wildfire Smoke and Mental Health

- Exposure to PM2.5 has been associated with anxiety and depression after controlling for socioeconomic factors.<sup>23</sup>
- The disruptive effects of wildfires, including evacuations, school relocations, business closures, property loss, reduced outdoor and physical activity, food insecurity, and stress and uncertainty have been associated with poor mental health outcomes.
- Posttraumatic stress disorder and insomnia are also commonly diagnosed after wildfire events.<sup>24</sup>
- Outcomes may persist for years or manifest years after wildfire and wildfire smoke exposures, particularly among children and adolescents.

#### **Relevant Links Wildfire Smoke and Mental Health**

- » <u>UC Climate Center Infographic on Wildfire Smoke and</u> <u>Mental Health</u>
- » Disaster Distress Helpline
- » Wildfires: What Parents Need to Know
- » <u>National Child Traumatic Stress Network Guidelines on</u> <u>Wildfire/Wildfire Smoke</u>
- » <u>Guidance for Health Professionals: Health Risks of</u> <u>Wildfires for Children</u>
- » <u>Guidance for Health Professionals: Protecting Children</u> from Wildfire Smoke
- » <u>Health effects of wildfire smoke in children and public</u> <u>health tools: a narrative review</u>

#### Wildfire Smoke and Child and Adolescent Health

- Children who reported a longer duration of indoor wildfire smoke exposure were more likely to report upper respiratory symptoms and lower respiratory symptoms.
- During the 2017 wildfire in San Diego, though pediatric respiratory visits were increased overall, the largest relative increase in respiratory visits at the university health system was for older children.<sup>25</sup>

# Relevant Links for Wildfire Smoke and Child and Adolescent Health

- » <u>UC Climate Center Infographic on Wildfire Smoke and</u> <u>Children's Health</u>
- » CDC Advisories for Children affected by Wildfire Smoke
- » Protecting Children from Wildfire Smoke and Ash
- » Wildfires: What Parents Need to Know
- » National Child Traumatic Stress Network Guidelines on Wildfire/Wildfire Smoke

#### **Additional Resources for Physicians**

- Health Advisory: Wildfire Smoke Exposure Poses Threat to At-Risk Populations
- EPIC ALERT: Protect Yourself from Wildfire Smoke
- <u>Create a Clean Room to Protect Indoor Air Quality During</u> <u>a Wildfire (EPA)</u>
- Fires: Current Conditions (AirNow)
- Protect Yourself from Ash
- <u>Protect Your Lungs: Respirators</u>
- Reduce Your Smoke Exposure
- Smoke Ready Toolbox for Wildfires
- Wildfire Smoke: Public Health Officials
- Smoke Sense App

#### **Continuing Medical Education**

- Confronting Health Care's Climate Crisis Conundrum
- <u>Climate Change, Climate Justice, and Healthcare:</u>
   <u>A Beginner's Primer</u>
- The Environment Is a Health Issue

# **VI: CASE STUDY, CALIFORNIA AND WILDFIRES**

Communities without much experience with wildfires, especially those that are adjacent to currently wildfire prone areas, may be increasingly at risk for wildfire events. Wildfire smoke can affect communities far from the source. As an example, in June 2023, smoke from wildfires in Canada drifted hundreds of miles to New York City, resulting in increased ambient fine particulate matter (PM2.5). California remains one of the most wildfire smoke impacted states.

- California saw six of the largest 20 wildfires in state history in 2020, burning more than 4.1 million acres.
- The August Complex Fire, the largest in California's history, consumed more than 817,000 acres.
- Wildfires can transform chromium 3 naturally present in soils into carcinogenic readily airborne chromium 6, the same toxin Erin Brockovich lobbied against.

- Humans cause about 85% of wildfires with activities including burning debris or leaving campfires unattended.
   Fallen electric power lines and lightning strikes are also top causes.
- Number of days with extreme fire weather in the fall has more than doubled over the past 40 years.

Climate change has warmed temperatures, lengthened the fire season, and wildfire frequency and severity have increased every decade since the 1970s. An <u>interactive map</u> available online from AirNow shows where wildfires are currently occurring in the United States as well as the associated air quality.

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