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# PUBLIC HEALTH RESPONSES TO WILDFIRE SMOKE EVENTS



Prepared by:  
Sally Maguet  
British Columbia Centre for Disease Control,  
National Collaborating Centre for Environmental Health



**BC Centre for Disease Control**  
An agency of the Provincial Health Services Authority



National Collaborating Centre  
for Environmental Health  
Centre de collaboration nationale  
en santé environnementale

## THANK YOU TO ALL THE CONTRIBUTORS TO THE PROJECT:

Janet Bates  
British Columbia physician

Greg Baytalan  
British Columbia Interior Health Authority

Jennifer Chairotto  
Manitoba Health

André Corriveau  
Northwest Territories Health and Social Services

Miranda Du Preez  
British Columbia physician

Alison Everitt  
Canadian Red Cross

Jeff Eyamie  
Health Canada

Angela Eykelbosh  
National Collaborating Centre for Environmental Health

Dan Ferguson  
British Columbia Interior Health Authority

Kamran Golmohammadi  
British Columbia Interior Health Authority

Cathy Goodfellow  
New Brunswick Department of Health

Sarah Henderson  
British Columbia Centre for Disease Control

Cailin Hodder  
Canadian Red Cross

Courtney Howard  
Northwest Territories physician

Denise Koh  
Manitoba Health

Kami Kandola  
Northwest Territories Health and Social Services

Tom Kosatsky  
British Columbia Centre for Disease Control

Na-Koshie Lamptey  
New Brunswick Horizon Health Network

Selena Lawrie  
British Columbia physician

Kari Lentowicz  
Manitoba Northern Regional Health Authority

Amy Lubik  
British Columbia Centre for Disease Control

Karen White Masry  
New Brunswick Department of Health

Stephen Moss  
Northwest Territories Health and Social Services

Cristin Muecke  
New Brunswick Department of Health

Casey Neathway  
British Columbia First Nations Health Authority

Darlene Oshanski  
Manitoba Health

Linda Pillsworth  
British Columbia First Nations Health Authority

Leela Steiner  
National Collaborating Centre for Environmental Health

Diana Tesic-Nagalingam  
British Columbia Interior Health Authority

Jacqueline Turvey  
British Columbia Interior Health Authority

Joe Tyson  
Indigenous Services Canada

Angela Yao  
British Columbia Centre for Disease Control



## PUBLIC HEALTH RESPONSES TO WILDFIRE SMOKE EVENTS

Introduction .....	1
Public Health Priorities .....	2
Background .....	3
Needs Assessment .....	3
Sampling Strategy .....	4
Research Questions .....	5
Methodology .....	6
Jurisdictions Assessed .....	7
British Columbia .....	7
Manitoba .....	7
New Brunswick .....	8
Northwest Territories .....	8
Decision-making .....	9
Forecasting and Monitoring .....	14
Community Impacts .....	17
Impacts on the Health Care System .....	20
Partnerships, Collaborations, and Co-ordination .....	21
Communication .....	25
Clean Air Shelters .....	27
Evacuations .....	30
Evaluation and Lessons Learned .....	31
Discussion .....	32
References .....	33
Appendix 1: Canadian public health guidance documents regarding wildfire smoke .....	36
Appendix 2: AQHI, PM2.5 and Visual Assessment .....	37





## INTRODUCTION

The public health response to wildfire smoke events is complex, involving inter-sectoral collaboration, community engagement and the use of many sources of information in decision-making. The focus of this project is to understand the perceptions, challenges and needs of public health practitioners in Canada when responding to wildfire smoke events. The project was undertaken as part of the *Research, surveillance, and public health practice: Activities to build and strengthen the Canadian response to forest fire smoke events* agreement between The British Columbia Centre for Disease Control (BC CDC) and Health Canada's Water, Air and Climate Change Bureau between April 2016 and March 2018. This project fulfils the agreement's objective to evaluate public health performance around wildfire smoke events and is intended to contribute to the Canadian public health system's capacity to respond to future wildfire smoke events by understanding Canadian experiences and evolving practice in preparing for and managing recent wildfire smoke events in British Columbia, Manitoba, New Brunswick, and the Northwest Territories.

Findings from interviews with 26 public health practitioners are presented in nine sections reflecting common themes that emerged across all four jurisdictions. Public health practitioners in the context of this report refers to Medical Health Officers, emergency and disaster management teams, environmental health officers, community physicians, health service managers and air quality specialists who have been involved in a public health response to wildfire smoke. Unless otherwise cited, the findings in the thematic sections come directly from the series of interviews conducted for this project and are representative of interviewees' experiences

only. When exemplary practices were identified in a particular jurisdiction, they have been included in this report as a means of sharing the experience of others in addressing common issues. Tools or resources that were recommended have been included for reference in the appropriate section. Thirteen issues emerged as relevant for further consideration and development of responses to wildfire smoke across jurisdictions and are presented below as public health priorities.



## PUBLIC HEALTH PRIORITIES

The following issues emerged as common challenges, concerns, and needs of public health practitioners when responding to wildfire smoke events in British Columbia, Manitoba, New Brunswick, and the Northwest Territories.

1. Generating evidence regarding the health effects of long-term exposure to wildfire smoke;
2. Clearly defining the role of public health as part of an emergency response;
3. Documenting experiences with the implementation of community clean air shelters and developing guidance for their identification and use;
4. Making educational resources and opportunities available to public health practitioners, community healthcare providers and primary care providers regarding the health implications of wildfire smoke and evidence-based health protection interventions;
5. Actively involving community based public health practitioners in emergency response planning, familiarizing them with the processes and mechanisms of an emergency response and clarifying their role within it;
6. Engaging communities about how to prepare for and respond to a wildfire smoke event;
7. Developing guidelines and resources for repatriation after an evacuation when air quality is still an issue;
8. Developing mechanisms for the integration of primary care into an emergency response;
9. Developing monitoring systems specifically for wildfire smoke and enhancing access to them for remote communities;
10. Developing public health guidelines that have a temporal scale and consider the duration of exposure as well as the concentration of smoke-related pollutants;
11. Creating central hubs for the public and public health practitioners to access resources, information, and guidance during a smoke event;
12. Raising public awareness about the health risks associated with exposure to wildfire smoke and the ways in which the public can prepare for and protect themselves from these health risks.
13. Building the technical capacity to service, upgrade, and maintain air exchange systems in health care facilities that are capable of filtering high concentrations of particulate matter.



## BACKGROUND

Fires are a naturally occurring part of the forest lifecycle with fluctuations in frequency and severity that can span several decades; this volatility tends to make predicting future forest fire activity challenging.<sup>1</sup> Models predicting forest fire activity in Canada vary due to uncertainty about human activity and changes in precipitation; however, it is estimated that overall forest fire activity will increase by 25% by 2030 and 75% by the end of the 21<sup>st</sup> century.<sup>2</sup> Eighty-five percent of the total forest area burned in Canada between 1959 and 1997 was in the boreal or taiga ecozones.<sup>3</sup> The boreal forest covers 270 million hectares or 30% of the Canadian landscape from Yukon to Newfoundland and Labrador<sup>4</sup> making wildfires in the boreal forest an important environmental and public health issue across the country.

Wildfire smoke contains both primary pollutants, such as NO<sub>x</sub>, CO, and fine particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>), as well as secondary pollutants such as O<sub>3</sub>.<sup>5</sup> The health impacts of wildfire smoke, however, are largely attributable to particulate matter finer than 2.5µm, commonly referred to as PM<sub>2.5</sub>.<sup>6</sup> These impacts include: exacerbations of asthma and COPD, general respiratory morbidity, possible increases in respiratory infections, cardiovascular morbidity and all-cause mortality and possible, but inconclusive evidence of adverse birth outcomes.<sup>6</sup>

Public health guidance in the event of a wildfire smoke event has evolved substantially in the last 20 years. Large fires that burn close to populated areas and severely affect air quality for large numbers of people such as the 2003 Okanagan Mountain Park fire, Kelowna fires in 2009, Fort McMurray in 2016, the widespread, weeks long fires in the Northwest Territories in 2014 and the 2017 wildfire season that saw unprecedented smoke levels in BC and Manitoba for several weeks, have drawn attention to the health impacts of forest fire smoke and prompted Health Authorities and public health agencies across Canada to develop planning and educational resources in preparation for future events. The US Environmental Protection Agency (EPA) released a comprehensive guide to public health practitioners in 2001 as part of a response to the loss of a record 8.4 million acres (3.4 million hectares) of forest to fires in 2000.<sup>7</sup> Several Canadian jurisdictions have followed in the years since and developed their own guidance and planning documents.

## NEEDS ASSESSMENT

A needs assessment conducted in 2016 by the National Collaborating Centre for Environmental Health identified outdoor air quality, environmental disasters, emergency response, and climate change adaptation as important priorities for public health practitioners. Respondents included environmental health officers, medical health officers, environmental health managers, and directors from all ten provinces and three territories. They identified the following as areas of interest and further improvement:

- Air quality monitoring and forecasting systems;
- The role of public health in emergency response and climate change adaptation planning;
- Indicators for the health impacts of climate change and the ecological determinants of health;
- The impacts of wildfires on Indigenous, rural, and isolated communities;
- Research into the long-term health impacts of wildfire smoke exposure;
- Communications strategies during wildfire smoke events;
- Infrastructure and building design that consider air quality and environmental health issues;
- Community resilience in the context of climate change; and
- Best practices and tools for climate change adaptation.



## SAMPLING STRATEGY

In order to gain a broad understanding of experiences across Canada, jurisdictions were chosen to reflect a diversity of ecozones, healthcare delivery models, and historical wildfire events. Participants were invited based on their roles and responsibilities during a wildfire smoke event.

A Google search was conducted to identify publicly available, English-language documents to guide public health responses to wildfire smoke events in each province and territory. Search terms included the name of the jurisdiction and 'wildfire smoke'. The first five pages of Google search results were reviewed. A search of provincial and territorial health service websites was also conducted using the term 'wildfire smoke'. Documents that were intended to provide guidance to communities and services threatened directly by fire, repatriation following an evacuation, or general emergency response guidance not specific to wildfire smoke were not included. Webpages, factsheets, and resources intended for the general public were not included. Public health guidance documents were found for eight provinces and territories; Alberta, British Columbia, Manitoba, Newfoundland and Labrador, the Northwest Territories, Quebec, Saskatchewan, and Yukon. Three jurisdictions were chosen from those that had public health guidance documents based on the following criteria:

**Ecozones** - Jurisdictions were chosen to represent as many ecozones across Canada as possible. The Canadian Council on Ecological Areas (CCEA) has identified 18 distinct terrestrial ecozones, which are characterized by their geography, climate, vegetation, human activity, and wildlife.<sup>8</sup> The three provinces and one territory chosen represent 14 of Canada's 18 ecozones. Population density and the distribution of populations were also considered.

**Health care delivery** - Jurisdictions were chosen to represent a variety of health care delivery models including a territorial health care system that is delivered through one central agency, and three provincial health care systems with multiple regional agencies, two in which the delivery of public health and health promotion services to on-reserve communities is supported federally and one in which it is supported provincially.

**Wildfire history** - Jurisdictions that had experienced multiple, significant wildfire events between 2014 and 2017 were chosen to better understand the evolving nature of the public health response to wildfire smoke events.

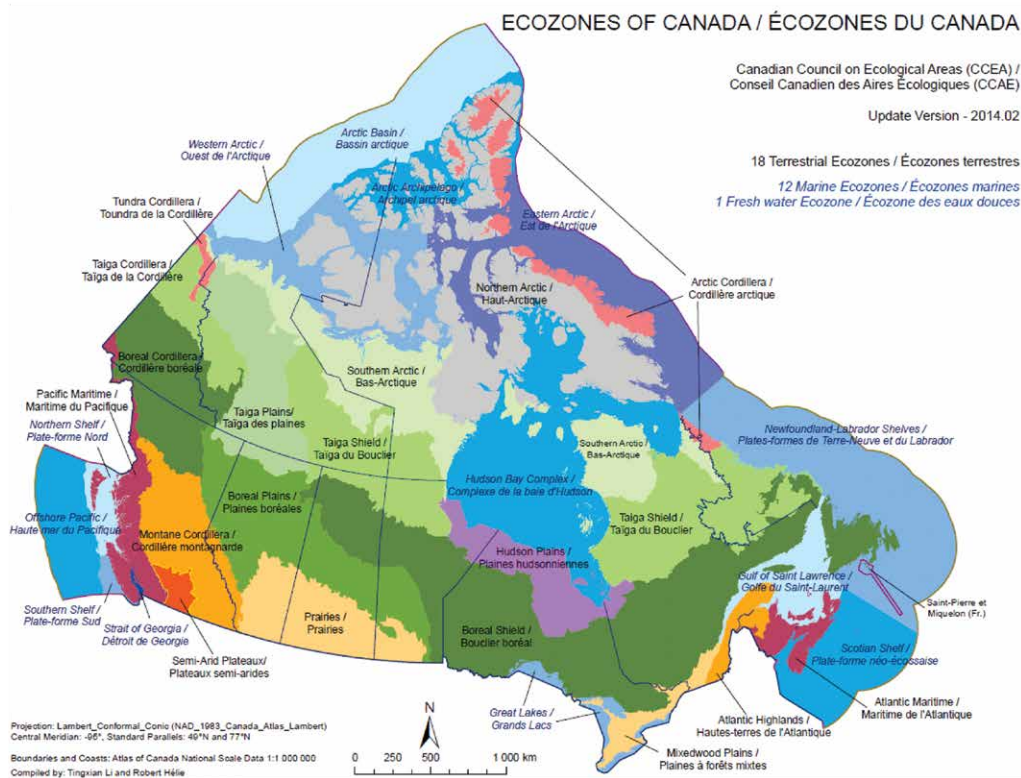


Figure 1: Ecozones of Canada<sup>8</sup>

One jurisdiction was chosen that did not have a public health guidance document specific to wildfire smoke and had not experienced a recent, significant wildfire event in order to better understand differences in planning, preparation and decision-making processes. British Columbia, Manitoba, and the Northwest Territories were chosen as jurisdictions that had planning documents and New Brunswick was chosen as a jurisdiction that did not yet have a public health guidance document specific to wildfire smoke.

Responding to a wildfire smoke event requires collaboration between several agencies, organizations, and sectors including health care, emergency services, environmental services, and non-profit agencies, among others. Three tiers of public health practitioners were identified as having distinct roles and responsibilities during a wildfire smoke event, each bringing a unique perspective to the experience.

**Medical health officers** are key decision makers during wildfire smoke events and provide advice and guidance regarding the population health effects of smoke exposure.

**Emergency managers** are largely responsible for the operational management of an emergency response and, if necessary, an Emergency Operations Centre. Though their role is generally related to risks associated with the direct interface of fires, infrastructure and populations, they can also play a key role in operationalizing responses to wildfire smoke. Health emergency managers play a lead role in overall planning and coordination to ensure the health system within their respective jurisdictions are able to effectively prepare for, mitigate, respond to, and recover from wildfire smoke events. Health emergency managers act as a liaison between the health system and emergency management organizations and are often engaged in developing guidance for smoke events in collaboration with medical health officers, actively monitoring smoke conditions and coordination of health services during smoke events.

**Environmental health officers/community health care providers** are an integral part of feedback and communication channels between affected communities and decision-makers during a wildfire smoke event and have insight into the effects of wildfire smoke on the populations they serve.

Purposive sampling of each tier of practitioners in each jurisdiction began with regional, provincial and territorial medical health officers with direct experience managing a wildfire smoke event. An exponential snowball sample was then taken in each jurisdiction based on chain referrals to emergency managers and environmental health officers,

community health nurses and community physicians who had been involved in responding to a wildfire smoke event.

## RESEARCH QUESTIONS

Research questions for the project were based on those set out in the Research, Surveillance, and Public Health Practice agreement. They were refined throughout the data collection process to more clearly reflect the current state of public health knowledge and practice with regard to wildfire smoke. This process resulted in the following questions:

1. What long term public health planning is most important in preparing for a wildfire smoke event?
  - a. What are the most important considerations when working with communities to prepare for and respond to a wildfire smoke event?
2. How were forecasting systems and guidance documents used in decision-making processes?
3. What have public health practitioners learned from their experiences implementing the following interventions?
  - a. Clean air shelters (CAS)
  - b. Public advisories and communications
  - c. Delaying or cancelling public events and activities
  - d. Evacuations
4. What roles did key partners play in planning and responding to wildfire smoke events?

Findings related to these questions are included in each of the nine thematic sections of this report. Theme topics were chosen based on questions included in the interview guide, the interest of public health practitioners who were interviewed and areas of potential practice development identified in the literature.







## METHODOLOGY

A semi-systematic literature review was conducted using PUBMED to identify key components of a public health response to wildfire smoke, the role of public health within emergency management, and the impacts of wildfire smoke events on health systems using the search terms ‘wildfire’, ‘bushfire’, ‘forest fire’, ‘public health’, ‘environmental health’, and ‘emergency response’. Publicly available after-action reports of major fires in Canada, as well as provincial, territorial, and select international wildfire smoke public health guidance documents were also reviewed. An interview guide was developed based on commonly provided public health guidance and knowledge gaps identified in the peer reviewed literature.

The first semi-structured pilot interview was conducted in October, 2017. Twenty-five additional participants in a variety of roles were interviewed between December 2017 and April 2018 across all four jurisdictions.

	BRITISH COLUMBIA	MANITOBA	NORTHWEST TERRITORIES	NEW BRUNSWICK
Medical Health Officers	1	1	2	2
Emergency Managers/ Environmental Health Manager	3	5	1	2
Environmental Health Officers/ Community Health Care Providers	6	2	1	0

Interview transcripts were analysed using NVivo 11 and coded according to themes identified in the interview guide as well as emergent patterns across jurisdictions.

## JURISDICTIONS ASSESSED

### British Columbia

There are four large, urban centres in British Columbia (BC) with populations greater than 100,000 people; Vancouver, Victoria, and Abbotsford on the west coast, and Kelowna in the province's Interior region. Nearly half (2,264,823) of BC's total population of 4,648,055 people lives in Greater Vancouver.<sup>9</sup> The provincial population density is 5.0 persons per square kilometer with over 100 medium and small communities and 198 First Nations.<sup>10</sup>

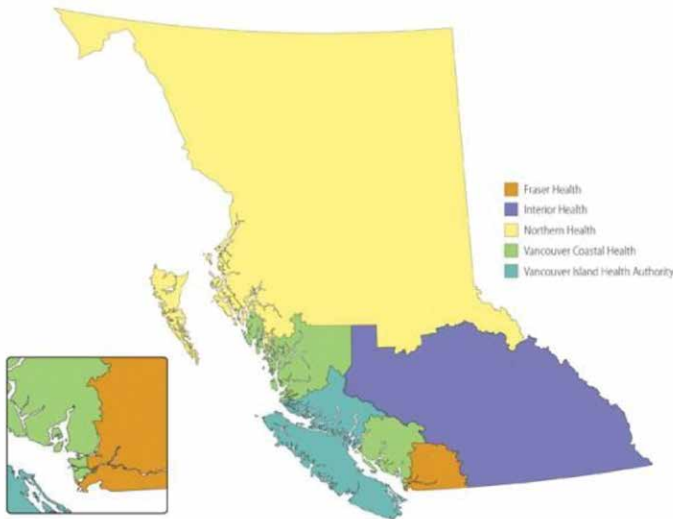


Figure 1: British Columbia regional health authorities<sup>11</sup>

Six of Canada's 18 ecozones are represented within BC's 944,735 km<sup>2</sup> (95 million hectares), from the Pacific Maritime zone on the west coast; Boreal Plains, Boreal Cordillera, and Taiga Plains in the north; and Montane Cordillera and Semi-arid Plateau in the southern and central regions of the province. Roughly 60 million hectares of BC is covered by forest, with forestry accounting for 15% of the province's economic activity.<sup>12</sup>

British Columbia has five regional health authorities and two provincial health authorities. The five regional authorities work collaboratively with the Provincial Health Services Authority and First Nations Health Authority to provide highly specialized health care and First Nations health programs and services across BC. In 2013, the First Nations Health Authority assumed responsibility for programs, services, and responsibilities formerly administered federally by Health Canada's First Nations Inuit Health Branch, creating a unique system of health care for First Nations people and communities in Canada.

British Columbia has experienced several severe wildfire events, both in terms of the number of hectares burned

and the impacts on communities when fires occur at the wildfire urban interface (WUI). In the 1990s, the Penticton fire resulted in the evacuation of 3,500 people and the loss of homes, businesses, and 5,500 hectares of forest. In 2003, the Okanagan Mountain Park Wildfire burned 25,600 hectares, 234 homes, and required the evacuation of 33,050 people. The Binta Lake Wildfire in 2010 burned 40,000 hectares and resulted in evacuation orders and alerts in several communities. The most devastating year to date, however, was 2017 when 1.2 million hectares of land burned, 65,000 people were evacuated, and a provincial state of emergency was declared.<sup>14</sup> Remarkably, no deaths have been directly attributed to the wildfires or evacuations of 2017.

### Manitoba

Manitoba has one large urban centre, one medium urban centre (30,000 – 99,000 people), 49 small urban centres (less than 29,000 people),<sup>15</sup> and 63 First Nations. More than half of Manitoban First Nations people live in one of 23 communities that do not have access to an all-weather road.<sup>16</sup> Of the 1,278,365 people living in Manitoba in 2016, 705,244 lived in Winnipeg,<sup>15</sup> 148,455 were registered First Nations members and 48,859 lived in Brandon. The population density of the province in 2016 was 2.3 people per square kilometre.

Five ecozones are represented in Manitoba, including the Prairies and Boreal Plains in the south, the Boreal Shield through the central region, and the Hudson Plains and Taiga Shield in the north. Roughly 26.3 million hectares of the province's 54.8 million hectare land base are forested.<sup>17</sup>



Figure 3: Manitoba Regional Health Authorities<sup>13</sup>

Manitoba has five regional health authorities. The delivery of primary care, public and mental health services and emergency management support for on-reserve communities is provided through a complex combination of services through Indigenous Services Canada, non-governmental organizations such as the Canadian Red Cross, tribal council-based organizations and regional health authorities.

A record 3.28 million hectares of land burned across Manitoba during the historic 1989 wildfire season that resulted in the evacuation of 24,500 people. While most evacuations were due to the immediate danger of fire, there were several evacuations of communities due to heavy smoke reducing visibility to less than one kilometre at times.<sup>18</sup> Over one million hectares burned in 2013 and 2017 saw several evacuations and prolonged periods of smoke across large parts of the province. Twenty-seventeen was the worst year for wildfires in Manitoba since 1989, with up to 7,500 people evacuated at one time. It was the first use of congregate settings to house evacuees in Manitoba, although this type of setting has been used in other jurisdictions.

### New Brunswick

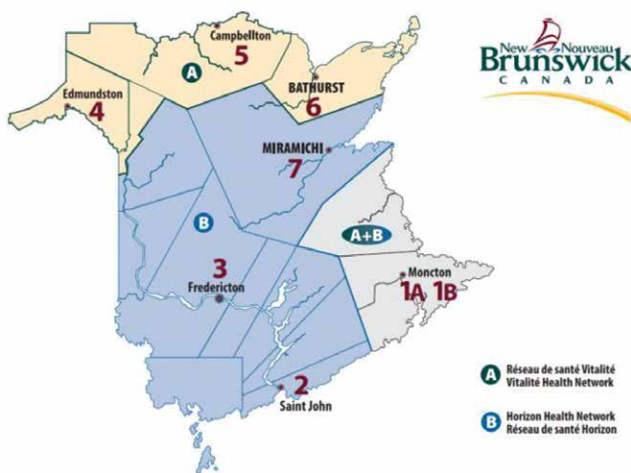


Figure 2: New Brunswick regional health authorities<sup>19</sup>

New Brunswick (NB) has a land mass of 7.1 million hectares with a population of 747,100 people. There is one large urban centre, 30 small and medium centres, and 15 First Nations.<sup>20</sup> New Brunswick is densely populated with 10.5 people per square kilometre.<sup>15</sup>

New Brunswick has two regional health authorities with the delivery of primary care, public and mental health services, and emergency management support for on-reserve communities provided federally through Indigenous

Services Canada. Atlantic Highlands and Atlantic Maritime ecozones are present in NB which has coastlines on the Bay of Fundy and the Gulf of St Lawrence.

In 2017 46 fires burned 23.6 hectares of land in NB and in the first six months of 2018, 164 fires have already burned 162.4 hectares of land, approaching the 192.2 total hectares burned between 2008 and 2017.<sup>21</sup> A forest fire in 2017 forced the evacuation of 25 homes on Miscou Island and smoke from neighbouring provinces often affects communities in NB.

### Northwest Territories

The Northwest Territories (NWT) have a land mass of almost 114.4 million hectares and a population of 44,597 people with an official population density of 0 people per square kilometre.<sup>22</sup> In 2012, NWT was home to 13,345 First Nations and 4,340 Inuit people with Indigenous peoples making up 52% of the total population.<sup>23</sup> Nearly 22,000 of NWT's residents live in the capital city of Yellowknife, 10,000 in the towns of Norman Wells, Inuvik, Fort Smith and Hay River and roughly 12,000 in smaller settlements and communities across the territory.



Figure 3: Northwest Territories communities and settlements<sup>24</sup>

The Northwest Territories Health and Social Services Authority (NTHSSA) was established in 2016, amalgamating six regional health authorities. The Tlicho Community Services Agency and Hay River Health and Social Services Authority serve their communities through independent management boards.<sup>25</sup>

In 2014, NWT experienced an exceptionally active fire season, with 3.4 million hectares of land burned.<sup>26</sup> Fine particulate matter (PM<sub>2.5</sub>) concentrations far exceeded air quality objectives, with the highest daily and monthly concentrations recorded since monitoring began in 2003. Maximum daily averages in August of 2014 reached 320.4 µg/m<sup>3</sup>, well over the 28 µg/m<sup>3</sup> 24-hour average objective for PM<sub>2.5</sub>.<sup>27</sup>





## DECISION-MAKING

### PUBLIC HEALTH EXPERIENCES

Decision-making is difficult during times of heightened stress and anxiety when communities are in proximity to fire and experiencing smoky skies. Public health practitioners are somewhat limited in what they can do to respond to wildfire smoke events and the information required to make decisions during such events is not always available or easily interpreted.

Public health officials, including medical health officers and community leaders, can issue smoky skies advisories, bulletins, and alerts, usually in conjunction with federal or provincial ministries of the environment, advising people to take precautions and monitor their health. Decisions about the cancellation of community or cultural events and community evacuations are primarily at the discretion of community and municipal leaders, most often in consultation with public health or medical officials.

The decision to evacuate a community results in the activation of federal or provincial emergency response mechanisms, which are structured slightly differently in each jurisdiction. Funding for evacuations is generally

managed provincially or federally depending on the community. Emergency response mechanisms are intended to protect life, infrastructure, and property and do not include health protection if there is no immediate threat to life. During an extreme or prolonged smoke event, this distinction can become less clear, particularly for vulnerable populations or those living in remote communities where rapid evacuations may not be possible due to a lack of road access, limited ability to land large planes, or lack of access to safe waterways.

Research into the health effects of long and short-term exposure to wildfire smoke is not widely available, making health-based decision-making a challenge. Public health practitioners and decision-makers reported using PM<sub>2.5</sub> concentration thresholds defined by the US EPA and the World Health Organization (WHO) and Air Quality Health Index (AQHI) levels as defined by Health Canada in their assessment of possible risks to health (see Appendix 2). While these were helpful in deciding on when and how to communicate with the public about health risks, PM<sub>2.5</sub> concentrations of 700–1000µg/m<sup>3</sup>

were not considered sufficient to justify the evacuation of communities, despite levels above 500µg/m<sup>3</sup> being considered hazardous. The difficulty with assessing the risk in such situations is related largely to uncertainty about the risks associated with the duration of exposure and weighing the risks to health at such elevated levels with the risks of evacuating populations, particularly vulnerable populations such as the elderly.

Criteria used in decision making in various jurisdictions included;

- PM2.5 concentrations,
- Duration of exposure,
- AQHI levels,
- Reports of increased use of health care services,
- Extremely poor visibility,
- BC Asthma Monitoring System (BCAMS) data,
- Community perceptions of risk based on knowledge of the landscape, access to evacuation routes and current community assets,
- Proximity of people to the fire itself,
- Smoke forecasting information such as BlueSky and FireWork and,
- Reports from government agents other than health agencies of conditions in communities.

Further detail on the ways in which these criteria influenced decision making is included in subsequent sections.

Because of the lack of health-related evidence regarding the risks associated with exposure to PM2.5 from wildfire smoke, decisions are often made based on qualitative evidence or perception rather than quantitative criteria. Trust between communities and government agencies, was identified as key for collaborative decision-making in such conditions.

If a community is evacuated because of the immediate risks from fire, repatriation may be delayed because of the hazard associated with severe smoke, particularly for vulnerable populations such as the elderly, pregnant women, infants, very young children, and those with respiratory conditions such as Chronic Obstructive Pulmonary Disease (COPD) and asthma. Assessing the risk of repatriating these populations is difficult because smoke can affect communities far longer

than the immediate risk of fire and is difficult to forecast due to rapidly changing weather conditions, particularly on open landscapes or mountain valley microclimates. The sophisticated algorithms that have been developed for decision-making when fire threatens life or property in a community were not considered appropriate for decision making when a community is experiencing heavy smoke. The presence of heavy smoke heightened the perception of risk among community members even if the fire was a considerable distance away and not considered an imminent danger by fire and emergency response officials. Community members felt reassured, however, if they knew there was a pre-existing plan for managing a smoke event.

## GUIDANCE AND PREPARATION

Public health guidance documents specific to wildfire smoke are available for Alberta, British Columbia, Manitoba, Newfoundland and Labrador, the Northwest Territories, Quebec, Saskatchewan, and Yukon. Guidance documents from the US EPA, California Department of Health, other Canadian jurisdictions, and the US Centre for Disease Control (CDC) were helpful in drafting these documents.

Current public health guidance documents focus to a large degree on the health effects of wildfire smoke and, as a result, are often useful as a starting point for understanding symptoms and outcomes of exposure to smoke. Clean air shelters were cited in several documents as priorities for local authorities and local emergency coordinators.<sup>28</sup> Some guidance documents point to environmental health officers as resources for identifying community clean air shelters, their locations, and their suitability in advance of a wildfire smoke event.<sup>29</sup> New Brunswick's Provincial All-hazards Plan notes the importance of maintaining a resource list of temporary shelter options in conjunction with the Red Cross to best prepare communities for hazardous smoke conditions.<sup>30</sup> The US EPA and CDC guidance documents reiterate the importance of designating these types of shelters ahead of the wildfire season and being flexible in the type of building that might be suitable. They encourage the inclusion of large commercial buildings, educational facilities, shopping malls, or any building with effective air conditioning and particle filtration.<sup>31</sup> The Northwest Territories guidance document outlines the types of buildings that may be most amenable and provides detailed criteria for identifying and selecting shelters at the community level.<sup>32</sup>





Visual assessments of smoke density are a critical component of these guidance documents. British Columbia's *Health Wildfire Smoke Response Coordination Guideline* emphasises that communities without monitoring stations require an alternate means of assessing particulate levels and visually assessing smoke levels is one approach.<sup>29</sup> The document provides guidance on how to estimate particle concentration using landmarks at known distances and recommends that environmental health officers assist communities in this process. The Northwest Territories document also provides a visibility index chart for public use; the infographic lays out an air quality self-assessment method using an easy to understand flow chart and clear risk messages that correspond to visual criteria.<sup>32</sup>

Health messaging described in the guidance documents are tailored to different at-risk populations and the general population. In Manitoba's document, actions are further delineated to health teams based on each air quality category.<sup>28</sup>

Masks are included as an intervention in several of the guidance documents. Alberta's guidelines do not recommend wearing masks under smoky conditions as they may make breathing more challenging and may also lead to a false sense of security.<sup>33</sup> Saskatchewan's report reiterates the point that masks are not helpful in the context of firesmoke as particles are often so small that they can go through most mask materials.<sup>34</sup> The US EPA guide suggests that face coverings are likely to provide little or no

protection.<sup>31</sup> All of the documents that mention mask use emphasize that staying indoors and avoiding strenuous outdoor activity are far more effective at minimizing health risks.

Though such documents can provide a framework for decision-making, the responsibility for wildfire smoke preparedness in the jurisdictions included in this report, was often not designated to a specific team and ran the risk of getting lost among agencies and programs. Because smoke from wildfires crosses jurisdictions and the response is nuanced and complex, often involving several agencies, levels of government, and external agencies, the development of a national guidance document was suggested by some participants in this project. While a high-level framework may be helpful in co-ordinating a response across agencies and jurisdictions, understanding community context was also considered extremely important, mapping available assets and analysing community specific hazards.

Having public health guidance documents was identified by participants in this study as being helpful when working with multiple partners as they can provide a framework for decision-making across agencies whose primary focus may not be health. Clarifying roles and responsibilities as much as possible prior to an event was seen as helpful as planning and decision-making during an event is far more difficult. Practitioners noted that plans require continual updating as new evidence becomes available and organizational





structures change. Guidance specific to wildfire smoke was seen as important during a fire event as the immediate danger posed by fire can overshadow the potential health risks of smoke; having guidance and information readily available was helpful for including smoke exposure as a consideration in decision-making processes. It was also important to have tools and mechanisms to operationalize high level guidance for interventions such as the designation of clean air shelters.

Working with community-based staff such as nurses, physicians, and environmental health officers ahead of time to familiarize them with emergency response plans, structures, and people was helpful for integrating them into an emergency response quickly during an event. Ideally community-based staff would be included in drafting guidelines or modifying higher level guidance to reflect community level concerns and contextual information. Building capacity among community-based staff was seen to be most effective if it was activity-focused rather than strictly theoretical. Table top or practice exercises were suggested as ways to build capacity and foster connections within and across agencies. Making these connections helped community-based practitioners understand their role in a response and access information and resources more easily. It was noted by several practitioners that it was important that frontline workers were clear about their roles and responsibilities during an emergency prior to an event in order to maximize their capacity to contribute to the response.

Currently, little or no training is available for community-based practitioners to learn about the health effects of wildfire smoke. Regular in-service training was suggested as a strategy to better inform frontline workers; however, high staff turnover in Northern and remote communities was sighted as a considerable impediment to capacity building on an organizational level.

Encouraging and supporting staff to prepare their own families and homes for an emergency also helped them to be more available when an emergency affected their home community. Smoke events are less predictable than other public health issues such as seasonal influenza, making it more difficult to plan for and mobilize resources when necessary.

There was a general recognition that wildfire events are likely to be increasingly frequent and planning and preparation for such events is essential. Many practitioners considered wildfire preparedness as part of what will be required to respond more broadly to the effects of climate change. Climate change planning was generally not designated to a specific team or person but rather happened “off the side of people’s desks.” It was also recognized that wildfire events often coincide with extreme heat events and planning a response to both is necessary. Climate change adaptation was considered an important consideration for public health planning going forward.

## INTERIOR HEALTH AUTHORITY, BRITISH COLUMBIA

Following the devastating fire season in 2009, the Interior Health Authority (IHA) created an emergency liaison role in 2014 to serve as a link between communities and regional Emergency Operation Centres (EOC) in the event of a public health emergency. Ten environmental health officers (EHO) were selected from across IHA. Emergency liaison EHO's participated in emergency response planning throughout the year, learning the structure of an emergency response and connecting with those involved. During the extreme fire events of 2017, this preparation helped EHOs to better understand roles within an emergency response, more quickly access the resources and information they needed, and provide feedback directly from the affected communities to the EOC to identify gaps in service and community needs.

## CONSIDERATIONS FOR PLANNING

- Encourage staff to prepare their own homes and families for an emergency
- Include frontline staff in planning and preparing for an emergency response
- Provide learning opportunities for frontline staff to better understand the health impacts of wildfire smoke
- Draft a locally appropriate guidance document for public health practitioners in the event of a wildfire smoke event
- Share available public health guidance documents as widely as possible within and beyond the health care sector
- Support and encourage municipal and community planning for clean air shelters

## RESOURCES

Aboriginal Disaster Resilience Planning Tool<sup>35</sup>  
<https://adrp.jibc.ca/>

Health Canada's Climate Change and Health Adaptation Program for First Nations South of 60°N Funding Program<sup>36</sup>  
<http://www.climatetelling.info/uploads/2/5/6/1/25611440/24-17-1884-cchap-guide-en.pdf>

USDA-Forest Service Wildland Fire Air Quality Response Program<sup>37</sup>  
<https://www.wildlandfiresmoke.net/>

California Environmental Protection Agency Wildfire Smoke Guide to Public Health Officials<sup>31</sup>  
[https://www3.epa.gov/airnow/wildfire\\_may2016.pdf](https://www3.epa.gov/airnow/wildfire_may2016.pdf)

Alberta Health Services Simplified Wildfire Smoke Guide<sup>33</sup>  
<http://craz.ca/wp-content/uploads/2017/10/2017-09-19-Simplified-Wildfire-Smoke-Guide.pdf>

British Columbia Centre for Disease Control Guidance for Public Health Decision Makers<sup>31</sup>  
[http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Health-Environment/WFSG\\_BC\\_guidance\\_2014\\_09\\_03trs.pdf](http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Health-Environment/WFSG_BC_guidance_2014_09_03trs.pdf)

Manitoba Health Smoke Exposure from Wildland Fires<sup>28</sup>  
<https://www.gov.mb.ca/health/publichealth/environmentalhealth/docs/wildlandfiresmokeexposure.pdf>

Newfoundland and Labrador Forest Fire Smoke Guidelines<sup>38</sup>  
[http://www.lghealth.ca/docs/Forest%20Fire%20Smoke%20and%20Air%20Quality%20\(Revised%20June%202015\).pdf](http://www.lghealth.ca/docs/Forest%20Fire%20Smoke%20and%20Air%20Quality%20(Revised%20June%202015).pdf)

Northwest Territories Smoke Exposure from Wildfire Guidelines<sup>32</sup>  
<http://www.hss.gov.nt.ca/sites/hss/files/smoke-exposure-wildfire-guidelines.pdf>

Quebec Health Impacts of Particles from Forest Fires<sup>39</sup>  
[https://www.inspq.qc.ca/sites/default/files/publications/1793\\_health\\_impacts\\_forest\\_fires.pdf](https://www.inspq.qc.ca/sites/default/files/publications/1793_health_impacts_forest_fires.pdf)

Saskatchewan Guidelines for Health Staff in Northern Communities<sup>34</sup>  
<http://www.pnwbha.org/wp-content/uploads/2012/07/SMOKE-and-Fire-Guidelines-2012.pdf>

Yukon Wildfire Smoke Response Guidelines<sup>40</sup>  
<http://www.hss.gov.yk.ca/pdf/wildfiresmokeresponseguidelines.pdf>



## FORECASTING AND MONITORING

### PUBLIC HEALTH EXPERIENCES

Air quality monitoring and smoke forecasting information were extremely important in decision-making during smoke events in all four jurisdictions. The availability and reliability of this information varies greatly, however, depending largely on the geographical location and size of the community in relation to the location of the monitoring station. Readings of PM<sub>2.5</sub> concentrations from government monitoring stations, Health Canada's AQHI ratings, and smoke forecasts from BlueSky and FireWork were considered the most reliable and informative sources of data.

The AQHI was developed by the federal government as a tool to provide air quality and health information in such a way that the public and government institutions could understand air quality risks and implement protective behaviours.<sup>41</sup> The index provides a simple to understand scale from 1 to 10+ which indicates the health risk associated with air quality; the higher the number, the greater the health risks (see Appendix 2).

Canada's Wildfire Smoke Prediction System, FireWork, provides daily smoke forecast maps from early April to late October. Maps indicate the amount of fine particulate matter that will be added to the air from wildfire smoke. FireWork is based on estimated wildfire emissions using hotspot and fuel consumption data and illustrates how smoke from wildfires is expected to move across North America over the

course of 48 hours. The program also includes information on the effects of wildfire smoke on human health, actions that the public can take to protect their health, and details about the FireWork prediction system.<sup>42</sup>

BlueSky Canada is a software framework used to model fuel consumption, emissions, fire, weather, and dispersion to produce forecasts. It was modified from an U.S. Forest Service tool, to include regional operating technologies and Canadian components such as emissions and meteorological model outputs. It began operating as a pilot during the summer of 2010 in B.C. and Alberta and expanded to cover all of Canada when interest in the tool grew. There are three main components of the system: hourly meteorological forecasts, wildfire locations and fuel consumption, and transport and dispersion. This information is translated into web available output that focuses on animations of hourly smoke plume trajectories and ground-level concentrations of PM<sub>2.5</sub> for Western Canada. BlueSky continues to be hosted and operated by the University of British Columbia Weather Forest Research Team.<sup>43</sup>

While the AQHI was recognized as helpful in decision making, respondents widely acknowledged that it was limited in its use for wildfire smoke as it was originally designed to provide information about urban and industrial air quality issues and not ideally formulated to provide information about air quality during wildfire smoke events. When PM<sub>2.5</sub> concentrations were above 500 µg/m<sup>3</sup>



practitioners were unsure of how to interpret the hazard of smoke as it exceeded the maximum AQHI rating of 10. The US EPA's wildfire smoke guidance document was used as a reference document in the development of many provincial documents and is still considered a primary reference document by some practitioners. It uses an air quality index scale of 0–500, which created confusion if Canadian agencies or media were using this instead of the 1-10+ AQHI scale. The AQHI-plus developed in British Columbia was seen as an improvement on the AQHI, though was not well understood by many practitioners.

A single source of information was not considered sufficient for decision-making and a combination of monitoring and forecasting data was used most often due to the limitations of each source of data. Smaller, remote communities generally did not have air quality monitoring stations and relied on visual assessments and more qualitative data for decision-making. The lack of monitoring data in small and remote communities often caused concern and uncertainty in those communities as residents and local decision makers did not feel they had the information they needed to make informed decisions. Regional or provincial AQHI or rolling averages of PM<sub>2.5</sub> concentrations from larger centres often did not correlate with people's experiences in smaller, remote communities, which resulted at times in tensions between community members and public health professionals.

There are currently two monitoring stations collecting data for AQHI calculations in Manitoba (located in Brandon and Winnipeg),<sup>44</sup> three in the Northwest Territories (located in Fort Smith, Inuvik, and Yellowknife),<sup>45</sup> and seven in New Brunswick (located in Bathurst, Campbellton, Edmundston, Fredericton, Miramichi, Moncton, and Saint John).<sup>46</sup> By contrast, there are 25 AQHI data collection stations throughout British Columbia, four of which are located in Metro Vancouver.<sup>47</sup>

Rural and remote communities often requested mobile units during poor air quality episodes to inform decision-making and reassure residents. They were; however, considered expensive and not easily accessible by most respondents. With few mobile units available, they were often booked months in advance. When units were available, there were challenges with internet access in remote locations, which is required to relay data to health and emergency response agencies. Installing, securing, and operating equipment may also require time and expertise that may be beyond the capacity of limited staff at health units, nursing stations,

or other government sites. Partnering with utilities and other government agencies that have permanent, secure infrastructure was possible in some jurisdictions; however, the data gathered was generally only used for research purposes and by provincial specialists during a wildfire event in conjunction with additional qualitative information from effected communities. The expense and challenges associated with deploying mobile units was generally not considered justifiable given the relatively small impact monitoring data had on decision-making.

Forecasting information was extremely useful, particularly for communities without monitoring stations. Forecasting information was often used with caution, however, due to the dynamic and unpredictable nature of weather prediction and the challenge of assessing the altitude of a smoke plume in relation to affected communities. In the absence of monitoring data, forecasting information was almost always used in conjunction with qualitative assessments based on the visibility of predetermined landmarks. Practitioners acknowledged and appreciated advances and improvements in forecasting information in recent years despite their limitations.

The volume of information, the time sensitive nature of decision-making, and the complexity of a wildfire event made it difficult for practitioners to gather, synthesize, and interpret relevant information. Having a single, central source of easily interpretable information was identified as being extremely important. Using a single source of information and shared understanding of how to interpret it across agencies was recommended by many practitioners. It was also suggested that there be a source for professionals and a site specific for the public with easily accessible, simple, and consistent information. Developing a template to communicate within and across agencies that could be updated daily was found to be extremely helpful.

Air quality monitoring by third party agencies was not considered to be a viable option as data was not considered reliable and providers were not accountable to the public. Though it was not used for decision-making, private data collection platforms such as PurpleAir<sup>48</sup> were used anecdotally in areas where there were several private air quality monitors.

## RESOURCES

BlueSky Canada forecasting system<sup>43</sup>  
<http://firesmoke.ca/>

FireWork wildfire smoke prediction system<sup>42</sup>  
[https://weather.gc.ca/firework/index\\_e.html](https://weather.gc.ca/firework/index_e.html)

Air Quality Health Index<sup>49</sup>  
[https://weather.gc.ca/airquality/pages/index\\_e.html](https://weather.gc.ca/airquality/pages/index_e.html)

Air Quality Health Index App<sup>50</sup>  
<https://open.alberta.ca/interact/aqhi-canada>

PurpleAir Monitoring Network and Equipment<sup>48</sup>  
<https://www.purpleair.com/>

British Columbia Ministry of Environmental Protection and Sustainability Air Quality<sup>51</sup>  
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/air>

USDA-Forest Service Wildland Fire Air Quality Response Program<sup>37</sup>  
<https://www.wildlandfiresmoke.net/>

National Collaborating Centre for Environmental Health Air Quality Assessment Tools: A Guide for Public Health Practitioners<sup>52</sup>  
[http://www.nccch.ca/sites/default/files/Air\\_Quality\\_Assessment\\_Tools\\_Dec\\_2011.pdf](http://www.nccch.ca/sites/default/files/Air_Quality_Assessment_Tools_Dec_2011.pdf)

Public Weather Alerts for Canada<sup>53</sup>  
[https://weather.gc.ca/warnings/index\\_e.html](https://weather.gc.ca/warnings/index_e.html)

## NORTHWEST TERRITORIES

During a period of poor air quality in the summer of 2014, a remote community in the Northwest Territories was able to install a mobile air quality monitor to assist with decision making and provide community members with information. Though there were many challenges with connecting the equipment to computers that were not connected to government networks and having to manually download data several times a day, the information was very helpful in assessing the hazard of the smoke. Community members felt reassured by having quantitative data as a basis for decision making as visual assessments alone were difficult to interpret at times.

## CONSIDERATIONS FOR PLANNING

- Decide on a common source of information on which to base decisions during a wildfire smoke event across agencies and organizations
- Develop a central information hub for professionals and one for the public and publicize their locations





## COMMUNITY IMPACTS

### PUBLIC HEALTH EXPERIENCES

Though this project did not interview community members directly, the experiences of community health care providers and community based environmental health officers offer some insight into the experiences of community members during an event. Community experiences of wildfire smoke events differed depending on prior experience with air quality issues, location and previous wildfire and smoke events. There were, however, some recurrent themes that emerged across jurisdictions.

Uncertainty about how to protect themselves during a smoke event was a common experience reported by community members. The presence of heavy or dense smoke in a community often heightened fear and concern about the proximity of the fire, regardless of where the smoke originated or any change in the risk associated with the fire. People living in remote communities that could not evacuate easily were particularly concerned. Providing community members and leadership with as much information as possible was reassuring and supported decision-making processes. A direct line of communication, either through community-based health care providers or community leaders seemed the most effective way to get information to those who needed it. Community members were also more willing to accept decisions based on quantitative rather than purely qualitative data or observations.

Prolonged smoke events, where fire was not an immediate risk to the community but moderate or high concentrations of PM<sub>2.5</sub> affected communities for days, weeks, or months were a challenge for public health practitioners. The lack of evidence regarding the health effects of prolonged exposure to wildfire smoke made it difficult for public health practitioners to respond to community concerns or communicate the risks to individuals. A limited number of interventions are available to public health practitioners during such an event and current practices rely largely on raising public awareness about the risks posed by wildfire smoke, the signs and symptoms associated with smoke exposure and ways to avoid or minimize exposure.

Communities that were familiar with air quality issues because of ongoing industrial activities tended to be less concerned about the health impacts of wildfire smoke but were also more familiar with the AQHI and how to use the rating scale to protect their health. Communities that were not often exposed to air pollutants were more alarmed and concerned about the presence of wildfire smoke, even when PM<sub>2.5</sub> concentrations were relatively low. Remote communities often did not have the same resources available to them, such as designated community clean air shelters or indoor spaces that were suitable for spending prolonged periods of time, particularly when smoke events coincided with heat and limited primary care resources were available for vulnerable populations.





Families with children were particularly uncertain of how to respond, weighing the risk of exposing young children to smoke during outdoor activities and limiting their children's physical activity by keeping them indoors. Public health practitioners received feedback from parents that they were both concerned about their children being kept indoors at schools and daycares and having them exposed to smoke if allowed to play outside. Community sports clubs, summer camps, as well as cultural and community events were also faced with making decisions regarding the protection of children and community members. While public health agencies were generally well connected with schools, private sports clubs tended to rely on the awareness of their leadership to make decisions to protect their members. Community based organizations also expressed concern for the health of their volunteers during a smoke event.

Decisions to cancel cultural or community events due to heavy smoke are made by community and municipal leaders. Community perceptions of the health risks of smoke exposure were cited as an important part of the decision-making process as cancelling events often had significant social and economic implications. Smaller communities often relied on tourism as a significant source of income and heavy smoke was thought to be a deterrent to visitors even if the health risks associated with smoke exposure were seldom seen as sufficient justification to cancel community events that might attract visitors.

Community perceptions seemed to shift over time during prolonged smoke events. Respondents observed that wildfire smoke initially evoked concern or even alarm, however over time people tended to become less concerned and resumed some of their regular outdoor activities, such as jogging or sports activities, even when PM<sub>2.5</sub> concentrations remained high. It was unclear to public health practitioners whether this was due to a lack of awareness of the risks or a need to balance the benefits of physical activity with the risks posed by smoke. Though there is still limited data or peer reviewed research to support it, there was a growing concern among public health practitioners that prolonged exposure to wildfire smoke could be having a significant impact on the health of sensitive or vulnerable populations and may have implications for the health care system in both the short and long term.

Community members often felt concerned, anxious, and uncertain about whether they should wear a mask or what kind of mask was appropriate as members of the media often appeared wearing masks when reporting on fires and smoke near their communities. Concerns about community member's mental health were not limited to perceptions of the media, however. Community members expressed frustration and anxiety about having to remain indoors for long periods of the summer, particularly in the north following a long winter. There was a growing recognition among respondents and community members that the effects of climate change would likely contribute to worsening fires in addition to warming weather and rising

sea levels. There was a sense of anxiety reported by some practitioners with the arrival of spring and anticipation of another summer of fires.

Practitioners reported people contacting emergency response agencies, fire departments, municipal officials, and community agencies such as the Lung Association for information and resources, often before or instead of health authorities or government agencies.

Respondents recounted incidents where access to power, communications, food, supplies and evacuation routes were affected in remote communities during a wildfire event. While this may present unique challenges during an event, remote communities were often thought to be more resilient because they are likely to have had a number of experiences with power loss or limited communication and have developed alternative and backup systems. People living in smaller communities were eager to help whenever necessary and were aware of vulnerable community members who may need support.

Avoiding exposure to smoke by staying indoors meant that seasonal activities such as hunting, fishing, and berry picking were often reduced or avoided all together. This had short and long-term impacts on food security in some communities as such foods are often important staples throughout the year. Poor housing conditions in some communities make it difficult to avoid smoke exposure by staying indoors and closing doors and windows can increase the risk of extreme heat exposure. Such conditions make it challenging for some remote communities to shelter in place and for community members to protect themselves from smoke.

During periods of poor air quality, community members were often asked to reduce all sources of emissions including wood-burning and exhaust from cars and engines. Some remote communities rely on diesel generators for power and limiting the use of generators during a smoke event meant limiting the use of fans and air conditioners indoors. Access to fuel was also sometimes limited by hazardous transport conditions due to heavy smoke or fire.

## HEALTH CANADA

Air quality experts from Health Canada, the Sports Medicine Science Council of Manitoba and the Manitoba Coaches Association Manitoba Health worked with community coaching associations to include guidance for volunteer coaches on how to manage a smoke event in their training materials. Training manuals were distributed throughout the province to community-based sports organizations to prepare their volunteers to better protect their members.

## CONSIDERATIONS FOR PLANNING

- Provide community groups and community partners with information and guidance
- Work with health providers to identify vulnerable populations
- Consider mental health concerns in public health guidance and advice

## RESOURCES

Ecology North Summer of Smoke<sup>62</sup>  
<http://ecologynorth.ca/project/summer-of-smoke/>



## IMPACTS ON THE HEALTH CARE SYSTEM

### PUBLIC HEALTH EXPERIENCES

Though little peer-reviewed evidence is available regarding the impact of wildfire smoke events on the health care system, some mechanisms are being developed that link smoke exposure and the use of health care services. The BC Asthma Monitoring System (BCAMS) provides medical health officers in BC with near-real time information about smoke exposure risks to inform decision making processes. It uses asthma-related physician visits, pharmaceutical dispensations and air quality monitoring data to evaluate whether populations are being affected by forest fire smoke. Community health care providers interviewed as part of this project reported seeing an increased number of patients for respiratory concerns during prolonged and heavy smoke events.

Though evacuations for smoke alone were unusual, communities that were evacuated due to the risks posed by fire, sometimes found themselves in receiving communities where smoke remained a concern. Access to primary care was identified as a possible challenge during an evacuation for a number of reasons including; a shortage of primary care providers in receiving communities prior to the evacuation, lack of connection between the emergency response organization and primary care providers in receiving communities, and an inability to identify vulnerable community members and connect them with the appropriate care. Concern was expressed that those with respiratory issues – issues which may be exacerbated by exposure to smoke while in a receiving community – may have difficulty accessing primary care or require additional care. When primary care is not available either through the emergency response centre or community-based providers in the receiving community, respondents reported that evacuees often resorted to hospitals to access care.

Wildfire smoke events can affect small, remote and rural communities as well as larger, urban centres with the potential to expose large numbers of people. Public health practitioners suggested that community-based health care providers might be better prepared if given information prior to wildfire season about how to advise patients on protecting themselves during a smoke event and to prepare their services to support vulnerable community members. Even preparation for short term smoke exposure, though, sometimes did not prepare patients for long term exposure to smoke. Public health advice during an event is necessarily generalized and not intended for individuals.

Individuals were recommended to consult with their primary care provider if they have specific concerns, which respondents worried may result in increased demand on primary care services.

Recent public health efforts to reduce obesity rates by encouraging physical exercise were challenging to reinforce when people were advised to stay indoors and avoid physical exertion during periods of heavy smoke. When smoke persisted for days and weeks, public health practitioners found it increasingly difficult to balance the benefits of physical exercise with the risks of exposure to particulate matter and smoke. In communities without indoor recreation facilities or access to housing where it is possible to create clean indoor air, the problem was even more pronounced.

### INTERIOR HEALTH AUTHORITY, BRITISH COLUMBIA

A community respiratory therapist working in collaboration with a primary care practice in Kamloops, BC, held group sessions to prepare vulnerable patients several months in advance of a possible wildfire smoke event in 2017. Groups of 6–10 patients receiving care for respiratory conditions such as COPD and asthma were invited to participate in information sessions about how to protect themselves from wildfire smoke exposure and what to do should they have an exacerbation of their condition. Patients developed a plan and were encouraged to make sure they had sufficient medication prior to an event. Physicians with patients participating in the sessions were not aware of any of their patients requiring emergency care during the extreme smoke events that followed.

### CONSIDERATIONS FOR PLANNING

- If an emergency response is required, connecting physicians in the receiving community with the emergency response centre could provide greater access to health care for evacuees
- Connect to and provide advice to vulnerable populations on how to prepare themselves for an event

### RESOURCES

BC Asthma Monitoring System  
<http://www.bccdc.ca/health-info/health-your-environment/air-quality>





## PARTNERSHIPS, COLLABORATIONS, AND CO-ORDINATION

### PUBLIC HEALTH EXPERIENCES

The role of public health during a wildfire event was often unclear to respondents. Emergency response mechanisms are activated when fire is a direct threat to life, property, or infrastructure; however, the health risks associated with smoke when PM2.5 concentrations are very high and/or smoke persists for long periods of time are not generally considered justification for the activation of an emergency response. Practitioners felt that public health was well positioned to respond to extreme or prolonged smoke events given the complexity, cross-jurisdictional, and transdisciplinary nature of an effective response. Public health practitioners cannot order the evacuation of communities except under extreme circumstances, however, and the distinction between the risk of fire and the risk of heavy smoke to health was not always easy to make. Risks posed by exposure to smoke were often overlooked when fires posed a direct threat to community safety. For this reason it was important for public health practitioners to work closely with partner agencies and communities to protect the health of community members. Deciding on decision-making processes with emergency response agencies and funders about who will respond to a smoke event and how, prior to an event was helpful in mobilizing resources when they were needed. Many practitioners felt that public health needed to raise its profile within

emergency management because government agencies as well as the general public do not always think of public health as a resource during wildfire or smoke events.

Developing connections with communities was an extremely important theme in all four jurisdictions and across service provider roles in this project. Having direct connections between public health and emergency response agencies, community leaders, and health care providers facilitated communication and supported decision-making to protect the health of community members. Lines of communication were most effective when there were mechanisms for the flow of information in both directions between public health agencies and communities. Building relationships and making connections with community leaders took time and the most effective point person was often quite different from one community to the next. Building trust with communities such that their members will feel safe if evacuated and that there are accessible and culturally safe resources and services was identified as essential when beginning to make these connections and often took time.

Direct lines of communication were sometimes the only means of reaching a community if there were power losses or issues with access. Having a designated community contact made it possible to find alternative means of getting supplies and information to communities. Local community knowledge also helped to identify vulnerable community members who needed additional support during a fire or smoke event. When connections and relationships had been built prior to the event, public health and health



emergency management officials were able to help community leaders identify priority community members for evacuation and support, as well as prepare them to deal with media inquiries about the health and wellness of their communities.

Working with communities and municipalities to repatriate people following an evacuation was also important, particularly when considering those at higher risk if smoke remained present in the community. Environmental health officers served as a link between public health agencies, emergency response centres, municipalities and communities in some instances and were able to facilitate communication and co-ordination between them. They were identified as possibly being able to relieve nurses in remote communities of some of the additional communication and co-ordination responsibilities associated with an evacuation order or alert; however, they are often overburdened themselves and not able to take on additional responsibilities. Non-governmental agencies such as the Canadian Red Cross were key partners in managing emergency situations, particularly for First Nations communities. In addition to managing the evacuation of communities, they provided linkages between regional health authorities and evacuees in receiving communities.

Mobilizing existing community resources was somewhat challenging and required considerable organizational capacity. Community members and health care providers often wanted to volunteer but were unsure of how to get involved or where to go. Regional health authorities were critical for connecting evacuees with primary care in receiving communities. It was suggested that this might be facilitated through community-based physician groups such as the divisions of family practice, which could connect evacuees to existing primary care within communities. Working closely with community-based non-governmental organizations was also important for connecting with people who might be difficult to reach, such as street involved, unstably housed, or transient populations.

Wildfire smoke often crosses jurisdictional boundaries, making it necessary to work across agencies and jurisdictions and requiring the establishment of co-ordinated networks well in advance of an event. Such networks facilitated the dissemination of information, the co-ordination of actions, and sharing of knowledge across and between multiple levels of an emergency or public health response including community, regional, provincial, territorial, and federal bodies. Health emergency managers are an important part of such a network as they act as a

bridge between public health departments and emergency response agencies. They are uniquely positioned to respond to both the health implications of an emergency situation and the logistics of an emergency response. Working together prior to an event helped those within networks to better understand the roles and responsibilities of various agencies and plan within their own agencies to better utilize the knowledge and resources that were already available. Without this, service providers were sometimes confused about where to go for information and unclear of the roles of various agencies during an event. Organizations and agencies have different structures, processes, and mandates, which practitioners identified as a challenge for them in working together during a time of heightened stress if they had not established relationships and an understanding of their roles and responsibility beforehand. Networks were important for keeping community health care providers informed and helping them prepare themselves and their communities for a smoke event or a fire. Including researchers, air quality specialists, knowledge brokers and,

knowledge translators within networks was also identified as being important for including health-based evidence in planning and decision making. Networks were also suggested as a way to address challenges of organizational capacity that can exist when high staff turnover can make it difficult to build and sustain institutional knowledge.

Working with non-health partners such as hydro, forestry, environmental, fire service, and parks agencies provided opportunities to install monitoring equipment, share health information, and receive information on current conditions in remote locations. Working with the media as a partner was also important when communicating with communities about health-related risks both in urban as well as in rural and remote areas. Ongoing partnerships and networks were helpful for sharing knowledge, building trust, planning, and co-ordination; however, it was acknowledged that these activities can require considerable time and dedicated resources to establish and maintain.

PARTNERS AND COLLABORATORS INCLUDED	
International	US Forest Service, Environmental Protection Agency, US Center for Disease Control
Federal	Environment and Climate Change Canada, Indigenous Services Canada, Health Canada, Canadian Armed Forces, Coast Guard, Department of National Defence, Public Health Agency of Canada, Royal Canadian Mounted Police, Public Safety Canada
Provincial/Territorial	Public Health Departments, Ministry of Health, Ministry of Environment, Transportation and Infrastructure Departments, Parks Department, Conservation and Sustainability Departments, Fire Service, Provincial Police Departments, Health Emergency Management, Utilities, Department of Natural Resources, Office of Disaster Management or Emergency Measures Organization, Emergency Social Services, Divisions of Family Practice, BC Centre for Disease Control
Regional Health Authorities	Communications Departments, Homecare, Hospitals, Environmental Health Departments, regional health emergency managers, regional Medical Health Officers
Local, Municipal and External Agencies	Canadian Red Cross, local and municipal leadership, pharmacies, Parks and Recreation Departments, extended care facilities, shelters and social service NGOs, academic institutions, schools, Salvation Army, St John's Ambulance, local emergency response teams, Indigenous Friendship centres



## MANITOBA HEALTH

The Canadian Red Cross worked collaboratively with federal, provincial and regional health organizations to design a form to identify evacuees who might require medical care. This enabled them to connect those that needed medical attention to the appropriate care in receiving communities.

## BRITISH COLUMBIA FIRST NATIONS HEALTH AUTHORITY

British Columbia's First Nations Health Authority staff working in communities provided direct connections to provincial and regional health authorities as well as emergency response agencies; they were able to work closely with these agencies to identify culturally safe services and locations for evacuees. Because of their existing connections and relationships within the community, they were better able to identify community members who may require more support during a wildfire or smoke event.

## NEW BRUNSWICK DEPARTMENT OF HEALTH

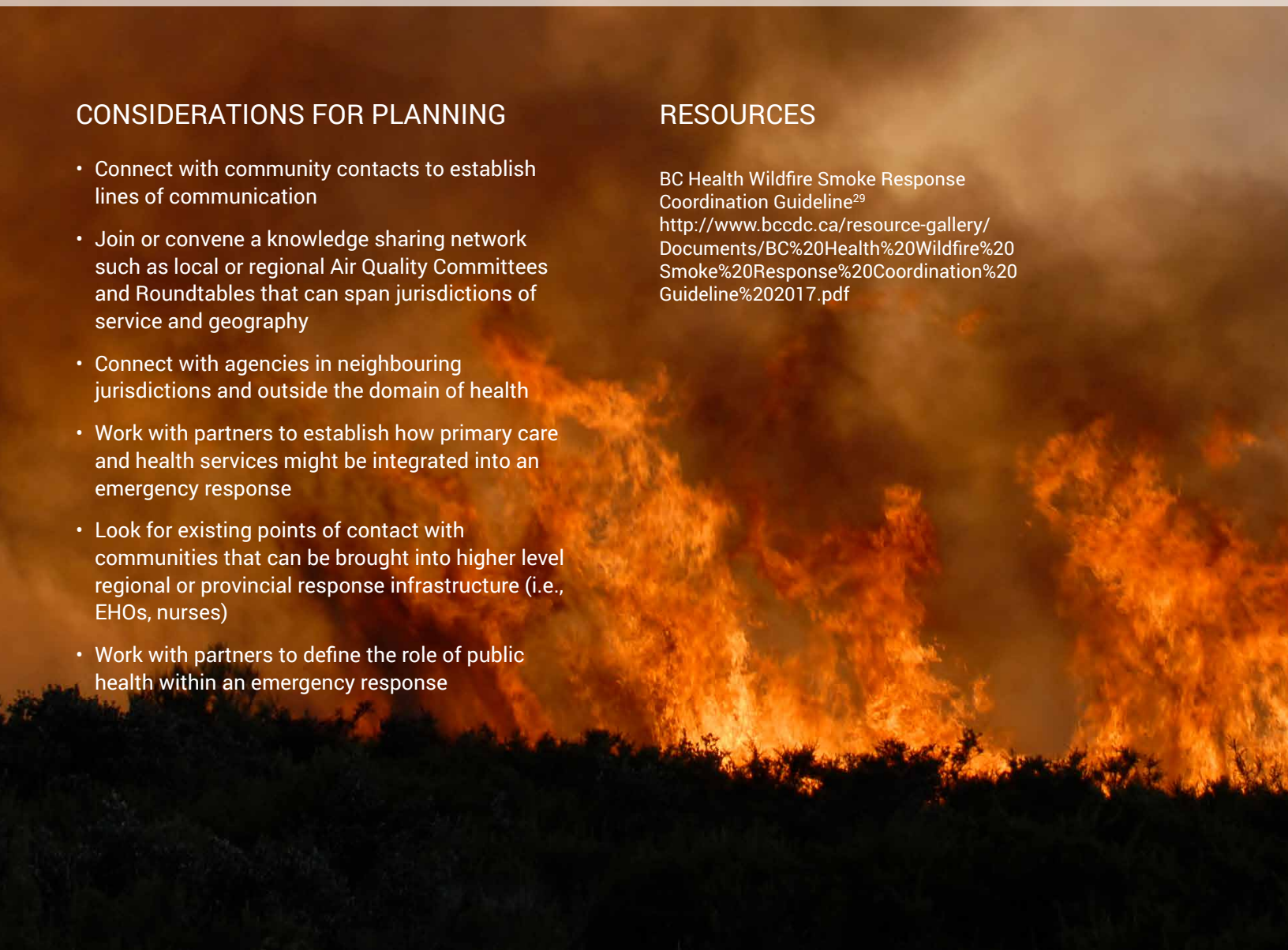
The New Brunswick Department of Health worked in co-operation with the Department of National Defence (DND) when smoke from a grassfire was affecting a community close to a military base. DND shared data from air quality monitors they had installed on their base, which they would not have done ordinarily, that helped the Department of Health inform the community and make public health decisions.

## CONSIDERATIONS FOR PLANNING

- Connect with community contacts to establish lines of communication
- Join or convene a knowledge sharing network such as local or regional Air Quality Committees and Roundtables that can span jurisdictions of service and geography
- Connect with agencies in neighbouring jurisdictions and outside the domain of health
- Work with partners to establish how primary care and health services might be integrated into an emergency response
- Look for existing points of contact with communities that can be brought into higher level regional or provincial response infrastructure (i.e., EHOs, nurses)
- Work with partners to define the role of public health within an emergency response

## RESOURCES

BC Health Wildfire Smoke Response Coordination Guideline<sup>29</sup>  
<http://www.bccdc.ca/resource-gallery/Documents/BC%20Health%20Wildfire%20Smoke%20Response%20Coordination%20Guideline%202017.pdf>





## COMMUNICATION

### PUBLIC HEALTH EXPERIENCES

Communication during and prior to a smoke event was an important part of the public health response and took several forms. Two broad categories of communication were identified by practitioners; communication within and between agencies and communication with community members and the general public.

Communication within and between agencies was important for the co-ordination of efforts and ensuring those responding to the situation had consistent information. Primary care providers did not always feel they had received the guidance and information they felt might be helpful to them in preparing and protecting community members for a smoke event in a timely manner. Several acknowledged that preparation in advance might have helped them respond more quickly and perhaps more effectively during an event. Stronger communication channels between regional health authorities and primary care providers might facilitate the flow of information and assist community-based health care providers.

A template for daily communication across agencies was found to be helpful in accelerating the transmission of information. Partnering with agencies such as the BC CDC was extremely helpful as they were able to translate and package technical information in ways that were accessible and immediately usable for public health practitioners. A designated, single communication connection between agencies and partners was also helpful in decision-making and the transmission of information to broader networks.

The methods and platforms used to communicate to the public during a smoke event varied widely depending on the size, geographical location, and characteristics of a community. Health authority websites received a lot

of traffic during smoke events in BC and Manitoba. They were identified as a convenient and easily accessible way to provide information to a very wide audience. Social media was used as a way to direct people to websites and provide very general advice, though it was not very helpful in communicating directly to communities as conditions and circumstances varied across jurisdictions. Social media was, however, seen as an effective means of raising awareness in communities.

Traditional media sources such as television, newspapers, and radio were also used to communicate with the public, though not all mediums worked in all settings. Public service announcements on television and radio were used to direct the public to websites for information and to provide information about how to use and understand the AQHI. Local radio and community Facebook pages were effective ways of reaching some remote communities; however, internet connections and cellular networks may not be available in many communities and may be lost during a wildfire event. Direct communication through established relationships was often the only effective way to connect with community members, often through nursing stations or health centres.

Community newspapers were helpful in providing advice to the public about how to protect themselves during a smoke event, but not very helpful for providing timely updates on smoke conditions. It was widely appreciated that Medical Health Officers can become overwhelmed with media requests, particularly when large fires are threatening several communities, and calling press conferences or media scrums were seen as an effective and efficient way to get information out to the public.

Print media such as brochures and even billboards were also used. Billboards were used to raise awareness about health issues related to smoke in advance of wildfire season. Printed materials were distributed in grocery stores, pharmacies, and primary care sites as a means to reach

populations that may not regularly access the internet, social media, or television. Using infographics was seen as an effective way of communicating complex information in a simple way in all forms of media.

When communicating with the public, it was important that the messaging be consistent across agencies. A communication hub or co-ordination centre was helpful between agencies to ensure consistency in messaging. It was also important in some jurisdictions to consider the role of a communications department and establishing processes and procedures with them in advance of an event. Working with non-governmental agencies to co-ordinate messaging was somewhat more challenging and community members were sometimes confused when communications were not synchronized or consistent between government and non-governmental agencies.

Municipal leaders were often reluctant to communicate health related information, preferring to refer people back to health care agencies and health authorities. Respondents acknowledged that community leaders and local decision-makers can become overwhelmed with large amounts of highly technical information; however, they did find that providing clear and simple technical information was helpful to community leaders in decision-making. Practitioners felt that providing community members with clear information about what they can do to protect themselves during a smoke event was reassuring and helped to allay some of the anxiety and uncertainty they were feeling. Community members did on occasion report feeling overwhelmed or confused by too much information, particularly in highly changeable environments. Messaging needs to be culturally sensitive and translating messages to local languages was helpful not only for effective communication, but also to build relationships with communities.

It was felt in many jurisdictions that public health messaging to the public about wildfire smoke could have been initiated earlier. Community members often felt frustrated and scared without enough information about how to protect themselves or how to interpret information such as the AQHI. Because the hazard of smoke is more complex to communicate than that of fire, communicating with community members in advance of an event was considered important to build the capacity of community members to use the information they received during an event to make better decisions about protecting themselves and their families.

## MANITOBA HEALTH

Public health practitioners in Manitoba's Northern Health Region translated communications into Cree and Dene for local communities. Not only were the communications seen as more effective and accessible, it also provided an opportunity to build trust with the community.

## CONSIDERATIONS FOR PLANNING

- Prepare easily accessible information well in advance of an event
- Update online resources regularly
- Connect with community health care providers to make sure they have the information they need in advance
- Consider designating a central communication hub for all agencies to use
- Translate documents whenever possible
- Prepare communications templates
- Build connections with community leaders and health care providers who can get information to community members when necessary
- Prepare to make resources available on government/agency websites well in advance and update resources as necessary
- Dedicate a specific page to wildfire and wildfire smoke resources
- Include internal and available external resources

## RESOURCES

EPA Wildfire Smoke and Health Risk Communication Workshop<sup>54</sup>  
[https://www.epa.gov/sites/production/files/2017-04/documents/02\\_workshop\\_report\\_2017mar10\\_version\\_clean.pdf](https://www.epa.gov/sites/production/files/2017-04/documents/02_workshop_report_2017mar10_version_clean.pdf)

Indi the Caterpillar – Air Quality Health Index<sup>55</sup>  
[https://www.youtube.com/watch?time\\_continue=132&v=sPph4ruFqTE](https://www.youtube.com/watch?time_continue=132&v=sPph4ruFqTE)

Crisis and Emergency Risk Communication Toolkit for Wildfires<sup>56</sup>  
<https://www.nphic.org/Content/Awards/2014/CERC/CERC-IH-OR-ToolkitWildfires.pdf>

National Collaborating Centre for Environmental Health Introduction to Air Quality Advisories<sup>57</sup>  
[http://www.ncceh.ca/sites/default/files/Air\\_Quality\\_Advisories\\_Sept\\_2010.pdf](http://www.ncceh.ca/sites/default/files/Air_Quality_Advisories_Sept_2010.pdf)





## CLEAN AIR SHELTERS

### PUBLIC HEALTH EXPERIENCES

Providing access to or supporting community members to create clean air shelters during a smoke event is a public health intervention that was of interest to all four jurisdictions. Clean air shelter (CASs) are indoor areas where air quality is improved using an air filtration system that reduces the concentration of contaminants from outdoor wildfire smoke. CASs can be in peoples' homes, either in a single room or an entire home, or be publicly accessible buildings such as recreation centres, schools, libraries, sports facilities, community halls, or even shopping centres. Health infrastructure such as hospitals and medical buildings also needed to consider indoor air quality for their patients and staff during wildfire smoke events.

Publicly accessible buildings, or community clean air shelters (CCASs), are a relatively new idea in most jurisdictions and the work to identify suitable structures and ensure that they can function as CCASs is early in development. There are distinct considerations and challenges with identifying, implementing and directing people to make use of CCASs in urban, rural and remote communities.

Respondents found that remote communities may have few if any buildings that would be suitable to function as a CCAS. Buildings may not be large enough to accommodate large numbers of people, they may not be in good enough condition to restrict the flow of contaminants into the building, they may be difficult to access for some community members with transportation or mobility challenges, and they are unlikely to have air filtration systems that are designed for or capable of filtering large amounts

of particulate matter. Some remote and First Nations communities used community buildings as clean air shelters and found that they were natural gathering places in the community, encouraging people to use them as clean air refuges. Once established, they also served as effective hubs for the dissemination of information to community members. Some communities that did not have a suitable structure were considering working with neighbouring communities to share access to infrastructure that may be more suitable.

While most public buildings are not specifically designed to function as CCASs and may not have adequate air intake and filtration systems, community members often felt that they provided improved air quality than could be achieved in their homes. This was particularly true when wildfire events coincided with extreme heat events and homes were not air conditioned.

Environmental health officers continue to work with some communities to identify structures that may be suitable for use as CCASs and assess what modifications or upgrades might be necessary for them to function as such. The process is quite time consuming, as it must be done community by community in remote areas and is not always a priority when smoke is not an immediate risk to community members. Identifying and operationalizing a CCAS during a smoke event was extremely challenging due to heightened levels of stress and anxiety as well as the competing priorities of community members and community leaders when fire was, or was perceived to be, an imminent threat.

When considering sites for CCASs factors such as infiltration of outside air, air exchange and ventilation systems, accessibility, transportation and parking, availability of washrooms, water supplies, accommodations for service animals and children, low or no cost admission were identified as important. It was also important to have activities available to keep people occupied and provide them with health-related information. Funding for improvements to buildings and the operation of a CCAS during an event may need to be negotiated between agencies, governments and organizations and was considered best done well in advance.

Shopping malls and other public buildings in more urban centres were not necessarily seen as natural gathering places and communicating with the public about considering them as CCASs was important. Though such buildings may be well suited to accommodate large numbers of people, their air filtration and exchange systems were not often designed to handle the concentration of particulates that

might be present during a smoke event. Making alterations to the filtration capacity of heating, ventilation and air conditioning (HVAC) systems can have other implications for indoor air quality that require significant expertise to manage. Hospitals and medical buildings similarly were not always capable of filtering high concentrations of particulate matter and air filtration systems would sometimes need to be turned off to avoid damaging them.

Practitioners reported that community members may not want or be able to access CCASs due to mobility issues, physical or mental health concerns, or possible costs. When a CCAS was not available or not accessible to community members, they may be advised to create a CAS in their home. The simplest way to achieve this is by staying inside with doors and windows closed when the air quality is poor. In communities that experienced prolonged periods of poor air quality, this was not particularly helpful, as after several days the air quality indoors was generally not significantly better than outdoors. Respondents recognized that homes may not be well sealed, letting contaminants into the home, or they may not have air conditioning, which can result in dangerously high temperatures inside the home if doors and windows are kept closed. In addition to keeping doors and windows closed, community members were sometimes advised to seal off a single room and install a high-efficiency particulate air (HEPA) filter. Community members required guidance on the capacity of the filter required and the possible risks associated with coinciding heat if they did not also have air conditioning. The risks associated with evacuating vulnerable community members from areas with very heavy smoke had to be carefully weighed against their ability to create or access a CAS.

## BRITISH COLUMBIA FIRST NATIONS HEALTH AUTHORITY

Following several weeks of extremely heavy smoke in some communities in the BC Interior in 2017, the First Nations Health Authority (FNHA) identified high-risk community members through staff at community nursing stations and supplied them with HEPA filters for use in their homes. Filters were distributed by the staff and community members. Local and regional supplies of HEPA filters were severely limited due to increased demand, requiring FNHA to attain filters directly from a manufacturer. Conversations were sometimes required to help community members understand the criteria for receiving a filter and why only some people had received them.

## INTERIOR HEALTH, BRITISH COLUMBIA

To protect staff and patients during the 2017 wildfire season, BC's Interior health Authority maintained indoor air quality in their hospitals by increasing the minimum efficiency reporting value (MERV) rating of filters in their buildings from 4–13, allowing them to trap finer smoke particles. Over 2,000 filters were replaced, and air exchange systems were closely monitored to prevent overloading their capacity. Maintenance staff needed to be educated on the need for and implementation of increased filtration throughout the process. Some hospitals created clean air rooms for outpatients; however, they were not intended, nor suitable, for public use.

## NORTHWEST TERRITORIES

During a prolonged smoke event in the summer of 2014, the city of Yellowknife opened its indoor recreational facility, the Fieldhouse, to the public free of charge. While the facility was well suited to accommodate large numbers of people and provide opportunities for physical activity, it was not designed specifically as a CCAS. Community members felt the air quality was better inside the Fieldhouse than outside, however, and it provided some respite from the poor air quality outside.

## CONSIDERATIONS FOR PLANNING

- Raise public awareness about private clean air spaces well in advance of an event
- Make educational materials on the use of in-home HEPA filters available to the public (i.e., the size of unit for a space, sealing off one room if necessary, etc.)
- Connect with primary care providers in smaller, remote communities to estimate the number of vulnerable or higher risk people in the community
- Identify suppliers of HEPA filters in advance (retail or manufacturers)
- Health-focused information that could be available to HVAC installers
- Consider recommending indoor PM2.5 monitors
- Work with communities to identify appropriate spaces well in advance of an event
- Continue to work with communities to make ongoing improvements to access and planning
- Consider activities that might attract and/or occupy people while there
- Create a communications link to health services and other community partners that could go through a CCAS
- Discuss funding for facilities, activities, and services

## RESOURCES

BC CDC Evidence Review of Home and Community Clean Air Shelters<sup>58</sup>

[http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Health-Environment/WFSG\\_EvidenceReview\\_CleanAirShelters\\_FINAL\\_v3\\_edstrs.pdf](http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Health-Environment/WFSG_EvidenceReview_CleanAirShelters_FINAL_v3_edstrs.pdf)

First Nations Health Authority Clean Air Shelters<sup>59</sup>

<http://www.fnha.ca/Documents/FNHA-Wildfire-Smoke-Clean-Air-Shelters-Information.PDF>

Interior Health Air Shelters During a Wildfire<sup>60</sup>

<https://www.interiorhealth.ca/YourEnvironment/EmergencyPreparedness/Documents/Air%20Shelters%20During%20Wildfires.pdf>

Oregon Health Authority Identifying Clean Air Shelters<sup>61</sup>

<http://www.oregon.gov/oha/PH/PREPAREDNESS/PREPARE/Documents/IntificationOfCleanAirShelters.pdf>





## EVACUATIONS

### PUBLIC HEALTH EXPERIENCES

Evacuations due to smoke alone were very unusual. The risks associated with evacuating vulnerable community members were often considerable and needed to be carefully weighed against the risks of exposure to smoke. Remote communities were more likely to evacuate if smoke became very heavy as they may have restricted access to evacuation routes, CASs, or health care resources. There was no threshold for evacuation based solely on smoke or PM<sub>2.5</sub> concentrations in the four jurisdictions included in this project; however, communities expressed concern about the safety of exposure to prolonged and/or heavy smoke. Lessons learned from the massive and rapid evacuation of communities near Fort McMurray, Alberta, in 2016 informed decision-making in some communities, particularly alerting them to the dangers of waiting too long to evacuate.

If communities were evacuated due to fire, repatriation was often delayed due to poor air quality; however, air quality in receiving communities was not always significantly better. During a smoke event, if high risk community members were already out of the community, they were sometimes encouraged to extend their absence to avoid exposure to poor air quality. If evacuated, evacuees often arrived in receiving communities without necessary medications and the coordination of primary care and pharmacy services was extremely important. Evacuees were concerned at times that health care services in receiving communities might not be as culturally safe as those in their home communities and careful consideration was given to the location of the most suitable evacuation site.



## EVALUATION AND LESSONS LEARNED

### PUBLIC HEALTH EXPERIENCES

Most jurisdictions conducted some form of debrief, after-action report, or evaluation following a significant fire event, though not necessarily following a smoke event. Practitioners working at the community level often did not have access to the reports as they are not always publicly available. Debriefs were generally intended for organizational learning and not necessarily intended for community members. The participation of community members in these evaluations was unclear.

Key components of the public health response to a wildfire smoke event identified by public health practitioners included:

- Identifying and planning in advance for CCASs
- Providing communities with as much information as possible to inform their decision-making
- Getting accurate information to the public, often through websites
- Co-ordination and effective communication across agencies
- Consistent messaging to the public
- Having designated community liaison(s)
- Raising public awareness of the health impacts of wildfire smoke exposure
- Providing enhanced, early, and ongoing mental health support for vulnerable populations
- Building relationships with communities
- Acknowledging the work of community level service providers following an event
- Improving air quality in health care facilities
- Having easily accessible fact sheets and communication templates available in advance of an event

The most important learning and greatest opportunities for improvement that were identified included:

14. Minimizing the impacts of evacuation on First Nations communities by supporting communities to shelter in place when possible, providing additional community level support during an event, providing access to monitoring data whenever possible, working to strengthen relationships, and building capacity in receiving communities to provide culturally safe and responsive health and social services
15. Improving evacuees' access to primary care by connecting with community health care providers
16. Providing opportunities and platforms for community members and community level practitioners to share what they have learned to help others better prepare
17. Preparing communities for future events as part of a broader climate change adaptation strategy
18. Building the technical capacity to service, upgrade, and maintain air exchange systems in health care facilities that are capable of filtering high concentrations of particulate matter
19. Working across agencies to best utilize existing capacity within the system through a better understanding of roles and responsibilities prior to an event



## DISCUSSION

During an emergency situation when a community is directly threatened by fire, emergency management organizations and agencies (EMOs) assume a leadership role in ensuring the safety of community members and evacuating them if necessary. Though they worked collaboratively with EMOs in most jurisdictions, the role of public health practitioners within an emergency response was not always well understood or well defined. Due to the high-risk nature of the work of EMOs and the consequence of any error in judgement, responsibilities and decision making processes tend to be very clearly delineated and well established. Integrating partners such as public health, primary care or community agencies into an emergency response created some challenges because the processes, organizational structures and priorities of each partner are different. Creating collaborative processes and building connections was important in facilitating decision making and co-operation during an event. Clearly articulating the role and potential contribution of public health and health emergency managers during an emergency fire or non-emergent smoke event well in advance of it occurring might facilitate the integration of public health into emergency response planning by more clearly defining the role it could fill. Health emergency managers are well positioned to play a key part as connectors, knowledge brokers and points of co-ordination between and across agencies.

One of the ways in which public health was valuable in contributing to an emergency response was to act as a liaison between EMOs, communities and other agencies through practitioners such as EHOs. In some jurisdictions, environmental health officers served an important linkage role during the decision making, evacuation and repatriation processes. There remain gaps; however, in the linkages between evacuees and primary care; public health departments, community and municipal leadership; as well as between regional, provincial and federal health services in responding to smoke and fire events. While public health departments and practitioners may not have a role to play in bridging all these gaps, the role of community liaison and knowledge broker was important and a potentially valuable contribution.

Some of the challenges with acting as a knowledge broker include the scarcity of evidence regarding the health impacts of wildfire smoke and variability in the quantity and quality of data available to assess air quality. Though there is much to still be learned about the health impacts

of wildfire smoke exposure, there is a lot we do already know that can be mobilized as we build our knowledge and understanding. Because wildfire smoke can affect large numbers of people with rapidly changing, unpredictable and highly localized conditions, it can be difficult to provide specific advice or information that is relevant and timely as an event is unfolding. Equipping community members, leaders and primary care providers with practicable, relevant and easily accessible information about how to protect themselves well in advance of an event seems the most effective strategy moving forward. Continuing to share and build on the experiences of public health practitioners across the country will help to consolidate learning in this field and clarify where work remains to be done.

This report is not a comprehensive survey of public health practices across Canada regarding wildfire smoke, but rather provides some insight into where future inquiry and capacity development might be warranted.



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## APPENDIX 1: SUMMARY OF CANADIAN PUBLIC HEALTH GUIDANCE DOCUMENTS REGARDING WILDFIRE SMOKE

PROVINCE/ TERRITORY	PUBLIC HEALTH GUIDANCE DOCUMENTS	MOST RECENT VERSION	INTENDED USERS
Alberta	Simplified Wildfire Smoke Guide	2017	Airshed managers, municipalities, companies, schools
British Columbia	BC Health Wildfire Smoke Response Coordination Guideline	2017	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
Manitoba	Smoke Exposure from Wildland Fires: Interim Guidelines for Protecting Community Health and Wellbeing	2012	Health sector, communities, community leaders
New Brunswick	None found	2015	
Newfoundland and Labrador	Forest Fire Smoke and Air Quality Public Health Guidelines	2016	Public health decision makers
Northwest Territories	Smoke Exposure from Wildfire: Guidelines for Protecting Community Health and Wellbeing	2016	Health sector and community governments
Nova Scotia	None found		
Nunavut	None found		
Ontario	None found		
Prince Edward Island	None found		
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	2013	Health workers in northern Saskatchewan
Yukon	Yukon Wildfire Smoke Response Guidelines for protecting Public Health	2017	Public health decision makers

## APPENDIX 2: AQHI, PM2.5 AND VISUAL ASSESSMENT

HEALTH RISK	AQHI LEVEL	1-3 HOUR AVERAGE PM2.5 CONCENTRATION	VISIBILITY	HEALTH MESSAGES	
				AT RISK POPULATIONS	GENERAL POPULATIONS
LOW	1-3	0-40 µg/m <sup>3</sup>	15 km and up	Enjoy your usual outdoor activities	Ideal air quality for outdoor activities
MODERATE	4-6	41-175 µg/m <sup>3</sup>	5-14 km	Reduce or reschedule prolonged strenuous activities and limit time spent outdoors	Be aware of health effects of smoke and related symptoms
HIGH	7-10	176-300 µg/m <sup>3</sup>	2.5-4 km	Reduce or reschedule prolonged strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion	Consider reducing or rescheduling strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation
		301-500 µg/m <sup>3</sup>	1.5 -2 km		
VERY HIGH	Above 10	>500 µg/m <sup>3</sup>	< 1 km	Avoid strenuous activities outdoors. Children and elderly should also avoid outdoor physical exertion	Reduce or reschedule strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation

ADAPTED FROM:

**Environmental Protection Agency: Wildfire Smoke: A Guide for Public Health Officials**

<http://www.arb.ca.gov/smp/progdev/pubeduc/wfgv8.pdf>

**Manitoba Health: Smoke Exposure from Wildland Fires: Interim Guidelines for Protecting Community Health and Wellbeing**

<https://www.gov.mb.ca/health/publichealth/environmentalhealth/docs/wildlandfiresmokeexposure.pdf>

**Environment and Natural Resources Canada: Understanding Air Quality Health Index Messages**

<https://www.canada.ca/en/environment-climate-change/services/air-quality-health-index/understanding-messages.html>