COMMUNITY TOOLS AND RESOURCES:
WAYS TO MITIGATE THE ADVERSE HEALTH IMPACTS
OF WILDFIRE SMOKE

Tom Long, PhD
Assistant Director for Air and Energy
National Health and Environmental Effects Research Laboratory
Office of Research and Development, US EPA
May 21, 2019
AIR QUALITY IMPACTS OF WILDLAND FIRES

**Annual average daily fire-PM$_{2.5}$ footprint for US counties**

How much does smoke contribute to air quality and how often does it lead to exceeding daily standard?

**Health protective standards**
- **Annual:** 12 μg/m$^3$ daily avg.
- **Daily:** 35 μg/m$^3$

# of days with fire-PM$_{2.5}$ above 35 μg/m$^3$ by counties of continental US

WILDLAND FIRES & THEIR EMISSIONS

A COSTLY INDIVIDUAL AND PUBLIC HEALTH ISSUE

Estimated Economic Value of Wildfire-Attributed PM$_{2.5}$-Premature Deaths & Respiratory Admissions

Short-term
$10-20$ billion/year

Long-term
$76-130$ billion/year

WILDLAND FIRE SMOKE HEALTH RISKS AND WHO IS MOST AT RISK

**Known**
- Respiratory effects
  - Asthma & COPD
  - Bronchitis & pneumonia

**Suspected**
- All-cause mortality
- Cardiovascular effects
- Adverse birth outcomes

**More data needed**
- Risk of mortality
- Cardiovascular effects
- Susceptible populations

- Susceptible populations
  - Children, elders and those with chronic disease

---

**Critical Review of Health Impacts of Wildfire Smoke Exposure**

Colleen E. Reid,1,2 Michael Brauer,3 Fay H. Johnston,4,5 Michael Jerrett,1,6 John R. Balmes,1,7 and Catherine T. Elliott3,8

1Environmental Health Sciences Division, School of Public Health, University of California, Berkeley, Berkeley, California, USA; 2Harvard Center for Population and Development Studies, Harvard T.H. Chan School of Public Health, Cambridge, Massachusetts, USA; 3School of Population and Public Health, University of British Columbia, Vancouver, British Columbia, Canada; 4Menzies Institute of Medical Research, University of Tasmania, Hobart, Tasmania, Australia; 5Environmental Health Services, Department of Health and Human Services, Hobart, Tasmania, Australia; 6Department of Environmental Health Sciences, Fielding School of Public Health, University of California, Los Angeles, Los Angeles, California, USA; 7Department of Medicine, University of California, San Francisco, San Francisco, California, USA; 8Office of the Chief Medical Officer of Health, Yukon Health and Social Services, Whitehorse, Yukon, Canada

Reid C et al. *Environ Health Perspectives* 2016;
124:1334–1343
PRESENTATION STRUCTURE

1. EPA’s wildland fire smoke tools and resources

2. Other tools from EPA on air quality and health

3. Future directions for EPA’s research and communications on the health effects of wildland fire smoke
Smoke Ready Toolbox for Wildfires

- Resources health officials can use to educate the public about the risks of smoke exposure and actions people can take to protect their health

AIRNOW.GOV AND THE AIR QUALITY INDEX (AQI)

AQI – National uniform index mandated by Congress

Air Quality Basics

Fires: Current Conditions
FIRES: CURRENT CONDITIONS PAGE

- Current Smoke Map generated by NOAA Hazard Mapping System
- Current Advisories – State/Local/Tribal agency blogs
- Wildland Fire Air Quality Response Program

More Fire Tools

Fires and Your Health

CDC: Before, During & After a Wildfire
How Smoke from Fires Can Affect Your Health

Updated January 2017

Smoke may smell good, but it’s not good for you

While not everyone has the same sensitivity to wildfire smoke, it’s still a good idea to avoid breathing smoke if you can help it. And when smoke is heavy, such as can occur in close proximity to a wildfire, it’s bad for everyone.

Smoke is made up of a complex mixture of gases and fine particles produced when wood and other organic materials burn. The biggest health threat from smoke is from fine particles. These microscopic particles can penetrate deep into your lungs. They can cause a range of health problems, from burning eyes and a runny nose to aggravated chronic heart and lung diseases. Exposure to particle pollution is even linked to premature death.

Some people are more at risk

It’s especially important for you to pay attention to local air quality reports during a fire if you are

- a person with heart or lung disease, such as heart failure, angina, ischemic heart disease, chronic obstructive pulmonary disease, emphysema or asthma.
- an older adult, which makes you more likely to have heart or lung disease than younger people.
- caring for children, including teenagers, because their respiratory systems are still developing, they breathe more air (and air pollution) per pound of body weight than adults, they’re more likely to be active outdoors, and they’re more likely to have asthma.
- a person with diabetes, because you are more likely to have underlying cardiovascular disease.
- a pregnant woman, because there could be potential health effects for both you and the developing fetus.

How to tell if smoke is affecting you

https://airnow.gov/index.cfm?action=smoke.index
WILDFIRE SMOKE GUIDE

ANTICIPATE AVAILABILITY LATE SUMMER/FALL

- Updated look
- Smoke vs urban particles
- Addition of ozone
- Add sections
  - PM web course
  - Ash clean-up
  - Sensors

- Stand-alone fact sheets
  - Children
  - Older adults
  - Pets/livestock
  - Preseason preparedness
  - Exposure reduction
  - Know when to evacuate
  - Respirator use
**WILDFIRE SMOKE GUIDE: FACTSHEETS**

**FACT SHEETS BEING RELEASED AS APPROVED**

---

**WILDFIRE SMOKE FACTSHEET**

**Prepare for Fire Season**

If you live in an area where the wildfire risk is high, take steps now to prepare for fire season. Being prepared for fire season is especially important for the health of children, older adults, and people with heart or lung disease.

**Before a Wildfire**

- If any family member has heart or lung disease, including asthma, check with your doctor about what you should do during smoke events. Have a plan to manage your condition.
- Stock up so you don’t have to go out when it’s smoky. Have several days of medications on hand. Buy groceries that do not need to be refrigerated or cooked because cooking can add to indoor air pollution.
- Create a “clean room” in your home. Choose a room with no fireplace and as few windows and doors as possible, such as a bedroom. Use a portable air cleaner in the room.
- Buy a portable air cleaner before there is a smoke event. Make sure it has high efficiency HEPA filters and it is the right size for the room.
- Know how you will get alerts and health warnings, including air quality reports, public service announcements (PSAs), and social media warning you about high fire risk or an active fire.

**WILDFIRE SMOKE FACTSHEET**

**Reduce Your Smoke Exposure**

When wildfires create smoky conditions, there are things you can do, indoors and out, to reduce your exposure to smoke. Reducing exposure is important for everyone’s health — especially children, older adults, and people with heart or lung disease.

**Reduce smoke exposure indoors**

- **Stay inside** with the doors and windows closed. Whether you have a central air conditioning system or a room unit, use high efficiency filters to capture fine particles from smoke. Ask an air conditioning professional what type of high efficiency filter your air conditioner can accept.
- **Seek shelter elsewhere** if you do not have an air conditioner and it is too warm to stay inside with the windows closed.
- **Do not add to indoor air pollution.** Do not burn candles or use gas, propane, wood-burning stoves, fireplaces, or wireless sprays. Do not fry or grill meat, smoke tobacco products, or vacuum. All of these can increase air pollution indoors.

**WILDFIRE SMOKE FACTSHEET**

**Protect Your Lungs from Wildfire Smoke or Ash**

Wildfire smoke and ash can irritate your eyes, nose, throat, and lungs. They can make you cough or wheeze, and can make it hard to breathe. A respirator is a device (mask) that covers your nose and mouth, fits tightly to your face, and can filter out smoke or ash particles before you breathe them in. Respirators are not used for children.

**Protecting Your Health**

The most effective way to protect yourself during wildfire emergencies is to stay indoors or limit your time outdoors when there is smoke in the air. This is especially important if you have heart or lung disease and are at higher risk for adverse health effects. Reducing physical activity and using HEPA-filtered air cleaners indoors are other ways to reduce your smoke exposure. Consider temporary relocation out of the smoky area if possible, by limiting your exposure one of these ways, you may not need to wear a respirator.

**Respirators Can Help Protect Your Lungs**

- Use a respirator to reduce indoor air pollution. Make sure it is sized for the room and that it does not make noise, which is a harmful air pollutant. Portable air cleaners can be used along with efficient central air systems with efficient filters to maximize the reduction of indoor particles.
- Use a respirator to reduce smoke from smoke or ash. Straps must go above and below the ears.

---

Note: The text above is a natural representation of the content in the image, formatted for better readability and coherence.
WILDFIRE SMOKE FACTSHEET: FACTSHEETS

WILDFIRE SMOKE FACTSHEET

Indoor Air Filtration

When wildfire smoke gets inside your home, it can create your indoor air unhealthy. But there are steps you can take to protect your health and improve the air quality in your home. Reducing indoor sources of pollution is an important way to lower the concentrations of particles indoors. For example, avoid burning candles, smoking tobacco products, using aerosol products, and avoid using a gas or wood burning stove or fireplace. Another step is to air out your home. This best practices discussion offers effective options for reducing your indoor air pollution.

Filter Options

There are two effective options for improving air filtration in the home: upgrading the central air system; and 2) using high-efficiency portable air cleaners. Before discussing filtration options, it is important to understand the basics of filter efficiency.

Filter Efficiency

The most common air filter standard for filter efficiency is the Minimum Efficiency Reporting Value, or “MERV” rating. The MERV scale ranges from 1 through 16. The higher the MERV number the more particles are captured as the air passes through the filter. Higher MERV (higher efficiency) filters are especially effective at capturing very small particles that can most affect health.

Central Air System Filter

The filter used in the central heating/cooling system of the home can effectively reduce indoor particle concentrations when the system is operating or when only the fan is turned on. Most home systems use a low MERV (1-4) filter that is 1-inch thick. Replacing this filter with a more effective filter, such as a MERV 8 or higher, can significantly improve the air quality in your home. Higher efficiency filters (MERV 8+12+) will work even better, and a true high efficiency filter (MERV 13-16) can reduce indoor particle levels as much as 95%.

Portable Air Cleaners

Portable air cleaners are self-contained air filtration appliances that can be used alone or with enhanced central air filtration to effectively remove particles. How well they reduce air particle concentrations depends on several factors such as the size of the air cleaner, the area to be cleaned, the filter efficiency, how frequently the unit is turned on and the filter speed. Portable air cleaners fitted with high-efficiency filters can reduce indoor particle concentrations by as much as 95%. Furthermore, portable units can be operated continuously or slower to extend the life of the filter. Portable air cleaners are not designed to replace a central air system.

Preventing Wildfires

Smoke and Ash

Smoke is a visible and pungent material that may contain harmful chemicals. Smoke may cause eye, nose, and throat irritation, headaches, and fatigue. Ash is a fine, powdery material that can irritate the respiratory system.

The most effective way to reduce smoke or ash exposure is to avoid air pollution sources. The EPA recommends that people who are sensitive to smoke or ash avoid being outside during high air pollution events. People who are sensitive to smoke or ash should consider using air purifiers with HEPA filters to reduce indoor smoke or ash levels.

Protecting Yourself from Ash

Avoid direct contact with ash. If you get ash on your skin, in your nose, or in your mouth, wash it off as soon as you can.

People with heart or lung disease, including asthmatics, elderly adults, children, and pregnant women should use special caution around ash.

Children and pets: Children should not be near smoke or ash while you are cleaning up. Be sure to wash all children’s toys before use. Clean ash off pets and other animals, keep pets away from contaminated sites.

Recommended Actions

Clothing: Wear loose, long-sleeved shirts, long pants, shoes, and socks, to avoid skin contact. Cover your nose and mouth with a mask when ash is falling. Keep your face clean. Every day wash all clothing, bedding, and other household items that may have been exposed to ash.

WILDFIRE SMOKE FACTSHEET

Protecting Children from Wildfire Smoke and Ash

Protect yourself from harmful ash when you clean up after a wildfire. Cleanup work can expose you to ash and other products of the fire that may irritate your eyes, nose, or skin and cause coughing and other health effects. Ash should deeply into lungs may cause asthma attacks and make it difficult to breathe.

A ash is made of larger and finer particles (dust, dirt, and soot). Ash deposited on surfaces both indoors and outdoors can be inhaled if it becomes airborne when you clean up. Ash from burned structures is generally more hazardous than forest ash.

Avoid Ash Exposure

Avoid direct contact with ash. If you get ash on your skin, in your nose, or in your mouth, wash it off as soon as you can.

People with heart or lung disease, including asthmatics, elderly adults, children, and pregnant women should use special caution around ash.

Children and pets: Children should not be near smoke or ash while you are cleaning up. Be sure to wash all children’s toys before use. Clean ash off pets and other animals, keep pets away from contaminated sites.

Use an N95 respirator and avoid direct contact with ash.

Protecting your lungs: Wear a tight-fitting respirator that filters ash particles from the air you breathe to help protect your lungs. Select a respirator that has been tested and approved by NIOSH and has the words “N95” on the front. These can be ordered online and are available at retailers. Use an N95 respirator when ash is falling and is more than 50 microns in diameter.

Recommended Actions

Clothing: Wear loose, long-sleeved shirts, long pants, shoes, and socks to avoid skin contact. Goggles are also a good idea. Cover your face with a mask when ash is falling. Keep your face clean. Every day wash all clothing, bedding, and other household items that may have been exposed to ash.

Use common sense to guide your child’s activity. If it looks, feels, or smells smoky, or if local air quality is reported as poor, or if local officials are giving warning signs, wait until air quality improves before your family is active outdoors.
HOW TO USE A RESPIRATOR CORRECTLY: FACTSHEET

The right respirator* and proper fit can reduce your exposure to wildfire smoke.

Cloth (wet or dry), paper masks, and tissues will NOT filter out wildfire smoke. Look for respirators (masks) marked NIOSH with N95 or P100. They can be found online, or in hardware, home repair, or drugstores.

* Respirators are not designed to fit children. Facial hair prevents proper fit and reduces effectiveness.

Respirator should collapse as you breathe in and not let air in from the sides.

Use a respirator only after first trying other, more effective methods to avoid smoke. That includes staying indoors and reducing activity. When possible, people at risk should move away from the smoke area.

airnow.gov

Reduce health risks in areas with wildfire smoke:

Follow these tips, especially if someone in your family (including you!) has heart or breathing problems, is an older adult or child, or is pregnant.

DO

- Stay inside
- Pay attention to local advisories and check air quality (airnow.gov)
- Set car A/C on recirculate (to keep smoke out)
- Keep a supply of medicine and non-perishable food
- Use a well-fitted N95 or P100 respirator if you go outside when it is smoky
- Prepare to evacuate if smoke levels get too high

KEEP AIR CLEAN

Close windows and doors. Close fresh intake on A/C units. If your home is too warm, try to stay with friends or relatives.

Use a portable air cleaner with HEPA filters properly sized for a specific room.

DON’T

- X Play or exercise outdoors
- X Fry or broil foods, which can add particles to indoor air
- X Use a fireplace, gas logs or gas stove
- X Smoke indoors
- X Vacuum, it can stir up dust
CITIZEN SCIENCE: AIR QUALITY AND SMOKE PLUME INFORMATION

SMOKE SENSE

- Smoke Sense provides information about current and future air quality
- Forecasted smoke plumes can be visualized
- Less time outside during smoke episodes to decrease exposure, & protect health
- Smoke Sense helps collect information about who, when, and how frequently people are impacted by smoke
- Information about smoke in the air and symptoms experienced in the past week will be logged
CITIZEN SCIENCE: SMOKE SENSE AND EXPOSURE-REDUCING BEHAVIORS

- **Smoke Sense** had >23,000 users and 100,000 sessions in 2017, with a 92% return rate.

- User-provided information enables analysis of symptoms and exposure-reducing behaviors.

- While 91% of users believe that smoke exposure affects health, exposure-reducing behaviors do not depend on health history and do not occur until after multiple days of exposure.

- Indicates that behaviors are reactive not proactive.
OTHER EPA INITIATIVES: PARTICULATE MATTER WEB COURSE

FOR HEALTHCARE PROFESSIONALS AND EDUCATORS

CME credit from CDC to physicians, nurses and health educators

Particle Pollution and Your Patients' Health

An evidence-based training course for healthcare providers that:

- Describes the biological mechanisms responsible for the cardiovascular and respiratory health effects associated with particle pollution exposure.
- Provides education tools to help patients understand how particle pollution exposure can affect their health and how they can use the Air Quality Index to protect their health.

Course website - https://www.epa.gov/pmcourse

This course is designed for family medicine physicians, internists, pediatricians, occupational and rehabilitation physicians, nurse practitioners, nurses, asthma educators, pulmonary specialists, cardiologists, and other medical professionals.

Start the Course
PARTICLE POLLUTION AND YOUR PATIENTS’ HEALTH

CONTINUING EDUCATION COURSE CONTENT

• What is Particle Pollution?
• Respiratory Effects
• Cardiovascular Effects
• Patient Exposure and High Particle Pollution Events
• Clinical Scenarios
• Patient Education Tools
EPA’s Healthy Heart program aims to prevent heart attacks and strokes by:

• Raising public awareness about the role outdoor air pollution plays in cardiovascular health, and

• Steps individuals can take to reduce their pollution exposure

http://www.epa.gov/healthyheart/
PARTNERING WITH MILLION HEARTS®

JOINT INITIATIVE OF CDC AND CENTERS FOR MEDICARE AND MEDICAID SERVICES

EPA’s contributes the Healthy Heart program to Million Hearts in the fight against heart attacks and strokes

http://millionhearts.hhs.gov/aboutmh/partners/epa.html
EDUCATIONAL TOOLS ON PARTICLE POLLUTION

https://millionhearts.hhs.gov
WILDLAND FIRE SMOKE AND HEALTH

FUTURE DIRECTIONS

- Do health effects from short-term exposures to high concentrations differ from long-term exposures to low concentrations of smoke?

- Do health effects from smoke from wildfire differ from prescribed fire?

- Is the toxicity of smoke modified by fuel type or burning conditions, or mixing with urban air pollution?

- Is there a concentration at which evacuation should be ordered?
DOING SOLUTION-DIRECTED SCIENCE

**In Vitro and In Vivo Testing**
- Wildfire PM or emissions
- Inhalation or Oropharyngeal Aspiration

MOUSE
- Biochemical
- Physiological
- Pathological
- Lung injury
- Lung inflammation
- Cardiac function

**Smoke Toxicology**
NHEERL

**Smoke Exposure**
(Monitors/Sensors)
NERL, NRMRL

**EPA A&E Wildland Fire Research**

**FASMEE Initiative w/ OAR-OAQPS**

**Smoke Emissions and AQ Impacts Modeling**
NERL, OAR-OAQPS

**Smoke Epidemiology and Public Health**
NHEERL, OAQPS

**Biomass Emissions Factors & Speciation**
NRMRL, OAR-OAQPS

**Emergency Room Visits**

**Wildfire**
PM or emissions

**Smoke Exposure**
(Monitors/Sensors)
NERL, NRMRL

**Smoke Emissions and AQ Impacts Modeling**
NERL, OAR-OAQPS

**Biomass Emissions Factors & Speciation**
NRMRL, OAR-OAQPS

**Smoke Toxicology**
NHEERL

**EPA A&E Wildland Fire Research**

**FASMEE Initiative w/ OAR-OAQPS**
WILDLAND FIRE SENSORS CHALLENGE

MULTI-FEDERAL AGENCY CHALLENGE TO PRODUCE A SENSOR CAPABLE OF RAPID DEPLOYMENT AND CONTINUOUS MONITORING OF AIR POLLUTION DURING A FIRE EVENT

First Place Award

Jason Gu (left) and Bryan Tomko of SenSevere/Sensit Technologies in Pittsburgh, Pennsylvania, with R. Subramanian of Carnegie Mellon University, received first place and $55,000.

Second Place Award

Scott Wallis (left) and Andrew Smallridge of Thingy LLC, Bellevue, Wash. received second place and $25,000.
PROTECTING POPULATION HEALTH – TRANSLATIONAL SCIENCE

DEVELOP, IMPLEMENT, AND EVALUATE THE IMPACT OF PUBLIC HEALTH COMMUNICATION ON POSITIVELY AFFECTING PROTECTIVE DECISIONS

Evaluate the effectiveness of:

- communication strategies
- interventions to decrease wildfire smoke exposures, and
- lower biomarkers of exposure to wildfire smoke, and
- adverse health outcomes

Translational Pilot Project in Missoula, MT

- Partnering with the local health department to evaluate the use of filtration devices in homes and public buildings
- Create “clean air spaces” in schools, libraries, senior centers, fitness centers
Thank you

Tom Long, PhD
Assistant Director for Air and Energy
National Health and Environmental Effects Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency

Email: long.tom@epa.gov

- No conflicts of interest
- Disclaimer: The presentation represents the opinions of the speaker and does not necessarily represent the policies of the US EPA