



Wildfires and Health

For Providers

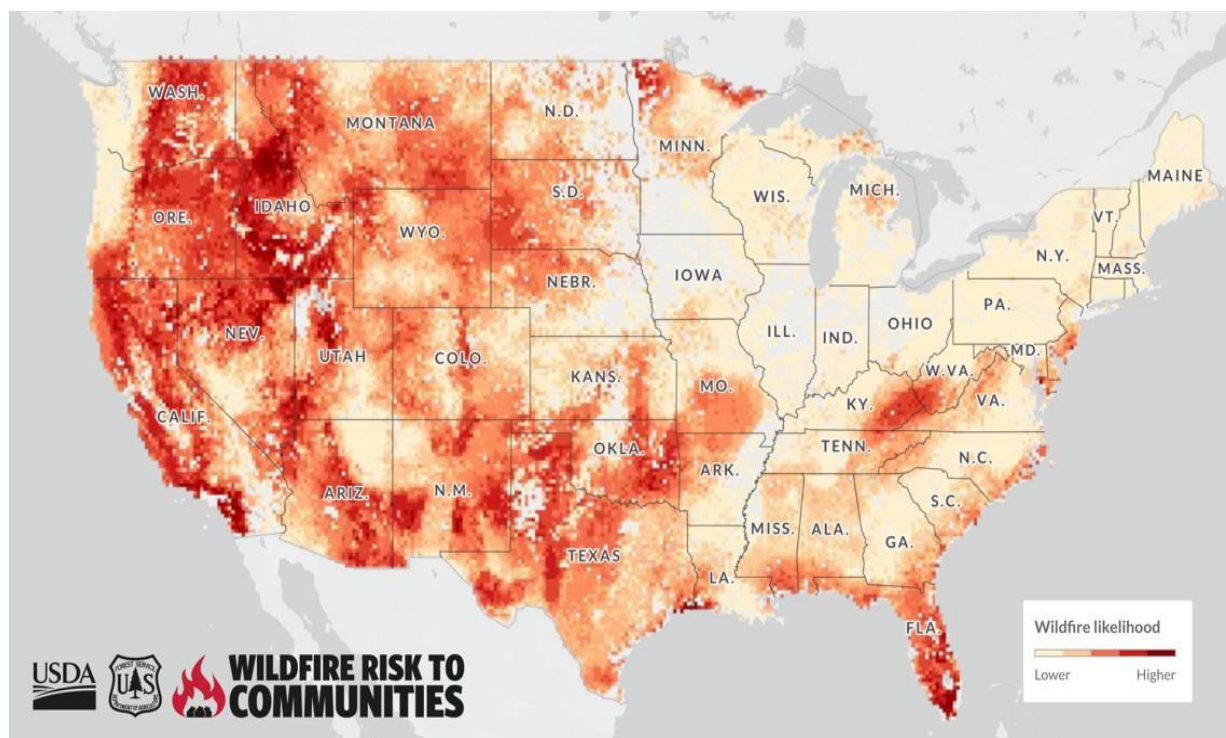
This sheet is an overview on wildfires and wildfire smoke providing background on how wildfires impact health and how providers can help patients prepare.

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Wildfires and climate change

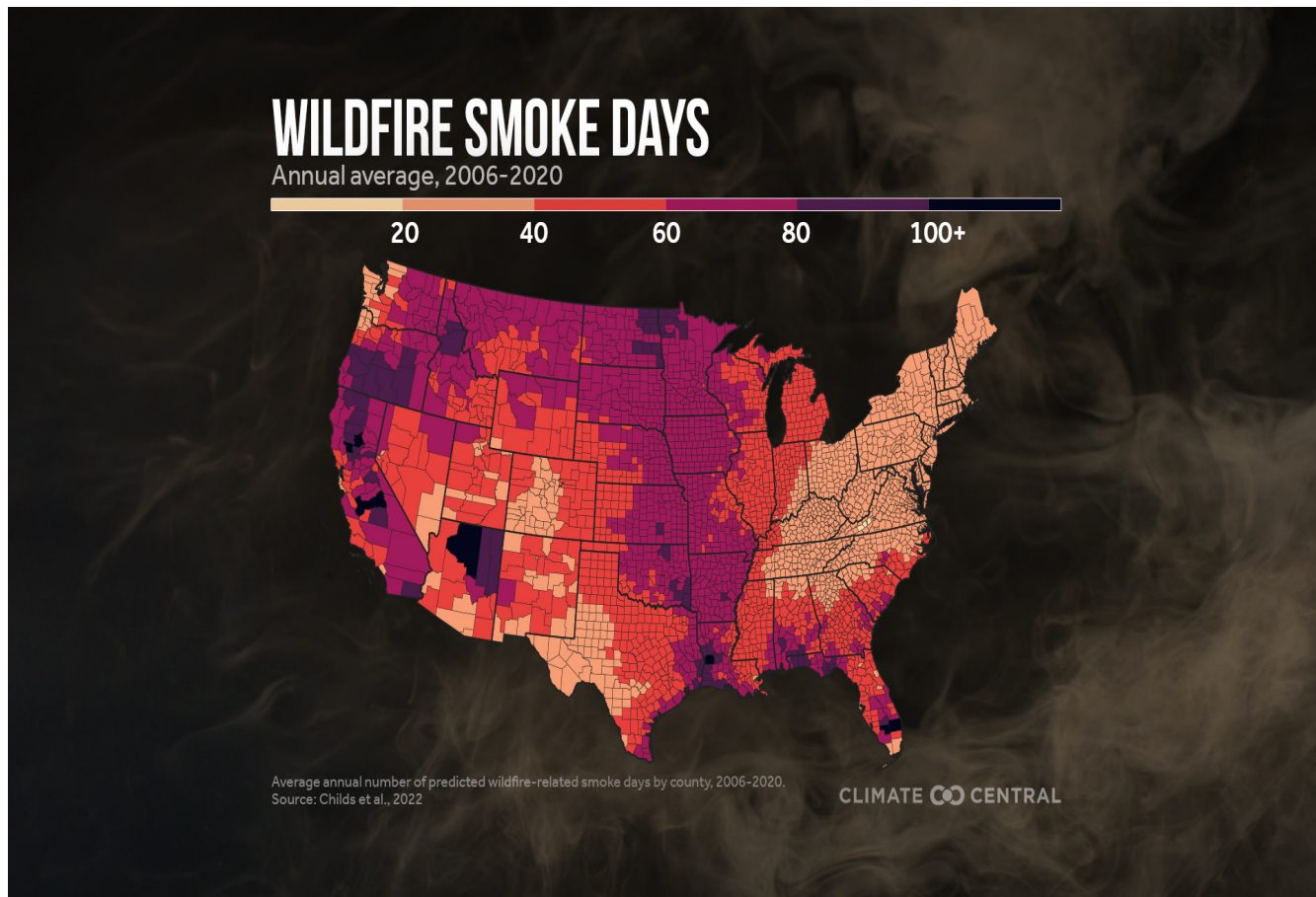
Wildfires and wildfire smoke have many effects on health, especially for individuals with certain chronic medical conditions, such as heart disease, chronic respiratory diseases (e.g., COPD and asthma), and neurodegenerative diseases (e.g., Alzheimer's and Parkinson's). Additionally, wildfires have adverse impacts during pregnancy, with increased incidence of preterm birth and low birthweight infants.

Historically, wildfires and wildfire smoke were contained to certain western states. However, due to climate change, many more regions of the country are increasingly at risk, with increasing chances of large wildfires. The map below shows where wildfires are likely to occur in the U.S. based upon where they have occurred over the past few decades. By mid-century, climate change is expected to increase the chances that a very large fire occurs in places such as Montana, the upper Midwest, and parts of the southern U.S.



Climate change has raised temperatures and lengthened the fire season; wildfire frequency and severity have increased every decade since the 1970s. Wildfires are complex events, influenced by many factors, including forest management and land development. Increasing populations are at risk from wildfires due to a combination of population growth, development at the urban-wildland interface, and climate change.

In addition to the increasing risk of large fires, there is also an increasing risk related to wildfire smoke across the United States. The map below shows that wildfire smoke has far-reaching impacts, affecting people far away from the fires themselves, with every county in the contiguous United States experiencing at least 16 days of poor air quality due to wildfires each year. Over 60% of wildfire smoke experienced in the Midwest and Northeast has come from Canadian wildfires. Wildfire smoke exposure is increasing over time but also varies widely from year to year; per capita smoke exposure in 2023 was more than double that of 2020.¹



Although large landscape fires occur mostly in the West, the majority of smoke-attributable morbidity and mortality occurs in the Eastern US, due to the higher population.² Most smoke-related asthma morbidity occurs in the spring and summer.²

Prescribed or controlled burns

In certain areas with high risks of wildfires, there will be prescribed or controlled burns that are lit intentionally in carefully monitored conditions to allow the fire to consume some of the leaves and branches and other smaller trees to prevent severe wildfires. These are carefully controlled to improve forest resilience and by checking weather to send smoke away from communities, although there may be some smaller amounts of smoke for shorter times than uncontrolled large fires.³ It can be helpful to understand how these burns are planned and timed, and how they can reduce future wildfire risk; for example, the City of Ashland in Oregon has an [Ashland Forest Resiliency Stewardship Project](#) that is a collaborative forest restoration project that uses controlled burns and thinning overcrowded forests to reduce the risks of severe wildfire.

Wildfire smoke exposure risks

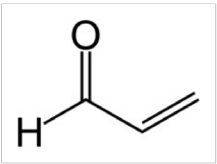
Wildfire smoke

Smoke is the most pervasive human health risk from wildfires. Wildfire smoke contains many harmful substances. In the United States, wildfire-PM_{2.5} causes an estimated 6,300 deaths and between 1,300 and 5,900 ED visits per year. Because of increased population density, wildfire-PM_{2.5} causes a higher number of deaths in the eastern United States than the West, despite more large landscape fires in the West. Wildfire-related hazardous air pollutants, such as acrolein and formaldehyde, are estimated to cause 309 disability-adjusted life years annually.⁴ Wildfire smoke has also been shown to be enriched in heavy metals, especially when wildfires impact structures.⁵

Patient case

A 13-year-old female with asthma presents to your clinic with her mother requesting a refill of her inhaler. The mother notes that her daughter has been going through inhalers more frequently and wonders if it has to do with smoke from wildfires in an adjacent state. They live in a two-bedroom apartment in an older building that does not have central air, and air cleaner, or air conditioning.

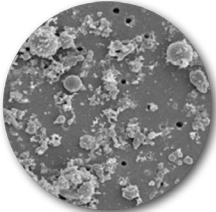
How would you counsel the patient and her mother regarding the relationship between the wildfire smoke exposure and her asthma, and what actions would you suggest they take?



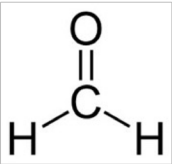
acrolein
Lung irritant

Wildfire source PM may be more toxic than PM in general

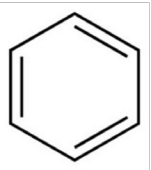
Nature Communications 12.1 (2021): 1-8.



PM_{2.5}



formaldehyde
Lung irritant
Carcinogen (long term exposure)



benzene/PAHs
Leukemia & lymphoma
Anxiety, depression
ADHD

NO_x
oxides of nitrogen
Asthma (causal)
Respiratory infections

Several studies have identified wildfires as a more toxic source of particulate matter than other sources, although dependent on many factors. Wildfire smoke harms everyone's health, but certain individuals may be especially at risk.

Populations at increased risk from wildfire smoke exposure

Condition/individual with greater sensitivity to smoke exposure	Potential health effects from wildfire smoke exposure
Asthma, COPD, and other chronic respiratory diseases	Respiratory symptoms including breathing difficulties (e.g., coughing, wheezing, and chest tightness). Greater medication usage, emergency department visits, and hospital admissions. ^{6,7,8}
Cardiovascular disease (CVD)	Ischemic events; worsening of heart failure; or arrhythmias. Excess emergency department visits, hospital admissions, and even death from CVD. ^{9,10}
Children	Coughing, wheezing, difficulty breathing, chest tightness, decreased lung function, pneumonia. ¹¹
Chronic kidney disease	Excess same-day mortality for dialysis patients. ¹² Decreased renal function and progression to end-stage renal disease. ¹³
Low wealth individuals	Greater smoke exposure as well as lesser access to exposure reducing measures (e.g., air filtration) and healthcare. ¹⁴
Older adults	Increased vulnerability to smoke effects, and therefore higher rates of healthcare utilization and mortality, due to higher prevalence of chronic medical conditions. ⁶
Outdoor workers	Increased vulnerability to smoke effects due to extended periods of time exposed to high concentrations of wildfire smoke, possibly without adequate protection.
Pregnancy	Heat exposure increases risk of poor birth outcomes including low birth weight and preterm birth. ^{15,16}

Adapted from <https://www.epa.gov/wildfire-smoke-course/which-populations-experience-greater-risks-adverse-health-effects-resulting>

Racial inequities have been documented in wildfire-PM_{2.5} exposure and health effects. A study of 5 million Medicare enrollees in the western U.S. found that Black American enrollees were more likely to be exposed to high levels of wildfire-PM_{2.5} and had higher rates of hospital admission.^{13,16} These discrepancies may result from variability in health status, occupational exposures, indoor air quality, and access to other protective measures.

Wildfire event risks

Flames

Fires can result in thermal burns, as well as physical trauma from falls, collapsing infrastructure, and auto accidents during evacuation. Real-time maps of fires and smoke plumes can be found from either AirNow, [NOAA-HRRR](#) (click the eye icon next to near surface smoke, then click the play button at the bottom of the screen), or the [Incident Information System](#).

Ground and water pollution

Hazardous chemicals within buildings and homes get mobilized by heat and fire into air, water (including private drinking wells), and soil. They are also spread in wildfire ash, which often covers surfaces in homes and agricultural fields. Ash can be irritating to the skin, eyes, and cause breathing problems and care should be taken to keep your environment clean from ash and use respirators to protect breathing. Additional information and guidance for patients is available from the CDPH here:

- [Reduce exposure to ash when returning home after a fire](#)
- [How to protect your home garden from ash](#)

The composition varies based upon the materials consumed in the fire and may contain heavy metals and toxic chemicals. Older buildings may contain asbestos and lead.

Landslides and flooding

Fires that burn vegetation, such as trees and shrubs, on hillsides can destabilize soil and increase landslide risk. Soil affected by fires is also more prone to subsequent flooding.

Power outages

Power outages may occur due to wildfire damage but are also sometimes planned to prevent wildfires; Public Safety Power Shutoffs in California are one example of this practice. Alerts from PG&E (the major electricity supplier in much of California) are available and can be accessed [here](#); there may be other local alert options available depending on your electricity provider. People with certain electricity-dependent medical and mobility needs can sometimes sign up for programs to ensure priority reconnection to electricity or other support services during planned outages. This is important because power outages can result in electric medical devices (e.g., ventilators, nebulizers, infusion pumps) and electric water wells becoming inoperable. Additionally, medications needing refrigeration may be lost in a power outage; please see the medication guidance sheet for more information. For instance, although insulin should be refrigerated, FDA guidance for emergencies indicates insulin may be left unrefrigerated at a temperature between 59°F and 86°F for up to 28 days and continue to work.¹⁸

Additional health risks from wildfires

Fires pose additional health risks even after they are extinguished. Individuals returning home after wildfire should be aware of these potentially harmful exposures:

- Hot spots can occur when a small area of material remains hot after a fire. Even after fires stop burning, hot spots can flare up without warning. Shoes should have thick soles that are resistant to melting.
- Downed power lines can lead to electrocution.
- Burned trees and utility poles can become unstable and fall on people and property.
- Individuals experiencing power outages may try to heat homes or cook food by burning fuels (e.g., wood or propane) indoors resulting in carbon monoxide exposure.
- Ash and debris may contain hazardous materials and can cover surfaces and reduce air quality leading to irritation to skin and cause respiratory disease.

Patient case

A 74-year-old male with a history of osteoarthritis, obesity, hypertension, coronary artery disease, and limited mobility, who relies on an electric wheelchair to get around, visits your clinic asking for help refilling his medications. He recently lost his insurance and is staying with family in a house on the outskirts of town for the time being due to financial problems. He expresses concern about wildfires that have occurred in the area, and his fragile medical condition, dependence on his electric wheelchair, and concerns about being able to evacuate if wildfire were to break out near his current place of residence.

How would you suggest this patient go about preparing for wildfires in his area? What specific actions do suggest he take to help address this risk?

Wildfire action plans for patients

We recommend that you familiarize yourself with the **Wildfire Action Plan and Tip Sheet** provided in the toolkit and review it with any patient at risk of experiencing a wildfire. The document can be provided during care visits for adolescents and adults and can be the basis for a discussion around a wildfire action and evacuation plan, especially for patients particularly vulnerable to wildfire smoke (see Table above). Wildfire planning should be done before fire season in your locale. You can sign up for the Office of Climate Change and Health Equity's Climate and Health Outlook to anticipate climate risks like wildfires by emailing ocche@hhs.gov. Check with your local community about plans as well to align with local guidance and resources.

Anticipatory guidance for patients

Anticipatory guidance for wildfires may contribute to improved health outcomes. These strategies and resources are also covered in the accompanying patient-facing handout titled **Wildfire Action Plan and Tip Sheet** which we encourage you to share with at-risk patients. The information below provides additional detail on the strategies to prepare you for patient conversations.

To reduce risks from fire exposure:

1. Create “defensible space” and “harden” the home

Defensible space is a buffer between a building and the grass, trees, shrubs, or any wildland area that surround it. This space is needed to slow or stop the spread of wildfire and helps protect buildings and homes from catching fire—either from embers, direct flame contact, or radiant heat. Proper defensible space also provides firefighters a safe area to work to defend the building.

Defensible space can be created by removing flammable material, including shrubs and trees, next to the building to lessen the potential of flames reaching it. Other steps to create defensible space can be found at [CAL FIRE](#).

Hardening your home, are changes you can make to the materials or structure to make it more resistant to fires.

Tips are available from CAL FIRE here: <https://readyforwildfire.org/prepare-for-wildfire/hardening-your-home/>

2. Sign up for emergency alerts, such as at NIXLE

For general information on alerts: [Emergency Alerts | Ready.gov](#).

3. Be prepared and evacuate when ordered to do so

Have an emergency “grab and go” kit to take with you and a “stay at home” kit ready to stay in place. See **Building an Emergency Kit** for more information on what to include.

Evacuation may be the best choice when wildfires or wildfire smoke are expected near a patient’s home. Patients can be encouraged to pay attention to local media outlets for evacuation orders (e.g., through newscasts, social media, or automated alerts on a smart phone).

Responsiveness to evacuation alerts has been found to vary by age, gender, and other factors. Men and full-time residents may be more likely to want to stay and protect their property, whereas homes with children, older adults, pregnant people, individuals with health concerns, or part-time residents are more likely to evacuate early.

Providers can ask whether a patient would be willing to evacuate when asked to do so. For those individuals who are unwilling to evacuate, especially for individuals with chronic medical conditions or who rely on electronic devices such as ventilators, reviewing the risks from hurricanes and floods may be helpful to enabling evacuation to safety when necessary.

Providers should identify if their local jurisdiction has an emergency management program or other resources available for persons that would need assistance in evacuating. Connect high-risk patients who need assistance evacuating with available local resources, or see if they have a friend, family, or neighbor to call to assist.

Extensive, multilingual [guidance on evacuation planning](#) is available from FEMA.

Wildfires can spread quickly, and seemingly manageable conditions can deteriorate. See the evacuation planning section of **Wildfire Action Plan and Tip Sheet** for patient resources.

To reduce risks from smoke exposure:

1. Track air quality

AirNow provides both [current](#) fire-related air quality reports and forecasts for [future](#) air quality conditions. Most phone weather apps also include air quality information i.v. For rural communities, leveraging smoke forecast data such as [NOAA-HRRR](#) (click the eye icon next to near surface smoke, then click the play button at the bottom of the screen) can provide more accurate information.

These sites and apps report the air quality index (AQI). The AQI is an integrated assessment of air quality based upon five pollutants (particulate matter (PM), ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide). The higher the number, the worse the air quality.

See the table below for more information on understanding AQI thresholds and alerts. You can learn more about how AQI is computed from [AirNow](#).

Understanding wildfire smoke air quality index (AQI)					
AQI Levels	Good AQI: 0-50	Moderate AQI: 51-100	Unhealthy for Sensitive Groups AQI: 101-150	Unhealthy AQI: 151-200	Very Unhealthy - Hazardous AQI: 201+
AQI Level Descriptions:	Air quality is good	Air quality is acceptable. However, there may be a risk for some people, particularly those who are particularly sensitive to air pollution.	Members of sensitive groups may experience health effects. The general public is less likely to be affected.	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.	Health alert: The risk of health effects is increased for everyone. Health warning of emergency conditions: everyone is more likely to be affected.
Sensitive Groups: People with heart or lung diseases, 65+ years old, children and teenagers, pregnant people, minority populations, and outdoor workers.					

Adapted from:

[Air quality Guide for Particle Pollution, August 2015, EPA-456/F-15-005 \(airnow.gov\)](#)

[AQMD - AB 661 AQI Chart \(General Public Rebrand\) - SMAQMD-0122-12 - V10 - PROOF \(airquality.org\)](#)

[NM-Tracking - Fires, Smoke and Health](#)

2. Manage indoor air quality

To reduce exposure to air pollution indoors, several measures can be taken, including reducing introduction of outdoor air to the inside of the building, reducing indoor air pollution sources, and using air filters.

Ways to reduce wildfire smoke exposure

Avoid exposure

Seal home / air filtration / stay home

Reduce exposure

Wear N95 or go somewhere with cleaner air

Limit time outdoors

Do not exercise outdoors or open windows

These are actions that can reduce exposure to polluted air, including wildfire smoke. Providers should look for local resources for clean air shelters if they advise patients to leave their home for patients to go to.

Additional actions include:

a. Seal the home.

Minimizing polluted air from entering a home can reduce indoor exposure. Closing windows and doors to keep out wildfire smoke should only occur when the AQI is elevated (over 50), as typical indoor air can be more polluted than outdoor air.

For an AQI 50 - 150, decisions to close windows and doors should be made based upon an individual's health status, ability to comply with closing windows, and availability and adequacy of indoor air filtration.

For an AQI > 150, windows and doors should be closed in all homes.

As the AQI can change quickly, especially with rapidly changing fires or wind directions, decisions about trying to seal a home from outdoor air should be regularly re-evaluated.

Sealing a room may also require taping duct tape around windows and door frames.

Be aware that closing windows and doors and sealing the home could also make the home dangerously hot, which can be a more deadly risk to health. Providers should discuss with patients staying aware of the heat as well as the smoke and prioritize keeping the home cool.

b. Reduce indoor air pollution sources.

Indoor sources of air pollution should be minimized, especially for sensitive groups. Common sources of indoor air pollution include smoking, wood fires, candles, incense, and cleaning products as well as vacuuming.

Cooking can also release air pollutants, especially cooking with a gas stovetop. Natural gas stove tops, especially older ones, have been found to release many air toxins, including carbon monoxide, and oxides of nitrogen (which can cause flares of asthma and COPD).

Exhaust hoods for gas stove tops should be used if available. If they are not present or not vented outdoors (many hoods recirculate air back indoors), cooking on a gas stove top should be avoided. Ovens can also generate smoke that is released into a home and should be avoided during times of poor air quality. You can also use indoor air sensors to monitor the quality of the air inside your home.

Reduce indoor air pollution sources



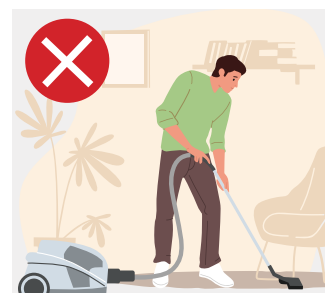
Close windows.



Reduce cooking indoors.



Do not smoke or burn firewood, candles or incense.



Avoid vacuuming.

c. Manage indoor air filtration

Homes with forced air heating and cooling typically have replaceable air filters in their air handlers. These filters are given a MERV (minimum efficiency reporting value) rating. The higher the rating, the better the filters work.

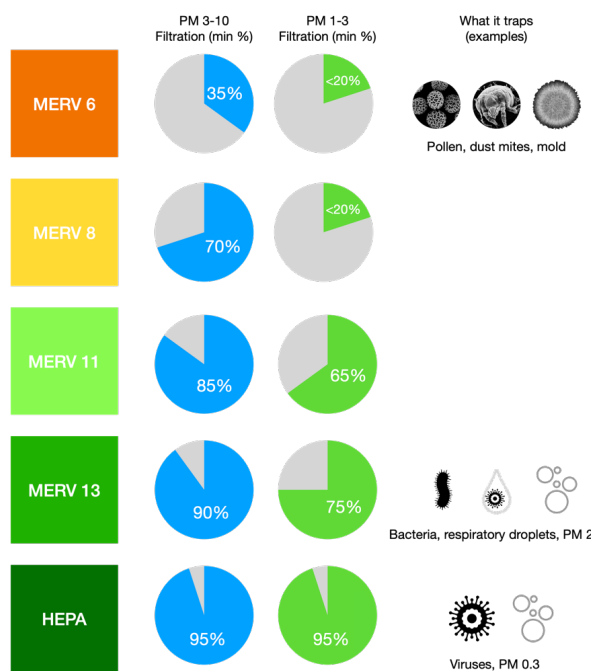
Only MERV 13 and higher, or a high efficiency particulate air (HEPA) filter, will substantially remove PM_{2.5} (as well as bacteria and viruses attached to respiratory droplets). These are increasingly sold-out during wildfire smoke events, and it is not yet clear the health impacts of using a lesser rated filter. As you can see in the diagram, filters under MERV 13 are not as good for filtering particulate matter, particularly PM_{2.5} associated with wildfire smoke.

Portable air cleaners, however, which are designed for use in individual rooms, may have HEPA filters. How well these filters reduce air particle concentrations depends on their size, the area to be cleaned, the filter efficiency (i.e., MERV rating), and the fan speed.

If medically necessary, providers may be able to prescribe air cleaners as durable medical equipment and check if it is reimbursable through Medicare Part B.

Low-cost portable air cleaners can be made with a box fan, a MERV filter (ideally MERV 13 or higher), and some bungee cords or tape (optional). A simple example of such a do-it-yourself filter can be found on the [All About Air Purifiers](#) sheet.

Patients can also create improvised air filters suitable for short-term use with materials available at most local hardware stores. Refer to the information sheet on air cleaners for more information.



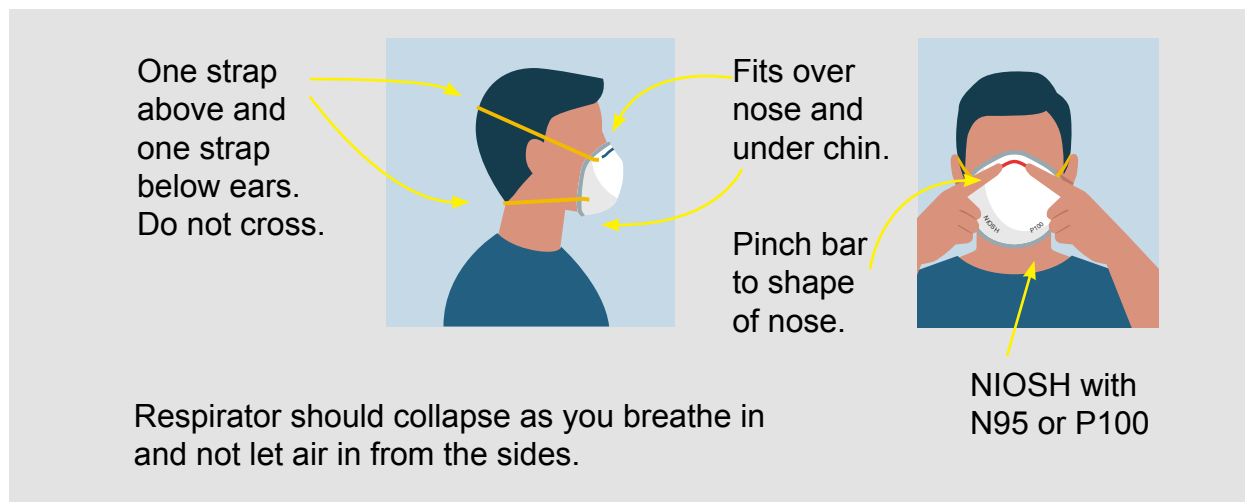
d. Create clean rooms

Creating a clean room in a home involves many of the steps above: 1) find a room that can fit all the people living in the home, 2) seal it by closing windows and doors, 3) filter the air using a built-in HVAC system or a portable air cleaner. Ideally clean rooms have air conditioning as well.

e. Wear respirators

- To filter wildfire smoke, respirators must be rated as N95 or P100, NOT cloth masks.
- Patients can be instructed on how to properly fit and wear respirators (see image below). Respirators come in small and regular sizes and, if properly fit, should collapse when a person breathes in.
- Children over ~7 years old can wear small or extra small N95/P100 masks. Adults typically wear “regular” or small sizes. Children <2 years old should not wear a mask.
- Respirators should be disposed of when dirty or when breathing through them becomes difficult.
- Respirators do not fully remove particulates and do not remove gaseous pollutants (e.g., oxides of nitrogen such as nitrogen dioxide or NO₂). A clean room can provide better protection from wildfire smoke.

How to wear a respirator



Notes:

References

1. Wildfire smoke can travel far and harm health. We can expect to breathe in more of it in a warming climate. Climate Central. Accessed 6/13/2024. <https://www.climatecentral.org/climate-matters/wildfire-smoke-nationwide-health-risk-2023>.
2. O'Dell K, Bilsback K, Ford B, Martenies SE, Magzamen S, Fischer EV, Pierce JR. Estimated Mortality and Morbidity Attributable to Smoke Plumes in the United States: Not Just a Western US Problem. *Geohealth*. 2021 Sep 1;5(9):e2021GH000457. doi: 10.1029/2021GH000457. PMID: 34504989; PMCID: PMC8420710.
3. Controlled Burns. City of Ashland. Accessed June 14, 2024. <https://ashlandoregon.gov/345/Controlled-Burns>
4. Westerling ALR. Increasing western US forest wildfire activity: sensitivity to changes in the timing of spring. *Philosophical Transactions of the Royal Society B: Biological Sciences*. 2016;371(1696). doi:10.1098/RSTB.2015.0178
5. Boaggio et al *Environ Sci Technol*. 2022 doi:10.1021/acs.est.2c02099; Sparks et al *Aerosol Sci Technol* DOI: 10.1080/02786826.2021.1895429;
6. Cascio WE. Wildland fire smoke and human health. *Science of The Total Environment*. 2018;624:586-595. doi:10.1016/J.SCITOTENV.2017.12.086
7. Borchers Arriagada N, Horsley JA, Palmer AJ, Morgan GG, Tham R, Johnston FH. Association between fire smoke fine particulate matter and asthma-related outcomes: Systematic review and meta-analysis. *Environmental Research*. 2019;179:108777. doi:10.1016/J.ENVRES.2019.108777
8. Tse K, Chen L, Tse M, Zuraw B, Christiansen S. Effect of catastrophic wildfires on asthmatic outcomes in obese children: breathing fire. *Ann Allergy Asthma Immunol*. 2015;114(4):308-311.e4. doi:10.1016/J.ANAI.2015.01.018
9. Chen H, Samet JM, Bromberg PA, Tong H. Cardiovascular health impacts of wildfire smoke exposure. *Particle and Fibre Toxicology* 2021 18:1. 2021;18(1):1-22. doi:10.1186/S12989-020-00394-8
10. Liao NS, Sidney S, Deosaransingh K, van den Eeden SK, Schwartz J, Alexeeff SE. Particulate air pollution and risk of cardiovascular events among adults with a history of stroke or acute myocardial infarction. *J Am Heart Assoc*. 2021;10(10):19758. doi:10.1161/JAHA.120.019758
11. Holm SM, Miller MD, Balmes JR. Health effects of wildfire smoke in children and public health tools: a narrative review. *Journal of Exposure Science & Environmental Epidemiology* 2020 31:1. 2020;31(1):1-20. doi:10.1038/s41370-020-00267-4
12. Xi Y, Kshirsagar A v., Wade TJ, et al. Mortality in US hemodialysis patients following exposure to Wildfire smoke. *Journal of the American Society of Nephrology*. 2020;31(8):1824-1835. doi:10.1681/ASN.2019101066/-/DCSUPPLEMENTAL
13. Bowe B, Xie Y, Li T, Yan Y, Xian H, Al-Aly Z. Particulate matter air pollution and the risk of incident CKD and progression to ESRD. *Journal of the American Society of Nephrology*. 2018;29(1):218-230. doi:10.1681/ASN.2017030253/-/DCSUPPLEMENTAL
14. Liu JC, Wilson A, Mickley LJ, et al. Wildfire-specific Fine Particulate Matter and Risk of Hospital Admissions in Urban and Rural Counties. *Epidemiology*. 2017;28(1):77-85. doi:10.1097/EDE.0000000000000556
15. Requia WJ, Amini H, Adams MD, Schwartz JD. Birth weight following pregnancy wildfire smoke exposure in more than 1.5 million newborns in Brazil: A nationwide case-control study. *The Lancet Regional Health - Americas*. 2022;11:100229. doi:10.1016/J.LANA.2022.100229
16. Heft-Neal S, Driscoll A, Yang W, Shaw G, Burke M. Associations between wildfire smoke exposure during pregnancy and risk of preterm birth in California. *Environmental Research*. 2022;203:111872. doi:10.1016/J.ENVRES.2021.111872
17. Liu JC, Wilson A, Mickley LJ, et al. Who Among the Elderly Is Most Vulnerable to Exposure to and Health Risks of Fine Particulate Matter From Wildfire Smoke? *American Journal of Epidemiology*. 2017;186(6):730-735. doi:10.1093/AJE/KWX141
18. Information Regarding Insulin Storage and Switching Between Products in an Emergency. US Food and Drug Administration. Accessed 6/14/2024. <https://www.fda.gov/drugs/emergency-preparedness-drugs/information-regarding-insulin-storage-and-switching-between-products-emergency>