Wildfire Smoke: Igniting a Health Hazard

CLINICAL QUESTION

How does wildfire smoke exposure affect health, and what can healthcare practitioners do to help patients reduce their risk?

BOTTOM LINE

Wildfire smoke contains fine particulate matter (PM2.5) capable of penetrating deep into the lungs and entering the bloodstream. While all patients can be harmed by wildfire smoke exposure, children, the elderly, pregnant individuals, Indigenous peoples, and those with chronic health conditions are particularly vulnerable. Healthcare practitioners can play a key role by identifying high-risk patients and advising all patients to monitor air quality, reduce exposure, and use protective strategies (such as indoor air filtration and N95/KN95 masking) during wildfire season.

EVIDENCE

Wildfire Smoke

- Fine particulate matter measuring 2.5 µm or less (PM2.5) can penetrate deep into the lungs where it can enter the bloodstream and cause extrapulmonary organ damage (Pryor et al., 2022).
- A 2019 modelling study found that wildfire smoke is the leading source of PM2.5 in Canada, making up 17% of total contributions). In 2023, Canadian fires accounted for 13% of total fire-related PM2.5 exposure worldwide (Meng et al., 2019; Zhang et al., 2025).
- One study reported that public buildings lacking air filtration systems had indoor PM2.5 concentrations equivalent to 69–94% of outdoor levels, while another study found that households without air filtration systems had indoor concentrations at 76% of outdoor levels (Deng et al., 2017; Chen et al. 2022).

Health Impacts

- One observational study in southern California found that PM2.5 from wildfire smoke was 10 times more likely to lead to increased hospitalizations for respiratory causes than PM2.5 from other sources, suggesting pollutants from wildfires pose a greater risk for health (Aguilera et al., 2021).
- A 2022 systematic review found that PM2.5 exposure is associated with increased healthcare utilization and multiple adverse outcomes, including higher rates of cardiopulmonary disease, adverse perinatal outcomes, cancer, and all-cause mortality (Thangavel et al., 2022).
- Several Canadian studies have demonstrated that increases in Air Quality Health Index (AQHI) were associated with increased healthcare utilization and adverse health outcomes. In Ontario, days with an AQHI of 10 led to over 15,000 additional healthcare visits compared to days with an AQHI of 3. Other studies found each unit increase AQHI led to an escalation in both same-day and delayed asthma-related emergency room visits (adults alone increased by 48%). In Edmonton, poor air quality was associated with an increase in emergency department visits for ischemic stroke during summer months, especially among adults over the age of 75 (To et al., 2015; Chen, 2025; Chen et al., 2014; Szyszkowicz & Kousha, 2014).

- Two systematic reviews have demonstrated an association between maternal wildfire exposure and increased risk of birthweight reduction and preterm birth (Amjad et al., 2021; Foo et al., 2024).
- Indigenous populations in Canada face disproportionate health risks from wildfire smoke (PM2.5) due to geographic, social, and health-related vulnerabilities. Although representing 5% of the population in Canada, they account for 42% of wildfire-related evacuations (Public Safety Canada, 2023; Howard et al., 2021).
- Outdoor workers face greater exposure to wildfire smoke and are at increased risk of acute and chronic airway disease, including respiratory infections, asthma, and COPD (Weheba et al., 2024).

Reducing Risk

- The AQHI is a risk communication tool derived from ozone, nitrogen dioxide, and PM2.5 concentrations to estimate population health impacts from air pollution. All individuals should regularly monitor AQHI and adjust their activities based on their level of risk and AQHI score. (Stieb et al., 2008; Government of Canada, 2018).
- During heavy smoke conditions, patients should remain indoors with windows and doors closed. Indoor air quality can be improved using portable air filters (e.g. HEPA filters) in main living areas and bedrooms. Evidence shows portable HEPA cleaners can reduce indoor PM2.5 by 32–88%, with mean reductions around 49%, though effectiveness depends on number of units, airflow, ventilation, and user operation. Canadian studies confirm that HEPA filters significantly lower indoor PM2.5 during wildfire and wood smoke episodes across seasons (Health Canada, 2024; Chen et al., 2022; Barn et al., 2016; Ebrahimifakhar et al., 2024; Barn et al., 2008).
- For necessary outdoor exposure during smoke events, wearing a well-fitted N95 or KN95 respirator has been shown to reduce inhalation of PM2.5 by over 90%, and offers superior protection to cloth or surgical masks. N95/KN95 masks have been shown to be safe and well-tolerated in most individuals, including children as young as 7 and pregnant individuals. Contraindications to respirator use include severe cardiopulmonary disease, inability to remove mask independently, and being less than 2 years of age. (Shakya et al., 2017; Sharma et al., 2022; Jones, 1991; Rebmann et al., 2013; Goh et al., 2019; Weigelt et al., 2023; Roberge et al., 2014; Huson, 2019)
- Short-term symptoms like cough, sore throat, headaches, or nasal irritation are common, even in healthy people, and can be managed by wearing a respirator, going indoors, or adjusting activity. However, severe or ongoing symptoms, such as shortness of breath, wheezing, severe cough, chest pain, dizziness, or palpitations, require medical evaluation (Health Canada, 2024).

CONTEXT

- Wildfire smoke is a complex mixture of water vapour, gaseous pollutants (e.g. carbon monoxide, ozone), hazardous air pollutants (e.g. polycyclic aromatic hydrocarbons, heavy metals), and particulate matter (U.S. Environmental Protection Agency, 2025).
- In Canada, climate change is driving hotter, drier conditions that make wildfires larger, more frequent, and more intense. As a result, smoke-related PM2.5 levels and air quality advisories are rising, with smoke traveling thousands of kilometers to affect urban centers far from fire zones (Jain et al., 2024).

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