

Further Reading for Health and Emergency Professionals

Booklet E

from the *Understanding Health Impacts of Wildfires in Urban Areas* series

Other booklets in this series:

A. Health Impacts of Wildfires in Urban Areas
B. During the Fire: Smoke, Air Quality, and Protecting Yourself
C. After the Fire: Lead and other Fire Contaminants in and around your Home
D. Mental Health and Wildfires
E. Further Reading

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Further Reading for Health and Emergency Professionals on Health Impacts of Wildfires that Reach Urban Areas

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Series Note: This series addresses some of the health concerns from wildfires that reach urban areas. These fires are also called Wildland-Urban Interface (WUI) fires. Since the general public may not use the term WUI, we use "wildfires that reach urban areas" or, more briefly, "fires" to refer to large, catastrophic fires that may also burn buildings, cars, and other non-natural sources.

Key point!



Look for these "Key points" throughout this handout for the most important summaries.

What we know: Health impacts seen from *previous* large fires





Dates	Fire	Smoke	Size	# People	**Health Impacts found measuring smoke** (Particulate matter, PM2.5)
July-Aug 2018	Mendocino Complex Fire	26-51 smoke days	459,123 acres	Analysis of 3.2 million adults (Kaiser)[1]	High PM2.5 levels linked to a **23.1% increase in heart health events (such as heart attack or stroke)** and a 35.8% rise in death/mortality.
California's largest wildfire as of 2025!					
Nov 2018	Camp / Paradise Fire	11-15 smoke days	153,336 acres	Analysis of 3.2 million adults (Kaiser)[1]	Despite high PM2.5 levels, researchers found **no increase in heart health events**.
California's largest structure fire as of 2025!					
2007-2020	All US Wildfires	Average PM2.5 from **all wildfires**		Nationwide study of weather, PM2.5 and death records[2]	High PM2.5 **linked to increased deaths** from heart diseases, diabetes, kidney disease, and mental disorders. **Older adults and racial minorities faced greater risk**, especially Black/Latino populations (not due to genetics). **Extreme heat + wildfire smoke** increase mortality risk for cardiovascular and mental health issues.
Aug 2023	Maui	1-2 smoke days	1,081 acres	Survey + health, 679 adults in Feb 2024	Up to 74% showing potential impacts on lung health.

Key point!

It is helpful to learn from past fires and their health impacts, though we need more studies on specific populations with different exposures and vulnerabilities, including children. Differences in the fire may also lead to different health impacts (see page 4).

1. Alexeeff SE, Van Den Eeden SK,. Wildfire air pollution and rates of cardiovascular events and mortality in northern California in 2018. *J Am Heart Assoc*. 2025
2. Ma Y, Zang E, Liu Y, et al. Long-term exposure to wildland fire smoke $PM_{2.5}$ and mortality in the contiguous United States. *Proc Natl Acad Sci U S A*. 2024
3. https://uhero.hawaii.edu/wp-content/uploads/2024/05/MauiExposureStudy.pdf

Challenges in understanding the health risks of large fires

Depends on the *fire conditions*



1. What is in the smoke varies! It is hard to know what's in the smoke because it depends on what is being burned at that moment.



2. Size and duration of active fire. Each fire is different in size, length, and smoke intensity. Smoke severity can also fluctuate and change with distance from the fire.



3. Weather conditions. Wind can carry smoke long distances; fog or immersion layers can trap smoke; rain can help clear and settle smoke particles; and high heat can increase stress on the body during smoke days.

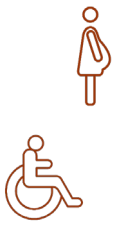


4. How people were exposed. Exposure to fire contaminants may occur in different ways: through the air we breathe, the water we drink (if contaminated), and the soil we may interact with (if contaminated).

Depends on the *person*



A. Dose/exposure. It is impossible to know exactly how much a person was exposed to. Differences in exposure can be large (e.g., between outdoor and indoor workers).



B. A person's age and health conditions. Populations whose health is affected in different ways may include pregnant people, children and infants with developing lungs, older adults, and people with health conditions or weakened immune systems.



C. Protective or unprotective factors and behaviors. It is difficult to know how much protective factors may impact health, such as changes in behavior like staying inside during smoke, access to air purifiers, or health insurance.



I. Lag time between exposure and health impacts: Long-term health effects are unknown, understudied, and become increasingly difficult to attribute to distant exposures over time.

Why health data may not show the full health impact of fires...

EASIER TO ACCESS DATA:

Examples of data that are more accessible or already exist that researchers may be able to obtain after the wildfires.

- Emergency department visits and hospitalizations
- Mortality (death certificates)
- School absences

HARDER TO ACCESS DATA:

Examples of data you'd have to actively collect or study further (require money, time, etc.)

- Changes in lung function or capacity (not a routine test conducted at doctor appointments)
- Increased use of inhalers, medicines, or other respiratory symptoms (coughing, COPD)
- Health outcomes of specific high-risk populations. For instance, those who may not have health insurance, especially workers conducting cleanup, remediation, and construction.

Key point:

We may not be able to easily measure all the health impacts of wildfires that reach urban areas using the data we have. We need new research to understand the full range of health impacts as wildfires increase.

Understanding behaviors and fire health risks

People may unintentionally increase their risk of fire-related health impacts for many reasons. Understanding these motivations can help emergency and public health responders communicate more empathetically and practically. Some examples of these behaviors and attitudes may include:

Example actions that increase health risks from fires	Reasons and motivations why health may not be prioritized
Staying behind to defend a home during the fire (firefighting)	• Belief that one can save a home, regardless of whether it may be feasible. • Deep emotional attachment to their homes: A home holds memories and is tied to their identity. The thought of losing a home can feel more distressing at the moment than the physical danger of the fire or potential health risks posed by smoke. May include concern for pets, animals, or livestock. • Peer influence: Observing neighbors instead of assessing the actual dangers they may personally face. • Lack of awareness related to firefighting activities, resulting in confusion about what is safe. Underestimating the speed, heat, destructiveness, and unpredictability of fires and embers. • Lack of awareness of health risks: Unawareness of the long-term health risks associated with smoke exposure and a lack of knowledge about the importance of personal protective equipment (PPE).
Work-related exposures: • Working outdoors without a mask during a smoke event • Cleaning up after a fire without proper PPE	• Lack of resources: Personal protective equipment (PPE) is either not provided or is too expensive. • Immediate need for income: The necessity to meet basic needs such as food, housing, and family support takes precedence over long-term health risks. • Discomfort with PPE: The discomfort of wearing respirators and PPE, particularly during hot weather or strenuous activity, is a concern. • Peer influence: Observing colleagues working without PPE can lead to similar behavior. • Lack of awareness: Limited knowledge about the long-term health risks associated with smoke exposure, as well as a lack of understanding of the benefits of using PPE.
Sifting or digging through ash and fire debris for valuable or sentimental items	• Lack of resources: Personal protective equipment (PPE) is either not provided or is too expensive. • Deep emotional attachment: Mementos hold memories and personal identity; losing these can feel greater than the physical danger or potential long-term health risks. • Defense: Wanting to prevent looters from scavenging the site. • Peer influence: Seeing others in the area without PPE. • Lack of knowledge: Limited knowledge of longer-term health risks from off-gassing or fire debris; lack of knowledge of the benefits of PPE.

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Effective communication to reduce the health risks of fires: for emergency and public health response

Effective wildfire risk communication recognizes people's circumstances, respects their values, and provides practical actions they can take to protect themselves.

Ineffective communication	Why it fails	What may work better instead	Rationale
"Staying behind to defend your home is risking your life."	Judgmental messaging is ineffective. It attacks the individual's identity, courage, and values, leading to cognitive shutdown and defiance.[1-3]	*"Many people feel a strong responsibility to protect their home and community. Let's talk about ways to reduce your risk if you're staying, and when conditions may become too dangerous to remain. Know that fire and smoke exposure can have short- and long-term health risks. Also, heat and thick smoke can cause sudden confusion and physical exhaustion within minutes..."*	Being non-judgmental and reducing harm are essential when individuals may engage in high-risk behaviors. Offering a realistic framework to self check and establishing a "pivot point" for protecting their health honors their autonomy.[4]
"Your health matters more than looking for personal items."	Devalues the urgent, identity-driven need to protect and restore one's belongings[2]	*"Because fire debris contains hazards like asbestos and heavy metals, avoid direct contact. If you return to a burn zone after a fire, here's how you can protect yourself..."*	Acknowledging the desire to recover precious items decreases resistance to protections. It shifts the focus to harm reduction.[2,5]
"N95 masks are required due to toxic ash."	Institutional mandates trigger defiance to reassert control[1]	*"Fires burn toxic things, and that ends up in the air you breathe. Wearing a snug-fitting N95 mask when you go outside can help protect your lungs during smoke events."*	Enhance self-efficacy by explaining health risks and framing PPE as a personal tool, which increases adoption compared to mandates.[6,7]
"Everyone should stay indoors, shutting doors and windows."	Fails to account for immediate discomfort (e.g., heat) vs. an invisible future health risk. [3]	*"Keeping smoke out can be challenging, especially when smoke days occur during hot weather. If you lack A/C, choose the coolest room with the fewest windows and run a portable air cleaner."*	Expecting perfect adherence fails when it creates discomfort. Provide a low-cost, high-efficacy alternative (like a Corsi-Rosenthal box) to bridge the gap.[8]
Leading with terrifying PM2.5 data and toxic chemical lists.	High-fear data without clear, step-by-step actions causes people to tune out or deny the risk.[6]	*"Smoke levels are high today and can affect everyone, even healthy adults. Here are some things you can do right now: set your car AC to recirculate, close windows and doors, run your air purifiers, or check our map for a community clean-air shelter near you."*	To prevent defensiveness or fatigue regarding invisible toxic health threats, provide actionable, low-barrier solutions to give people options and control.[7]
Official agency alerts telling people to look at AQI charts.	Disconnected from reality. People trust local knowledge over abstract data indexes[9]	*"Public health has set up clean-air spaces at the local library for you. Drop by to grab a free mask."*	Leveraging localized, peer-led networks to distribute information and PPE builds far greater compliance and trust than impersonal references, links, or charts and data.[10]

1. Brehm SS, et al. Psychological reactance. New York. 1981 2. Belk RW. Possessions and the extended self. Journal of Consumer Research. 1988 3. Kahneman, Daniel, Jack L. Knetsch, and Richard H. Thaler. "The endowment effect, loss aversion, and status quo bias." 1991. 4. Reynolds B, et al. Crisis and emergency risk communication as an integrative model. Journal of Health Communication. 2005 5. Lundgren RE, et al. Risk communication: A handbook for communicating environmental, safety, and health risks. John Wiley & Sons; 2018. 6. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist. 2000 6. Witte K. Putting the fear back into fear appeals: The extended parallel process model. Communications Monographs. 1992 Dec 1;59(4):329-49. 7. Tversky A, Kahneman D. The framing of decisions and the psychology of choice. science. 1981. 8. Albrecht G, Sartore GM, Connor L, Higginbotham N, Freeman S, Kelly B, Stain H, Tonna A, Pollard G. Solastalgia: the distress caused by environmental change. Australasian Psychiatry. 2007. 9. Schultz PW, Nolan JM, Cialdini RB, Goldstein NJ, Griskevicius V. The constructive, destructive, and reconstructive power of social norms. Psychological Science. 2007 May;18(5):429-34.

2025 Los Angeles fires: Health impacts



Palisades and Eaton fires, 38,000 acres and ~16,000 structures

Note: The studies below may not represent the general population, as the data are from medical visits, including emergency room visits, which may reflect more vulnerable groups. We also don't have general population details, including disparities in healthcare access and insurance coverage, as well as differences in symptoms and fire-related exposures.

Data Source	What was measured and when	Health impacts found
LA County Dept. of Public Health	**ED (Emergency Department) visits**, compared to before and after the high smoke days[1]	During the peak of the smoke, Los Angeles County emergency room (ER) visits related to wildfires spiked, nearly doubling.
Cedars-Sinai Medical Center	**ED visits** up to 90 days after the fires, compared to 2018-2024, adjusting for COVID in 2020-2021[2]	• Lung/pulmonary illness was 24% higher • Heart attacks (myocardial infarction) was 46% higher • Abnormal blood tests were 118% higher
Kaiser Permanente Medical Centers	**Virtual/outpatient visits**, 1 week after the fires, compared to the previous period[3]	• Respiratory visits were 34-41% higher • Cardiovascular visits were 35% higher *For the highly exposed groups, on the first full day of fire*: • Outpatient and virtual injury visits were 18% higher • Neuropsychiatric visits were 18% higher
LA County Death Counts	**All-cause mortality**, one month after the fires, compared to 2018, 2019, and 2024 (except COVID yrs)[4]	Deaths in LA County were ~7% higher following the fires

1. Kajita E. Notes from the field: emergency department use during the Los Angeles County wildfires, January 2025. MMWR. Morbidity and Mortality Weekly Report. 2025;74.
2. Casey JA,, et al. The 2025 Los Angeles Wildfires and Outpatient Acute Healthcare Utilization. medRxiv. 2025:2025.2003. 2013.25323617.
3. Ebinger JE, et alJ, Botting P, Tan ZS, Claggett BL, Kwan AC. Emergency Encounters for Illness During and After the Los Angeles Wildfires. JACC. 2025 Dec 17.
4. Paglino E, et al. Excess deaths attributable to the Los Angeles wildfires from January 5 to February 1, 2025. JAMA. 2025 Sep 16;334(11):1018-9.

2025 Los Angeles fires: Mental Health impacts



After the 2025 LA fires:

- Adult residents living in wildfire evacuation or warning zones experienced a greater increase in self-reported symptoms of anxiety and depression nearly a year later compared to those unaffected.[1]
  - Socioeconomic Disparities: The psychological damage was starkly concentrated among low-income households, individuals struggling with housing costs, and those with pre-existing mental health challenges. [1]
- Adolescents: 2,839 high school students (10th and 12th graders) three months after the fires revealed massive structural and emotional disruptions due to the fires: [2]
  - 35.8% of adolescents reported chronic worry regarding the health of their family members.
  - 23.1% feared for their personal safety.
  - 21.9% directly reported feeling anxious, stressed, or depressed.
  - 10.4% experienced a family member or loved one losing their home entirely.
- Over half (66%) of all fire-affected adults (1,229) described anxiety, stress, or depression related to fire damage to air, soil, water, and nature.[3]
- 80% of displaced survivors report a sharp decline in their mental health, ranking emotional strain and trauma as a top post-disaster challenge right behind immediate financial stress and housing loss. [4]
- 5-Fold Increase in Crisis Calls: The National Mental Health Lifeline (988) reported a five-fold (500%) increase in calls to its associated Disaster Distress Helpline from the Los Angeles area during the first week of the fires (January 7–15, 2025). [5]
- A majority of fire-affected populations faced financial, physical, mental health and housing challenges after the fires. [6]

1. L.A. Wildfires Had Lasting Mental Health Impacts for the Most Vulnerable Residents. Published in JAMA Network Open
2. Harlow AF, Soto DW, Unger JB, Lee RC, Barrington-Trimis JL. The mental health impact of the 2025 Los Angeles wildfires among adolescents. Environmental Epidemiology. 2026 Jun 1;10(3):e474.
3. Purdue: The REBUILD Survey: https://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1001&context=red
4. Dept of Angels: https://www.deptofangels.org/news/six-months-later-recovery-in-crisis
5. Time magazine: https://time.com/7207912/los-angeles-california-wildfires-mental-health-support/
6. Los Angeles County Wildfire Rapid Needs Assessment Report November 2025 http://publichealth.lacounty.gov/media/wildfire/docs/LAC_Wildfire_RNA_Report-Nov2025.pdf

2025 Los Angeles fires: Social impacts



...which can also affect mental and physical health

After the 2025 LA fires:

Job and economic loss[1]

- Unemployment claims spiked: 11,000 workers filed for unemployment due to the fires.
- Low-wage workers were hit the hardest (50% higher increase in filing for unemployment for those with a high school diploma or less)

Food insecurity[2]

- Lost access to school-provided meals for youth
- Lost access to kitchens, having to eat prepared foods
- Increasing other living costs, which impacts food budget

Schools and lost learning time[3]

- Disruption to learning time including school closures, challenges getting to school or new locations, and challenges with online learning.
- Loss of sports and other extracurricular activities
- Disruption to teaching and administration staff
- Longer-term impacts including mental health challenges for students and disruptions to future plans
- Concerns over health risks associated with returning to schools impacted by fire

Housing insecurity[4,5]

- Homelessness
- Family separations
- Loss of home or material goods
- Having to add new rental or moving costs
- Money lost to evacuation (costs, job loss)
- Time, effort, and stress in dealing with insurance, FEMA, rebuilding, and potential environmental hazards

Changes in safety nets and community services[6]

- Community-based organizations faced new challenges in supporting communities after fires

1. Lapinski, P., et al. Unemployment Insurance Claims After the LA Wildfires. California Policy Lab. (2025). https://capolicylab.org/unemployment-insurance-claims-after-the-la-wildfires/
2. https://thelalocal.org/los-angeles-county/a-year-after-the-la-fires-survivors-are-still-going-hungry/
3. https://insideclimatenews.org/news/14032025/latino-disadvantaged-students-hit-hardest-after-los-angeles-fires/
4. https://dornsife.usc.edu/news/stories/labarometer-wildfire-survey-of-housing-instability-and-income/#:~:text=Nearly%20a%20quarter%20of%20housing%2Dinsecure%20Angelenos%20said%20they%20lost,of%20those%20with%20stable%20housing.
5. https://www.latimes.com/environment/story/2026-04-16/how-la-unhoused-population-was-devastated-by-2025-wildfires
6. https://cnmsocal.org/wp-content/uploads/2025/03/CNM.LAwildfires-SurveyFindings.pdf