

A Story of Health, Sofia's Story: Wildfire Health Impacts



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WILDFIRE HEALTH IMPACTS Sofia's Story

Sofia is a healthy 9-year-old girl who lives in Southern California. Sofia and her friend Brett love playing soccer together. Brett is the same age, lives nearby and has asthma.

Charles, one of Sofia's dads, coaches the soccer team. He often picks up Sofia and Brett from school on practice days.

Unfortunately, this year a lot of their practices and games have had to be cancelled because of wildfire smoke.

- + What's in Wildfire Smoke?
- + Envisioning Particulate Matter
- + Don't Rely Entirely on Odor or Visibility to Determine Risk

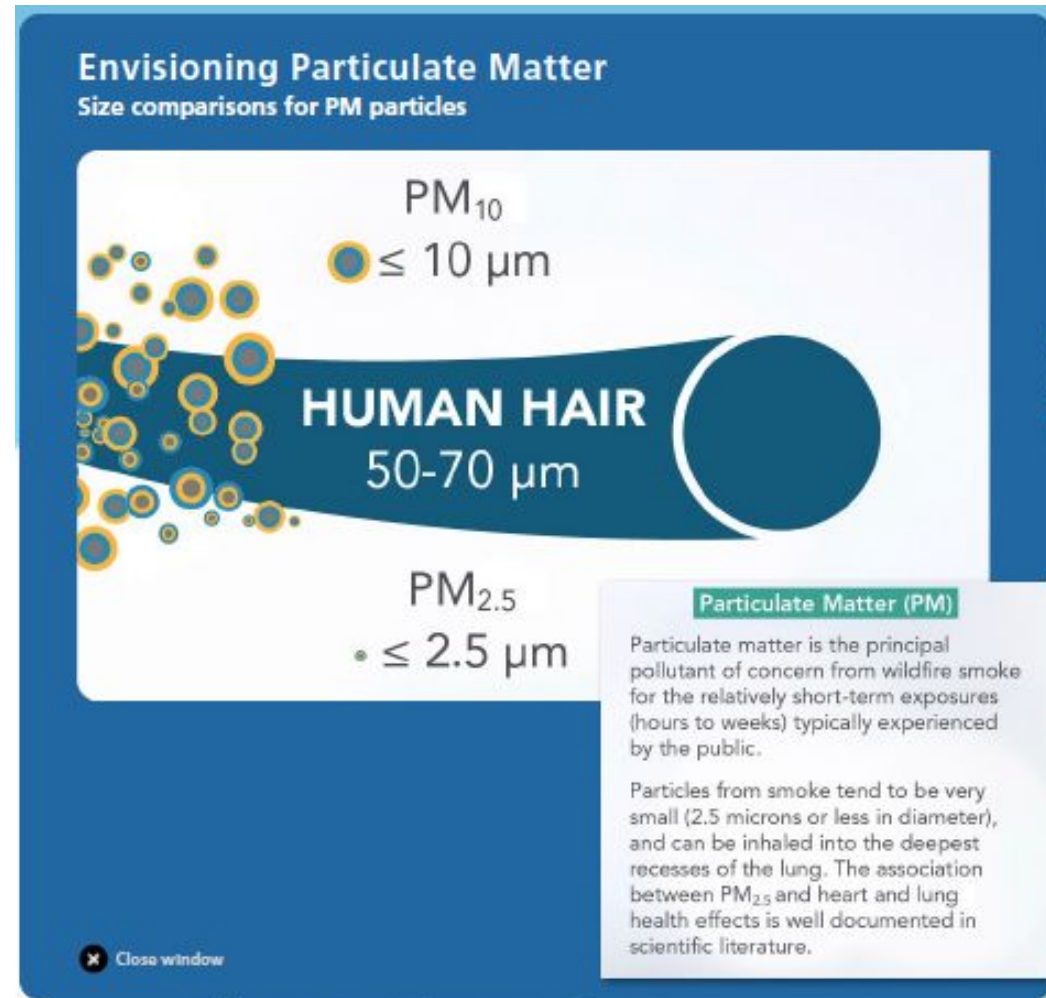


Particulate size infographic used with permission from [California Air Resources Board](#).

What's in Smoke?

- Particles
- Toxic gases
- Heavy metals

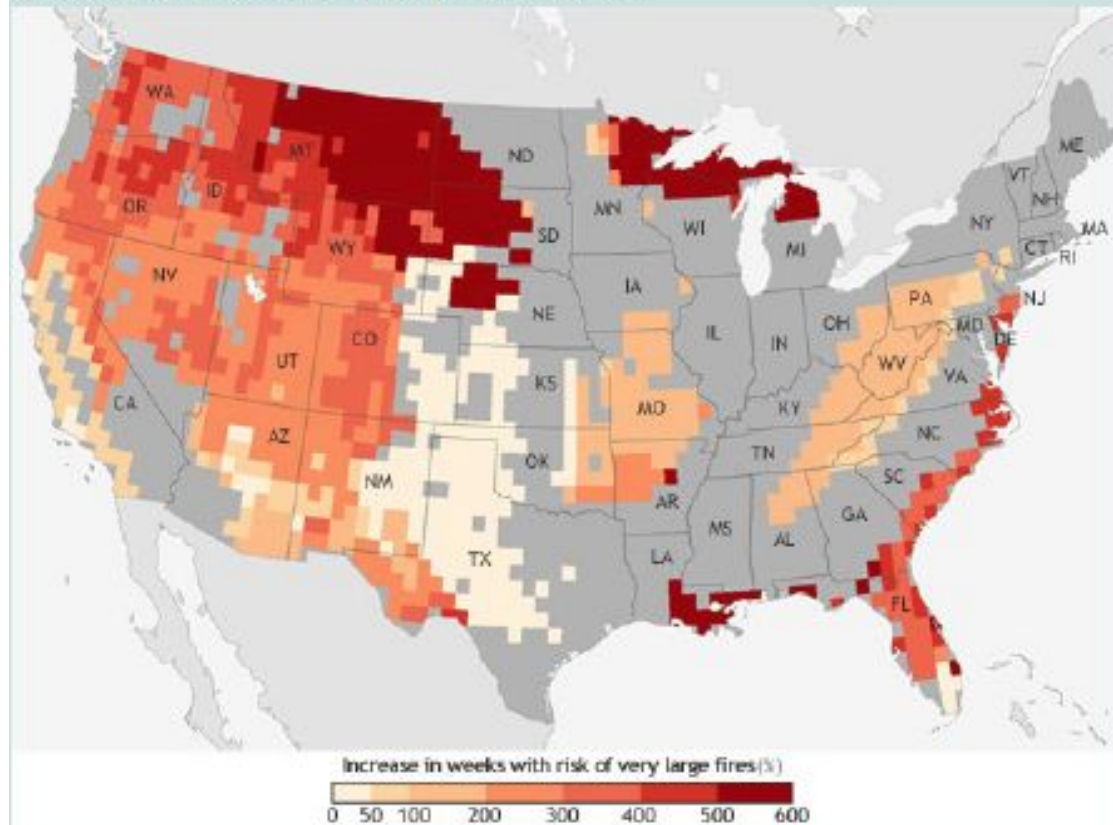
Don't rely on odor or visibility to assess exposure!



Climate Change

- Drought, high temperatures, low humidity, and high winds result in “fire weather” with high risk for wildfires.
- Dead trees and changes in vegetation result in high fuel load
- Increases in lightning strikes ignite many fires
- Increased winds and lengthened fire season increase the number and intensity of fires

Increasing risk of very large fires in US



The map shows the projected increase in the number of “very large fire weeks”—weeks in which conditions are favorable to the occurrence of very large fires—by mid-century (2041–2070) compared to the recent past (1971–2000). The darkest shades of red indicate that up to a six-fold increase is predicted across parts of the West. This area includes the Great Basin and Northern Rockies, as well as the Sierra Nevada and Klamath Mountains in Northern California.



WILDFIRE HEALTH IMPACTS Sofia's Story



“What about Tia Alejandra?” asks Sofia “Is it okay for her and the baby to be around smoke? Doesn’t she live where the fires are right now?”

“Great question!” Jose says to Sofia,

“People who are pregnant are also extra sensitive to smoke. Some other adults can be sensitive too. We are worried about her so we called her today.”

“She said she called her OB/GYN doctor but the doctor wasn’t in her office due to the fire. Her doctor had left a message with information for her patients and an emergency number so Alejandra called and set up a virtual visit with her.”

+ Pregnancy is a vulnerable period for wildfire smoke and air pollution exposure

+ Pre-existing health conditions increase wildfire smoke impacts in adults

+ Health risks related to wildfires fall disproportionately on already at-risk communities



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Health risks related to wildfires fall disproportionately on already at-risk communities



Adults exposed to wildfire smoke have increased risks for both asthma and congestive heart failure (CHF) visits to the emergency room. These are accentuated by socioeconomic status (SES) with low SES counties demonstrating increased risks of asthma and CHF related visits of 85% and 124% respectively compared to top SES counties (Rappold et al., 2012). Communities more vulnerable to experiencing the health effects induced by wildfire smoke, (e.g. those with higher incidence of asthma in children and adults or low SES or high unemployment), are also areas that are more likely to experience frequent wildfire smoke exposure (Rappold et al., 2017).

Vulnerability is a combination of risk of exposure, sensitivity of an individual or community to the exposure, and adaptive capacity (Lyth et al., 2018). Adaptive capacity is in part a function of community income, support services and health care, isolation, etc. Communities with Black, Hispanic or Native American majorities experience around 50% greater vulnerability to wildfire (Davies et al., 2018).

Any public recommendations should consider potential ethical and equity

issues. Guidance that creates face mask, HEPA filter, MERV 13 filter use as a standard response raises concerns about availability, cost, and distribution of these. Providing accurate information and advice to allow families to improve their decision making based on benefits and risks, including the resources each family has available is an ethical and respectful response (McDonald et al., 2020). Failure to provide accurate and helpful information to the public may increase mistrust of the government and public health agencies. Community participation in wildfire preparedness and response is an essential component of successful programs. Mapping the combination of social and economic vulnerability with wildfire risks can provide guidance for targeting available resources to communities most highly impacted and which need increased capacity for resilience.

Close window

WILDFIRE HEALTH IMPACTS Sofia's Story

Today is one of those days when there is a nearby fire blowing smoke into their area.

“Before we go to practice we’re going to stop at home for a snack and to check on the air quality because there is some smoke in the air,” says Charles. “OK Dad but let’s not stay too long because we really want to practice, we have a big game coming up,” says Sofia.



+ Air Quality Index: How do I know if the air around me is bad?

Air Quality Index table via airnow.gov.

Additional resources:

- ▶ Go to airnow.gov to check your local air quality.
- ▶ Go to fire.airnow.gov for detailed information on air quality in your community.
- ▶ If conditions are changing rapidly, some maps show changing information faster, such as the [PurpleAir](#) map, but this data may be less high-quality.



Watch: Be Smoke Ready: Know Where to Go for Air Quality Info
The US EPA demonstrates the use of some of their tools for finding your local Air Quality Index (AQI).

Air Quality Index:
How do I know if the air around me is bad?

“The Air Quality Index (AQI) is a nationally uniform color-coded index developed by EPA for reporting and forecasting daily air quality. The AQI reports the most common ambient air pollutants that are regulated under the Clean Air Act, including ozone and particle pollution (PM₁₀ and PM_{2.5}). It uses a normalized scale from 0 to 500: the higher the AQI value, the greater the level of pollution and the greater the health concern.” (US EPA, 2019)

Daily AQI Color	Levels of Concern	Values of Index
Green	Good	0 to 50
Yellow	Moderate	51 to 100
Orange	Unhealthy for Sensitive Groups	101 to 150
Red	Unhealthy	151 to 200
Purple	Very Unhealthy	201 to 300
Maroon	Hazardous	301 and higher

The EPA conducts integrated science assessments regularly for each of the “criteria pollutants” (carbon monoxide, lead, nitrogen dioxide, ozone, PM and sulfur dioxide). These assessments include detailed review of the scientific evidence of health effects that may be related to that pollutant, and are used for determining revisions of the national ambient air quality standards. The intent of these air quality standards is that they are set at a level that would be protective of even the most vulnerable populations, with a margin of safety. The AQI for each pollutant uses the air quality standard concentration to anchor the AQI value (at 100). This means that in

the green (0-50) and yellow (51-100) ranges, acute health effects are not expected, even for sensitive groups. But as you go above a value of 100, more people will have increasingly severe health effects. Sensitive people (children, the elderly, those with chronic illnesses) would be expected to experience symptoms at lower AQI values than non-sensitive people. The advantage of the AQI is that providers and the public don’t need to worry about knowing different pollution concentration cut-offs, the air quality standard always corresponds to an AQI of 100.

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Health Effects in Childhood and Early Life Exposures



Other:

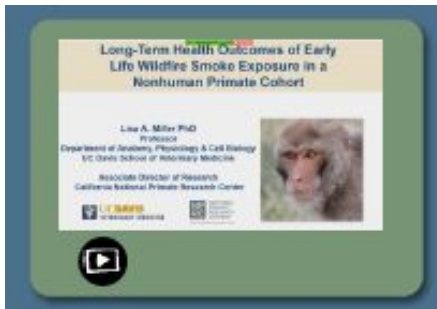
- Metabolic effects
- Neurocognitive effects
- Cancer

Upper Respiratory Effects:

- Itchy eyes
- Sore throat
- Cough
- Sneezing
- Runny nose
- colds

Lower Respiratory Effects:

- Wheeze
- Asthma
- Pneumonia



Masks

1. How well does it filter?
2. Is it easy to breathe through and safe?
3. How tightly does it fit to my child's face
4. Are they regulated so I can confidently provide guidance to my patients?

WILDFIRE SMOKE EXPOSURE

Some Masks Protect You and Your Family from Wildfire Smoke More than Others

When there is smoke outside, the best place to be is an indoor space with good air quality. If you don't have access to a clean indoor space, consider a mask when the AQI is 151 or higher or if your child is coughing. Certain types of masks can move you into a healthier AQI category. For example:

AIR QUALITY INDEX

CATEGORY	VALUES
GOOD	0-50
MODERATE	51-100
UNHEALTHY FOR SENSITIVE GROUPS	101-150
UNHEALTHY	151-200
VERY UNHEALTHY	201-300
HAZARDOUS	301+

In unhealthy conditions:

medical mask
20% EFFECTIVE



UNHEALTHY

NIOSH N95 mask
80% EFFECTIVE



MODERATE

Fit-tested NIOSH N95 mask
95% EFFECTIVE



GOOD

Find out more about the health impacts of wildfire smoke exposure [here](#).



wspehsu.ucsf.edu

WILDFIRE SMOKE EXPOSURE

Some Masks Protect You and Your Family from Wildfire Smoke More than Others

NIOSH N95 mask

- Look for masks labeled as "NIOSH N95", these are the most effective masks.
- Children age 7 and older may be able to use small adult N95 masks. Choose the size that best fits their face.
- Put on the mask with the nose clip over the nose. Straps should not be twisted. One strap should go above the ears and one below.



Medical/Surgical mask

- The bigger the gaps between your child's face and the mask, the more smoke they will breathe in. A mask with ties usually seals tighter than one with ear loops.
- Select the size that best fits the face (some come in child sizes).



Your child can use a mask safely when:

- They are awake and over age **2**;
and: They will tell you if they have problems with the mask so it can be taken off;
and: They will not pull on it or choke themselves with it, and;
and: They are supervised by an adult if they are young.

If you have concerns, check with your child's health care provider.

Perform a seal check to improve the fit of the NIOSH N95.

- 1** Cup your hands around the edges of your child's face
- 2** Have the child blow out hard (like blowing birthday candles). Feel for air leaking out around the mask.
- 3** Have the child take a big breath in. Feel for air sucking around the edges. The mask should compress slightly toward the face.
- 4** If you felt any air moving around the edges of the mask, adjust the mask on the face and try again.





Indoor Air

How does smoke get into the house?

- Through open windows and doors, also called **natural ventilation**
- Through **mechanical ventilation** devices such as bathroom or kitchen fans that vent to the outdoors or heating, ventilation and air conditioning (HVAC) systems with a fresh air intake
- Through small openings, joints, cracks and around closed windows and doors through a process called **infiltration**.

Create a Cleaner Air Space

Choose a room that fits everyone and is comfy enough to spend time in.

Close windows and doors, but do not block exits.

Filter the air. Use a certified portable air cleaner and run continuously on the highest setting.

Avoid activities that create smoke or other particles indoors.

Stay cool. Run fans or AC on recirculate with a new filter.

Use a damp cloth or mop to trap settled dust and particles.

CARB
Graphic courtesy of California Air Resources Board

Do It Yourself Air Filter Fan

Innovative appropriate technology solutions can provide some low-cost protection from wildfire smoke. An example is the "Do It Yourself Air Filter Fan."

Using an ordinary house fan and a MERV 13 filter, these can be made at much less cost than purchasing a room HEPA filter and thus provide an option for many in vulnerable low-income families where cost or availability may hamper protection efforts.

Information on how to make your own is available at the Puget Sound Clean Air Agency website. Their tests showed that in a small room a filter fan can reduce particulates by as much as 90%.



Preparedness

For more info:

[NIXLE Local Agency Alerts](#)

This is an example of a private company that allows local agencies to provide alerts.

[FEMA mobile device location alerts](#)

[Ready.gov family disaster planning \(Spanish version\)](#)

[American Academy of Pediatrics Family Readiness Kit](#)

[Firesafe Marin Example of a local evacuation checklist](#)

Preparedness for potential wildfire evacuations

FEMA describes 6 basic actions to begin to prepare for disasters (have supplies to last 3 days, talk with others about preparing, attend a local meeting, seek information, participate in a drill, make an emergency plan). With the recent increase in dramatic wildfires in the West, rates of preparedness have been increasing. 86% of respondents report having 3 days of supplies but only 52% report making a plan for wildfires.

There are many general disaster and wildfire specific resources available for health professionals and the public. The rules are simple:

Make sure to get warnings and alerts.

- Download appropriate apps including the **FEMA** app (alerts for your locations, emergency tips, checklists, and more).
- Check air quality and alerts from **AirNow** and **SmokeSense** apps from US EPA.

Make an emergency plan.

- Develop a communications plan (for example, identify an out of state friend or relative that everyone can check in with).
- Develop a reunification plan. Identify a meeting place, create a family password to keep children from going with a stranger.



- Have a battery operated or weather radio to stay informed.
- More information at [Ready.gov](#) (Spanish version).

Have a Kit

- Wildfires can come upon us quickly. Put together a back pack, suitcase, plastic box or other container.
- Include emergency information and supplies including food and water, medical and personal records, insurance information and necessary pet items.
- Make sure to include at least 7–10 day supply of necessary medications. During COVID, also include masks and sanitizing supplies.

Illustration: American Academy of Pediatrics Family Readiness Kit (link at left).

WILDFIRE HEALTH IMPACTS Sofia's Story

Later that evening Jose's sister Alejandra and her daughter Lucia arrive and they are anxious and worried. Alejandra's husband is a firefighter so he has stayed behind as part of the fire response.

"We didn't want to leave our home and Lucia's dad but the fires were getting so close and the smoke so bad that we were ordered to evacuate," says Alejandra. "But we were lucky to have transportation, some of our neighbors don't. And the smoke is especially hard on those with heart or lung disease."

"We love having you here and are so happy you are safe," Jose and Charles both say at once. "We'll watch what's happening and tell you if there is something you need to know."

"Muchas gracias," says Alejandra. "We are so tired and worried about Eduardo fighting the fire, and our house and everything happening in our community. But there's nothing we can do right now."

+ Communities need long-term mental health support after wildfires

Resources to help children/families cope with wildfires:

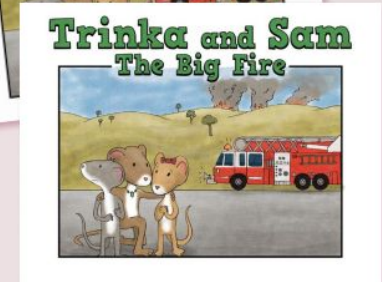
[National Assn of School Psychologists Helping Children After a Wildfire: Tips for Parents and Teachers](#)

[Amer Psychological Assn Resources on Wildfires Managing Distress Related to Wildfires](#)

Communities need long-term mental health support after wildfires

A wildfire in a community may be very stressful and upsetting to both children and adults. Wildfires have been associated with such things as changes in infant feeding practices and high rates of psychiatric symptoms, including PTSD and depression (Brown et al., 2019; Felix et al., 2015; McDermott et al., 2005). Children with higher self-esteem and resilience were less impacted.

Children may experience significant emotional distress resulting from excess anxiety, ongoing stress, changes in family and community life, and grief associated with loss and trauma related to having lived through a natural disaster. Children take their cues from adults around them, so their reactions to the wildfires and their aftermath are strongly influenced by how their parents, teachers, and other caregivers cope during and after the events. They often turn to these adults for information, comfort, and help. Families should be cognizant of behavior changes and consider reaching out to a trained mental health provider if needed, both for their children and themselves. Community and school-based programs aimed at increasing resilience before and after a wildfire may reduce population mental health problems (Brown et al., 2019b).



A story book to help children and caregivers understand and manage feelings and behaviors surrounding large wildfires is available from the National Child Traumatic Stress Network

WILDFIRE HEALTH IMPACTS Sofia's Story

The next day everyone was worried about family health issues regarding the fire, so they decided to call their family practitioner, Dr. Holm.

They asked a lot of questions and she was able to reassure them about some of their concerns, by showing them actions that they can take to decrease exposure to their family.

+ Examples of frequently asked questions to healthcare providers part 1

+ Examples of frequently asked questions to healthcare providers part 2



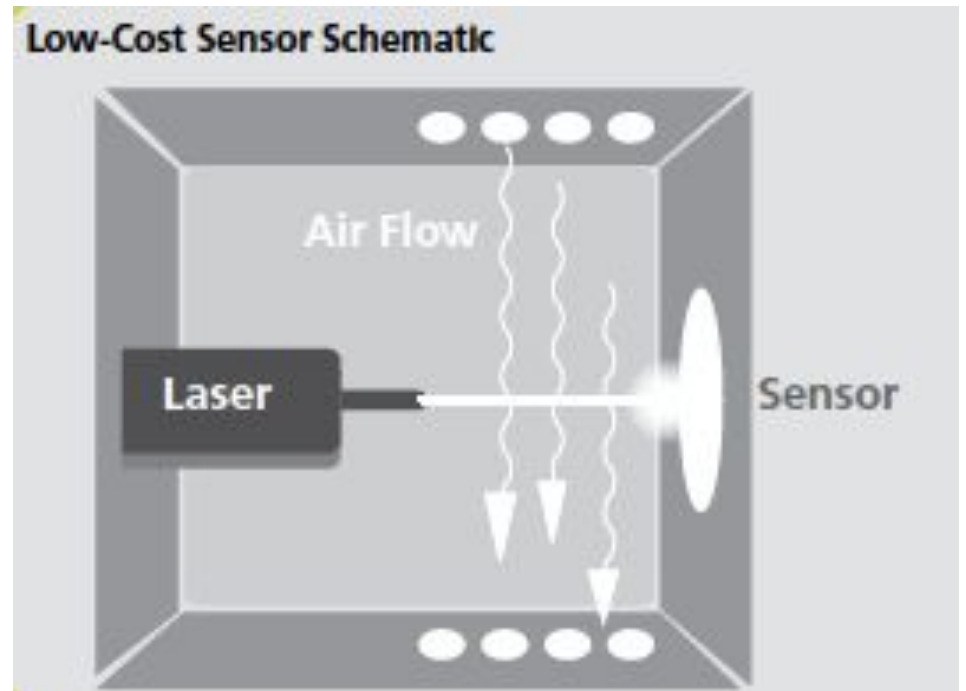
1 How do I know if the air is bad to breathe?

The EPA uses a scale called the air quality index AQI to communicate the air quality. You can look up air quality in your area on airnow.gov. Think of the AQI as a temperature scale. As the numbers on the AQI go up during a wildfire event, there is more chance of having symptoms, just like how when the temperature goes up during a heat wave, there's more chance of having symptoms.



Low-Cost Sensors for Schools

- 1) How well do the particle measurements actually go up and down as the concentration increases and decreases?
- 2) Is there a well-validated conversion factor for converting the particle counts into concentrations?



AQ-SPEC

Air Quality Sensor Performance Evaluation Center

How to Reduce Wildfire Smoke Exposure For Kids



▼ ≤ 100%

Go Somewhere Without Smoke



▼ ~50-80%

Go inside with
(1) HVAC & MERV 13 filter
or
(2) a portable HEPA air cleaner



▼ ~30%

Go Inside and Shut Windows

For Short Periods of Time:



▼ ~80%

Recirculate the air in your car



▼ ~80%

Wear a small size NIOSH N95 Mask *correctly*



▼ ~20%

Wear a medical mask *correctly*

DO NOT spend unnecessary time outside if the AQI is in the unhealthy ranges.

Cloth face coverings (like those for COVID) DO NOT reliably filter out small smoke particles.



More resources: wspehsu.ucsf.edu

WILDFIRE HEALTH IMPACTS Sofia's Story

POLICY RECOMMENDATIONS

Although we have seen favorable decreases in particulate matter levels from industrial sources in recent years, our nation's increase in wildfires has made wildfire smoke a substantial contributor to overall particulate matter exposure. The National Bureau of Economic Research estimates that wildfires have accounted for up to 25% of PM_{2.5} in recent years across the US, and up to half in some Western regions (Burke et al., 2020).

Some policy considerations for wildfire smoke prevention and mitigation are:

Climate Change

Decrease greenhouse gas (GHG) emissions

- ▶ Local, federal and multinational initiatives (e.g., [The Paris Agreement](#))
- ▶ Renewable energy (e.g., solar, wind)
- ▶ Economic strategies: (e.g., emissions tax)
- ▶ Increased funding for research to best predict high-risk areas and better understand how climate change is affecting wildfire behavior

For further information on climate change and policy by the American Academy of Pediatrics please follow the links below:

- ▶ [AAP Policy Statement on Global Climate Change and Children's Health](#)
- ▶ [How Climate Change Affects Children: AAP Policy Explained](#)

Health and Infrastructure Assessment & Response

- ▶ Development of guidelines for school administrators for air quality recommendations (e.g., [doh.wa.gov/](#))
- ▶ Air filtration standards for public buildings and schools
- ▶ Funding for state and local efforts for infrastructure hardening
- ▶ Funding and research on indoor air pollution monitoring and standards (e.g., low cost sensor initiatives)
- ▶ Funding for schools for maintenance and improvements to improve indoor air quality (e.g., filtration)
- ▶ Health experts utilized as air resource advisors on fire incident teams

Forest Management

- ▶ Forest maintenance initiatives (federal and state), including mechanical clearing and prescribed burns
- ▶ Allocation of funding to allow for more focus on prevention (e.g., ["The Fire Funding Fix"](#) beginning in FY 2020)
- ▶ Reduction of building expansion adjacent to wooded areas (Wildland-Urban Interface)

⊕ Prescribed Burns

⊕ Cultural Burns

Listen: NPR: [To Manage Wildfire, California Looks To What Tribes Have Known All Along](#)

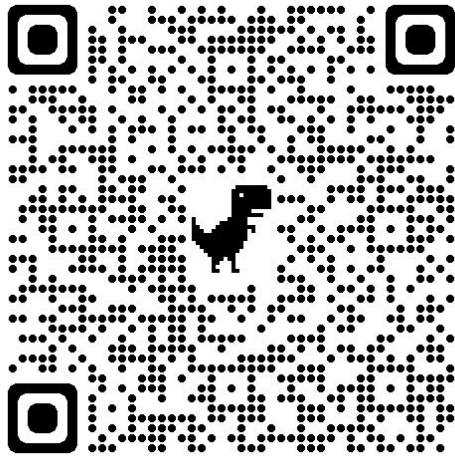
▶ 4-Minute Listen



**GOOD FIRES PREVENT
BAD ONES.**

USDA Pacific Northwest Research Station

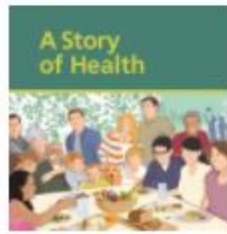
*Good Fires' graphic: [Pacific Northwest Research Station](#)



<https://wspehsu.ucsf.edu/main-resources/for-clinical-professionals/training/a-story-of-health-a-multi-media-ebook/>

Download

WE INVITE YOU TO DOWNLOAD A *STORY OF HEALTH* EBOOK BY CHAPTER. **NOTE THAT IN ORDER TO NAVIGATE THE EBOOK PROPERLY, YOU MUST DOWNLOAD, SAVE, AND VIEW THE BOOK USING ADOBE ACROBAT READER (OUR RECOMMENDED SOFTWARE FOR INTERACTING WITH THE EBOOK). THE SIX CHAPTERS ARE:**



- **NEW!** Sofia's Story (Health Effects of Wildfires)
- Sam's Story (cognitive decline)
- Stephen's Story (childhood cancer - leukemia) **RECENTLY UPDATED!**
- Reiko and Toshio's Story (infertility/reproductive health)
- Brett's Story (asthma)
- Amelia's Story (developmental disabilities)



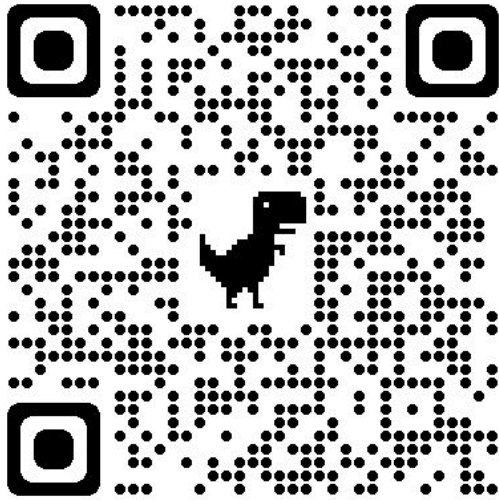
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(PDF, 23 pages, 7.25 MB)

NEW! SOFIA'S STORY (HEALTH EFFECTS OF WILDFIRES)

Follow Sofia and her family as they learn how to protect themselves from the immediate and longer term health dangers of a wildfire, with a focus on children's health and prevention strategies.

Remember to download, save, and then view the eBook pages through Adobe Acrobat Reader. Note that if you are using a PC save the eBook by *right clicking* (or if you are using a Mac, *Control-Click*) on the above green download button and "Save Target As" a pdf to your computer. Now you will have the intended experience of the eBook!



Large forest fires in the western United States have been more frequent in recent years and many have been much more devastating. With a changing climate this is likely to continue or worsen. Because children breathe more air per minute than adults, and have lungs that are still developing, they are especially vulnerable to health effects during wildfires, especially children that are very young or who already have respiratory diseases. Below are resources for further exploring wildfire and air quality data as well as associated health effects.

RESOURCES CREATED BY WSPEHSU ON WILDFIRE SMOKE



NEW! *A Story of Health: Sofia's Story*

Check out our new multimedia e-book chapter on wildfire. Get CE credit while you learn about wildfire smoke exposures and how to prepare your patients and your office.

Infographics on Wildfire Smoke:



NEW! [How much can different kinds of masks help?](#)

NEW! [Child Safety for Mask Wearing](#)

NEW! [Performing a User Seal Check](#)

NEW! Poster on Mask Use During Wildfire Smoke Exposure



<https://wspehsu.ucsf.edu/projects/wildfires-and-childrens-health-2/>