Penticton, B.C. — August 29, 2021

Chapter 5: Wildfires

KEY FINDINGS

- Severe wildfire seasons are among the greatest climate risks facing B.C., with the **intensity and frequency of wildfire activity increasing** over time.
- Wildfires in B.C. significantly **impact population health**, primarily due to wildfire smoke. Evidence demonstrates associations of wildfire smoke with increased respiratory issues, emergency department visits, hospitalizations, and deaths. Asthma exacerbations are a consistent outcome, with emerging evidence of cardiovascular and birth-related effects, and repercussions for individuals with diabetes and end-stage renal disease.
- **Wildfire evacuations** in B.C. disrupt access to health care, medications, and supplies; influence community social cohesion; and have impacted mental health through increased stress and emotional trauma.
- Wildfires can indirectly impact the health and well-being of B.C. populations by influencing the **determinants of health**, such as access to cultural sites, economic productivity, and outdoor activities.
- Wildfires in B.C. **disproportionately affect specific populations**, driven by factors such as greater exposure to wildfires, reduced adaptive capacity, and increased susceptibility. Children, older adults, individuals with cardiorespiratory conditions, pregnant individuals, and marginalized communities are at higher risk of health impacts from wildfire smoke.
- **Many First Nations communities** in B.C. are particularly susceptible to the effects of wildfires, due to their proximity to wildland areas. Uncontrolled wildfires disrupt traditional activities and ways of life, compounding emotional trauma. Additionally, First Nations communities face greater challenges in recovery.
- **Wildfire adaptation strategies** to protect public health, enhance disaster preparedness and build resilience in the face of increasingly severe wildfire events include:
  - improved coordination and collaboration within the health care system;
  - the use of low-cost sensors to monitor air quality and smoke infiltration;
  - enhancements in wildfire smoke monitoring, warning systems, and public-risk communications;
  - patient-care adaptations;
  - facility and infrastructure upgrades; and
  - Indigenous-led adaptations, such as prescribed cultural burns.

THE 2021 WILDFIRE SEASON IN B.C.—A RECORD-BREAKING YEAR

The conditions for the fourth-most destructive wildfire season in B.C.'s history[1] were set in the months leading up to the summer of 2021. Below-average precipitation in the southern half of B.C. during the fall and winter of 2020–21 led to extended drought conditions into the spring, with the first wildfire evacuation alert issued April 8, 2021 [272]. By June, unprecedented record-breaking heat and dryness had raised fire danger to extreme levels, and led to burning conditions more typically seen in August [272]. More than 1,500 wildfires were identified through the summer. The majority of notable fires burned in the Interior region, [272] in the traditional and unceded territories of the Secwépemc, Nłeʔkepmx Tmíxʷ and Syilx Nations [273].

The communities of Lytton, Lytton First Nation, and Monte Lake were completely or partially burned by wildfires. Thousands of people were evacuated from communities and health facilities, some for long-term periods of months and even years [274,275]. Two community members tragically lost their lives trying to escape the rapidly moving Lytton fire [276].

2021 WILDFIRE SEASON BY THE NUMBERS

~869,000 hectares burned, making this the fourth-most destructive wildfire season in B.C. history [272]

300+ active wildfires burned simultaneously in the province, at the peak [273]

1,642 wildfires burned over the season; 67 categorized as "wildfires of note"—meaning they were highly visible or posed a potential threat to public safety [272]

137 wildfire-smoke related special air quality statements were issued by ECCC for B.C.[2]

527 structures destroyed, including primary residences, seasonal homes, and commercial buildings [277]

~90 percent of the Village of Lytton destroyed by the Lytton Creek fire, including most homes and structures, the local ambulance station, health clinic, and RCMP detachment [276]

56 days of a provincial state of emergency for wildfire response [272]

181 evacuation orders and **304** evacuation alerts triggered [272]

~32,000 people displaced by the fires [278].

1,151 patients/residents from Acute, Long-Term Care, Assisted Living, and Home and Community Care evacuated in the Interior Health region [42]

2 people tragically lost their lives fleeing the Lytton Creek fire [276]

$719 million in fire-suppression costs to the Province [272]

$1.7 billion–$2.5 billion in total economic costs to the Province [44]

1 Based on total area burned.
2 Data source: Environment and Climate Change Canada (ECCC)—see Appendix 1 for more details.

5.1 Exposure to wildfires in B.C.

Wildfire trends in B.C.

Severe wildfire seasons are among the greatest climate risks facing B.C. [30]. Due to prolonged extreme-fire weather conditions and longer fire seasons, wildfires are projected to increase in number, size, and intensity, particularly in northern boreal forest regions [279]. The 2019 Preliminary Strategic Climate Risk Assessment ranked severe wildfire season as having both an increasing likelihood of occurring and the highest level of consequences (considering health, economic, social, cultural, and ecosystem consequences), compared to 14 other assessed climate hazards [30] [3]. It projected that a severe wildfire season would occur roughly once every three to 10 years in B.C. by 2050 [30].

Data shows increasing wildfire activity in B.C. over time, driven in part by climate change [280,281]. In line with globally observed trends, B.C. is seeing an increase in mega-fires, which are often described as ecological disasters; they burn vast areas of land and are characterized by high intensity outside of observed historical ranges [282,283]. In the 102 years of recorded wildfire history in B.C., the four most destructive (by area burned) occurred during the last decade (Table 2): 2017 (1.2 million hectares), 2018 (1.3 million hectares), 2021 (0.9 million hectares), and 2023 (2.8 million hectares) [272,284].

Table 2. Record-breaking wildfire seasons in B.C. since 2009 [272,285]

Indicator	B.C. Wildfire Year							
	2009	2010	2014	2015	2017	2018	2021	2023
Historic ranking in terms of area burned	8th	6th	5th	7th	3rd	2nd	4th	1st
Total area burned (thousand hectares)	>247	>337	>369	>280	>1216	>1354	>869	>2841
Number of fires	3,064	1,672	1,481	1,858	1,353	2,117	1,647	2,245
Provincial state of emergency (# of days)	0	0	0	0	70	23	56	28
Number of people evacuated / displaced	20,000	1,383	4,500	3,432	65,000	3,200	32,882	~48,000
Total costs fire suppression (million dollars)	382	212	298	277	649	615	719	817

Direct exposure to wildfires occurs when communities and infrastructure are in close proximity to wildland areas. A large proportion of B.C.'s land mass is in the "wildland human interface" zone[4], with the highest percentages in the Interior and Northern regions of the province [279].

3 Severe wildfire season was defined as at least one million hectares burned that affect human settlements and significant infrastructure. Possible consequences included negative acute and long-term impacts to health due to smoke exposure, displacement, loss of possessions and livelihoods, severe psychological distress, economic impacts, and disruption to industries (such as tourism, timber, mining, and agriculture), operations and infrastructure (such as transportation, electricity supply, telecommunications, water treatment, and sewage systems).

4 The wildland urban interface (WUI) is typically described as the area where communities meet or intermingle with the natural environment. When we live, work, and play in WUI zones, we become more exposed to the danger of wildfire. [286]

Wildfire smoke exposure in B.C.

What is in wildfire smoke?

Wildfire smoke is complex and can change over time, depending on what materials are burning and other factors [287]. Major smoke constituents include carbon monoxide, volatile organic compounds, mercury, ozone, pollutant mixtures, and particulate matter (PM) [287], with fine particulate matter ($PM_{2.5}$) posing the greatest risk to human health [288]. Wildfire smoke is not the only source of $PM_{2.5}$ in B.C.; other major sources include wood-burning stoves and fireplaces, heavy-duty equipment, industry, and traffic [289]. However, over time, wildfire smoke is accounting for an increasing proportion of $PM_{2.5}$ exposure in B.C. [138].

Wildfire smoke can travel large distances, sometimes moving hundreds or thousands of kilometres from the fire zone [290], impacting communities far away [291,292]. B.C. communities have experienced some of the worst air quality rankings in the world during periods of high wildfire activity, even being impacted by active fires outside the province [6,7,10]. Air quality modelling for B.C. has found that, while concentrations of wildfire-$PM_{2.5}$ are greatest in areas closest to wildfire activity, wildfire-$PM_{2.5}$ can be widely dispersed [292]. During the 2017 western Canadian wildfires, smoke was injected high (up to 23 kilometres) into the stratosphere, and was detectable by satellites for more than eight months [291].

Peachland, B.C.

Because of the transboundary nature of wildfire smoke, large proportions of the B.C. population are exposed to wildfire smoke each year at levels above the recommended threshold to protect human health [292]. During the 2017 wildfire season, approximately 70 percent of the B.C. population and 32 percent of the B.C. landmass was exposed to wildfire-$PM_{2.5}$ above a seasonal average of 10.0 ug/m^3 (May–September)[5] (Appendix 1 – Table A1.4).

Additional analyses by Statistics Canada for the 2018 wildfire season found many B.C. communities were exposed to poor air quality at levels representing a high risk to human health; Prince George in Northern B.C. ranked highest, experiencing 32 high-risk days[6], followed by Castlegar in the Southern Interior, with 30 days [293] (Figure 8). This Air Quality Health Index (AQHI) figure highlights the regional differences in exposure to wildfire smoke in B.C. At a national level, the 10 Canadian communities with the highest average exposures to wildfire-$PM_{2.5}$ in Canada from 2013–2015 and 2017–2018 were all in B.C., particularly in the B.C. Interior and Northern regions [292]. During this period, the population in the B.C. Cariboo region had the highest average exposure to wildfire smoke of all regions in Canada, with wildfire-$PM_{2.5}$ driving much of the overall $PM_{2.5}$ exposure from May to September (Appendix 1 – Table A1.5) [292].

5 The threshold of 10.0 ug/m3 represented the Canadian Ambient Air Quality Standard (CAAQS) for annual $PM_{2.5}$ for the study time period. The annual threshold was used as a proxy threshold in this study, though seasonal averages may not be directly comparable to the annual CAAQS threshold.

6 High risk was defined as an Air Quality Health Index (AQHI) of 7 or higher.

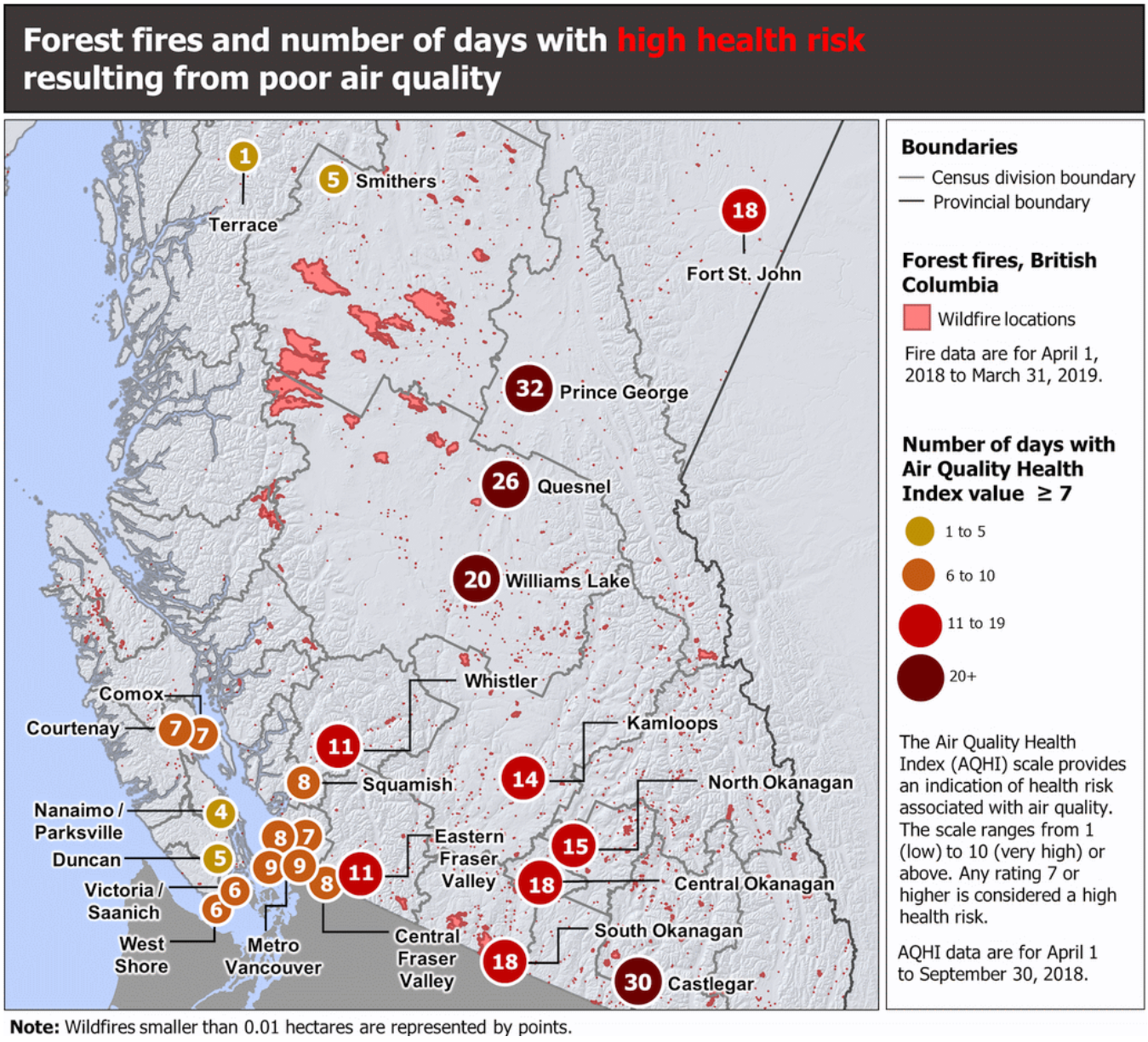


Figure 8. Number of days with high health risk resulting from poor air quality in B.C. communities during the 2018 wildfire season [293]

In 2021, 137 (77 percent) of the 177 special air quality statements (SAQS) [7] issued for B.C. by ECCC were due to wildfire smoke, and the province had one or more regions under an advisory for wildfire smoke for a total of 77 days. Interior Health had the most days with one or more regions under a SAQS (77 days), followed by Fraser Health (particularly the Fraser East health service delivery area, with 57 days) (see Appendix 1 – Table A1.7).

7 Special Air Quality Statements (SAQS) are issued by Environment and Climate Change Canada based on air quality advisories from the B.C. Ministry of Environment and Metro Vancouver.

Cascading impacts of wildfires in B.C.

Wildfires can result in cascading impacts, with implications for health and well-being:

- Severe wildfires damage the forest canopy, the vegetation, and the soil, which can lead to soils becoming more hydrophobic (i.e., less able to absorb moisture), resulting in increased runoff after intense rainfall or rapid snowmelt [294,295]. Particularly in areas that experienced high burn severity, the chances of soil erosion, floods, landslides, rock falls, snow avalanches, and drought increase [296], which can put infrastructure and communities below and downstream from a burned area at risk [295]. After the 2017 Elephant Hill wildfire in B.C., for example, severely damaged vegetation in the area created hydrophobic soils, and several intense rainfalls following the fire caused damage, flooding, and drainage issues [297]. After the 2017 wildfires, Tl'etinqox experienced numerous floods [34].
- Wildfires can impact freshwater availability [298], with impacts to drinking water quality and quantity through factors such as more hydrophobic soil; damaged water infrastructure; the build-up of ash, soil erosion and debris; and a rise in soil and water chemical levels (e.g., phosphate, nitrate, nitrite) if fire retardant is used [299] or if pipes, meters, and wellheads are burned. After Alberta's 2016 Fort McMurray wildfire, for example, levels of suspended sediment, nutrients (nitrogen, phosphorus), and metals (lead and others) from impacted rivers were 1.2 to 10 times greater than from those draining unburned regions [300].
- Air quality after a wildfire can also be impacted, due to contamination from burned structures and materials. After wildfires burned structures in Lytton (2021) and Telegraph Creek (2018), for example, contaminants such as asbestos and lead were reported in ash samples and debris [301–303].
- Wildfire smoke can influence ozone levels; the long-range transport of wildfire smoke from Siberia in 2012, and wildfires from B.C. and the western United States in 2017 and 2018, for example, are believed to have led to the higher ozone levels in these years [138].
- Wildfire impacts on a range of ecosystems can also have downstream effects on human health. For example, wildfire ash deposition on marine and freshwater systems can be toxic to organisms and can lead to increased growth of harmful algae blooms [304]. This can in turn can significantly affect fish and shellfish populations, which can have impacts on food security [305]. Wildfires are also associated with mercury contamination in downstream aquatic ecosystems, including increased mercury concentrations in fish [306,307]. Wildfires can weaken, damage, or stress trees (including fruit-bearing trees) and make them more susceptible to insect attack [308]. Further, wildfires have also been shown to be directly responsible for permafrost peatland melt in Western Canada (including areas of Northeastern B.C.) [309], which has cascading food security impacts for Indigenous Peoples that rely on permafrost regions for traditional hunting, fishing and gathering activities. For more details on how wildfires have impacted food supply chain, see pop-out box in section 5.3 of wildfire-influenced food supply impacts in B.C.

5.2 Wildfire impacts on B.C. population health and the health system

There is growing evidence globally that wildfires impact health through multiple pathways [310]. A large body of research shows that wildfire smoke (and $PM_{2.5}$ exposure more broadly) increases rates of respiratory medication use, ambulance calls, emergency department visits, hospital admissions, and deaths [311–314].

Respiratory health impacts of wildfire smoke are among the most consistently reported in the literature, with the clearest evidence for exacerbations of asthma, and mixed evidence for an association with chronic obstructive pulmonary disease (COPD) and respiratory infections [311,315,316]. There is also growing evidence of acute cardiovascular health impacts from short-term wildfire smoke exposures [310,311], and emerging evidence of impacts on outcomes among people with diabetes and end-stage renal disease [311]. In addition, there is emerging evidence of exposure during pregnancy impacting adverse birth outcomes [317,318].

In addition to morbidity and mortality, wildfires are having broad impacts on the social, economic, and cultural determinants of health in B.C.

5.2.1 Wildfire impacts on B.C. population and public health

Wildfire-related deaths in B.C.

Deaths occurring directly due to wildfires in B.C. rarely occur. According to the Canadian Disaster Database and media reports, there were nine wildfire deaths reported in B.C. between the years 2003 and 2023, with six occurring among wildfire crews working on the frontlines [285,319,320]. In 2021, two people in the community of Lytton lost their lives trying to escape the rapidly approaching fire [276], marking the first year since 2003 in which community members perished due to wildfire.

Deaths in B.C. have also been associated with wildfire-smoke related $PM_{2.5}$, with reported increases in the number of deaths due to any cause [321] and deaths occurring prematurely [292]. In 2023, a young boy tragically lost his life following a severe asthma attack exacerbated by wildfire smoke in an Interior B.C. community [322]. Modelling by Health Canada estimated that between 2013-15 and 2017-2018 , $PM_{2.5}$ from wildfires resulted in 293 premature deaths from acute exposure, and 2,979 premature deaths from chronic exposure in B.C. (Appendix 1 – Table A1.6). These findings suggest that, on average, B.C. has the largest proportion of estimated premature deaths due to acute and chronic wildfire smoke exposure of all Canadian provinces, accounting for roughly half of all estimated wildfire-smoke associated premature deaths in the country over the study period [292][8].

Vancouver, B.C. — July 5, 2015

8 These are estimates derived using statistical models.

Wildfire-related illnesses in B.C.

Wildfire smoke

B.C. community members surveyed during and after wildfire smoke events frequently report respiratory health impacts, for example:

- In a survey about the 2017 wildfire smoke impacts on residents of the Interior B.C. community of Kamloops, more than half of 641 respondents said their lifestyles had been severely affected by the smoke. More than three-quarters reported eye and throat irritation, headache/irritability, fatigue/malaise, cough/phlegm/asthma, and nose irritation, and many reported increased medication use [323].
- During the 2017 Elephant Hill wildfire, some evacuees reported experiencing respiratory illnesses such as bronchitis or pneumonia, with respiratory symptoms exacerbated by conducting daily activities outdoors in the high smoke conditions [324] [9].
- The 2019 First Nations Leadership Council Climate Emergency Survey, which included 139 First Nations and Tribal Councils across B.C., asked participants what health problems they or others in their community have experienced that may be related to climate change impacts (e.g., warming temperatures, wildfires, etc.). Of the 221 respondents, 63% indicated "respiratory disease" caused by exposure to indoor or outdoor air pollutants or allergens. It was second only in frequency to mental health impacts (65%) [61].

> *"We drove through the flames. I was just crying watching my whole valley burn. All the berry picking. All gone. We grew up in those mountains... I needed to go to the hospital right away. I have my inhalers and they're not even doing anything at this point. My nose and my throat is full of soot and I'm trying to get it out... I needed oxygen and fluids. They said if I was there any longer, my lungs would give out."*
>
> —Suzanne Kilroy/Huculak, community member of Downtown Eastside, interview in Megaphone Magazine [325]

Cardiorespiratory health impacts are also among the most frequently reported health impacts of wildfire smoke in B.C. population-based studies, evidenced by:

- Increased asthma medication use in multiple wildfire years [321,326–328]; and
- Increased health care utilization, including visits to the emergency department [329] and physicians [327,328,330]; hospitalizations [326] and ambulance calls [321] for respiratory illnesses during wildfire smoke events; and cardiovascular- and diabetes-related illnesses in some studies. (See Chapter 10: Health Emergency Management, Evacuations and Health Service Delivery for more details about health service use during wildfire events in B.C.).

9 These data were collected through in-depth interviews of seven members of the Ashcroft Indian Band as part of a case-study analysis of the impacts of long-term evacuations from the Elephant Hill Wildfire of 2017.

Work is ongoing to investigate impacts of wildfire smoke on birth outcomes and infant health in B.C. [331,332]. One Canadian study found that long-term exposure to wildfire smoke may increase the risk of certain cancers. Compared to populations that were never exposed to wildfire smoke, incidence of lung cancer and brain tumors were elevated for populations who were exposed to wildfire smoke in Canada. The authors caution, however, that further research is required before causation can be assumed. [333]

Wildfire evacuations

The process of evacuation has impacted the health of B.C. populations in different ways: limiting peoples' access to health care, medications, supplies; reducing their access to healthy and sufficient food sources; and impacting mental health through increased stress and trauma.

Exacerbations and increases in diagnoses of chronic physical illnesses have also been reported among long-term evacuees in B.C. Some long-term evacuees from the 2017 Elephant Hill wildfire, for example, reported increased chronic physical health conditions, such as asthma and diabetes, and infectious diseases [324]. Mental health impacts have also been among the most frequently reported health impacts of wildfires for community members in B.C., particularly in association with evacuations. More discussion about the impacts of wildfire-related evacuations in B.C. is included in Chapter 9: Mental Health Impacts and Chapter 10: Health Emergency Management, Evacuations, and Health Service Delivery.

Wildfire impacts to social, economic, cultural, and environmental determinants of health

In addition to their direct impacts, wildfires also indirectly impact the health and well-being of B.C. populations by influencing the determinants of health. For example:

- Displacement can result in social fragmentation from friends and family and diminished community cohesion, especially when community members are evacuated for several weeks or months [273].
- Wildfires have contributed to reduced access to sacred and cultural sites among First Nations communities in B.C. [61] They have also contributed to reduced social connection in some Indigenous communities, due to people staying indoors during wildfire smoke periods and community events being cancelled [223].
- Economic losses, loss of livelihoods, and loss of productivity due to wildfire damage—and time spent away during evacuations—have impacted many workers and industries. People living in areas impacted by smoke have also reported a reduced ability to focus on work and disruption to work routines [323].
- Smoke exposure impacts outdoor recreational and community activities when sporting events or regular physical activity routines are cancelled. During the 2017 wildfires, for example, many recreational games were cancelled and outdoor exercise was severely affected, according to 346 (54.8 percent) of respondents to a Kamloops community survey [323]. Road closures, including forest-service roads and recreation trails [334], have also curbed recreational travel [335].

Pop-up camps for kids affected by 2021 wildfires

As a result of the 2021 wildfire season, many evacuated children had been stuck in hotel rooms for days on end, unable to play outside due to poor air quality or to access indoor recreational opportunities due to affordability. BGC (formerly Boys and Girls Club) Okanagan partnered with the United Way B.C. to provide a pop-up recreation program for children of families evacuated by the wildfires.

BGC's free pop-up recreation program provided children with a safe and friendly environment to participate in a range of activities and receive the help of supportive adults. The staff at BGC witnessed many signs of the trauma and stress that children had experienced. The program helped turn a stressful and chaotic introduction into a new community into a safe, supportive and fun experience. [336]

Source: United for BC Wildfire Recovery Fund 2021, United Way B.C.

5.2.2 Disproportionate impacts of wildfires on populations in B.C.

Some B.C. populations are disproportionately impacted by wildfires due to a combination of increased exposure (e.g., proximity to wildfires), reduced adaptive capacity (e.g., access to emergency services), and/or increased sensitivity (e.g., pre-existing health conditions).

Populations at increased risk from wildfire smoke

As reported in the global literature, those most susceptible to the health effects of air pollution also appear to be more susceptible to wildfire smoke. They include children, older adults, people with cardiopulmonary diseases (including asthma, COPD, and ischemic heart disease), and pregnant people as well as the developing fetus [311,337]. Additional evidence suggests people experiencing socioeconomic disadvantage, racialized populations, and Indigenous communities may be more impacted by wildfire smoke exposure [312,315,316]. Women are shown to be more impacted by wildfire smoke in some studies [312,315,337,338], due to possible factors such as higher susceptibility (e.g., asthma-related airway restriction due to having relatively smaller respiratory airways) [315] or greater exposure [338].

Evidence of some of these risk factors in B.C. include:

- ***Pre-existing health conditions:*** During wildfire smoke events, rates of hospitalizations, salbutamol (inhaler) prescriptions, physician visits, and ambulance dispatches are consistently found to be significantly higher for people with pre-existing cardiovascular and respiratory conditions, particularly asthma. There is also evidence suggesting higher rates of ambulance dispatches for people with diabetes during wildfire smoke events in B.C. [[326–330]
- ***Age:*** Older adults and young children have heightened sensitivity to wildfire smoke. In a B.C. study of the 2003 fire season, people over 70 years of age were disproportionately represented in hospitalizations for respiratory illnesses, making up 49 percent of hospitalizations even though they

make up just 17 percent of the population [326]. B.C. health care providers also report seeing significant increases in asthma exacerbations in children during smoke events [56].

- ***Low-income, marginalized and/or underhoused populations:*** B.C. health care clinicians who provide care to people who are marginalized, low-income, and/or underhoused in Vancouver's Downtown Eastside report significant and disproportionate increases in patient volumes and hospitalizations during wildfire smoke events [56]. They report exacerbations of asthma, COPD, and other respiratory issues, as well as increased frequency of strokes and heart attacks [56]. *Risk to Resilience Project* focus group participants noted that a large proportion of underhoused populations have baseline COPD and/or tobacco use disorder, and live in conditions with poor ventilation, such as in single-room-occupancy (SRO) hotels and supportive living facilities.

> *"A lot of [marginalized and homeless populations] are experiencing asthma, COPD, and respiratory issues…during the smoke…and exacerbation of their current symptoms…You couldn't really send them out because you would send them back out on the street."*
>
> —*Risk to Resilience Project* focus group participant

Overall, more research is needed to understand which populations are most susceptible to wildfire smoke exposure [315,316].

Wildfire impacts on Indigenous communities

Many First Nation communities are located close to the wildland-human interface, which increases the risk of wildfire exposure [279]. The Province's 2017 Freshet and Wildfires Provincial After-Action Review highlighted that many First Nations communities throughout the Central Interior of B.C. were disproportionately affected by the massive scale of the 2017 fires; 23 First Nation communities were directly impacted by wildfires, and as many as 1,800 Indigenous persons were impacted by evacuation orders. Significant damage and loss occurred to community infrastructure and First Nations traditional territories [75].

Due to their impact on traditional activities like fishing, hunting, and trapping, uncontrolled wildfires have significant direct consequences for Indigenous communities [44]. As highlighted in a review of the 2017 wildfires, many First Nations communities face greater challenges than non-Indigenous communities to recover from wildfire disasters [34]. The impacts on traditional ways of life, land, wildlife, and livestock also compound emotional trauma for many Indigenous communities.

First Nations communities in B.C. are more frequently evacuated from wildfires than other communities, as they are often situated in remote and forested areas. Of 253 wildfire-related evacuations in B.C. between 2009 and 2019 [339], more than one-quarter (26 percent) were from First Nations communities, primarily within Interior Health and Northern Health regions.[10]

First Nations in B.C. have long understood the interconnectedness of the health of forests, land, and communities since time immemorial. They are also leading wildfire adaptation practices, such as prescribed cultural burns, across the province (see example in section 5.3 Health-related adaptations to wildfire.)

10 Data obtained from the Canadian wildfire evacuation database [339]

Other disproportionate impacts from wildfires

Some B.C. populations are also disproportionately impacted by wildfires due to their geographic location (e.g., rural or remote communities), their reliance on essential health medications or treatments (e.g., people with complex care needs), or their occupation (e.g., farmers, ranchers, and firefighters). For example:

- ***Migrant farm workers:*** More than 8,600 people work on thousands of farms in B.C., many coming from countries including Mexico and Guatemala [340]. Migrant farm workers often live and work in or near areas frequently affected by wildfire smoke. They may also experience poor living and working conditions, face language barriers to understanding public health messaging, and have limited social supports and connections [341]. There are reports of migrant farm workers in B.C. becoming sick when working outside during wildfire smoke episodes [340].
- ***Farmers and ranchers:*** There are numerous reports of stress, burnout, and trauma among B.C. food producers, as a result of the loss of livestock and crops due to wildfires [67,68,342]. For example, over 500 breeding livestock died in B.C. wildfires in 2017 and 2018, according to one estimate [67].
- ***Wildland firefighters:*** Those on the firefighting frontlines are at increased risk for physical and mental health impacts, due to long, strenuous shifts and close proximity to wildfire activity [343]. Several recent studies and reports of wildland firefighters in B.C. found they had increased occupational exposures to toxic chemicals, such as polycyclic aromatic hydrocarbons [344]; high levels of fatigue and sleep disruption [345,346]; injuries such as burns, fractures, and sprains during their shifts; and longer-term mental health impacts [347]. One survey reported many B.C. wildland firefighters feeling concerned about the unknown physical and mental impacts of their jobs, with more research needed on the effects of smoke inhalation on respiratory health, fatigue and sleep, mental health, stress, and long-term risk of disease [348].

5.2.3 Wildfire impacts on the B.C. health system

The B.C. health system experiences impacts directly due to wildfires, evacuation response, and wildfire smoke.

> *"If [we] are working 16 hours, are [we] really showing up as our best self?... Because if we're in continuous response mode, [we] cannot continue to show up...in the way that [we] need to."*
>
> —*Risk to Resilience Project* focus group participant

Increased workloads, exposure to poor air quality, and heightened mental health challenges are all among the widely reported wildfire impacts on B.C.'s health workforce. Health care workers who live in wildfire-affected communities are additionally impacted by concerns for the safety of their own families and homes [56,349]. At the same time, health workers have demonstrated their resilience in working together during wildfire events to troubleshoot, come up with innovative solutions, and offer support for communities and each other [349–352].

During wildfire evacuations, in particular, health care providers have gone to exceptional lengths to keep patients safe and updated about their home communities [353]—even helping evacuated residents stay in contact with friends and family through phone and video calls [354]. (See the pop-out box "All Hands on Deck".)

Workplace and mental health impacts

Health system staff have reported increased workloads, longer hours, and a heightened pace of work during wildfire events, which can lead to burnout and fatigue [96,349,352,354–356]. (See Chapter 8: Cross-Cutting Impacts, for more details.)

Wildfire smoke exposure can also be a health hazard to emergency response workers [357], and its health impacts are not confined to the frontline. During recent B.C. wildfires, staff and patients complained about smoke smell within some facilities [227,228].

> *"Every summer...you never know if you're going to be on alert and not be able to return home... [Our community] is one of the most likely cities to burn in Canada. So, we're always kind of wondering when we're going to be evacuated."*
>
> —*Risk to Resilience Project* Interview participant

Providing care during a wildfire crisis can be emotionally taxing for health care workers who witness environmental destruction while supporting psychologically distressed populations. Some health care workers report that they now dread the coming summer season, because of uncertainties about potential wildfire activity, and not knowing where and when they will be deployed next [349]. Some describe "losing their summer" to the demands of multiple facility evacuations over the course of the season [56,354].

> *"What a lot of people in health don't realize is that you have to have your own personal stuff really well organized, because the emergency room is kind of the last thing to close in a facility, right? When it's in a town [being] evacuated, [physicians] are the last people out."*
>
> —*Risk to Resilience Project* Interview participant

For health workers in affected areas, it can be emotionally challenging to balance professional responsibilities with personal concerns about evacuating their own families [56,349]. In addition, because they are designated as essential workers, health care providers in hospitals have responsibilities that can prevent them from leaving quickly in the event of an evacuation alert.

One physician described health care providers as having to be "*super well-prepared for themselves, because they might not be able to help evacuate their family if they're dealing with emergencies at the hospital and there is a code orange/code green event.*"

Wildfire impacts on health facilities and infrastructure in B.C.

Damage to facilities

Damage or destruction of health facilities by wildfire directly is infrequently reported in B.C., but has occurred. In 2021, the Lytton Creek wildfire destroyed the BC Emergency Health Services (BCEHS) – Ambulance Station [96] and community health centre [358] in the Village of Lytton. This impacted the availability of health services for communities in the immediate and long-term aftermath of the event.

Wildfires in the Interior region also destroyed an assisted-living facility in 2017 [56]. While the residents were successfully relocated, the community has been unable to replace the facility.

> *"We still have no assisted-living site to replace the one that was lost. So, we've lost that resource; we're still providing it in an alternate location in an alternate city, alternate community. So, there's a real gap there…for how [to] return a health care resource to a community that has lost it due to a [wildfire] event."*
>
> —*Risk to Resilience Project* focus group participant

Damage to infrastructure

Wildfires can also threaten critical infrastructure, such as power and gas distribution systems, and telecommunications infrastructure. This can impede emergency response and impact the health system's ability to deliver timely and quality care.

In 2023, B.C. wildfires downed hundreds of power poles, electrical lines, and transformers in the community of West Kelowna [359]. In Osoyoos, damage to telecommunications infrastructure led to a loss of landline services for some communities, including disrupted access to 911 services [360]. And during the 2021 wildfire season, communication systems were no longer operating in some B.C. communities [361].

When BC Hydro transmission lines are threatened, essential services such as hospitals, fire halls, and police stations are prioritized, as there may not be enough capacity to meet the electricity needs of all customers [362–364]. When health facilities experience power outages, their ability to provide services can be compromised, sometimes requiring the evacuation of residents and patients to another location [56].

Smoke infiltration into facilities

Smoke infiltration into B.C. health facilities during wildfire smoke events impacts indoor air quality for patients and staff. One recent study, conducted in collaboration with Lower Mainland Facilities Management [which provides services for Fraser Health, Providence Health, Vancouver Coastal Health, and Provincial Health Services Authority (PHSA)] and the BC Centre for Disease Control (BCCDC) evaluated wildfire smoke infiltration into a large Lower Mainland rehabilitation hospital during the 2020 wildfire

season. The results indicated that smoke can quickly infiltrate a health facility; during the event, indoor $PM_{2.5}$ concentrations were elevated by an average of 19 percent throughout the building [365]. These levels were not uniform across the facility, however, suggesting that certain operating features could help to reduce smoke exposures.

Smoke events can also increase demands on health facility air-filtration systems [42]. During the 2017 wildfires, for example, Interior Health reported changing more than 2,000 air filters every two to three weeks throughout the B.C. Southern Interior, due to smoky conditions. Despite there being several air scrubbers in each hospital, a dozen more high efficiency particulate air (HEPA) scrubbers were purchased for the Thompson-Cariboo region to mitigate poor air quality [355].

Additional costs are incurred when extra filtration is needed. One regional health authority spent approximately $15,000 to add carbon filters to air-handling units during a 2019 wildfire smoke event, for instance. Enhanced filtration also strains aged infrastructure that either cannot keep up with air exchanges or fails, due to an inability to sustain heavier filters [150]. Identifying alternate means of ventilation, especially for sites that only use outdoor air, has been recognized as a challenge for facilities teams [42,56].

Wildfire impacts on supply chains in B.C.

Health-related supply-chain impacts are frequently reported during wildfire events in B.C. Ensuring people and pharmacies have access to essential medications and supplies is a common concern, particularly when transportation routes into communities are cut off by wildfires, or when communities are evacuated. For example, due to road closures in the 2017 wildfire season, some remote and isolated communities in Northern and Interior regions of B.C. were cut off for weeks from access to life-saving prescription medications, such as insulin, cardiac medications, and anticoagulants, as well as to essential supplies such as diapers, baby formula, and ostomy supplies. Health care providers went to great lengths to ensure patients received medications by airplane, helicopter, and even horseback [352,366–369].

Pharmacists and other health care providers ensure access to essential medications

During the 2017 wildfires, there were immense challenges in connecting people with basic health care and lifesaving prescription medications. In many communities, road closures meant the usual methods of accessing prescription medications were no longer viable for weeks on end. When the town of Williams Lake was evacuated, one pharmacist drove 240 kilometres to Prince George and back to bring in essential medications for patients trapped nearby [367].

Knowing their patients were running low on essential medications, such as insulin, cardiac medications, and anticoagulants, some remote physicians continued to provide care to eight remote and isolated communities spread across 350 kilometres of rugged, rocky terrain [368]. When the wildfires disrupted regular transportation, physicians worked with a Vancouver pharmacy to package and transport supplies to the airport. In the face of flight cancellations and road closures, a military helicopter was arranged to deliver supplies to isolated communities. In one remarkable instance, a physician rode a horse through smoky forests to reach an off-grid patient who would otherwise have been unreachable.

Food shortages

During wildfires, challenges arise in providing and distributing food to communities due to road closures, damaged infrastructure, and displaced residents. For instance, the 2021 Lytton wildfire led to the loss of grocery stores, inaccessible roads, and prolonged power outages, raising food safety concerns for many families. To address these issues, food donation centres were established, but the adequacy of supply, diversity, and quality varied with the donations. Traveling to urban stores became an expensive necessity for those who could afford it [370]. Focus group participants described the response to the Lytton wildfire where, in some cases:

> *"[They] were flying food in there working with food banks. You know, they had to get helicopters to take food into the location. And [they are] still delivering food there on a regular basis, fresh food and non-perishables, simply for the food security of everyone in that area."*
>
> —*Risk to Resilience Project* focus group participant

Strengthening food supply chains, especially for rural communities, is being championed at the local level through innovative transportation methods. But these stop-gap measures are rife with compound challenges, such as:

> *"The walking bridge connecting the west side of the Lytton First Nation to the village itself is no longer in use, due to the level of destruction, leaving just a two-vehicle ferry for general access, including for people from the First Nation to get groceries from the village store. With spring freshets, this ferry will stop running once the river debris gets too significant, effectively cutting it off from supplies and resources."* [371]

However, these learnings and experiences are now being addressed with provincial investment to streamline logistics, storage, and transportation options to increase food security and affordability, strengthening local economies [372].

Story of impact: Wildfires impact supply of food for those most in need on Vancouver Island [373]

Highway 4 is the only paved route to the 18,000-resident City of Port Alberni—as well as to Tofino, Ucluelet, and most communities in the Nuu-Chah-Nulth Nation on Vancouver Island. During the summer of 2023, food banks and charities in Port Alberni were impacted by the 17-day closure of Highway 4 (June 6-23, 2023) due to the Lake Cameron wildfire. Local charities, such as the Alberni Valley Salvation Army Community Food Bank and a local soup kitchen, reported food donations decreased by about 25 percent due to concerns about food shortages. A local soup kitchen staff member shared, "*It's sad to see, because people come in and they definitely are noticing the drop-off in food*." In addition, some local grocery stores implemented restrictions on the purchase of certain items, while others struggled to keep their shelves stocked while they experienced delivery delays. As a result of the wildfire-related road closure, local charities relied more on non-perishable staples and individual donations to help replace what stores could not provide.

This example illustrates that how those already experiencing food insecurity are disproportionately impacted by disruptions to food supply chains during emergency events.

Supply of adaptation technologies

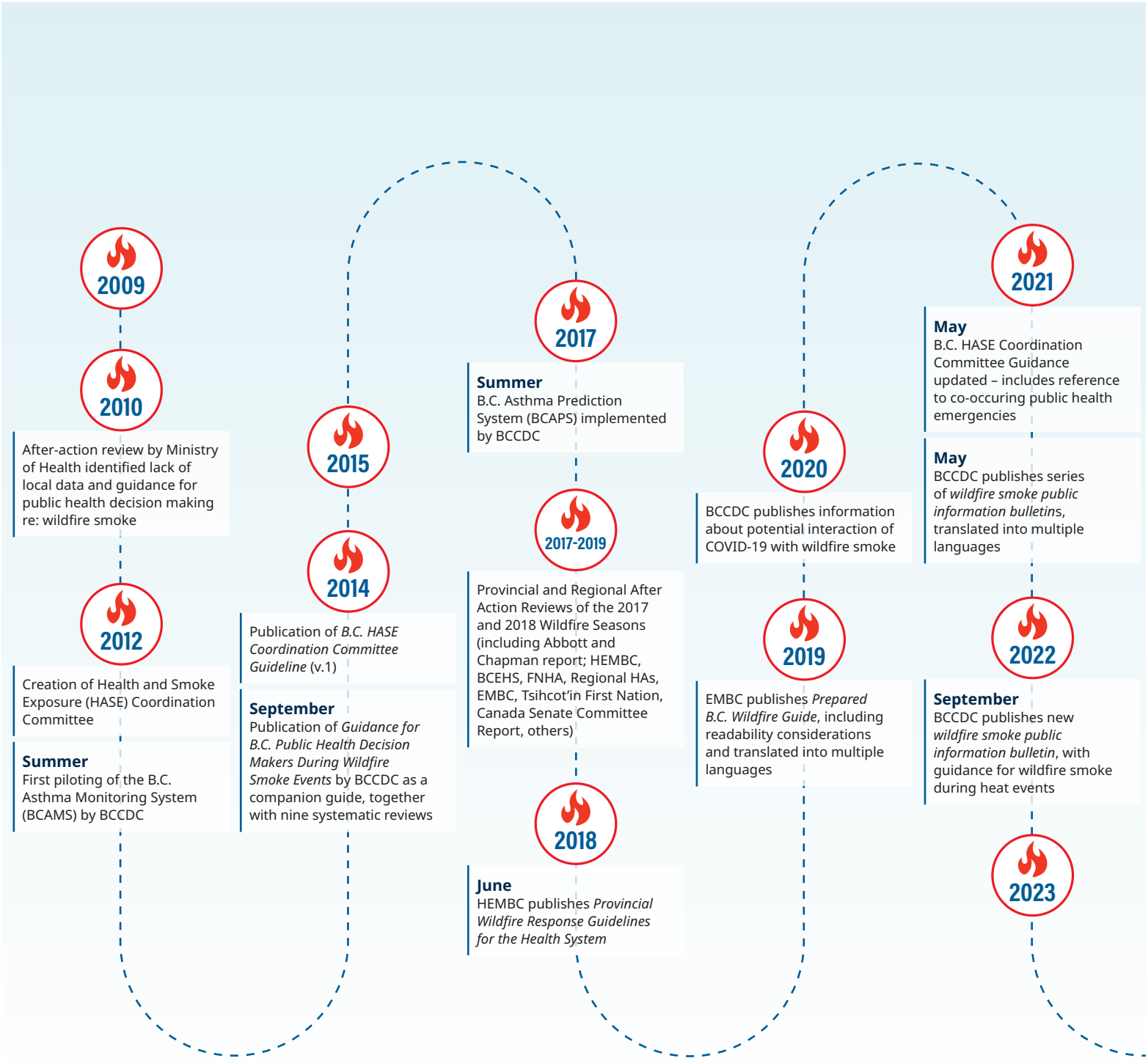
A high demand for air purifiers was another supply chain-related impact reported during wildfire seasons in B.C. As people sought ways to reduce their exposure to wildfire smoke, there were reports of some retailers selling out of air purifiers, with long restocking wait times [374,375]. Public health agencies such as the BCCDC provided guidance on how individuals can make their own box fan air purifiers using common items found at a hardware store [375].

5.3 Health-related adaptations to wildfires in B.C.

B.C. has a long history of wildfires and has been adapting processes and systems with successive wildfire seasons. Post-event learning processes, such as after-action reviews, enable an iterative process to identify what worked well, what challenges were faced, and discuss implications to adjust response strategies for the next wildfire season. Evidence reviews also assess current knowledge and identify knowledge gaps about the effectiveness of different wildfire-related adaptations to protect public health [376].

In response to the severe wildfire seasons in B.C. in 2009 and 2010, there was a recognized need to provide more public health guidance related to wildfire smoke and to health system preparedness and response [377]. A number of structures and committees were established to provide provincial coordination and guidance on preparedness and response to wildfires and wildfire smoke, as well as on developing systems to monitor health effects associated with forest-fire smoke. These adaptations support public health and emergency-management decision-making by providing valuable data to local health authorities [328,378]. Furthermore, the BCCDC initiated an ongoing program aimed at synthesizing and generating evidence to assist public health decision-makers during wildfire smoke events, with an emphasis on preparedness and response [377].

A TIMELINE OF SELECT HEALTH-RELATED WILDFIRE ADAPTATIONS IN B.C.



Preparedness for wildfires and wildfire smoke is crucial for protecting public health, minimizing immediate and long-term health risks, and ensuring the resilience of health care systems in the face of increasingly frequent and intense wildfire events. Some examples of adaptations specific to wildfires in B.C. are summarized below.

Expanded coordination and collaboration within and with the B.C. health system

After-action reviews of the 2017 wildfire season highlighted the need for more clarity around roles and responsibilities of health system organizations and partners. This has led to a wide range of adaptations in B.C., including:

- In June 2018, the B.C. Health System Wildfire Response Plan, was published which details roles, responsibilities, and expectations of the health system during wildfire response. It outlines the emergency response structure of the provincial health system, and details the coordination processes and information required for supporting wildfire response across the health system [379]. This builds on the 2012 Public Health and Medical Services Annex, which provides a framework for how the health system is organized during an emergency like severe wildfires.
- The BC Health and Smoke Exposure (HASE) Coordination Committee brings together a range of regional, provincial, and federal agencies to coordinate wildfire smoke response in B.C. The associated BC HASE Coordination Committee Guideline outlines how the Committee will convene to support the local response, describes the roles and responsibilities of HASE Committee members, and provides guidance on assessing the population health risk and considerations for public health interventions [380]. The Guidance was last updated in June 2023 with new information, technologies, and activities, including considerations for multiple concurrent hazards, such as pandemics and other climate hazards.

Partnership and collaboration with the B.C. health system also includes bringing broad groups of stakeholders and partners together to network and exchange knowledge, and to better prepare individuals and communities for wildfire events. For instance:

- In May 2019, the BCCDC hosted a Practical Smoke Preparedness Workshop in Prince George. The workshop was aimed at agencies involved in wildfire planning and management, including the Northern Health Authority, First Nations Health Authority, municipalities, NGOs, and air quality roundtables [381]. The event was part of a larger objective to promote coordination and collaboration among health authorities, municipalities, and NGOs in the face of disaster events such as wildfires.

Use of low-cost particulate matter (PM) sensors to improve air-quality monitoring and understanding of smoke infiltration into buildings

One developing area of research in B.C. and other jurisdictions is assessing indoor infiltration of outdoor wildfire smoke. This research is helping to evaluate the effectiveness of staying indoors during smoke events, and to more efficiently design buildings, such as health care facilities and residences [365].

In some cases, low-cost PM sensors are being used to monitor wildfire smoke infiltration. One recent study piloted the use of low-cost $PM_{2.5}$ monitors in a large rehabilitation hospital during a wildfire smoke event in Vancouver [365]. It concluded that long-term use of low-cost sensors could aid health-facility operators in testing and optimizing actions to protect occupants from wildfire smoke infiltration, and inform local health authority guidelines for new construction and renovation of health care facilities.

Another area being explored in B.C. is how low-cost air quality sensors can expand the geographical range of air-quality monitoring, particularly in more rural and remote areas where monitoring may be more

sparse [382]. For example, Vancouver Coastal Health has sent low-cost air quality monitors that measure fine particulate matter to communities to improve monitoring of the impact of wildfire smoke on a wider geographic scale. Monitors were sent to sites within Metro Vancouver as well as to remote communities, and included places like libraries, community centres, and neighbourhood houses. Vancouver Coastal Health has also partnered with the University of British Columbia to pilot the use of these monitors in daycares to study smoke infiltration. In addition, the First Nations Health Authority has been providing PurpleAir monitors to communities. As the technology is tested, lessons are being learned on overcoming barriers and building capacity for use [56].

Air quality monitor (photo: PurpleAir.com)

Adaptation in Action: Low-cost PM sensor pilot project [138]

A pilot project initiated in 2018 by Environment Climate Change Canada (ECCC) examined the use of low-cost PM sensors to measure $PM_{2.5}$ during high PM events, such as forest fires, in collaboration with universities, provinces and territories, communities, First Nations, and air quality groups. The project started in Western Canada and has now expanded to a nationwide study. A mapping tool for the low-cost PM sensor data is improving spatial coverage by adding the data from the low-cost PM monitors to current regulatory monitors. The tool—developed through a collaboration between the University of Northern British Columbia, Dr. Peter Jackson, and ECCC scientists—includes real-time observations, time series, model outputs, health messaging, and other information to support people in making informed decisions about air quality.

Improvements in wildfire smoke monitoring, warning systems, and public-risk communications

Adaptations for expanded monitoring of wildfire smoke, advancements in smoke forecasting and surveillance, and communication to the public about wildfire smoke are a key focus for practitioners and researchers in B.C. [383]

- Between 2012 and 2014, the BCCDC launched the B.C. Asthma Monitoring System (BCAMS), as well as a series of nine systematic reviews about wildfire smoke. Research led by the BCCDC better characterized the health risks of wildfire smoke for B.C. populations. The BCAMS was updated in 2016 to the B.C. Asthma Prediction System (BCAPS), to better capture forecasting. The models continue to be tested and refined after each wildfire season.
- An amended AQHI (AQHI+) that more accurately accounts for wildfire $PM_{2.5}$ during wildfire smoke events in B.C. was piloted in 2018, through consultation with researchers at the BCCDC[321]. In 2021, AQHI+ was permanently adopted by the Province [384].
- Researchers at BCCDC and the University of British Columbia (UBC), in collaboration with federal and provincial governments, are working to improve wildfire smoke forecasting models and smoke-related health surveillance and warning systems for B.C. This includes developing models with better spatial and temporal resolution [e.g., the Canadian Optimized Statistical Smoke Exposure Model (CanOSSEM) [385]].
- Tools for communicating with both decision-makers and the public about wildfire-smoke-related risks include publicly available map and data dashboards. These provide current and forecasted air-quality information, and subscription services (i.e., Air Quality Subscription Service and Metro Vancouver Air Quality Alerts) with public alerts for poor air quality [386,387]. Regional health authorities also publish information about wildfire smoke (e.g. Fraser Health shares information through social media and their website about the risks of wildfire smoke and how to reduce them). Examples of available public wildfire-related communication tools in B.C. include (Table 3):

Table 3. Examples of tools for public communication of wildfire smoke risks to health and preparedness

Name of resource	Description of resource
Air Quality Health Index (AQHI) [388]	The AQHI is a public communication tool that provides hourly air quality readings and related health messages, based on three major pollutants (PM, ground-level ozone, and nitrogen dioxide). It was the first tool internationally to recognize the cumulative nature of poor air quality on health [389]. The AQHI for B.C. (AQHI+) provides targeted health messaging to at-risk populations and the general public, indexed on a scale from one to 10 and four health-risk levels. An online public interactive map provides observed and 48 hours of forecasted AQHI levels [390]. The AQHI is available for 25 communities in B.C., accounting for more than 80 percent of the B.C. population [391].
Smoky Skies Bulletins [386]	Smoky Skies Bulletins are issued by the Province when regions are, or have reasonable potential to be, impacted by wildfire smoke within 24 to 48 hours. They are issued province-wide [392] with the exception of Metro Vancouver and the Fraser Valley Regional District, which issue advisories rather than smoky skies bulletins.[11] They are based on available information on pollutant concentrations, satellite data, smoke forecast models, and visual observations. These public advisories communicate information about wildfire smoke, including regions at risk of exposure, and include public health messaging about ways to reduce exposure and monitor symptoms. [386]
Special Air Quality Statements (SAQS)	Air Quality Advisories are issued by the Province for 37 communities in B.C. [386], while Air Quality Advisories/Bulletins are issued for the Metro Vancouver and Fraser Valley Regional District regions [387]. SAQS are then issued by ECCC, relayed as a public communication about poor air quality for specific regions when advisories are in place [396]. Weather Information – Environment Canada
B.C. Asthma Prediction System (BCAPS) [378]	BCAPS is a framework that forecasts and visualizes the population health impacts of wildfire smoke over the next 24-hour and 48-hour periods using five modules [378]. An interactive online map is also available to the public to support health protection during wildfire smoke events [397].
FireWork and *BlueSky Canada* – smoke forecast maps	Other resources available for the public include ECCC's FireWork forecast [398], and the BlueSky Canada forecast, developed by researchers at UBC [399]. These wildfire smoke prediction systems show maps of predicted smoke forecasts across Canada over the next 72 hours and 48 hours, respectively.
BCCDC Wildfire Smoke Fact Sheets [400]	BCCDC publishes wildfire smoke fact sheets, available in multiple languages, with information on: • the health effects of wildfire smoke; • how to prepare for wildfire smoke season; • portable air cleaners; • wildfire smoke and air quality; • composition of wildfire smoke; • wildfire smoke and outdoor exercise; • wildfire smoke and AQHI; • home-made box air filters; and • face masks for wildfire smoke.

11 Metro Vancouver operates 20 continuous air-quality monitoring stations (of the 100 province-wide) [393] and manages advisories for the region [394]. Fraser Valley Regional District shares the Lower Fraser Valley airshed with Metro Vancouver [395].

Some challenges identified with wildfire smoke monitoring and warning systems include the lack of air-quality monitoring stations in rural and remote locations of B.C., and the need for targeted messaging for specific sectors (e.g., schools) or populations [56]. *Risk to Resilience Project* focus groups recommended promising health adaptations such as aligning wildfire smoke models and tools for consistent messaging, enhancing air quality surveillance, and more research on indoor/outdoor air quality and messaging during wildfire smoke events.

Public health messaging during wildfire smoke events

Providing wildfire-smoke related messages in multiple languages and in accessible formats supports health equity by enabling diverse populations to prepare for and respond to wildfire smoke events. Expanding the range, content, and outreach of public wildfire smoke messaging—and understanding the effectiveness of different communications methods—is an active area of focus for researchers and practitioners in B.C.

A recent survey about wildfire messaging in B.C., with 757 respondents, found that people receive wildfire smoke messages from diverse sources, including websites, social media, radio, and television. Radio was identified as the most important source of information for populations that may have increased exposure or health risks, including Indigenous respondents and those working in the trades. Respondents with lower educational attainment expressed that messaging should be simplified [341].

More recent public health messaging around wildfire smoke in B.C. is focused on ways to reduce exposure [401], as well as providing guidance on protecting health during coinciding hazard events, such as how to prioritize actions when wildfires coincide with extreme heat events [402].

Adaptations in patient care

B.C. care providers are adapting the ways they support patients before and during wildfire smoke events. For example, physicians and health care providers are improving advanced planning for wildfire events for patients with asthma and COPD [56]. The B.C. clinical guidelines for Asthma Diagnosis, Education and Management were also recently updated with a climate lens, a broad-reaching and powerful adaptation guiding the practice of clinicians across B.C.

> *"I also asked my patients to register for the B.C. Air Quality [Health] Index so that they can get alerts on their phone, to get a bit of a trigger warning before air quality specs get bad in the area. They can make sure they have their inhalers and that they've got prednisone on hand if needed. I also talked to them a lot about air filters."*
>
> —*Risk to Resilience Project* focus group participant

Health facility and infrastructure adaptations

Wildfire smoke can infiltrate health care facilities, affecting indoor air quality and compromising the health and safety of patients, staff, and visitors. Health-facility staff have responded by upgrading and maintaining HEPA filters and ventilation systems to remove fine particulate matter ($PM_{2.5}$) and other pollutants from indoor air. Some have also deployed portable air purifiers equipped with HEPA filters in areas with particularly at-risk patients, or in spaces with compromised indoor air quality [56]. More details on cross-cutting impacts and adaptations to health care facilities and infrastructure can be found in Chapter 8: Cross-Cutting Impacts, Adaptations, and Opportunities.

Adaptation in Action: Protecting hospital air quality [355]

During the 2017 wildfires, facilities staff at Royal Inland Hospital in Kamloops acted quickly to ensure patients and staff were protected from wildfire smoke; 400 air filters were swapped out every two to three weeks to manage air quality throughout the building. In total, maintenance personnel changed more than 2,000 filters every two to three weeks at facilities throughout the Southern Interior. They also purchased additional HEPA air scrubbers for the Thompson-Cariboo region facilities to mitigate poor air quality.

Expanded availability of home and community cleaner air spaces

Adaptations to protect public health from wildfire smoke require leadership and collaboration from multiple sectors. Across B.C., cleaner air spaces (also referred to as clean air shelters) are community-led examples of adaptations to protect population health from wildfire smoke [383,403]. These are areas, rooms, or buildings equipped with a filtration system that traps particulates generated by wildfire smoke. The BCCDC and Health Canada have published detailed guidance on considerations for the effective operation and use of home and community clean air shelters [404,405].

Communities across the province have been increasingly designating locations which can operate as cleaner air spaces during wildfire smoke events. The City of Vancouver, for example, has designated a number of public facilities as cleaner air spaces, including libraries and community centres, all of which have high-efficiency particulate air filtering, or MERV 13 filters [406]. They provide an interactive map identifying locations of cleaner air spaces, with and without air conditioning.

It is critical to ensure that local strategies for clean air shelters consider issues such as awareness, accessibility, and transportation for populations who may be most at risk (e.g., individuals with respiratory or cardiovascular conditions, pregnant women, children, older adults, the underhoused, and those with limited mobility). In B.C., community considerations for the equitable design and distribution of clean air shelters is an emerging area of research [407].

Portable and do-it-yourself air cleaners

Portable air cleaners are units equipped with HEPA filters or electrostatic precipitators designed for use in a single room. They offer an alternative when access to community cleaner air spaces is limited and recommended by public health guidance in B.C. [408]. In B.C., the First Nations Health Authority has provided support for individuals at high risk from wildfire smoke to obtain air purifiers and replace HEPA filters since 2017 [409]. Priority is given to individuals and communities who are unable to access a clean air shelter due to limited transportation/mobility, or that live in a home without a ventilation system that can recirculate air.

Evidence suggests that do-it-yourself (DIY) air cleaners can also be a valuable supplementary tool to improve indoor air quality during wildfire smoke events [410,411]. When used appropriately, DIY cleaners can offer a safe and effective alternative to more expensive commercially available portable air cleaners [411]. The BCCDC partnered with UBC researchers to test a DIY air filter, and published a step-by-step guide to assembling an inexpensive DIY box-fan filter [410]. Over the summer of 2023, the BC Lung Foundation, together with community partners, also hosted free DIY air cleaner workshops for people at greater risk from air pollution impacts, including older adults, people on a limited budget, and those living with lung conditions such as COPD, asthma, and pulmonary fibrosis [412]. Similarly, Métis Nation BC worked with researchers at Simon Fraser University to take a train-the-trainer approach on building DIY air-cleaner systems with Métis regional health coordinators and collaborated with Fraser Health to disseminate information on DIY air-cleaner systems to Métis Chartered Communities [91].

Indigenous-led adaptations

Indigenous-led adaptations to wildfire value traditional ecological knowledge, and honour the holistic, culturally-rooted, and sustainable strategies that not only safeguard physical health, but also the broader cultural, spiritual, and mental well-being of Indigenous communities and the land. Adaptations, such as prescribed cultural burns, recognize the interconnectedness of the health of forests, land, and communities, and the importance of preserving traditional knowledge and practices. Prescribed burns are also one of the strategies recommended by the BC First Nations Climate Strategy and Action Plan (2022) [52].

Fighting fire with fire [413]

As wildfire seasons grow longer and more intense, many First Nations communities emphasize the importance of prescribed burns to prevent uncontrolled forest fires. For the ʔaq'am, a member community of the Ktunaxa Nation, the revitalization of traditional fire knowledge and practices has emerged as a crucial adaptation strategy, reintroducing fire to their land-management practices by drawing on cultural and traditional burning practices.

Collaboration between diverse groups is often necessary for prescribed burns to succeed. The BC Wildfire Service planned about 65 prescribed burns in the region in 2022, with a significant portion of these projects involving collaboration with First Nations.

Controlled brush fire lit with a drip torch, B.C.

5.4 Opportunities for action

Key opportunities for integrated action to address immediate health impacts and build long-term resilience to wildfire and wildfire smoke include:

Coordination and collaboration

- Clarify roles, responsibilities, and mandates of health agencies (e.g., HEMBC, Ministry of Health, health authorities) relative to those of other ministries (e.g., EMCR) and other partners to address both immediate physical and mental health impacts and long-term resilience to wildfire events.
- Collaborate with Indigenous organizations and communities to embed traditional knowledge and practices in wildfire preparedness and management approaches that reflect the unique health challenges faced by Indigenous Peoples.

Planning and interventions

- Work in partnership with local governments, First Nations, Métis, and community partners to explore the creation of safe indoor accessible community cleaner air spaces during wildfire smoke events.
- Examine ways to improve the accessibility of cleaner air spaces for priority populations in B.C.

- Continue to explore the value of low-cost air quality sensors to improve understanding of indoor smoke exposure and to expand the range of $PM_{2.5}$ measurement, particularly in areas with reduced coverage (e.g., more rural and remote regions).
- Promote the use of appropriate air cleaners, industrial air scrubbers, and HEPA filters before and during wildfire seasons.

Communications

- Continue to promote and update public awareness and education materials about the risks of poor air quality during wildfire smoke events and about adaptive behaviours (e.g., using air filters and box fan filters, wearing masks).
- Develop culturally and linguistically-tailored wildfire smoke risk communications, using diverse modes of communication and targeting messages to higher-risk populations.
- Develop targeted sector messaging and promotional strategies for AQHI+ and Smoky Sky Bulletins (e.g., schools, landlords).
- Evaluate the effectiveness of wildfire smoke communications with target populations and sectors, being mindful of the potential for messaging fatigue.

Surveillance and research

- Work across ministries and with partners to strengthen and expand air quality monitoring practices that enable more accurate and real-time data on air-pollution levels during wildfire events.
- Continue to research the combined impacts of heat and wildfire smoke.
- Enhance research on the short- and long-term mental and physical health impacts (e.g., adverse birth effects) of wildfire smoke exposure.
- Further explore the differential impacts of wildfire smoke exposure for priority populations in B.C. (e.g., older adults, pregnant women, those with chronic conditions, underhoused populations, etc.).

Health system capacity

- Enhance health care system training and capacity building to respond to the increased demand for health services during wildfire events.