WILDFIRES IN CANADA

Toolkit for Public Health Authorities

August 2023

Public Health Agency of Canada
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Canada

TO PROMOTE AND PROTECT THE HEALTH OF CANADIANS THROUGH LEADERSHIP, PARTNERSHIP, INNOVATION AND ACTION IN PUBLIC HEALTH.

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Wildfires in Canada: Toolkit for Public Health Authorities

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1) Rationale

Canada is experiencing longer wildfire seasons and more frequent and extreme fire behaviour, which has significant effects on human health and the natural environment.[1] In Canada, wildfire season typically runs from early April to late October. This year we are going through an unprecedented wildfire season, with larger geographic extent and severity than previously recorded.[2] A number of factors are likely contributing to this change. Anthropogenic climate change is affecting the number and severity of wildfires. Storms with lightning strikes, rising temperatures, erratic precipitation, and circumstances like disease and pests that kill or weaken trees, are all ways in which climate change affects the risk of wildfires.[3]

While wildfires are a natural part of the ecosystem, human behaviors and interactions with the environment can directly result in the ignition of wildfires. Furthermore, forest management and land use patterns have changed drastically over time. The way forests and other wildlands are managed for industry, housing and infrastructure can contribute to the risk of wildfires in Canada. In addition, policies discouraging Indigenous cultural burning, which has been used for centuries to naturally manage land by getting rid of dead plants and encouraging new growth, has interrupted the natural restoration of forests by fires. Some provinces and territories have focused on fire suppression efforts, which has also impacted natural restoration and therefore wildfire risk.

The role of public health authorities in wildfire response varies cross Canada. In most cases, public health authorities contribute to the emergency response by providing direction, recommendations, advice and communications aimed at minimizing the associated human health hazards and risks. While some regions of Canada experience cyclical wildfire events most years, large wildfires are more recently occurring in regions with limited experience, including public health involvement in wildfire emergencies. This has resulted in the engagement of public health professionals with differing levels of experience and familiarity with wildfire response. With the increased profile of public health authorities as health system responders during the COVID-19 pandemic, public health authorities at all levels of government are more engaged than ever before.

1.1) Purpose

The purpose of this toolkit is to summarize information and bring together existing resources to support public health authorities in the prevention and mitigation, preparedness, response and recovery to wildfire-related human health risks (including both physical and mental health risks). Some of the content may also be applicable to urban fires; however, this is not the focus of this document except in the case of wildfires that spread to and through the wildland urban interface.

Recognizing that local contexts and public health systems and resources vary, the public health actions and interventions that have been summarized in this document are not meant to be directive. They are potential actions that can be adopted or adapted in different jurisdictions and situations. The resources provided are a non-exhaustive compilation of existing documents including provincial and territorial guidance documents (Table 2: Provincial/Territorial Guidance Document Links), fact sheets, and literature. In addition, **the guidance provided in documents external to the Government of Canada may not reflect the views and opinions of the Government of Canada or be available in both official languages.**

1.2) Goal

The goal of this document is to provide a compilation of resources that can support the varying needs of public health authorities in the management of wildfire-associated human health hazards and risks in Canada.

1.3) Objectives

The objectives are:

- To facilitate evidence-based and timely decision making by public health authorities
- To synthesize existing resources in the form of evidence-based summaries of human health hazards and risks
- To support the sharing of best practices and lived experiences
- To apply an equity informed public health lens to the management of human physical and mental health hazards and risks for the 4 components of Emergency Management

2) Background

2.1) Health Hazards and Risks

Wildfires, and the response to them, present a range of physical and mental health hazards and risks. The main physical health hazards are due to fire, smoke and heat. Secondary consequences and mental health impacts can also occur or be exacerbated as a result of wildfire events. Climate change is expected to increase the frequency, duration, severity, and season length of wildfires, representing a significant public health concern, given potential impacts on health and wellbeing.[4] Increased exposure to wildfire smoke and evacuations will put increasing strain on those who live and work in the impacted areas. This includes those working in public health, healthcare, and response services, as well as other populations who are disproportionately impacted by smoke and/or the needs generated by evacuations.[5] Health hazards and risks could be reduced with comprehensive prevention, mitigation and preparedness activities that strengthen both community and individual resilience and address inequities with respect to the social determinants of health.

2.1.1) Fire

Wildland fires or wildfires are any non-structure fire that occurs in vegetation such as trees, grasses, and shrubs. This includes unplanned fires (both natural and human-caused) and intentional burning and prescribed fires (as a part of fire management). How wildfires develop and spread depends on a complex balance between ignition source(s), climate/weather, potential fuel(s), and geographic topography.[6]

Wildfires can contribute to the health and diversity of ecosystems; however, they can also be health hazards and lead to disasters and death. Wildfires can impact individual and community health (physical health, mental health, and well-being), harm ecosystems, threaten industry, damage infrastructure, and cause secondary impacts such as erosion, increased risk of landslides and flooding after fires.[7]

For more information, refer to: The First Public Report of the National Risk Profile (publicsafety.gc.ca) and to Public health risk profile: Wildfires in Canada, 2023 - Canada.ca.

2.1.2) Smoke

Populations geographically closest to wildfires have the highest exposure to the effects of fire and smoke from wildfires. However, wildfire smoke can travel large distances and can affect the air quality for extended periods of time, meaning populations across Canada face potential exposure.

Wildfire smoke is a complex mixture of gases, particles and water vapour that contains pollutants such as: sulphur dioxide, nitrogen dioxide, carbon monoxide, volatile organic compounds, fine particulate matter (PM2.5), and ozone. Fine particulate matter (PM2.5) is considered the main public health threat from wildfire smoke. Fine particulate matter is a general term for all small particles found in air measuring equal to or less than 2.5 µm in aerodynamic diameter. Since it is so small, this fine particulate matter can be inhaled deep into the lungs and enter the bloodstream.[8] Health Canada recommends that levels of PM2.5 should be kept as low as possible, as there is no apparent threshold that is fully protective against the health effects of PM2.5.[9,10] As smoke levels increase, health risks increase.

Carbon monoxide (CO) exposure from wildfire smoke does not pose a significant health hazard to the public, as it does not travel far from the original source. However, in the event of an improperly vented or malfunctioning combustion appliance, or if the source of the smoke is close, CO can be a health hazard indoors. Other pollutants present in wildfire smoke including nitrogen oxides (NOx), polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs) contribute to the cumulative hazardous potential of exposure.

For more information, refer to: Guidance for Cleaner Air Spaces during Wildfire Smoke Events –- Canada.ca and Public health risk profile: Wildfires in Canada, 2023 –- Canada.ca.

2.1.3) Health Effects

Wildfires can impact physical health as well as mental health and well-being. Closer proximity to wildfires can pose immediate risk to individuals from direct contact and smoke related health effects.

Most acute symptoms from wildfire smoke are transient and self-resolving. Milder and more common symptoms of smoke exposure include headaches, a mild cough, a runny nose, production of phlegm, and eye, nose and throat irritation. These symptoms can typically be managed without medical intervention. More serious symptoms that should prompt medical assessment include dizziness, chest pains, severe cough, shortness of breath, wheezing (including asthma attacks), and heart palpitations. Less commonly, exposure to wildfire smoke can lead to medical emergencies including heart attack, stroke and premature death.[11]

Exposure to wildfire smoke is associated with several health effects including, exacerbations of asthma and Chronic Obstructive Pulmonary Disease (COPD), increased respiratory infections, and premature

death. Additionally, there is some evidence to suggest an association between wildfire smoke and cardiovascular health effects, mental health and birth outcomes.[12] There is very little evidence on the long-term health effects from seasonal wildfire smoke, because the episodic nature of exposures makes such evidence hard to obtain. Therefore, the long-term effects are typically generalized from population-based studies of the long-term effects of ambient PM2.5, which consider the overall mix of PM2.5 from all sources, including wildfire smoke. In Canada, it is estimated that 54-240 premature deaths are attributable to short-term exposure to wildfire-PM2.5 annually and 570-2500 premature deaths attributable to long-term exposure annually, as well as many non-fatal cardiorespiratory health outcomes.[13]

With respect to mental health, people in closer proximity to a wildfire and evacuees may experience new or worsening post-traumatic stress disorder, depression, generalized anxiety, and other mental health impacts.[5,14,15,16] Evacuation can also result in disruption of traditional and subsistence activities in Indigenous communities, which can negatively impact mental and spiritual well-being. After a wildfire, residents who return home face financial, health and social stresses of rebuilding homes and community, in addition to a devastated landscape that serves as a daily reminder of their loss. This can lead to solastalgia, a form of mental or existential distress caused by environmental change.[17] Exposure to wildfire smoke may also have mental health impacts but the evidence is inconsistent and limited.[18]

Key considerations when determining the potential population health impacts from wildfire exposure include:

- Exposure characteristics: proximity, concentration of smoke, duration of exposure and minute ventilation.
- Population susceptibility: number of people at higher risk and populations in situations of vulnerability.
- Availability of interventions to reduce impacts such as population access to cleaner air spaces.
- Concurrent exposures such as heat.

For more information, refer to: Wildfire smoke, air quality and your health - Canada.ca and Public health risk profile: Wildfires in Canada, 2023 - Canada.ca.

Additional Resources:

- Health impact analysis of PM2.5 from wildfire smoke in Canada (2013–2015, 2017–2018) - ScienceDirect
- Particulate matter 2.5 and 10 - Canada.ca
- BCCDC_WildFire_FactSheet_HealthEffects.pdf

2.1.4) Smoke and Heat

Extreme heat events may occur in parallel to wildfires and exposure to wildfire smoke. Extreme heat events can cause significant morbidity and mortality. For example, over 600 people in BC died during an extreme heat event that occurred June 25-July 1, 2021.[19,20] In most cases, extreme heat is the more immediate risk to health and cooling should be prioritized over clean air if needed.

For more information, including advice for the public, refer to: https://www.canada.ca/en/health-canada/services/publications/healthy-living/combine-wildfire-smoke-heat.html and Extreme heat events: Overview - Canada.ca

Additional Resources:

- Medical health officers' letter about heat and smoke (interiorhealth.ca)
- Continuing Education Course: Wildfire Smoke and Your Patients' Health Wildfire Smoke and Your Patients' Health | US EPA
- Health of Canadians in a Changing Climate: Advancing our Knowledge for Action
- BC factsheet: Wildfire smoke during extreme heat events

2.1.5) High Risk Populations

Everyone's health is at risk from the pollutants in wildfire smoke but people at higher risk include:

- Older adults
- Pregnant people
- People who smoke
- Infants and young children
- People who work outdoors and those who have an occupational exposure
- People involved in strenuous outdoor exercise
- People with an existing illness or chronic health conditions, such as cancer, diabetes, lung or heart conditions

For more information, refer to: Wildfire smoke, air quality and your health - Canada.ca.

2.1.6) Equity Considerations

Wildfire associated health hazards are not experienced uniformly amongst populations in Canada. A range of social determinants of health (SDOH), including age, sex and gender, and socioeconomic status, among others, influenced the health outcomes of various population groups experiencing wildfires. These differential impacts included mental health and physical health outcomes as well as social and community impacts. Wildfires are expected to have a disproportionate impact on the high risk populations identified above as well as people who may experience other health equity limitations such as people with disability, those with lower socio-economic status, and Indigenous communities.[7] Populations living in communities closer to high fire-risk areas also experience higher rates of adverse physical and mental health impacts. Rural and remote areas and Indigenous communities are most often evacuated due to wildfires.

Wildfire evacuations can impact the mental and physical health, well-being, and social stability of evacuees who stay in host communities, as severe wildfires can cause prolonged evacuations. Evacuated communities have to wait until authorities deem that the wildfire hazard has passed and that it is safe for communities to return home. Host community arrangements also vary significantly across Canada and Indigenous evacuees have faced inadequate language, cultural, health and spiritual supports, insufficient or crowded communal and hotel accommodations, and racist treatment while evacuated.[21]

Even in the absence of evacuation, wildfires can restrict access to communities, especially those that are more remote with limited entry/exit points, due to impacts on infrastructure (e.g., highways/roads) and services; this can result in a lack of health and related services including medical supplies, personnel, and food.

The impacts of wildfires can be worse for many high risk populations and populations in situations of vulnerability, including those experiencing inequities. It is important that a health equity lens and cultural safety principals be embedded in the public health actions and interventions listed in this document. The recent 2022 Chief Public Health Officer report regarding public health action on climate change in Canada also emphasized how systemic inequities drive one's exposure, sensitivity, and adaptive capacity to climate hazards as different individual factors and SDOH influence people's climate vulnerability. Therefore, it is important to understand the ways different population groups, especially those already in situations of vulnerability, in Canada experience and are affected by wildfires to ensure that emergency management protocols and plans can incorporate evidence-based equity considerations and be well-positioned to support the needs of all people.

For more information, refer to: Public health risk profile: Wildfires in Canada, 2023 - Canada.ca.

2.2) Partnerships

Wildfire prevention, mitigation, preparedness, response and recovery is complex, involving intersectoral and interjurisdictional collaboration, community engagement, and the use of many sources of information in decision making. A key strength in public health efforts on any health issue is the value of convening and collaborating across diverse sectors and partners. Public health authorities develop relationship and trust with community groups, diverse leaders and response partners through a variety of public health programs and functions that are foundational to adaptation and mitigation measures for climate related events.

Since 2007, federal, provincial and territorial collaboration in emergency management has been guided by the Emergency Management Framework for Canada.[22] In Canada, emergencies are managed first at the local level. This may involve municipalities, fire departments, police, paramedics, hospitals, local public health, and other members of the emergency response team. If assistance is needed at the local level, a request can be made to the applicable province or territory. If the emergency exceeds the province or territory's capacities, the provincial or territorial government can request assistance from the federal government.

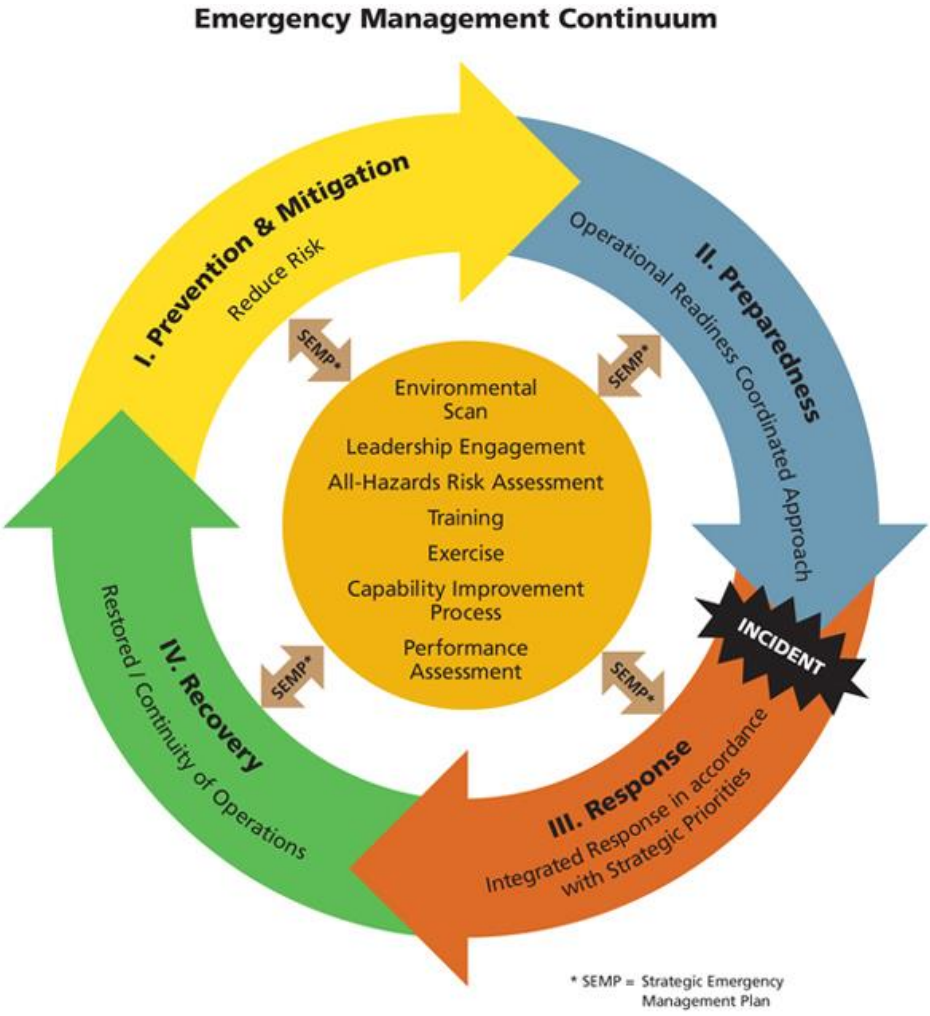
Once the federal government becomes involved, the federal response is coordinated using the 2011 all-hazards Federal Emergency Response Plan. In most cases, federal government institutions manage emergencies with event-specific or departmental plans in addition to the processes outlined in the Federal Emergency Response Plan.[7] The federal government has responsibilities for federal emergency response coordination; disaster financial assistance to provinces and territories; national situational awareness for wildfire events if requested by wildland fire management agencies; and for wildfires on national park land and military bases.[7] The Canadian Armed Forces may also be requested to assist in disaster response (e.g., Operation LENTUS).[23]

At the international level, Canada joined 187 countries at the United Nations (UN) General Assembly in 2015 in adopting the UN Sendai Framework for Disaster Risk Reduction (2015-2030).[24] This framework is a non-binding international agreement that establishes international priorities for disaster risk reduction. As a signatory to the Sendai Framework, the Government of Canada has committed to improving resilience strategies, preparedness efforts, early warning systems and cooperation to reduce disaster risks.[7]

3) Public Health Action and Interventions

Public health authorities at various levels of government may be involved in a variety of actions and interventions with respect to the emergency management of wildfires. There are potential actions and interventions for each of the 4 interdependent components of emergency management: prevention and mitigation, preparedness, response and recovery. It is recognized that these components can be undertaken sequentially or concurrently. Examples of potential interventions for each component are offered in subsequent sections.

Figure 1: The Emergency Management Continuum[25]



The resources in the list below provide content that encompasses all 4 components of the Emergency Management Continuum. Some specific links from these comprehensive resources are also provided under the respective component specific sections in this document. In addition, available provincial and territorial guidance documents are linked at the end of this document.

Wildfires (Canada.ca) – this Government of Canada Wildfires landing page has resources on the current situation, emergency response, support, recovery, and information for the public.

Wildfire Smoke and Health | National Collaborating Centre for Environmental Health (NCCEH – CCSNE) – this website has multiple resources regarding Wildfire Smoke and Health.

Wildfires (CDC) – this US Centres for Disease Control and Prevention page on wildfires has information on preparing for wildfires, staying safe during a wildfire, and staying safe after a wildfire.

Public health responses to wildfire smoke events | National Collaborating Centre for Environmental Health (NCCEH – CCSNE) – this resource is meant to better understand the perceptions, challenges and needs of public health practitioners in Canada when responding to wildfire smoke events.

3.1) Prevention and Mitigation

The two main components of a public health risk are the likelihood the hazard will occur and the potential impact of the hazard on an affected individual, group, population, system or society. From a public health perspective, prevention and mitigation of wildfire risk requires an examination of how both of these risk components can be reduced in order to minimize the negative physical and mental health impacts in a population. This includes identification of specific high-risk groups, settings and circumstances, as well as actions that can reduce exposure and vulnerability and enhance capacities and capabilities of whole-of-society emergency management.

3.1.1) Potential public health actions for prevention and mitigation

Supporting climate change mitigation measures.

Completing climate change and health vulnerability and adaptation (V&A) assessments.

Public communication and awareness raising initiatives regarding:

- the role of climate change in the occurrence of health hazards like wildfires
- human behaviours that increase the likelihood of a wildfire
- the ways wildfires impact peoples' health

Public health interventions to reduce the prevalence of chronic diseases that can put people at higher risk to the adverse effects from wildfires.

Initiatives to reduce inequities with respect to the social determinants of health and bolster individual and community resilience.

Promoting and engaging with communities and partners on wildfire prevention and mitigation measures.

3.1.2) Tools and Resources

The following reports provide context and content that may support the risk mitigation actions identified above.

Health of Canadians in a Changing Climate — Advancing our Knowledge for Action – this Health Canada report from 2022 includes chapters on: Air Quality, Climate Change and Health Equity, and Adaptation and Health System Resilience. A fact sheet on Climate Change, Wildfires and Canadian's Health that is based on the scientific assessment in the report is also available.

Mobilizing Public Health Action on Climate Change in Canada – this 2022 Chief Public Health Office of Canada Report examines the impacts of climate change on the physical and mental health of people in Canada, and the role that public health systems can play to prevent and reduce these impacts across the country.

Canadian Wildland Fire Strategy. A 10-year review and renewed call to action. (nrcan.gc.ca) – this report of the Canadian Council of Forest Ministers Wildland Fire Management Working Group from 2016 speaks to the need to enhance prevention and mitigation capability through increasing community responsibility and engagement and improving planning through collaboration and consultation with communities, First Nations and stakeholders. This progress report is not health focused but may serve as a reminder of previous commitments to steps that may benefit from public health engagement.

National Collaborating Centre for Environmental Health (**NCCEH - CCSNE**) - this website has multiple resources regarding Wildfire Smoke and Health. The Mitigating Wildfire and Smoke Risks section includes the following resources:

- **Wildfire management in Canada: Review, challenges, and opportunities (Tymstra *et al.*, Jan 2020)**
  This ***peer-reviewed article*** takes a broad view of wildfire management in Canada, providing important perspectives regarding the need to protect public health and safety while recognizing that current strategies are insufficient.
- **FireSmart™ Canada (2021)**
  This program, now administered by the Canadian Interagency Forest Fire Centre (CIFFC) is an essential resource for communities and citizens wishing to make their communities and properties "fire smart". Resources include manuals, articles, online courses, in-person workshops, and case studies of FireSmart™ Neighbourhoods across Canada. Many resources are available in both official languages.
  - **FireSmart™ BC homeowner's manual (Sept 2019)**
    This excellent illustrated ***guidebook*** instructs individual homeowners on how to dramatically reduce the risk that a wildfire will spread within the property.
  - **FireSmart™ guidebook for community protection (Government of Alberta, 2013)**
    This streamlined FireSmart™ ***toolkit*** provides essential background information, templates, and tools to help communities develop a wildfire response plan, based on local wildfire risk, based on topography, fuel types, and other factors. Communication strategies used in the guide are discussed in this ***peer-reviewed article***.

First Nations Fire Protection Strategy, 2023 to 2028 (sac-isc.gc.ca) – this strategy, co-developed by the Assembly of First Nations (AFN) and Indigenous Services Canada (ISC) promotes fire protection on reserve.

Lung Health Foundation – this foundation's website provides content for high-risk populations that links to Government of Canada content on wildfires. However, it also provides content on lung diseases (e.g., childhood asthma, COPD) and how to protect your lungs for the general public.

National Collaborating Centre for Determinants of Health – this website includes multiple resources that address various aspects of the determinants of health and current inequities in Canada.

Thirteen public interventions in Canda that have contributed to a reduction in health inequalities – this 2010 report from the National Collaborating Centre for Healthy Public Policy, identifies policies and programs that have been shown to reduce health inequities in Canada.

National Indigenous Fire Safety Council - this website contains the Wildland Urban Interface (WUI) Community Preparedness Digital Tool, National Incident Reporting System (NIRS), as well as programs in seven program areas, two of which focus on fire department management and community governance. The latter supports the development of policies and bylaws, communication plans and fire emergency plans.

3.2) Preparedness

Preparedness for a wildfire event includes identifying and addressing response capabilities[26], specifically outstanding needs and gaps that public health authorities might be in a position to fill. It may involve working with health and emergency management partners, and engaging inclusively and meaningfully with communities and individuals to build capacity and resilience across different population groups to ensure that health inequities are not inadvertently worsened. For some jurisdictions, wildfires are seasonal events and preparedness involves more "reminders", "re-assessment" and "reinstatement" type activities, whereas for other jurisdictions preparedness activities may include the development of new plans, training and exercises, arrangements/acquisitions, emergency information and public education products.

3.2.1) Potential public health actions for wildfire preparedness

Coordinate with partners including engagement with people with lived or living wildfire experience.

- This should include Indigenous Peoples and those who are disproportionately impacted by the effects of wildfires.

Identify roles and responsibilities for public health authorities at all levels of government in the event of a wildfire emergency.

Create emergency response plans for which interventions would be used/recommended under specific circumstances (i.e., with triggers for action).

Identify and ensure timely access to surveillance data streams and foster agreement on data thresholds/ranges that will be needed to inform decision making during response and recovery periods.

- Consider not just air pollution but also water and soil contamination, contaminated food sources (animal and animal products), and impact on wildlife that are potentially part of food security.

Identify potential cleaner air space locations, considering cultural needs, safety issues and protocols for use.

Recommend engineering evaluations of HVAC systems for institutions and public locations as needed (e.g., critical infrastructure).

Identify/ensure public health awareness of regions/communities at risk for wildfire smoke events, and identify high risk sub-groups in these areas.

Contribute from a health perspective to public communication and awareness raising initiatives regarding individual and institutional preparedness actions:

- Make personal/institutional emergency response plans for evacuation, sheltering in place, in-home cleaner air space and access to necessary medication and health services (when sheltering in place and in the event of an evacuation)
- How to manage heat and smoke events at the same time
- Recognizing if you are at high risk for wildfire related physical and mental health hazards and what you can do about it in advance
- Optimize personal and institutional HVAC systems to maintain clean indoor air
- Acquisition/access to N95 respirators

Identify and plan for mental health supports – including but not limited to:

- Stress related violence
- Companion animal care
- Economic hardship
- Prolonged absence from home, communities, daily routines
- Loss of life, property, culturally significant locations and infrastructure

Consider resource availability, procurement and stockpiling needs for:

- HVAC filters
- Air purifiers
- Air quality monitoring devices
- N95 respirators

3.2.2) Tools and Resources

The following reports provide context and content that may support the preparedness actions identified above.

"How to Prepare for Wildfire Smoke" factsheet **(Health Canada, June 2021)** -a public educational fact sheet that includes a "Checklist for wildfire smoke season preparedness"

Guidance for Cleaner Air Spaces during Wildfire Smoke Events **(Health Canada, September 2020)** – a guidance product that includes preparedness content pertaining to this intervention

National Collaborating Centre for Environmental Health (**NCCEH - CCSNE**) - this website has multiple resources regarding Wildfire Smoke and Health. The Preparedness and Response Planning section includes the following resources:

- **Prepare for the worst: Learning to live with wildfire smoke (Henderson, June 2021)**
  This ***webinar*** provides an overview of the worsening fire risks in western Canada and demonstrates the almost immediate public health impacts of smoke exposure to the community. The presentation also covers some of the tools and strategies that can be used to reduce health impacts and achieve the necessary state of preparedness for a smokier future.
- **Planning framework for protecting commercial building occupants from smoke during wildfire events (ASHRAE, June 2021)**
  This ***guidance document*** provides detailed information on heating, ventilation, and air conditioning (HVAC) and other building measures to protect occupants against smoke exposure, while also accounting for potential SARS-CoV-2 transmission. The document outlines how to develop, implement and evaluate a smoke readiness plan, with numerous additional linked resources.
- **BC Health and Smoke Exposure (HASE) coordination committee guideline (BC Centre for Disease Control, June 2023)**
  The purpose of this ***advisory document*** is to describe the coordination of regional, provincial and federal measures to minimize the public health impacts of wildfire smoke. It describes the roles and responsibilities, and process of activation, coordination and response to wildfire smoke, as well as assessing outcomes and making recommendations to protect public health interventions. Although specific to BC, this may be useful to policy makers in other jurisdictions.
- **Wildfire smoke: a guide for public health officials (US Environmental Protection Agency, Aug 2019)**
  This ***guide*** is designed to help public health officials prepare for smoke events, take measures to protect the public, and communicate with the public about wildfire smoke and health.
- **Forest fires: a clinician primer (Nsoh *et al.*, July 2016)**
  This ***article*** succinctly reviews populations most at risk during fire events, tools for situational awareness (e.g., smoke forecasting and environmental monitoring), and steps that can be taken to protect patients.
- **Guidance for BC public health decision makers during wildfire smoke events (BC Centre for Disease Control, Sept 2014)**
  This ***advisory document*** provides public health decision makers with current evidence and BC-specific guidance for the assessment of, preparation, and possible interventions for a wildfire smoke event.

- **Public Health Planning for Wildfire Smoke (Maguet, Aug 2019)**
  This ***report***, which is a follow-up to Maguet (2018) cited below, describes a multi-jurisdictional qualitative inquiry into current public health planning for wildfire smoke events. It also addresses the capacity to respond to wildfire smoke events and perceptions of wildfire smoke as a public health priority.

About FireSmart™ | FireSmart™ Canada – this is a website for a national program that helps increase neighborhood resilience to wildfire and minimize its negative impacts in Canada. It includes multiple preparedness educational resources and tools for the public and has links to provincial and territorial liaisons.

National Indigenous Fire Safety Council - this website contains the Wildland Urban Interface (WUI) Community Preparedness Digital Tool, National Incident Reporting System (NIRS), as well as programs in seven program areas with a focus on fire prevention and public education programs for Indigenous communities

Emergency Preparedness Guide for Community Members – this guide prepared by the Northern Inter-Tribal Health Authority (updated in 2021) includes information, tools and resources for northern communities, with an emphasis on wildfire smoke-related risk management.

Wildfire smoke and animals – this web content from the American Veterinary Medical Association includes signs and symptoms to watch for in your animals, and tips to protect pets and livestock.

Pets and Disasters - to plan for disasters and includes tools like a pet evacuation checklist. There are also links to content for horse owners, and large animals and livestock in disasters.

Appendix A – Federal Government Roles – Wildland fires – this is an example of the mapping of federal government roles and responsibilities. A similar document could be developed as part of preparedness activities that ensure awareness and engagement between public health authorities and partners at other levels of government.

3.3) Response

The public health response to wildfires may vary between jurisdictions. Depending on the roles and responsibilities of the various responders and government departments, public health's involvement could range from providing education and advice, to making recommendations, to issuing directive actions. However, in all situations it is expected that the focus of the public health response will be on measures, activities and interventions that reduce the negative physical and mental health impacts of the wildfire events with specific consideration of health equity issues. The concurrent use, or "layering", of multiple measures will support a comprehensive response to the health risks.

3.3.1) Potential public health actions for wildfire response

Provide advice/recommend/direct communications, regarding:

- How to assess your risk during smoke events, including visual assessment and how to access and interpret air quality monitoring data (e.g., local AQHI)
- Who is most at risk and what they should do differently
- When to reduce time spent outdoors
- When to decrease physical exertion outdoors
- When to cancel outdoor events
- When to go to a cleaner air space (in home or community) and how to set up one in your home
- Effective use of air purifiers and filters
- How to set up a community clear air shelter
- When and how to wear an N95 respirator
- What to do when both smoke and heat events are occurring concurrently
- How to access critical medical supplies, services and medications during smoke and fire events
- When and who to evacuate

Monitor surveillance data and update messaging and public health actions as needed.

Act as part of an interdisciplinary emergency response team.

3.3.2) Tools and Resources for: Key Public Health Measures, Activities and Interventions

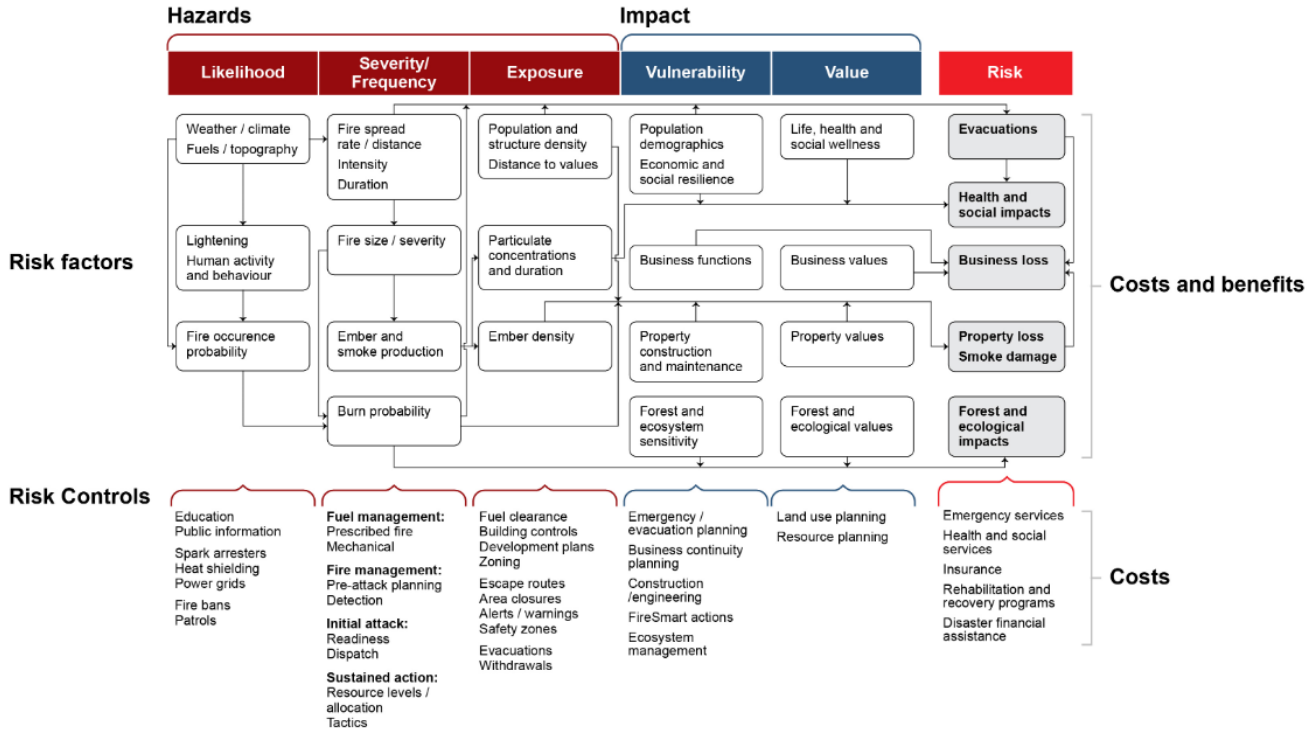
This section provides more in-depth reviews of key potential public health interventions and activities. Links to several tools and resources are embedded in each topic section.

- Situational Awareness

Situational awareness and risk assessment involve consideration of weather, wildfire and wildfire smoke forecasting, air quality measurements, and health surveillance if available. When wildfire, wildfire smoke, and heat events co-occur, it is important to balance the public messaging and interventions to protect from immediate life-threatening effects of heat and wildfire, and secondarily protect against wildfire smoke.

The First Public Report of the National Risk Profile (publicsafety.gc.ca) outlines the risks associated with wildfires as summarized in the following figure.

Figure 2: Wildland fire risk logic model[7]



It can be difficult to predict wildfires and there is a degree of uncertainty to hazard mapping tools. Consultation with experts in wildfires, provincial emergency management and related threat analysis may be needed.

The Canadian Wildland Fire Information System provides detailed information regarding current and projected wildfires. This includes forecasted weather information provided by the Canadian Meteorological Centre.[27]

Equitable and meaningful engagement with Indigenous Peoples who have been naturally caring for the land through cultural burning for centuries could also inform situational awareness. In addition, the following website: Wildfire risk and Indigenous communities (sac-isc.gc.ca) shows the locations of Indigenous communities and their proximity to recent wildfires. The information in this map comes from The Canadian Wildland Fire Information System at Natural Resources Canada.

- Air Quality

Smoke Forecasting

FireWork is an air quality prediction system that indicates how smoke from wildfires is expected to move across North America over the next 72 hours.

Air Quality Assessment

There are several methods to assess air quality. Traditional monitoring networks or sites use highly accurate, precise, and standardized instruments (United States Environmental Protection Agency (US

EPA) certified federal equivalent method monitors), which require trained technicians to maintain and operate. These sites are the "gold standard" for monitoring regional-scale trends in air quality across large geographic areas and are used by F/P/T governments for establishing air quality trends, assessing air quality impacts on health and the environment, and informing long term F/P/T air quality management strategies and compliance with Canadian ambient air quality standards. As of July 2023, there are 286 sites in 203 communities across Canada under Environment and Climate Change National Air Pollution Surveillance Program - Canada.ca.

To provide wildfire smoke information in rural areas, low-cost sensors that measure Fine Particles (PM2.5) can provide a lower accuracy measurement of fine particulate matter (PM2.5) when compared with traditional monitoring networks. These sensors can supplement traditional monitoring networks during wildfire events to better understand differences in pollutant concentrations within communities due to topography, wind direction or proximity to a source and can be particularly useful in rural or remote areas. In collaboration with UNBC, the aqmap.ca AQmap (EN) (unbc.ca) is available with real-time data as well as other wildfire smoke products such as map overlays of smoke plumes, active fires, and fire weather index. Models are currently used to forecast AQHI and wildfire smoke to all of Canada.

Air Quality Health Index (AQHI)

The Air Quality Health Index (AQHI) reaches 80% of the population with 123 locations reporting observations and forecasts across Canada. Major cities are available at Air Quality Health Index (weather.gc.ca) with additional communities and stations listed by province or territory.

The Air Quality Health Index was developed in 2007 by Canadian researchers, as a replacement to the single pollutant Air Quality Index, to better communicate the combined short-term health risks from multiple pollutants present in air pollution in Canadian cities. This scale was developed by calculating excess mortality risk due to three pollutants: ozone (0_3), particulate matter (PM2.5/PM10), and nitrogen dioxide ($N0_2$).[28]

Wildfire smoke differs from typical urban smog in that PM2.5 is generally present in higher concentrations. During wildfire smoke situations, the AQHI may under represent respiratory health risks since PM2.5 is most closely associated with short-term respiratory health effects from wildfire smoke.[29] In response to this concern, British Columbia developed an amendment to the AQHI, called the AQHI+ which reflected the increased respiratory health risks associated with PM2.5 from wildfire smoke. This amendment was validated in 2020 as being a better predictor of asthma-related health outcomes than the AQHI.[29] Since that time, the AQHI+ has been implemented across Canada by Environment and Climate Change Canada in conjunction with most provinces and territories. The two indices, AQHI and AQHI+ are calculated simultaneously in real time, with the higher value being reported. This is done in the background and the value reported does not state whether it is a AQHI value or an AQHI+ value. It was estimated that across BC, the AQHI+ would be expected to override the AQHI 0.4% of the time during low-intensity wildfire seasons (based on the 2011 season) and 3.8% of the time during high-intensity seasons (based on 2017 data).

The provinces of Alberta and Ontario do not incorporate AQHI+ into their index (as of Summer 2023). Quebec uses InfoSmog to predict smoke risk which is calculated using PM2.5 and ozone. More information is available at: How Info-Smog works - Canada.ca

AQHI Health Risk Messaging:
The evidence to date does not identify any "safe" exposure-response thresholds to wildfire smoke. The AQHI was found to be associated with a 1% increase in all-cause mortality per unit increase. The AQHI+, in comparison, was found to have a 0.5% increase in all-cause mortality per unit increase. During wildfire smoke situations, the AQHI remains the best indicator of short-term mortality and circulatory risks. However, the AQHI+ best reflects the respiratory risks during these situations.[29]

Figure 3: Air Quality Health Index Risk Scale[30]

- 1-3 Low health risk
- 4-6 Moderate health risk
- 7-10 High health risk
- 10 + Very high health risk

See the section on section on public messaging for more details on using the AQHI in public communications.

Additional Resources:

- The original research related to the AQHI A New Multipollutant, No-Threshold Air Quality Health Index Based on Short-Term Associations Observed in Daily Time-Series Analyses: Journal of the Air & Waste Management Association: Vol 58, No 3 (tandfonline.com)
- Subsequent articles specific to the AQHI:
  - Assessment of the Air Quality Health Index (AQHI) and four alternate AQHI-Plus amendments for wildfire seasons in British Columbia | SpringerLink
  - Full article: Evaluating an Air Quality Health Index (AQHI) amendment for communities impacted by residential woodsmoke in British Columbia, Canada (tandfonline.com)
- Guide to Air Quality Health Index forecasts - Canada.ca
- Wildfire smoke, air quality and your health - Canada.ca
- health-alberta-air-quality-notification-protocol-what-you-need-to-know.pdf
- BCCDC wildfire smoke and AQHI factsheet

Special Air Quality Statements
Special Air Quality Statements (SAQS) may also be issued for impacted communities. SAQS contain information about the source, expected duration of wildfire smoke events and advice on how to protect health during smoke events. These statements can be found on the Environment and Climate Change Canada website, WeatherCAN app, or often through local weather forecasts.

- Cleaner Air Spaces

Cleaner air spaces are an effective intervention that can be used to decrease the health risk associated with wildfire smoke. Private homes as well as public spaces can be designed to be cleaner air spaces to reduce individuals' exposure to wildfire smoke. This may include using appropriate HVAC system filters,

portable air cleaners, and ensuring well-sealed doors and windows to reduce the in infiltration of outdoor air.[9] Health Canada has developed a comprehensive resource entitled Guidance for Cleaner Air Spaces during Wildfire Smoke Events - Canada.ca which provides information in this area.

Additional Resources:

- WFSG_EvidenceReview_CleanAirShelters_FINAL_v3_edstrs.pdf (bccdc.ca)
- IJERPH | Free Full-Text | Can Public Spaces Effectively Be Used as Cleaner Indoor Air Shelters during Extreme Smoke Events? (mdpi.com)
- Portable air cleaners should be at the forefront of the public health response to landscape fire smoke | Environmental Health | Full Text (biomedcentral.com)
- Do-it-yourself (DIY) air cleaners: Evidence on effectiveness and considerations for safe operation | National Collaborating Centre for Environmental Health | NCCEH - CCSNE

Fact Sheets for the public:

- Wildfire smoke 101: Using an air purifier to filter wildfire smoke - Canada.ca
- BCCDC_WildFire_FactSheet_BoxFanAirFilters.pdf
- FNHA-Air-Purifier-Support-2023-Wildfire-Season.pdf
- FNHA-Wildfire-Smoke-Clean-Air-Shelters-Information.pdf

- Public Messaging

Effective risk communication with the public is important to achieve public health objectives during wildfire smoke events. Risk communication aims to communicate potential crisis and emergency situations, inform people about the hazard(s), share directive actions, promote goodwill, and reduce panic.[31]

Some resources for risk communication that may be useful when framing and delivering public messaging during a wildfire response include:

- The Crisis and Emergency Risk Communication (CERC) manual and associated wallet card
  - Identifies the 6 principles of risk communication: be first, be right, be credible, express empathy, promote action, and show respect.
- The US Environmental Protection Agency (EPA)'s Seven Cardinal Rules of Risk Communication (adapted from Covello and Allen, 1988)[32]
- Peter Sandman's Risk Communication website

Based on a recent rapid evidence profile by McMaster Health Forum, additional considerations for risk communication during a wildfire event include using short health-alert-style messages with plain-language content (including information on guidance, timeframe, geographic location, and specific hazards) and aiming for tailored, translated and more frequent messaging. With respect to communication channels, the evidence profile also identified that television, online (including social media) and smart phone based (e.g., mobile apps) communications are generally preferred sources of information. However, older adults and other populations who may have increased exposure or health risks, may prefer radio and television communications.[33,34]

When communicating with the public as part of the response to a wildfire, it is important to understand local community context and to be adapt and update messages accordingly.

Public messaging during a wildfire response may include:

- What wildfire smoke is
- Health effects
- The level of risk (and who may be at increased risk)
- Recommendations on what to do to protect health
- Information on the combined risk of smoke and heat (where applicable)
- Specific messaging for at risk populations
- Mental health considerations
- Sharing directive actions from response agencies

Example of key messages for the public to protect themselves during a wildfire event:

For those affected by **fire**:

- Be prepared to evacuate. If told to evacuate, do so.
- Monitor local radio stations or news channels for up-to-date information on the fire and possible road closures.
- If you do not evacuate, protect your indoor air by closing all windows and doors in the house to reduce debris and smoke entering your home. Follow instructions on how to minimize fire damage.
- Move all combustibles away from the house, including firewood and lawn furniture. Move any propane barbeques into the open, away from structures.

For those affected by **smoke**:

- Pay attention to air quality by referring to the Air Quality Health Index (AQHI) or other indicators of smoke levels in your area to help identify your level of risk and actions you can take to protect your health. Take note of any special air quality statements issued as part of your weather forecast.
- If you can, protect your indoor air from wildfire smoke by keeping windows and doors closed, and using a clean good quality air filter in your ventilation system. If possible, consider using a portable air purifier to remove smoke from your home or designated room. If you have an air conditioning system, ensure it is set to recirculation mode or close the outdoor intake damper. For more information on selecting a portable air purifier that is appropriate for your needs, refer to the "Using an air purifier to filter wildfire smoke" factsheet.
- If there is an air quality advisory and an extreme heat event, use your air conditioner. If you don't have an air conditioner, it may not be safe to stay inside with doors and windows closed when it's hot outside. When there is an extreme heat event occurring with poor air quality, cooling should be prioritized and staying hydrated is important.
- Consider reducing or rescheduling outdoor activities (especially strenuous physical activities) where possible when the air quality is affected by smoke. If you spend time outdoors, consider wearing a well-fitted respirator type mask, such as an N95 mask, to decrease exposure to smoke.
- If it's difficult to find clean, cool air, contact your local jurisdiction for information on local cooling and clean air spaces. This is also something you can do during extreme heat events.
- Take care of your mental health during a wildfire smoke event. Anyone who is having trouble coping with symptoms of stress, anxiety or depression should seek help from a health professional.

It is important to develop tailored messages for people at higher risk during a wildfire response. At risk populations in particular should be advised to listen to their bodies and to reduce or stop activities if they are experiencing symptoms. For more information, visit: Wildfire smoke, air quality and your health - Canada.ca.

The recent rapid evidence profile from McMaster Health Forum also pointed to the need for short plain-language content that is tailored to specific populations, notably those who do not speak English and those who are unable to adhere to advice for the general population (e.g., individuals who are homeless or precariously housed). However, additional research is needed to identify the most effective ways to target risk communication for populations at the highest risk of smoke exposure.[34] Public health authorities may want consult local or regional service providers and advocates to determine the best way to reach specific populations.

Additional Resources:

- Which Populations Experience Greater Risks of Adverse Health Effects Resulting from Wildfire Smoke Exposure? | US EPA
- Effectiveness of public health messaging and communication channels during smoke events: A rapid systematic review - PubMed (nih.gov)
- WFSG_EvidenceReview_ReducingTimeOutdoors_FINAL_v6trs.pdf (bccdc.ca)

Fact sheets for the public:

- Wildfire smoke, air quality and your health
- Wildfire smoke 101: Wildfire smoke and your health - Canada.ca
- Wildfire smoke 101: How to prepare for wildfire smoke
- Factsheet: Protecting your indoor air from outdoor pollutants
- Wildfire smoke 101: Using an air purifier to filter wildfire smoke
- Wildfire Smoke Factsheets (bccdc.ca)
- Be Ready! Wildfires
- Wildfires: Before, During and After - Canadian Red Cross
- MyHealth: Wildfire smoke and your health
- FNHA_Recognizing_and_Resolving_Trauma_in_Children.pdf
- FNHA-Recognizing-and-Addressing-Trauma-and-Anxiety-During-Wildfire-Season.pdf
- Wildfires | Inspection, Compliance and Enforcement (novascotia.ca)
- Forest Fire Smoke and Your Health | Environmental Health | Government of Saskatchewan

Additional information for the public on AQHI-based health messages

The AQHI provides tailored messages to populations with increased risk from air pollution at each AQHI health risk level. It communicates air quality health risks using four primary components;

- It measures the air quality in relation to health risk on a scale from 1 to 10+. The higher the number, the greater the health risk associated with the air quality. When the amount of air pollution is very high, the number will be reported as 10+.
- A category that describes the level of health risk associated with the index reading (e.g. Low, Moderate, High, or Very High Health Risk).
- Health messages customized to each category for both the general population and the 'at risk' population.
- Current hourly AQHI readings and maximum forecast values for today, tonight, tomorrow and the next day.

The following table provides the health messages for 'at risk' individuals and the general public for each of the AQHI Health Risk Categories.

Table 1: Health messages by AQHI Health Risk Categories[35]

Health Risk	AQHI	Health Messages	
		At Risk Population*	General Population
Low	1 - 3	Enjoy your usual outdoor activities.	Ideal air quality for outdoor activities.
Moderate	4 - 6	Consider reducing or rescheduling strenuous activities outdoors if you are experiencing symptoms.	No need to modify your usual outdoor activities unless you experience symptoms such as coughing and throat irritation.
High	7 - 10	Reduce or reschedule strenuous activities outdoors. Children and the elderly should also take it easy.	Consider reducing or rescheduling strenuous activities outdoors if you experience symptoms such as coughing and throat irritation.
Very High	Above 10	Avoid strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion.	Reduce or reschedule strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation.

* People with heart or breathing problems are at greater risk. Follow your doctor's usual advice about exercising and managing your condition.

For more information, see the section on AQHI and refer to: Understanding Air Quality Health Index messages - Canada.ca.

Additional information for the public on indoor air filtration

In addition to the key messages listed above, public messaging may need to include further details on how individuals can protect their indoor air.

Example of Health Canada public messaging on ventilation and air cleaners:

During a wildfire smoke event, people should keep windows and doors closed. If there is an air quality advisory and an extreme heat event, use air conditioning. If air conditioning is not available, it may not be safe to stay inside with doors and windows closed in the heat.

It is also important to consider ways to filter indoor air and limit the infiltration and intake of pollutants from outdoors. It is therefore recommended that people install the highest quality filter their ventilation system will allow, according to manufacturer's instructions or use a certified portable air purifier with a HEPA filter, to help remove wildfire smoke particles from the indoor air.

Air purifiers are self-contained air filtration appliances that are designed to clean a single room. They remove particles from the room they are operating in by pulling the indoor air through a filter that traps the particles. More information about selecting and using portable air purifiers can be found in Health Canada's Wildfire smoke 101: Using an air purifier to filter wildfire smoke factsheet.

Additional information for the public on the combined risk of smoke and heat

In Canada, wildfire season can occur at the same time as periods of extreme heat. It is important to advise the public on how to prioritize their health needs. Generally, the risks from heat should be

prioritized over the risks from smoke. Environment Canada uses defined threshold criteria for heat warnings that can be used to help determine when heat messaging may need to be prioritized. For more details on the combined risk of smoke and heat, visit: Wildfire smoke 101: Combined wildfire smoke and heat.

Example of Health Canada public messaging on the combined risk of smoke and heat:

During a wildfire smoke event, people should keep windows and doors closed. If there is an air quality advisory and an extreme heat event, use air conditioning. If air conditioning is not available, it may not be safe to stay inside with doors and windows closed in the heat.

Additional resources:

- Protect Yourself from Summer Heat and Wildfire Smoke | SaskHealthAuthority
- BCCDC_WildFire_FactSheet_HotWeather.pdf

Additional information for the public on participating in outdoor activities

During wildfire events, it is important to weigh the risks and benefits of being outdoors and participating in physical activity, taking into account unique population characteristics which may vary by location. Communicating risks and benefits to the public can help individuals make informed decisions.

Example of Health Canada public messaging for outdoor activities and events:

Outdoor activity/event organizers, coaches and sport officials should assess environmental conditions using the forecasted AQHI and Special Air Quality Statements (SAQS) information, the level of activity involved, as well as the needs of their participants and spectators, to determine if participating in outdoor activities or events is safe.

Coaches and sports officials can find additional specific advice at: https://sirc.ca/air-quality-and-sport/

Participants and spectators in outdoor events and activities such as sports, outdoor camps, cultural activities, concerts, festivals, etc. should also pay attention to the AQHI and SAQS, monitor symptoms and modify or limit outdoor activities as necessary. If there is an air quality advisory and an extreme heat event, organizers should pay attention to special air quality statements and weather forecasts.

In general:

- When the AQHI is moderate (4-6) and the event involves strenuous physical exertion by at-risk individuals, organizers should be attentive to the potential for participants to experience symptoms (e.g., coughing, throat irritation, shortness of breath, wheezing (including asthma attacks), severe cough, dizziness or chest pains). As smoke conditions can vary considerably from hour to hour, it is important to be prepared for changing conditions and stop activities if necessary.
- When the AQHI is high (7 or higher) or when a SAQS has been issued and the event involves at-risk populations or strenuous physical exertion, organizers are advised to reduce or reschedule the activity.
- When the AQHI is very high (10+), organizers may consider cancelling or rescheduling even if participants are unlikely to be part of the at-risk population and/or there may be a lesser degree of physical exertion associated with the activity.

Additional Resources:

- Air pollution & sport safety - The Sport Information Resource Centre (sirc.ca)
- Air-Quality-Guiding-Document-FINAL-EN.pdf (sirc.ca)

Additional information for the public on masks

Masks are one layer of protection which can be used to protect against wildfire smoke, as discussed in more detail in the masks section of this document. Clear public messaging on when and how to wear a mask properly may be necessary during wildfire response.

> Example of Health Canada public messaging on the use of masks during wildfire events:
>
> A well-fitted respirator type mask (such as a NIOSH certified N95 or equivalent respirator) that does not allow air to pass through small openings between the mask and face, can help reduce your exposure to the fine particles in smoke. These fine particles generally pose the greatest risk to health. However, respirators do not reduce exposure to the gases in wildfire smoke. It is important to listen to your body and reduce or stop activities if you are experiencing symptoms.

Additional resources:

- Wildfire smoke, air quality and your health - Canada.ca

Additional information for the public on mental health resources

Wildfires can impact mental health and well-being. Evacuees may experience new or worsening mental health impacts. After a wildfire, residents may also experience solastalgia, a form of mental or existential distress caused by environmental change.[36] Exposure to wildfire smoke in the absence of direct impacts from closer proximity to wildfires may also have mental health impacts, although this evidence is more limited.[37] Given potential for mental health impacts, it is important to consider specific mental health messaging and supports when communicating to the public during and after a wildfire event.

> Example of Health Canada public messaging for mental health:
>
> It's not unusual to feel anxious, stressed out, sad or isolated during a smoke event. Eating well, getting enough sleep, exercising indoors and staying in contact with friends can help. Anyone who is having trouble coping with symptoms of stress, anxiety or depression should seek help from a health care provider. Remember, a wildfire smoke event may last a long time, but it will eventually end. Sharing positive outlooks and attitudes will help you get through it.

Mental health resources for the public:

- Wellness Together Canada | Home
- Home - Hope for Wellness Helpline
- Mental health support: get help - Canada.ca
- Get support with these mental health resources - Kids Help Phone
- PocketWell app
- Wildfire Smoke and Your Mental Health (albertahealthservices.ca)

- Masks

Masks are one layer of protection which can be used to protect against wildfire smoke. Masks may be especially beneficial for high-risk populations during wildfire smoke events; however, consideration should be given to an individual's ability to wear a mask safely given their underlying health conditions.

The masks that offer the best protection against PM2.5 are well-fitting filtering facepiece respirators (For example: N95).[38] Filtering facepiece respirators with exhalation valves are effective at providing protection from PM2.5, while potentially improving the level of comfort for the user.[39]

Filtering facepiece respirators do *not* protect against the other gases present in wildfire smoke.[40] However, in the current evidence base, the most well known risks to human health from wildfire smoke are from PM2.5.[2,9]

NIOSH-approved Particulate Filtering Facepiece Respirators
Approved Particulate Filtering Facepiece Respirators | NPPTL | NIOSH | CDC
Approved N95 Respirators 3M Suppliers List | NPPTL | NIOSH | CDC
Assessment of international products:
International Assessment Results | NPPTL | NIOSH | CDC

Additional Resources:

- Evidence Review: Using masks to protect public health during wildfire smoke events (bccdc.ca)
- Masking during the COVID-19 pandemic – An update of the evidence | National Collaborating Centre for Environmental Health | NCCEH - CCSNE.
- Respiratory Protection Information Trusted Source | NPPTL | NIOSH | CDC
- Non-occupational Uses of Respiratory Protection – What Public Health Organizations and Users Need to Know | Blogs | CDC
- During public health emergencies, provinces and territories can request N95 masks and other emergency supplies from the National Emergency Strategic Stockpile. Information is located at: National Emergency Strategic Stockpile (NESS) - Canada.ca

Fact sheets for the public:

- BCCDC_WildFire_FactSheet_FaceMasks.pdf
- Wildfire Smoke: Frequently Asked Questions | WorkSafeBC (Occupational Health)
- Face Masks for Wildfire Smoke Poster May 2023 - Draft 2 (nitha.com)
- A Guide to Air-Purifying Respirators, DHHS (NIOSH) Publication No. 2018-176 (cdc.gov)

- Evacuations

Evacuations are a public health tool, which may be used in response to wildfire. As with all interventions, it is important to consider the risks and benefits of an evacuation. In collaboration with other professionals (e.g. emergency management), it may be determined that a community must evacuate due to the imminent risk of a wildfire. However, in the case of wildfire smoke, careful consideration should be given to the use of other protective actions, such as sheltering in place, as the health benefits from evacuating a community due to wildfire smoke are less clear. Wildfire smoke conditions may change rapidly and there are significant risks to the health and well-being of communities from evacuation, including both mental health and socioeconomic effects.[34] A recent retrospective assessment of 41 smoke-related evacuations in Canada found that in approximately half

the situations the criteria used to assess public health protection was met. For further details, refer to: Use of MODIS data to assess atmospheric aerosol before, during, and after community evacuations related to wildfire smoke - ScienceDirect

Wildfires and related evacuations have specific and disproportionate effects on Indigenous Peoples and remote communities. Indigenous communities are more likely to be evacuated than other communities. Pre-existing disparities in health status, such as a higher prevalence of respiratory disease in these populations as well as socioeconomic vulnerabilities in some Indigenous communities lead to increase impacts on Indigenous Peoples.[7] These effects are further outlined in section 5.2.2 Risk to Indigenous Peoples and remote communities in The First Public Report of the National Risk Profile (publicsafety.gc.ca).

In addition, racialized populations, pregnant people and those requiring ongoing access to community resources and infrastructure may also disproportionately be impacted by the physical and mental health issues related to evacuation and relocation.

The effects of long-term displacement and the implications for the public health response are outlined in the following resource: PUBLIC HEALTH RESPONSES FOR LONG-TERM EVACUATION AND RECOVERY – NCCPH

Additional Resources:

- Title: Review of Evidence for the Effectiveness of Evacuation as an Intervention for Forest Fire Smoke (bccdc.ca)
- Wildfire Smoke and Protective Actions in Canadian Indigenous Communities
- During public health emergencies, provinces and territories can request N95 masks and other emergency supplies from the National Emergency Strategic Stockpile. Information is located at: National Emergency Strategic Stockpile (NESS) - Canada.ca

Occupational Health Considerations

Wildfires and wildfire smoke can be a health hazard to emergency response workers and to outdoor workers exposed to smoke. People who work indoors may also be exposed to wildfire smoke at work since outdoor air quality affects indoor air quality.

The level of risk from wildfire smoke exposure in the occupational setting depends on:

- The location of work (indoors vs. outdoors)
- The type of activity being performed
- The duration and frequency of the activity being performed

Not all workers will experience potential adverse health effects from smoke exposure equally. The potential for adverse health effects from wildfire smoke depends on a variety of factors such as the duration of exposure, age of workers, and individual susceptibilities.

The primary approach to minimize health risks from wildfires is to reduce the exposure by limiting contact with smoke. The hierarchy of controls is a method of identifying and ranking safeguards to protect workers from occupational hazards. An example of the hierarchy of controls applied to wildfire smoke can be found at: Wildfire Smoke Health & Safety | Safety & Risk Services (ubc.ca).

If the nature of work requires workers to be outside, some considerations to decrease adverse health and safety risks due to wildfire smoke include looking for ways to reduce physical exertion, using air quality advisories to help inform work schedules, and wearing appropriate personal protective equipment (PPE). **Public health practitioners should also refer to the occupational health and safety legislation in their region for specific guidance around control measures such as recommended PPE.**

Firefighters are required to work in close proximity to the fire and therefore are at higher risk. The International Agency for Research on Cancer (IARC) has evaluated the carcinogenicity of occupational exposure of a fire fighter as carcinogenic to humans (Group 1) based on sufficient evidence for cancer in humans.[41] Wildfire response may also create additional occupational health and safety risks for firefighters. The Canadian Centre for Occupational Health and Safety (CCOHS) page has more details on occupational health risks for firefighters and key considerations. The UCLA Centre for Healthy Climate Solutions, David Geffen School of Medicine at UCLA, and Climate Resolve also put together a Review of the Mental Health Effects of Wildfire Smoke Solastalgia and Non-traditional Firefighters (healthyclimatesolutions.org).

For workers who are primarily working inside, it is important to consider that wildfire smoke can travel long distances from the fire source and affect indoor air quality. Workplaces should take steps to protect their indoor air quality through methods such as keeping windows and doors closed, using a clean high quality air filter in the HVAC system, or using a high-efficiency particulate air (HEPA) filter.

Additional Resources:

- CCOHS: Forest Fires and Wildfire smoke
- CCOHS: Temperature Conditions - Hot
- Fighting Wildfires | NIOSH | CDC
- NIOSH Outdoor Workers Exposed to Wildfire Smoke
- NOISH Hazards Fighting Wildfires – Hazards During Cleanup Work
- Wildfire Smoke: Frequently Asked Questions | WorkSafeBC
- Wild Fire Smoke Safety Poster Draft 1 (nitha.com)
- Research — National Indigenous Fire Safety Council – see research under human component section

3.4) Recovery

Recovery involves actions taken to recover from a wildfire emergency event. This can occur while response activities are ongoing in other parts of the same jurisdiction. Recovery should include restoration of physical infrastructure and the environmental, as well as emotional, social, economic, and physical well-being. It is also a time where decision makers can choose to build back better to reduce risk in the future.

The recovery component of any emergency response often comes at a time when responders are exhausted and ready for a break or at least to move on to other issues that have suffered from the diversion of resources to response-focused activities. It can be an “under-planned” for component of emergency management. The potential health implications of a wildfire and related response measures (e.g., environmental contamination, evacuations) require that public health authorities consider and assess new or residual hazards and risks to human health. While this is not the sole responsibility of public health authorities, it could require engagement of new or previously less involved partners and

government departments (e.g., agricultural and wildlife stakeholders, environmental health and protection authorities). Given the seasonal nature of the wildfire risks, it is important that recovery efforts be adequately resourced to prevent persistent public health concerns and strains on individual and community resilience.

3.4.1) Potential public health actions for wildfire recovery

Monitor surveillance data streams and provide advice/recommend/direct communications, regarding:

- When to discontinue implemented response measures
- Areas and resources (e.g., water, food and soil) that maybe have been negatively affected by wildfire smoke and control measures (e.g., fire retardant)

Collect and assess additional data as needed to identify health concerns with respect to:

- Water quality
- Food and soil contamination
- Wildlife that are potentially hunted for consumption/ food security
- Future risk of flooding and landslides in wildfire affected areas

Provide advice/recommend/direct communications, regarding:

- How to mitigate risks associated with water quality, soil and food contamination, including how to test, clean and prepare water and food prior to consumption or when to discard it
- Precautions to take when cleaning up potentially contaminated personal property (e.g., masks, safe disposal)
- Mental health resources to aid in recovery

Strategic monitoring and evaluation of response measures to inform future public health responses.

Collection of data (disaggregated by socio-demographic and socio-economic factors) to contribute to the evidence base on the impacts of wildfires on various populations.

Work with emergency response partners to identify any lessons learned; in particular for the emergency management of disproportionately impacted populations, and as a result of unprecedented interventions (e.g., the evacuation of an entire city).

3.4.2) Tools and Resources

The following reports provide context and content that may support the recovery actions identified above.

National Collaborating Centre for Environmental Health (**NCCEH - CCSNE**) - this website has multiple resources regarding Wildfire Smoke and Health. The "Returning home after a disaster" section includes the following resources:

- **Alberta Health Services: Wildfire resources (Government of Alberta, 2021)**

This ***webpage*** provides resources to the public on mental health supports, health care services, and information about restoring and preparing homes for reoccupation. Alberta Health Services also provides a guide for reopening businesses and other buildings following a wildfire.

- **Health and safety around fire retardants/suppressants (BC Centre for Disease Control, 2017)**
  This ***document*** helps returning residents to identify the presence of Phos-Chek and Thermo-gel fire retardant/suppressants on their property, and indicates whether garden produce coated in these substances can be safely consumed.

- **Longitudinal community assessment for public health emergency response to wildfire, Bastrop County, Texas (Kirsch *et al.*, Mar 2016)**
  This ***article*** investigated the effectiveness of public health and community response to wildfire smoke immediately and 3.5 years after a 34,064 acre wildfire.

- **Prevalence rates and predictors of generalized anxiety disorder symptoms in residents of Fort McMurray six months after a wildfire (Agyapong *et al.*, July 2018)**
  This academic article examines the prevalence and risk factors of generalized anxiety disorder symptomology in residents of Fort McMurray six months after the wildfire. Significant predictors included witnessing of homes being destroyed by the wildfire, living in a different home after the wildfire, and receiving limited governmental support. The study extends the literature on mental health conditions and risk factors following disasters.

- **After the fire: the mental health consequences of fire disasters (Laugharne, Jan 2011)**
  This evidence review examines the psychosocial effects of wildfires on responders and community members, as well as highlighting groups most at risk for psychological trauma.

Returning home after wildfire evacuation - the Government of Nova Scotia has produced two fact sheets, which are a collection of health and safety items (e.g., PPE for clean-up, food handling and use, well water safety) for the general public to consider. One is for those returning to a property that **has not been** directly impacted by fire damage. The second is for those returning to a property that **has been** directly impacted by fire damage.

Cleaning up after a Forest Fire – this fact sheet produced by the Northern Inter-Tribal Health Authority in 2015, highlights health risks and precautions that can be taken by individuals when cleaning up fire damaged properties.

Safe water - the Government of Nova Scotia has produced two fact sheets: a general one on Safe Water in an Emergency, and a more specific one on Using Well Water after a Wildfire.

Post-Disaster Food Assessment and Salvaging Best Practices – this 2020 literature review and jurisdictional scan commissioned by Alberta Health, includes but is not limited to best practices for inspecting, discarding, cleaning, and retaining food items affected by fires.

Ensure everyone's safety during an emergency **(Government of Ontario, June 2023)** – this web content is not specific to wildfires but includes considerations for children, people with disabilities, seniors and/or pets.

Pets and Disasters - this web content from the American Veterinary Medical Association includes strategies and measures for supporting animal recovery after a disaster.

Flood After Fire – Burned Areas Have an Increased Risk of Flash Flooding and Debris Flows – this content on the U.S. National Weather Service website, succinctly describes this risk that may occur in wildfire affected areas.

Post-wildfire Natural Hazards Risk Analysis in British Columbia – this 2015 technical report describes how to identify, assess and mitigate changes following wildfires, together with an evaluation of downslope and downstream risks to life, property, and infrastructure, or "elements at risk."

Coping with Crisis – this content on the Canadian Red Cross website includes links to several points of contact (e.g., help lines, Canadian Mental Health Association) and useful resources aimed at supporting mental health recovery from disasters and emergencies.

4) Guidance Documents

The following table includes links to publicly available provincial and territorial public health guidance documents. Fact sheets are included in the relevant sections above.

Table 2: Provincial/Territorial Guidance Document Links

PROVINCE/ TERRITORY	PUBLIC HEALTH GUIDANCE DOCUMENTS	MOST RECENT VERSION	INTENDED USERS
Alberta	Community Guide to Wildfire Smoke and Health	2022	Airshed managers, municipalities, companies, schools
	Smoke from outdoor recreational fires and wildfires: jurisdictional review and summary of management options	2018	
British Columbia	BC Health and Smoke Exposure (HASE) Coordination Committee Guideline BC Health Wildfire Smoke Response Coordination Guideline.pdf (bccdc.ca)	2023	Health sector partners including provincial ministries, regional and provincial health authorities, BCCDC, and the Public Health Agency of Canada
	Guidance for BC Public Health Decision Makers During Wildfire Smoke Events	2014	Public health decision makers
First Nations Health Authority	First Nations Health Authority Health Emergency Management Preparedness and Response Guide	2022	BC First Nations Community Leaders

Manitoba	Smoke Exposure from Wildland Fires: Interim Guidelines for Protecting Community Health and Wellbeing	2012	Health sector, communities, community leaders
New Brunswick	Part of *Provincial Health Contingency Plan for Severe Weather, Major Flooding and Wildland Fire*	2022	Department of Health, Health Emergency Management Branch, Health EOC members, and health care system stakeholders
Newfoundland and Labrador	Forest Fire Smoke and Air Quality Public Health Guidelines Microsoft Word - Forest Fire Smoke and Air Quality (Revised May 2018).doc (lghealth.ca)	2016	Public health decision makers
Northwest Territories	Smoke Exposure from Wildfire: Guidelines for Protecting Community Health and Wellbeing	2016	Health sector and community governments
Ontario	Protecting indoor air quality during wildfire smoke through filtration and reducing outdoor air entry [Public Health Ontario - internal] Wildfire Smoke and Air Quality Health Guidance, 2023	2023	Medical Officers of Health, Local Public Health Units
Quebec	Health Impacts of Particles from Forest Fires	2014	All public health stakeholders
Saskatchewan	Guidelines for Health Staff in Northern Saskatchewan Communities Preparation for Forest Fires and the Assessment of Health Effects from Forest Fire Smoke	2019	Health workers in northern Saskatchewan
Yukon	Yukon Wildfire Smoke Response Guidelines	2023	Public health decision makers

Table 3: International Guidance Documents

Country	PUBLIC HEALTH GUIDANCE DOCUMENTS	MOST RECENT VERSION	INTENDED USERS
Australia	Standard for smoke, air quality and community health	2022	Public health and other government agencies
	Environmental Health Standing Committee (enHealth) of the Australian Health Protection Principal Committee		Public health agencies
New Zealand	Response to Wildfires: Guidelines for Public Health Units	2021	Public health units
USA	Wildfire Smoke: A Guide for Public Health Officials | AirNow.gov	2019	Public Health Officials

5) Appendices

Appendix A – Federal Government Roles – Wildland fires

Public Safety Canada: The Government Operations Centre (GOC) leads federal response coordination for emergencies, which includes maintaining federal situational awareness, developing integrated risk assessments, and supporting response coordination.

Canadian Armed Forces (CAF): May provide limited self-sustaining support to front-line relief operations, excluding social crises and enforcement/security tasks, once all available options have been exhausted, including PT and private sector.

Natural Resources Canada (NRCan): Leads international memorandums of understanding/ arrangements for fire management cooperation and resource exchange; conducts monthly national fire season forecasting; provides wildfire intelligence and predictive services; and, monitors and reports on national fire locations and conditions.

Environment and Climate Change Canada (ECCC): Provides specialized weather and wildland fire-related products and forecasts including air quality and smoke transport modeling, which could be used for evacuation planning and assessing potential health impacts.

Indigenous Services Canada (ISC): Provides funding for preparedness, mitigation, response and recovery activities for on-reserve communities; helps facilitate the coordination of operations between FPT partners and supports impacted First Nations (FN); assists host communities with the delivery of services for FN evacuees; provides and makes arrangements for health programs and social services.

Parks Canada Agency (PCA): Manages wildland fires across 350,195 km^2 of federal Crown lands.

Service Canada/ESDC: Facilitates access to services and benefits and flows resources quickly to those whose employment has been interrupted and require temporary income support, identity document replacements and to employers whose businesses have been also impacted.

Public Health Agency Canada (PHAC) / Health Canada (HC): coordinates access to Health Portfolio health related support to provinces and territories; maintains the National Emergency Strategic Stockpile (NESS) which maintains emergency social services assets such as beds and blankets to support temporary accommodations for evacuations; work with ECCC to provide the Air Quality Health Index, health-risk messaging on wildfires and air quality.

Innovation, Science and Economic Development Canada (ISED): Information gathering and sharing systems, networks and protocols to detect telecommunication disruptions or events of significance that facilitate effective communication and collaboration across the telecommunication sector/industry

Transport Canada (TC): Situation Centre provides 24/7 monitoring of the transportation system and a single window for incident reporting by industry; facilitate transportation movement by issuing exemptions and adjusting regulatory requirements for air and rail when/where necessary.

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