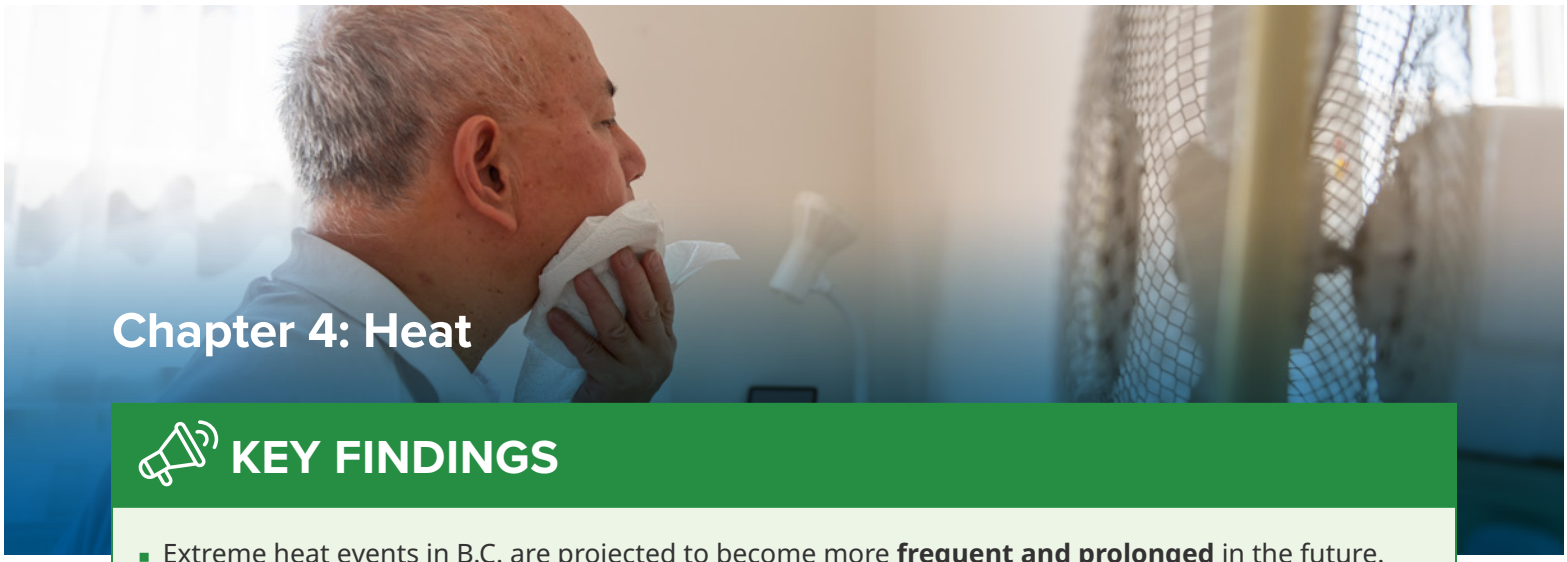


Chapter 4: Heat

KEY FINDINGS

- Extreme heat events in B.C. are projected to become more **frequent and prolonged** in the future. Heat waves are ranked as one of the highest-risk hazards for the province, with the potential for significant consequences and a high likelihood of occurrence.
- In B.C., extreme heat events are a significant **threat to public health**. They can lead to an increased risk of mortality and adverse effects on population health, particularly among groups at risk to extreme heat.
- Certain populations, such as older adults, individuals with pre-existing health conditions, those with lower incomes, people who live alone, people experiencing mental health challenges, and Indigenous communities, are **more susceptible to the health impacts of extreme heat**. All determinants of health (including social, structural, environmental, biological, etc.) amplify these impacts on population health.
- The B.C. **health workforce**, especially during the 2021 heat dome, experienced significant impacts, including increased workload, mental health challenges, work modifications, and occupational safety concerns.
- Extreme heat events put significant **strain on the B.C. health system**, including increased patient volumes with higher acuity levels, heat-strained medical equipment, and disruptions to vaccine and medication storage, food supply chains, and essential supplies.
- B.C. has made significant progress in **adapting to extreme heat** since 2021. These adaptations encompass health policies, services, and response strategies. From establishing heat alerts and community cooling centres to engaging in collaborative efforts across various sectors, B.C. is working comprehensively to address extreme heat challenges.
- Implementation of heat **early warning systems and heat response plans** is a critical adaptation strategy to reduce the health impacts of extreme heat events. These systems help communities and organizations prepare and respond in a coordinated manner, ultimately minimizing the adverse effects of extreme heat.

THE RECORD-BREAKING B.C. 2021 HEAT DOME

In the summer of 2021, B.C. experienced the deadliest and one of the costliest weather events in its history. A powerful high-pressure ridge formed a "heat dome" over the province between June 25 and July 1.

Temperature records were shattered across the province. Victoria recorded temperatures 20°C above average [44]. The period was also characterized by very high overnight temperatures and near-peak daylight hours, meaning there was little respite from the heat overnight [92]. The Village of Lytton, on the lands of the Nlaka'pamux People in the B.C. Interior, hit 49.6°C , the highest temperature ever recorded in the country, on June 29 [93,94]. A day later, the village was consumed by one of hundreds of wildfires fuelled by the extreme heat.

Air quality declined in areas around the province, including Metro Vancouver and the central Fraser Valley, as the heat dome trapped pollutants generated by the fires [95]. The COVID-19 pandemic compounded the heat dome's impacts and some people were hesitant to gather in cooler public areas due to physical-distancing measures.

Emergency health services experienced unprecedented surges in 911 call volumes and ambulance call-outs. Emergency departments saw increased patient volumes with higher acuity levels than typically seen. In total, the BC Coroners Service directly attributed 619 deaths to the 2021 heat dome [5], but the death toll is estimated to have been higher [2].

THE 2021 HEAT DOME

60 temperature records broken in B.C. on June 27, many shattered by 5°C to 10°C [39]

49.6°C recorded in Lytton on June 29, the highest temperature ever recorded in Canada [39]

55 heat warnings issued by Environment and Climate Change Canada (ECCC) province-wide between June 25 and July 5[9]

619 deaths due to the extreme heat confirmed by the BC Coroners Service [5]

740 excess deaths during this extreme heat event reported by the BC Centre for Disease Control (BCCDC) during later analyses [2]

11,970 calls received by E-Comm 911 on June 28—almost double the call volume of preceding and following days [5,96]

Hospitals and emergency departments experienced increased patient volumes around the province, with many patients presenting with more severe illness:

- Fraser Health reported a daily average of **2,193** emergency department visits during the event [97].
- Vancouver Coastal Health emergency departments experienced **252** heat-related visits, of which 29 percent were at a severe illness (acuity) level [98].

At least **10** cases of shellfish poisoning due to *Vibrio parahaemolyticus* reported to the BCCDC, which may have been prompted by the high temperatures [99]

19 of BC Hydro's top 25 all-time summer daily peak records for system load, as demand for air conditioning skyrocketed [100]

9 Data source: Environment and Climate Change Canada (ECCC)—see Appendix 1 for more details.

4.1 Exposure to extreme heat in B.C.

Extreme heat trends in B.C.

Extreme heat events, also known as heat waves, have emerged as a pressing public health concern globally [1–3]. Extreme heat is now an expected reality of summers all around the world, leading to a number of excess, though preventable, deaths [1]. Average annual temperatures in Canada are rising more than twice as fast as the global average, with extreme heat the leading weather-related cause of death [4,5].

Similar patterns are seen in B.C., where average temperatures are rising faster than the global average, driven in large part by warming winter temperatures [25]. Temperatures are rising at the fastest rate in northern B.C., at roughly double the rate of southern regions of the province [25]. Annual average temperatures in the province are projected to rise by up to 2.7°C by the middle of this century[10] [30].

Heat-related climate projections for B.C.'s health regions by the 2050s

By the 2050s, maximum daytime and nighttime temperatures, total number of days with higher temperature and humidity, frequency, and duration of extreme heat events, and cooling demand[11] are all projected to increase in B.C.[12] Some regions may be disproportionately impacted (see Appendix 1 – Table A1.1 for more details). For example:

- Maximum temperatures ("hottest day") are projected to increase by more than 3°C across all regions;
- Number of summer days with high humidity (Humidex above 35°C) are projected to increase in most regions, with Lower Mainland and Fraser Valley regions projected to see some of the largest absolute increases;
- Number of days with temperatures greater than 30°C are projected to more than double in most regions, with some of the highest absolute increases projected in some B.C. Interior regions;
- Number of extreme heat events are projected to increase and last longer; and
- Cooling demand is expected to increase more than five-fold in most regions.

10 Compared to the historical baseline of 1961 to 1990, and based on a high-emission scenario.
11 Cooling demand estimated as cooling-degree days (CDDs). CDDs measure how warm a given location is by comparing the mean outdoor temperatures recorded each day with a standard temperature (i.e., 18°C).
12 Data extracted from ClimateData.ca portal. All estimates are for high-emissions scenario, with a comparative baseline of years 1971–2000, using CMIP6 models.

Extreme heat events are a priority for the Province. The 2019 Preliminary Strategic Climate Risk Assessment ranked heat waves[13] as a high-risk hazard for the province—third-highest in terms of consequences and likelihood of occurring by the 2050s, behind severe wildfire season and seasonal water shortage [30]. Climate change is also increasing the likelihood of extreme heat events occurring, with several modelling studies concluding that, without global warming, the 2021 heat dome event would likely not have occurred [36,93,101]. One study concluded that the global average temperature increase of 1.2°C since pre-industrial times had made the event 150 times more likely [36].

What is an extreme heat event?

An extreme heat event is defined as a period of unusually hot weather lasting for two or more days, with an extended period of high daytime and nighttime temperatures [102]. To be classed as an extreme heat event, temperatures must be outside of historical averages for a given area [102]. For the purposes of response and public communications, the Province delineates between two types of heat events in B.C.: heat warnings and extreme heat emergencies. Heat warnings pose a moderate public health risk, occurring an estimated one to three times per summer, while extreme heat emergencies pose very high risks to human health, occurring once or twice per decade [103].

High temperatures have been felt across the province in recent years. Between 2018 and 2022, there were 115 days when one or more health regions of B.C. were under ECCC heat warnings—indicating that forecasted temperatures could pose a health risk. Over the five-year period, Vancouver Coastal Health had the most days with one or more of its regions under a heat warning (101 days), followed by Interior Health (97 days) and Fraser Health (97 days). (Appendix 1 – Table A1.3). However, heat emergencies have been infrequent in B.C.; two events have met this threshold since 2009—one impacting the Metro Vancouver area in 2009 and the 2021 heat dome [103].

What is a heat dome?

A heat dome, such as the one that occurred in B.C. in 2021, is caused when a high-pressure system traps hot air beneath it, creating a dome of heat over a region [103]. Heat domes can last for days to weeks, can cover across wide geographic regions, and can move over time [104]. They are typically tied to a change in the shape of the jet stream, a band of fast winds high in the atmosphere that flow in a wave-like pattern from west to east. A taller wave in the jet stream causes air to pile up and warm as it sinks under high pressure [104].

Research also suggests regional variability in heat-health impacts in B.C., with death rates shown to increase at different temperature thresholds in different regions of the province [105,106]. In one study analyzing deaths in B.C. between 1986 and 2000, BCCDC researchers found that while most deaths during high temperature days in B.C. occurred in the southern coastal ecoregion of the province (where the majority of the B.C. population resides), the northern B.C. ecoregion was most sensitive to increases in heat—with death rates increasing at lower temperature thresholds compared to other ecoregions of

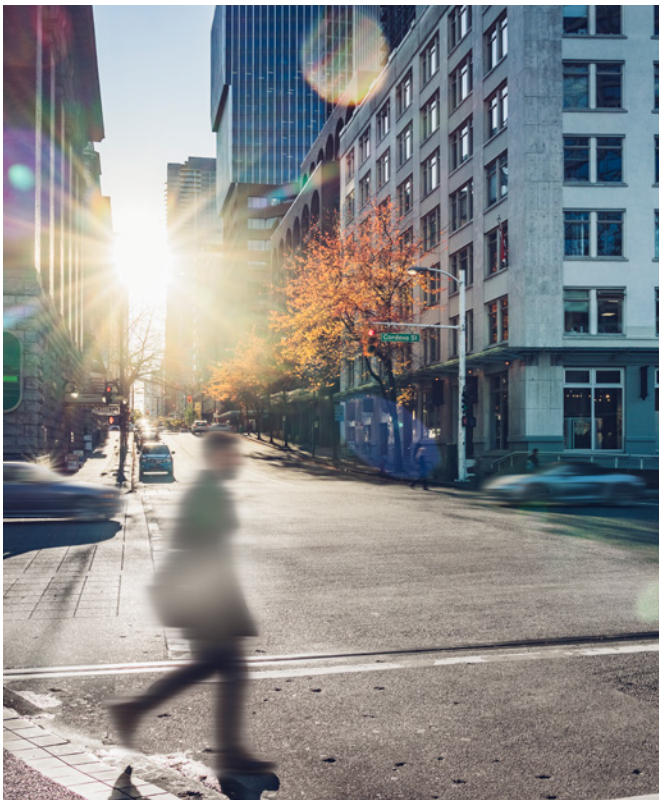
13 Heat wave defined in this assessment as extended periods of time with relatively high temperatures for a given location. The risk assessment was made for a heat wave of three or more days duration which impacts human health. A provincially significant heat wave = severe negative consequence for human health. Extreme heat wave projected to occur once every three to 10 years in B.C. by 2050 [30].

the province [106]. The authors suggested that more extensive experience with high temperatures and adaptation in some ecoregions, such as the Interior of B.C., may have been a protective factor against heat-related deaths. Acclimatization to heat has also been reported in other jurisdictions [107].

Urban heat island effect

Aspects of the built environment can increase our exposure risk to extreme heat [1]. In areas with high building density, limited green spaces, and close proximity to major roads, materials such as asphalt and concrete (e.g., in roofs, paved roads, and parking lots) can absorb large quantities of radiant heat from the sun, resulting in higher surface and air temperatures [92,108,109]. Greater population densities, with more vehicle transport and energy emitted from buildings, can further amplify this effect [1]. Higher air temperatures in urban areas, particularly at night, can limit the body's ability to cool down during extreme heat events [108]. This phenomenon has been termed "urban heat islands," however development in rural areas can create local microclimates similar to those experienced in cities, albeit smaller in scale [108].

Satellite-derived imagery illustrates the urban heat island effect in towns and cities across B.C., with wide variations in average summer temperatures in different neighbourhoods of individual municipalities—up to more than 10°C of difference in some cases [110]. Studies have mapped the urban heat island effect across the urban landscape of Vancouver, identifying large temperature variations during summer months, influenced by factors such as elevation, distance from the ocean, building coverage, and greenness [111,112].



Urban greenness is a measure of the presence and health of vegetation in urban settings and is used as a proxy measure for urban heat islands [113]. It reflects the presence of public or private vegetated areas such as parks, street trees, residential gardens, natural areas like wetlands or grasslands, and other urban green spaces [114]. In B.C., levels of urban greenness have been decreasing over time, corresponding to rapid population growth and urban spread in many of B.C.'s larger population centres [115].

B.C. is ranked sixth highest among the 10 Canadian provinces for urban greenness, with approximately 73 percent of the land area of its population centres classed as green[14] [113]. Among the five largest population centres in Canada, Vancouver has had the second-highest decline in average urban greenness since 2000, with an approximately 14-percent reduction [113]. The City of Kelowna, in the B.C. Interior, has had more than a 16-percent reduction in average urban greenness since 2000 – the third-highest percentage decrease among all 41 large population centres in Canada, and the highest in B.C. [113]

14 Greenness defined in this study as the percentage of the land area with a Normalized Difference Vegetation Index (NDVI) of 0.5 or more. Average greenness estimates reported as the differences in five-year averages of two time periods: 2000–2004 and 2018–2022. Population centres defined as having a population of at least 1,000 and a population density of 400 people or more per square kilometre, based on the Statistics Canada 2021 Census. Large urban centre = population of 100,000 or more.

What is the humidex?

Maximum, minimum, or mean temperatures, with and without humidity, have typically been used to estimate heat exposure to populations [116]. Outdoor (ambient) temperatures are often easier to measure than indoor temperatures, using data collected through such sources as monitoring stations and satellite imagery. These measures, however, may not always reflect the exposures most relevant to human health [111,117]. Apparent temperature, reflected in humidex values, is more closely related to mortality during extreme heat events than other temperature variables [117].

Humidex combines the temperature and humidity into a value that reflects how hot and humid the weather feels to the average person [117]. Higher humidity can reduce the human body's ability to cool itself through sweat evaporation, which can aggravate heat strain and the risk of adverse health outcomes [118]. Humidity levels are projected to increase by the 2050s in B.C., with Vancouver seeing some of the largest increases among B.C. municipalities (experiencing up to 10 days with high humidity each year, compared to only one day between 1981 and 2010)[15] [119].

Heat as a driver of other climate hazards in B.C.

In addition to the direct impacts of heat on health, extreme heat events (and warming average temperatures more broadly) can act as drivers for other climate hazards in B.C. Changes to the physical environment, including longer droughts, wildfires, and floods are mainly driven by the combination of rising temperatures and extreme precipitation [4]. Warming temperatures have also been linked to, for example:

- Expanded range and frequency of infectious diseases and pests [120–129];
- Increasing frequency and size of harmful algae blooms in warmer oceans and lakes [130–134];
- Reductions in food and water safety and security; [18,70]
- Increasing risk of aerosolization of waterborne pathogens, such as *Legionella*, with increased use of HVAC systems and other water spraying/cooling systems [135,136]; and
- Worsening air quality. Ground-level ozone, for example, forms when nitrogen oxides and volatile organic compounds react in sunlight and stagnant air [137]. Between 2015 and 2022, ozone advisories were issued most years in Metro Vancouver and Lower Fraser Valley Regional District during warm weather periods, including record-breaking levels experienced during the 2021 heat dome[16] [138–140]. The 2021 heat dome was also associated with increased pollen counts [141].

15 High emissions scenario (CMIP6 SSP 5-8.5), high humidity defined as a humidex > 35°C.

16 2023: Four advisories issued in Fraser Valley Regional District (FVRD); 2022 one advisory FVRD; 2020: two advisories issued Metro Vancouver; 2018: seven sites exceeded national standards (5 FVRD, 2 Metro Vancouver); 2017: 10 FVRD stations exceeded national standards; 2015: two advisories in Metro Vancouver [138,139].

Beacon Hill Park, Victoria, B.C.

Extreme cold

Climate change is leading to warmer winters overall, but is paradoxically also creating more extreme cold events, due to arctic warming driving southward dips in the jet stream [142,143]. Extreme cold events are declared when temperatures drop below a defined threshold. This temperature threshold varies across provincial regions, and is based on a region's preparedness for cold weather, the effects of wind chill, and the acclimatization of its residents [143,144].

Extreme cold can cause frostbite, windburn, and hypothermia [143,144], and lead to more hospitalizations and premature deaths, due to increased spread of infection and increased risk of respiratory or cardiovascular events up to several weeks after cold weather exposure [143]. Populations at higher risk include infants, seniors, people consuming alcohol, people with certain medical conditions (e.g., diabetes) or taking certain medications, and people experiencing homelessness or living in a home without adequate heating [143–145].

In B.C., extreme cold events can increase risk of morbidity and mortality [143,146,147], [148], increase paramedic calls [149], and cause impacts to health facilities and delivery of health care services. There are reports, for example, of extreme cold events leading to older pipes freezing and bursting; older buildings lacking proper heating, with single-pane or poor double-pane windows; and/or power outages, leading to loss of heat and hot water, and disrupting clinical flow and patient care [150]. During one B.C. extreme cold event, a hospital's water pipes burst, leading to the emergency entrance doors freezing shut, the need to haul water into the site, temporary cancellations of dialysis and lab outpatient services during repairs, and limitations on hospital visitations [151].

As one type of adaptation in B.C., communities have created public warming centres in response to extreme cold events. BC Housing, for example, manages the Extreme Weather Response program, and provides funds for temporary winter shelters and extreme-weather response shelters for unhoused populations [152]. Public health recommendations to reduce the impacts of exposure to winter weather on people experiencing homelessness in B.C. have also been published [145].

4.2 Extreme heat impacts on B.C. population health and the health system

The association between extreme heat and increased rates of death and illness is well-established in global literature [1,153,154]. Direct impacts of heat exposure can range from less severe illness, such as heat edema, rash, and cramps, to more severe illness, such as syncope (fainting), exhaustion, and heat stroke [155]. Extreme heat exposure has been associated with increased rates of death due to respiratory and cardiovascular illness (particularly strokes and coronary heart disease) [154,156], as well as higher rates of heart arrhythmias and cardiac arrest [156]. Worsening of existing mental health conditions, and increased rates of mental health-related illness and death, including suicide, have also been observed during extreme heat events [157,158].

4.2.1 Extreme heat impacts on B.C. population and public health

Heat-related deaths in B.C.

During extreme heat events in B.C., the risk of mortality increases. The highest numbers of heat-related deaths in B.C. were reported during the major extreme heat events of 2009 and 2021:

- The 2009 extreme heat event resulted in approximately 110 excess deaths, likely attributable to heat, over a seven-day period in Metro Vancouver; in comparison, only 62 deaths were attributed to the H1N1 pandemic across B.C. that same year [159].
- In total, 619 heat-related deaths were reported by the BC Coroners Service over the heat dome event of 2021 [5]. Follow-up analyses suggested that as many as 740 excess deaths may have occurred province-wide (with some deaths not specifically recorded as "heat-related," or still under investigation at the time of the BC Coroners Service report) [2]. Metro Vancouver experienced the highest number of deaths, including 434 community deaths in people aged 50+ years—a 440-percent increase over the expected total [160]. Heat-related deaths were also observed across all regions of the province and in all health authorities (Table 1).

Table 1: 2021 Coroner-reported heat-related deaths by health authority [5]

Regional health authority	Count	Percentage	Rate (per 100,00)
Fraser	312	50%	15.9
Interior	84	14%	10.2
Island	55	9%	6.3
Northern	23	4%	7.6
Vancouver Coastal	145	23%	11.6
Provincial	**619**		

Accurately estimating the number of deaths caused by heat exposure in B.C. is challenging, however. Oftentimes, the cause of death is assigned to another condition, such as one exacerbated by heat exposure, resulting in an underestimation in the number of heat-related deaths [159].

High indoor temperature is a major driver of heat-related deaths in B.C. Trapped hot air inside buildings persists over time, causing residents to experience prolonged periods of intense heat, even when outdoor

temperatures decrease overnight. During the 2009 extreme heat event in Metro Vancouver, elevated mortality was observed among those in more densely populated urban areas, living alone, having a low income, and aged 65 to 74 years. These data suggest that residential factors, in addition to a number of social and demographic factors, were associated with more severe impacts of high heat exposure [161].

Similar patterns emerged during the 2021 heat dome event. Of all coroner-reported deaths, 98 percent occurred indoors: 73 percent in private residences and 10 percent in social/supportive housing or single-room-occupancy hotels [5]. The BCCDC observed that individuals faced significant danger when indoor temperatures remained above 26°C throughout the heat event [5]. More than half of all people (53 percent) who died lived alone. Half (50 percent) of those who died were found deceased during check-ins by concerned friends, family, neighbours, care workers, or police officers [5]. However, the major factor contributing to heat-related deaths was the elevated indoor temperature [2,5,162].

Heat-related illnesses in B.C.

> *"A lot of people were having health issues. I saw a lot of people were taken away in ambulances. I never did find out if they were okay or not. I have no idea what the statistics or numbers were, but I know there was a lot more than usual. Not just overdoses, but from heat exhaustion and sun stroke."*
>
> *—Julie Chapman, Writer, Megaphone Magazine* [163]

During high heat episodes, heat stress, dehydration, and heat stroke are common heat-related illnesses in B.C. [164,165].

A majority (70 percent) of 21 service providers surveyed about their experiences during the 2021 heat dome indicated that the populations they support experienced a great deal of physical impacts during the event [85]. Others have reported that individuals with disabilities experienced symptoms including high body temperatures, migraines, disorientation, fatigue, breathing challenges, and, in some instances, passing out [166].

In the Fraser Health region, there were significant increases in emergency department visits for heat stroke during the 2021 heat dome, including 195 visits specifically attributed to these conditions on June 28 alone—roughly 100 times higher than the daily average [97].

Heat-related illness and injury rates in B.C. are also likely underestimated [98,167]. While some people, particularly those with more severe illness, may visit health care centres, such as emergency departments, many more may experience heat-related illnesses without seeking health care services.

> *"For every person who died from the heat dome, 10 or more may have suffered heat stroke, dehydration, or other complications, including permanent, life-altering injuries."*
>
> —Dr. Melissa Lem, Canadian Association of Physicians for the Environment [168]

Other types of illnesses and injuries have been reported during extreme heat events in B.C., including:

- **Mental health impacts:** There have been reports of increased anxiety and distress, incidents of aggression, and mental health emergencies during and after extreme heat events. In B.C., roughly half of 21 service providers surveyed in one study reported their clients experiencing a great deal of mental health impacts [85] during the 2021 heat dome. The Crisis Centre of BC reported an increase in calls for anxiety and other crises during the 2021 heat dome—a pattern they report seeing whenever there are heat waves [169]. The heat dome also exacerbated conditions for people with pre-existing mental health or substance use issues. See Chapter 9: Mental Health for more discussion about climate-related mental health impacts in B.C.
- **Respiratory and cardiovascular illnesses:** Extreme heat events in B.C. can lead to more frequent smog days, worsening existing respiratory and cardiovascular illnesses [170].
- **Infectious disease outbreaks**: Warmer sea surface temperatures have been associated with increased rates of Vibrio illness in B.C. [171] , a bacterial disease often associated with eating undercooked shellfish or being exposed to contaminated water [172]. The 2021 heat dome may have contributed to an outbreak of Vibrio illness. At least 10 cases of shellfish poisoning due to *Vibrio parahaemolyticus*, which may have been prompted by the high temperatures, were reported to the BCCDC, with most individuals falling sick after consuming self-harvested shellfish, or engaging in recreational activities such as swimming [99,173]. Regional health authorities issued public announcements alerting residents to the increased *Vibrio parahaemolyticus* infections across the province [174].

Heat-related impacts on social, economic, environmental, and cultural determinants of health

Extreme heat can have wide-ranging impacts across many sectors. Manufacturing, construction, transportation, and warehousing are projected to be among the highest-risk sectors in Canada for labour productivity impacts due to extreme heat [64]. Extreme heat can also adversely impact food, transportation, and electricity systems, among others [64,175].

Social, recreational, and community events have also been impacted; community events and spaces have been cancelled or closed in B.C. due to extreme heat [176,177], and some Indigenous communities have described events being cancelled in their communities, which are important for social cohesion, community connection and health and well-being [42]. Schools in some regions closed during the 2021 heat dome [178], with concerns about high temperatures in older schools and portables prompting the development of guidelines around when to close schools during extreme heat events [179,180].

4.2.2 Disproportionate impacts of extreme heat on populations in B.C.

There is a growing body of evidence globally showing how some populations are disproportionately impacted by heat exposure. Seniors and younger children are at higher risk for heat-related illness, in part due to a reduced ability to thermoregulate [153,156,181]. People with preexisting cardiovascular, respiratory, diabetes, and renal diseases are also at increased risk [1,156,181,182], as are people taking medications such as antipsychotics, antidepressants, diuretics, and illicit substances like cocaine, which can impact thermoregulation [183,184]. Exposure to extreme heat during pregnancy has been associated with adverse birth outcomes, including pre-term births, stillbirths, and low birth weight [185–187], as well as gestational diabetes, sudden infant death syndrome, and placental abruptions [188–190]. Some populations are also at increased risk due to greater exposure, including underhoused populations who lack or have limited access to shelter [191,192] and people living in densely populated urban areas [18,183]; their risks are often exacerbated by social and economic vulnerabilities like poverty and social isolation [1,2].

The health impacts of extreme heat are not evenly distributed in B.C. Certain populations are disproportionately affected due to heightened exposure, heightened sensitivity, and/or limited adaptive capacity (e.g., mobility barriers in getting to a cooling centre), among other factors. Evidence of some disproportionate impacts from heat in B.C. are described below.

Older adults

During the 2021 heat dome, more than two-thirds of all coroner-reported deaths in B.C. (67 percent, 415 deaths) occurred among those aged 70 or older, and almost all (90 percent) among people aged 60 or older [5]. Although there were no coroner-reported deaths among those under 30, some Canadian studies have reported increased emergency department visits among children during extreme heat events [5,193].

The largest increases in acute care visits for heat-sensitive conditions province-wide were seen in people over 60. In people aged 90 years and older, emergency department and hospital admissions increased 114 percent and 59 percent, respectively [194]. Older females may have been at higher risk during the heat dome, because they are more likely to live alone [5,92].

For someone who is at higher risk from heat, a check-in may be lifesaving

The Heat-Check-In Support Framework for Non-Governmental Organizations (2023) acknowledges heat-related risks for certain populations, including older adults. Developed by the Vancouver Coastal Health's Healthy Environments and Climate Change team, the document is meant to empower organizations to conduct heat check-ins by providing guidance on check-in processes and logistics, and general information on heat-related illness. [195]

People with chronic conditions

Of deaths investigated by the BC Coroners Service during the 2021 heat dome, 91 percent of the deceased had been previously diagnosed with at least one chronic disease [5]. The risk of death increased with the number of existing chronic diseases; people with 10 or more chronic diseases had double the associated risk of death of those with only one chronic disease[17] [196]. One study found a general lack of awareness of the warning signs of heat-related illness or of heat exacerbating existing conditions (e.g., cardiovascular, respiratory, and renal conditions), resulting in confusion about when to seek support [85].

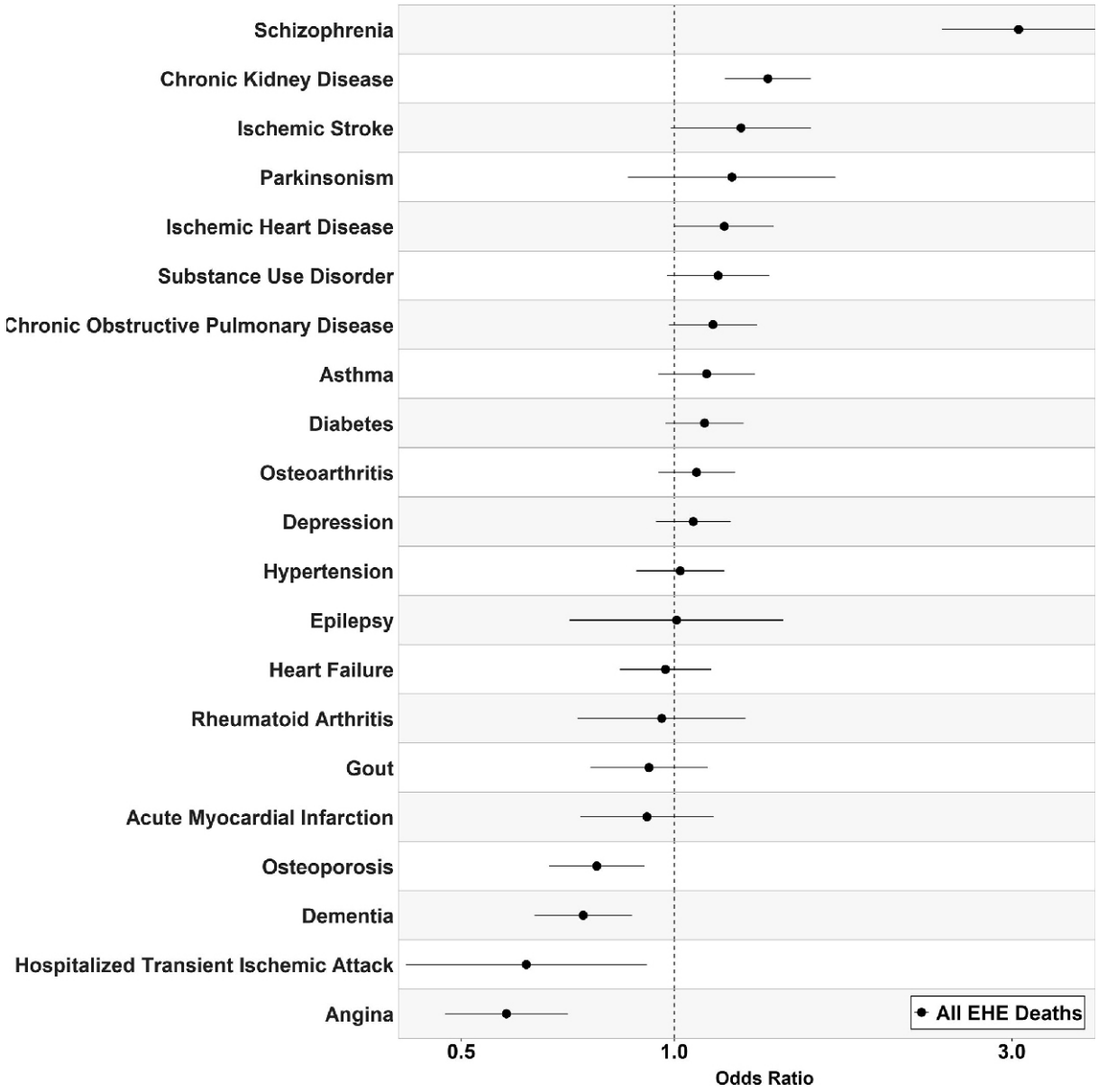


Figure 7. Chronic conditions and odds of death during the 2021 heat dome [18]

17 Risk estimated as Odds Ratios (ORs).

18 Odds ratios (ORs) and 95-percent confidence intervals, derived from conditional logistic regression, for each chronic disease (adjusted for age, sex, and all other chronic diseases) among all extreme heat event (EHE) deaths compared with typical weather deaths. The chronic diseases are ordered from top to bottom by the OR point estimates [196].

People with mental health conditions

Schizophrenia was the illness most strongly associated with the risk of extreme heat death during the 2021 heat dome (Figure 7), after accounting for 20 chronic diseases [196]. Multiple factors likely contribute to this increased risk, including limited self-awareness of health status, disorganized thinking, social isolation, economic marginalization, and the influence of co-occurring conditions and medications affecting heat perception and thermoregulation [196]. Since the 2021 heat dome, the BCCDC has developed information briefings on the risks of extreme heat events for people with schizophrenia [197], to inform heat planning for organizations and support networks that serve people with mental health challenges.

People who use substances

> *"During the heat wave, it was hard for anybody to take care of themselves. A lot of these people [have] addiction. Where I work, we had 15 overdoses within an hour."*
>
> —DJ O'Brian, a Harm Reduction Outreach Worker in Vancouver's Downtown Eastside [198]

In Vancouver's Downtown Eastside, visits to the Overdose Prevention Society spiked by 25 percent during the 2021 heat dome, rising to over 900 a day [199]. Findings from a long-term study of 4,913 people who died due to drug toxicity (cocaine, opioids, or amphetamine) in B.C. between 1998 and 2017 found that higher temperatures were associated with increased odds of death, particularly for cocaine—on its own and when combined with other drugs. The study concluded that people who use substances may not know that they are at higher risk [184]. As extreme heat events become more frequent with climate change, targeted interventions could include training staff and volunteers who work with people who use substances, and displaying and distributing heat awareness resources in areas where people who use substances gather, such as overdose prevention sites [184].

People with disabilities and/or mobility challenges

Individuals with mobility challenges can face significant difficulties staying safe and cool, due to a lack of accessible cooling centres, nearby parks equipped with seating and shade, and/or transportation options (e.g., transit) [85,199–201]. Some people with disabilities experienced fear and anxiety about seeking help during the 2021 heat dome, due to ableism, stigma, and past negative experiences with the health and social care system [168]. Measures such as specialized air-conditioned buses, curbside pickup, temporary free transit during heat events, mobile cooling centres, and cooling shuttles help to address these needs and support equitable access to cooling areas [5,168].

Materially disadvantaged populations

Populations with lower incomes are at a higher risk of adverse effects from extreme heat. They are less likely to have access to cooling measures, such as air conditioners or curtains; more likely to live in neighbourhoods with less access to green space; and may experience additional risk factors, such as transportation barriers to cooling centres [85,92,202].

During the B.C. 2021 heat dome, a higher proportion of heat-related deaths occurred in materially and socially deprived groups [92], with 28 percent of deceased individuals residing in neighbourhoods characterized as the most materially deprived, and 33 percent living in neighbourhoods considered the most socially deprived [5]. In B.C.'s urban areas, such as Vancouver and Victoria, populations living in the

hottest locations (e.g., urban heat islands) also have lower median incomes, a higher proportion of low-income people, low-income older-aged people, immigrants, and less green cover than those living in the coolest locations [85,203].

People who are underhoused face increased heat exposure, due to living outside or in older buildings without air conditioning, for example. They also face a range of other factors that influence their capacity to adapt. For example, during the 2021 heat dome:

- Individuals living on the street reported not feeling safe leaving their belongings to access cooling areas [85,204,205].
- Underhoused populations reported feeling unwelcome and facing stigma when trying to access indoor air-conditioned public spaces or shaded green areas [85].
- Some underhoused populations reported a lack of accessible drinking water, making it challenging to stay hydrated during the heat dome. Some also reported avoiding drinking water to reduce the need to use public restrooms [85].

Heat response for under-housed populations

In response to the 2021 heat dome, non-profit organizations and their partners have been implementing strategies to protect underhoused populations from future extreme weather events.

Kelowna's Pop-up Cooling Tents:
Kelowna's heat response to protect the underhoused was supported by a collective of over 50 community partners, including the Central Okanagan Journey Home Society, Interior Health, the City of Kelowna, and the Ki-Low-Na Friendship Society. Members of the Lived Experience Circle on Homelessness identified that community cooling centres were not accessible and did not meet the needs of community members experiencing unsheltered homelessness. To support equitable access to cooling locations, the collaborative mobilized partners to develop "pop-up cooling tents" at accessible downtown locations. Peer-operated Personal Belonging Storage Programs, offered by partner agencies across the downtown core, ensured that people had a secure place to leave their belongings while accessing the cooling tents during the day. Having strong structures for working together enabled partners to mobilize quickly, leveraging resources and drawing on community capacity and strengths to keep the underhoused population safe during the heat dome.
Source: Heat Response Planning for Southern Interior B.C. Communities, 2023

PHS Community Services Society's Check-ins Save Lives During Heat Dome:
PHS Community Services Society provides housing, health care, harm reduction, and health promotion to some of the most at-risk and under-served populations in Vancouver's Downtown Eastside, which has less shade and shelter than other parts of Vancouver, with summer heat magnified by the urban environment. During the 2021 heat dome, staff conducted check-ins, identifying people who were dehydrated, with some being taken to the ICU. Staff helped people keep cool by providing fans and putting air-conditioning units in common areas, and in the rooms of the most medically at-risk people. The team also planned ahead by stocking up on fans and air-conditioning units well in advance, blocking out skylights, and preparing to install misting stations on patios, courtyards, and sidewalks. "We found the most important thing with the heat dome was to increase staff supports for residents," said PHS Housing Director Tanya Fader. "If staff last summer had not been doing check-ins, there would have been deaths."
Source: PHS provides shelter from extreme weather, 2022

Renters and strata owners

Housing type and ownership status affect what actions individuals can take during heat events to protect themselves in their home. In B.C., there are reports that some strata council rules, rental agreements, or landlords have created barriers to installing cooling systems (even temporary ones), objecting to covering windows with available materials (e.g., cardboard) and/or to absorbing the increased utility costs of cooling units [85,202,206].

Strata residents, co-op members, and tenants with medical conditions impacted by heat have a right to accommodation under the BC Human Rights Code [207]. Prior to the 2021 heat dome event, two human rights tribunal cases filed by strata owners who had chronic medical conditions resulted in rulings in favour of the residents [206]. Ensuring renters can stay cool during extreme heat events requires a combination of policy and regulation (e.g., building codes requiring proper ventilation [208]); financial assistance to help renters pay for cooling; and education and awareness [209].

People living alone

Those who live alone may have limited access to social support networks (friends and family) that can check in on their well-being and provide assistance if necessary. During the 2021 heat dome, more than half (56 percent) of those who died were socially isolated and lived alone [5]. As heat illness can progress quickly, those living alone may not have had daily contact with someone who would notice early warning signs of heat illness. By comparison, those who lived in community or assisted living situations (i.e., group, senior, or long-term care homes) made up only 8 percent of deaths during the 2021 heat dome, likely due to having been checked in on by caregivers.

It is well established that social networks are key aspects of emergency preparedness and resilience during extreme heat events. Health authorities, local governments, and community-based organizations are increasingly recognizing social connection as a protective factor during hot weather [66,210]. There is an opportunity during pre-season planning to identify potentially isolated residents, clients, and patients receiving health and social services such as home care and food delivery [66].

People who work outside and/or in hot indoor environments

Heat-related illnesses have been reported among B.C. workers exposed to high working temperatures. According to WorkSafeBC, work-related heat stress claims have been rising over time in the province. From 2018 to 2020, they averaged 41 accepted claims from heat stress per year, increasing to 115 heat stress claims during the 2021 heat dome (with two-thirds among outdoor workers) [211].

In 2022, there were 11,831 temporary foreign workers working within B.C. agricultural industries [212]. The BC Fruit Growers' Association estimates that migrant workers make up more than half of their members' workforce [213]. Many faced extreme heat stress during the 2021 heat dome, working in packing sheds, greenhouses, and warehouses [44]. They faced significant exposure to heat due to long workdays; challenging working conditions in direct sunlight during the hottest days of the year; and, in some cases, accommodations lacking access to fans or air conditioning [44,214,215]. Furthermore, migrant farm workers often live in rural communities without easy access to stores to purchase fans or other cooling devices.

Essential workers, such as health care workers, cooks in social services, kitchen staff, road workers, and those in industrial settings, also faced challenges finding shelter from the heat [216,217]. Their work conditions are often intense, involving heavy machinery and protective gear, with limited access to shade or suitable uniforms [216]. A study that looked into 528 accepted lost-time claims for heat-related illness by B.C. workers between 2000 and 2020 identified the majority of illnesses (84 percent) occurred in summer months. Most occurred in male workers, younger workers, and those in occupations related to primary industry

(including trades, transport, and equipment operators; and processing, manufacturing, and utilities). The authors attributed the higher rates among younger and male workers to their disproportionate representation in occupations with higher ambient heat exposures (e.g., outdoor work) and metabolic demands (e.g., manual labour), rather than to an innate sensitivity to heat [218].

Farmers and ranchers were impacted economically and psychologically by the 2021 heat dome, due to lost crops, lengthy recovery periods, and the event overlapping with the coinciding COVID-19 crisis [219].

WorkSafeBC accepted 115 claims for heat stress in 2021—a 180-percent increase over the previous three-year average of 41 [211].

Newcomers and those with linguistic barriers

Linguistic barriers increase vulnerability to climate change due to limited access to information, reduced participation in decision-making, and heightened health and safety risks [85]. In addition, newcomers to Canada may face challenges navigating a new community to locate cooling centres [202]. During heat events, warnings must be multilingual and delivered in a variety of formats [5]. As an example, HealthlinkBC, PreparedBC and health authorities have created Extreme Heat resources available in multiple languages [220].

Impact of heat on Indigenous communities

Due to their geographical location, some First Nation communities on reserve lands are particularly exposed to extreme heat in the summer months. Some are among the hottest communities in the entire province (e.g. Nlaka'pamux Nation, T'eqt"aqtn'mux, Tl'kemtsin, Líl̓wat Nation, Osoyoos Indian Band, and Ashcroft First Nation) [221–223].

Elders, youth, and those with pre-existing health conditions in some B.C. First Nations and Métis communities report being most affected. Specific impacts discussed included:

- Cancellation of community cultural events due to heat;
- Impacts on food security, food sovereignty, access to traditional medicines, and cultural practices, such as fishing, hunting and foraging, due to the cascading impacts of inhospitable conditions for animal and plant life;

- Lack of adequate cooling systems in community housing stock;
- Lack of cooling shelters for community members;
- Hesitancy in some community members to use air conditioners due to cost; and
- Impacts to accessible cool water due to ecosystem disruptions from other hazards, such as drought.

Indigenous communities in B.C. have also demonstrated leadership in developing heat response plans and caring for community members and Elders during heat events. (See the example of Indigenous-led actions in 4.3 Health-related adaptations to extreme health).

4.2.3 Extreme heat impacts on the B.C. health system

Extreme heat has impacted the health workforce and resulted in cascading impacts in health and long-term care facilities, as a result of strained cooling systems, medical equipment malfunctions, and disrupted medical procedures. More details about cross-cutting health system impacts from extreme heat, wildfires, flooding and drought can be found in Chapter 8: Health Emergency Management, Evacuations and Health Service Delivery, and Chapter 11: Cross-Cutting Impacts, Adaptations and Opportunities.

Heat impacts to the B.C. health workforce

> *"[The 2021 heat dome] was probably the most horrific, horrendous time that I've ever been through."*
>
> —*Risk to Resilience Project* focus group participant

The health workforce in B.C. has experienced significant impacts during extreme heat events, most notably during the 2021 heat dome. In fact, health care providers were found to be the occupational group *most impacted* by increased workload during this event due to factors such as patient surge, and staff experiencing mental health impacts, work modifications, cancellations or delays, and occupational safety concerns [219]. Emergency medical services across the province also reported being severely strained, experiencing at least a doubling of call volumes above normal [5,96]. Over the course of a single day during the 2021 heat dome (June 28), Vancouver Fire and Rescue attended 365 calls, including cardiac emergencies, heat emergencies, and overdoses [224] .

Mental health impacts to the health workforce

Emergency health service providers (e.g., paramedics, nurses, and physicians) experienced significant mental health impacts during the 2021 heat dome, including emotional trauma and burnout. Some physicians and nurses described being in "*response mode*" and needing to "*compartmentalize the trauma*," leading to delayed mental health impacts [56]. A number of health care workers reportedly left the profession in the wake of the event [217,225], and *Risk to Resilience Project* focus group participants shared stories of colleagues leaving the profession permanently.

Frontline health care workers also described the "*moral injury*" they sustained when demand for emergency care outstripped capacity, such as not having enough equipment for cardiac monitoring in overcapacity emergency departments [56]. Assisted living workers described the conflict of being expected to stay with clients while waiting for emergency services, but knowing other clients were also in need of support.

> *"I was [waiting] hours and hours for an ambulance to come. [We had to] make those decisions about what to do… Do I leave this person who is obviously in distress to go to my next client who is also most likely to be in distress? It was such a moral dilemma."*
>
> —*Risk to Resilience Project* focus group participant

Community health care workers in long-term care and assisted living described experiencing emotional trauma and guilt as a result of finding clients deceased during the heat dome—sometimes more than one in a day. Many asked themselves whether there was "*more that they could have done.*" [56]

Workplace impacts

In addition to the pressures of caring for patients during extreme heat events, health care staff working in facilities with elevated temperatures have reported physical and social impacts [226]. In a 2017 staff survey at one regional health authority—including acute care, long-term care, mental health, health centre sites, and home and community care services—more than half of the 218 respondents reported experiencing direct occupational health impacts from working in high temperatures, which contributed to low morale and motivation, and irritation [227].

> *"It's not just about the client safety, but how do we ensure our staff are safe as well?"*
>
> —*Risk to Resilience Project* focus group participant

During the 2021 heat dome, health care staff experienced many of these same impacts. In a number of facilities, complaints about high temperatures were made by staff as well as by patients and their families; temperatures in some program areas reached over 30°C [175,228]. Some staff experienced heat exhaustion, and surgeries were cancelled as high temperatures in some operating rooms created unsafe conditions for staff and patients.

Uncomfortable working conditions during the 2021 heat dome were also reported by paramedics [175] and home and community care workers, who reported elevated temperatures in clients' homes or hot vehicles [56]. As a result, some home care programs changed their protocols, requiring staff to attend home visits in pairs when temperatures hit a threshold.

> *"[During the heat dome, there] was a very significant interruption of planned services. We had to shut entire buildings. You know, the vaccine rollout was in full swing, and the buildings themselves were reaching temperatures well beyond anything that [was] sustainable to ask our staff to work in for any period of time."*
>
> —*Risk to Resilience Project* focus group participant

As the 2021 heat dome intersected with COVID-19, the impacts of high temperatures were compounded by pandemic-related occupational safety conditions. Laboratory staff reported experiencing uncomfortable working conditions when wearing impermeable personal protection gowns and gloves, and feeling additional heat generated by lab equipment [27].

Heat impacts to B.C. health service delivery

During the 2021 heat dome, acute care services in many regions of the province faced significant increases in patient volumes. Higher patient acuity levels also put additional strain on health services [97,98,230]. In one 24-hour period at the peak of the event, there were 17 patients in the Vancouver General Hospital emergency department at the highest acuity level[19]—representing the most acute and ill patients requiring immediate resuscitation (compared to an average of four to five on a typical day) [230].

> *"We had patients with temperatures of over 40°C who were presenting confused or even unconscious, and with full-on heat stroke."*
>
> —Dr. Heather Lindsay, Department Head, Emergency Medicine, Vancouver General Hospital, University of British Columbia CPD 2023 [230]

19 Acuity reported as CTAS levels on a scale of 1 to 5, with CTAS level 1 being the most severe.

Additional impacts to health service delivery included [56,150]:

- Pausing emergency department respiratory triage (during COVID-19) when indoor temperatures were too hot;
- COVID-19 protocols adding additional challenges due to it being too hot to wear personal protective equipment and the use of fans being unsupported by infectious disease protocols;
- Treatment of dialysis patients in emergency departments when other treatment areas were too hot;
- Risks of malfunctioning equipment in labs and transfusion medicine services, with resulting impacts to storage of blood products;
- Freezer failures;
- Reduction in the provision of diagnostics due to cooling problems;
- Running out of supplies such as cooling blankets and ice; and
- Impacts on the delivery of temperature-sensitive vaccines, including COVID-19 vaccines.

Challenges keeping residents cool in long-term care facilities

The heat impacts on long-term care facilities during the 2021 heat dome had significant implications for resident care across the province. Additional resources and operational changes were required at some long-term care facilities, such as bringing in portable air-conditioning units; moving residents to common cooler air spaces, such as dining rooms, disrupting normal service; ensuring residents were well-hydrated; menu changes; and serving cold foods on paper plates to reduce use of heat-generating appliances such as dishwashers. Other strategies included increasing the frequency of rounds (checking in on patients and clients), using ice packs, covering windows, and using water sprinklers to cool roofs [56].

Health Emergency Management BC (HEMBC) also worked beyond their traditional mandate, responding to gaps identified in the response to the heat event—such as supporting regional health authorities in sourcing and prioritizing equipment, like additional fans and cooling systems, for long-term care and assisted living facilities [231]. Despite a shortage of cooling units across the Lower Mainland region, HEMBC ensured priority sites received air-conditioning units and industrial fans. [232].

The Ministry of Health and health authorities have also been upgrading and installing HVAC systems in health system owned and operated facilities to meet the needs of a warming climate (see section 4.3 health-related adaptations to extreme heat for more details.)

More intensive outreach to home and community care clients

During the 2021 heat dome, home and community care services intensified outreach to clients, deployed additional staff in home care and home health programs, and expanded direct supports provided to clients and community partners in mental health and substance-use programs [233]. Health care workers in focus groups described needing to examine and adapt standard practices and protocols for extreme heat events. For example, when protocols restricted staff from transporting clients in their personal vehicles, staff tried working with families to meet client transportation needs; at times, the only option was to call an ambulance to take clients to the hospital emergency department. This was challenging due to wait times and emergency department capacity. In Vancouver, one strategy was to offer taxi vouchers to staff for transporting clients [56].

Heat impacts on health facilities and infrastructure

> *"We were caught off guard by the heat dome in 2021… We had HVAC systems [that] could not support heat of that level, for that long, at that length of time."*
>
> —*Risk to Resilience Project* focus group participant

When health infrastructure is impacted by extreme heat, a cascade of effects and impacts are felt by health staff and patients. In a 2018 survey of staff at Lower Mainland health authorities about extreme heat risks and impacts, the most commonly cited health infrastructure impact was cooling system overload, resulting in an inability to maintain normal operating temperatures (typically 26–36°C) [150].

Additional impacts included:

- Strained cooling systems, leading to disrupted medical procedures and increased workloads as a result of excess humidity and poor air quality;
- Adverse impacts on food refrigeration, mortuary use, and medical or patient material; and
- Air- and water-cooled medical devices, such as magnetic resonance imagers (MRI), being rendered inoperable, due to chillers failing or temperatures in the municipal water supply exceeding 15°C.

Similar impacts were reported during the 2021 heat dome event; medical equipment, including diagnostic computed tomography (CT) scans and MRIs, failed due to insufficient cooling capacity of chillers [175]. Following 2022 heat events, health authorities also reported heat-strained cooling systems and issues with chillers that led to unexpected replacements and additional costs, including costs to provide temporary cooling. Some sites also reported challenges maintaining indoor temperatures and set points, issues with air supply and ventilation, and higher utility costs when running cooling devices non-stop [234].

Aging health infrastructure and equipment is an ongoing challenge in B.C. and across Canada, as many buildings were not designed for extreme heat conditions [175,235]. Some older facilities, for example, cannot support HVAC or cooling systems due to limited electrical capabilities. This, in turn, leads to challenges in maintaining indoor temperatures [42,235].

During the 2021 heat dome, cooling-system failures impacted older buildings, including long-term care facilities where inadequate cooling in individual rooms required residents to move to common cooling areas. However, as reported by focus group respondents, there were also malfunctions of air conditioning in common areas. Power outages occurred when systems and power grids could not support air conditioning, requiring constant repairs by Facilities Maintenance and Operations teams. In smaller sites without around-the-clock engineering support, there were delays in restoring power [56].

> *"[Our region] is not a place that's historically had heat issues, and so there are so many older buildings that don't have the infrastructure in terms of their HVAC systems. They don't have central air conditioning, they don't have air conditioning in their rooms."*
>
> —*Risk to Resilience Project* focus group participant

Without adaptation action, many acute and long-term care facilities across B.C. are projected to have high heat failure probabilities by the year 2100[20] [194].

Heat impacts on health-related supply chains

As experienced during the 2021 heat dome, extreme heat events impact health-supply chains in B.C., including vaccines, medications, food, and essential supplies.

Vaccine and medication storage/spoilage

During the 2021 heat dome, B.C. health authorities were concerned about spoilage to essential temperature-sensitive medications—such as COVID-19 vaccines, insulin, EpiPens, and naloxone kits—and shared information with the public on how to prevent this from occurring. Some mass COVID-19 vaccination clinics in the province were forced to close when temperatures made it unfeasible to keep vaccine supplies cold [27,233].

Food storage and supply

Heat waves, including the 2021 heat dome, can create conditions that lead to spoilage of perishable foods throughout the food chain [236]. During the 2021 heat dome, impacts on food production across multiple suppliers led to a reduction in poultry and dairy products, seafood, fruits, and vegetables in the Okanagan, Kootenays, and Fraser Valley regions [44,93,175]. For example, 661,000 poultry raised for meat died, milk production declined by 17 percent, and 500,000 litres of milk were discarded because it could not be kept cold [175]. Both marine-harvesting and shellfish-farming operations experienced losses; mussel harvesting declined by 9 percent, and up to 70 percent of farmed shellfish died in some areas [175]. These losses posed a significant health impact on those who rely on food harvesting, cultivation, and production for their livelihoods, economic stability, or to feed their families.

Extreme heat can also indirectly affect food availability by disrupting transportation and distribution systems. High temperatures can damage roads, railways, or other infrastructure [237] critical for transporting food from farms to markets. Heat-related crop/livestock damage and supply chain disruptions can also cause food costs to rise, affecting access and affordability, which can lead to food insecurity in a variety of ways [238]. Messaging related to the spoilage of perishable foods was shared with the public during the 2021 heat dome event [236].

Availability of cooling devices

A shortage of portable air conditioner units was an issue during the 2021 heat dome. Lower Mainland retailers were unable to keep them stocked, and units began appearing in reseller marketplaces at inflated prices [239]. There were limited hotel vacancies in the Lower Mainland as locals searched for air-conditioned spaces [240]. Following the heat dome, shop owners began adapting by ordering more stock in advance. Supportive housing organizations, such as BC Housing and the Portland Hotel Society, began stocking up on fans and air conditioning units well in advance of summer months [241]. Similar patterns were seen during subsequent heat events in 2022 and 2023, when warmer weather alerts triggered shortages of air-conditioning units [242,243] .

20 Based on a high emissions scenario projection (RFP 8.5), with high heat failure (HF) probability defined as a HF occurring once every three years.

Disruption of transportation routes

Extreme heat events present transportation and supply-chain disruptions for remote communities that rely on air and sea traffic. For example, one remote B.C. Indigenous community found it difficult to bring in supplies during the 2021 heat dome, as their airport was impacted by flight cancellations and weight restrictions, due to the influence of extreme heat on engine performance and runway viability [244].

> *"A 19-seat plane can only really take off at [certain conditions]. There were... people in neighbouring communities who were very dependent on getting certain medications to stay alive... It was hard to get them their meds in the heat wave."*
>
> —*Risk to Resilience Project* Indigenous sharing circle participant

4.3 Health-related adaptations to extreme heat in B.C.

Since 2021, B.C. has made significant strides in extreme-heat preparedness province-wide, informing adaptations in health policies, services, and response strategies. Efforts have been made to increase timely heat alerts and messaging [103] along with development of guidance for community cooling centres [245]. Yet, it's important to acknowledge the challenges that persist, such as retrofitting buildings for passive cooling within the constraints of existing infrastructure. These challenges prompt a call for a broader approach, one that encompasses both short-term actions and long-term solutions. Below are a few examples of initiatives in the province that are building resilience to extreme heat.

Public health adaptation to extreme heat

In B.C., the journey towards resilience in the face of extreme heat is marked by significant progress and collaboration. The province's approach to addressing the escalating challenges of extreme heat events encompasses health system transformation, alongside partnerships and actions led by local governments and First Nations communities. This collective commitment to health and well-being is at the forefront of action.

Cooling Stations across Victoria, B.C.

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

2009

2010

BCCDC initiates program of research on heat health impacts and preparedness in B.C., including informing trigger temperatures for heat emergencies in greater Vancouver

City of Vancouver publishes *Extreme Hot Weather Preparedness and Response Plan*

2011

Heat Alert and Response System (HARS) launched for greater Vancouver, with trigger temperatures set by BCCDC, Vancouver Coastal Health and Fraser Health

2012

BCCDC publishes research on temperature thresholds for heat mortality in different provincial regions, risk factors for heat mortality, and methods for identifying heat-related deaths and heat exposures

2017

BCCDC publishes guidance for *Municipal Heat Response Planning in B.C.* and a resource specific for Medium-sized Municipalities

2018

Interior Health initiates a multi-year project to support planning & response to extreme heat (including a pilot HARS in Ashcroft)

BCCDC and ECCC establish heat alert thresholds for the entire Province

2019

BCCDC *launches the B.C. Heat Impacts Prediction System*

2020

Interior Health *Heat Alert Response Toolkit* published to support local heat response planning

Fraser Health releases tailored guidance for *Extreme Heat and people experiencing homelessness*

2021

Guidance released by BCCDC and B.C. Ministry of Health on *Community Cooling Centres During B.C.'s Restart Plan*

Seasonal Readiness Committees established in Lower Mainland Health Authorities

2022

January
B.C. Health Effects of Anomalous Temperatures Coordinating Committee (*B.C. HEAT*) Committee established to support planning and response related to public health impacts of extreme heat province-wide

Province publishes *Extreme Heat Preparedness Guide* in multiple languages

June
B.C. Coroner's *Review of Heat-Related Deaths in the Summer of 2022* released

June
B.C. Heat Alert and Response System (B.C. HARS) rolled out as a two-tiered system for the Province, including: Heat Warning and Extreme Heat Emergency

Spring/Summer
Vancouver Coastal Health develops a *Heat Framework Support Guide for Non-Governmental Organizations*, a companion guide to the NCCEH/ BCCDC's *Guide to Health Checks in Extreme Heat Events*

2023

May
B.C. HARS updated, integrating lessons learned in 2022

June
Interior Health updates *Heat Response Planning for Southern Interior B.C. Communities* reflecting B.C. HARS

Provincial heat response coordination

During extreme heat emergencies, collaboration and coordination are vital. Public health crises demand an all-of-society response, with clear frameworks and communication channels between relevant partners. Following the 2021 heat dome, the B.C. Ministry of Health and BCCDC formed the B.C. Health Effects of Anomalous Temperatures Coordinating Committee (BC HEAT) to support coordinated planning and response to the public health impacts of significant heat events in B.C. [103]. This committee includes representation from each of B.C.'s regional health authorities, First Nations Health Authority, BC Emergency Health Services (BCEHS), BC Housing, the Ministry of Emergency Management and Climate Readiness (EMCR), Environment and Climate Change Canada (ECCC), Health Emergency Management B.C. (HEMBC), Office of the Provincial Health Officer, the Union of BC Municipalities, BC Hydro, and WorkSafeBC. It was initiated as a forum for heat-related planning and response activities, creating a centralized point where partner organizations can address cross-sector and systemic challenges associated with extreme heat events. BC HEAT also assesses whether forecast temperatures constitute an extreme heat emergency, and makes recommendations to other partners at the ministry, health authority, community, and non-governmental organization (NGO) level about when to take action in accordance with their own organization's extreme heat plans.

BC HEAT is responsible for developing and updating the B.C. Provincial Heat Alert and Response System (HARS) [103]. In the system's inaugural summer of 2022, it identified specific roles and responsibilities for a range of partners, including Provincial ministries, health authorities, local governments, Indigenous communities, and partner organizations, for the periods before, during, and after extreme heat events. The recommendations and guidance of the B.C. HARS focuses on coordination to support a system- and community-level response that is better prepared and equipped to protect public health and safety for populations, communities, and individuals.

Guidance has also been prepared for provincial government ministries and agencies. Extreme Heat: Preparedness for Provincial Ministries and Agencies clarifies the roles and responsibilities of various government actors in activating sector-specific response plans, as needed [102]. The Ministry of Health currently oversees the response to public health impacts, while EMCR currently coordinates the response to non-health-related impacts, following the B.C. emergency management system. BC HEAT provides recommendations from a public health perspective to support planning and response.

B.C. Provincial Heat Alert and Response System

First implemented in the summer of 2022, the B.C. Heat Alert and Response System (HARS) is structured in two tiers: **Heat Warnings** and **Extreme Heat Emergencies**. During a Heat Warning, the health and emergency management sectors are promptly alerted through Environment and Climate Change Canada (ECCC) Weather Notification emails. ECCC disseminates public Heat Warnings through platforms including the WeatherCAN app and their website. Each authority tailors its actions based on their plans and recommended protocols.

Type of Alert	Heat Warning[21]	Extreme Heat Emergency
Public health risk	Moderate (5% increase in mortality)	Very high (20% or more increase in mortality)
Descriptor	Very hot	Dangerously hot
Historic frequency	1–3 per summer season	1–2 per decade
Criteria	Southwest = 29°C–16°C– 29° C* Fraser = 33°C–17°C– 33° C* Southeast (largely Interior region of B.C.) = 35°C–18°C–35° C* Northeast = 29°C–14°C–29° C* Northwest = 28°C–13°C–28° C*	

* Tmax ≥ daytime high, Tmin ≥ nighttime high, Tmax ≥ daytime high

When there is the potential for a Heat Warning to escalate to an Extreme Heat Emergency, the B.C. Health Effects of Anomalous Temperatures Coordinating Committee (BC HEAT) coordinates a series of consultations with designated leads, ensuring representation from subject matter experts. If the decision is made to issue an Extreme Heat Emergency within the province, it will initiate a series of response actions, including coordination calls at provincial and regional levels, press releases, and activation of regional and local Emergency Operations Centres (EOCs). EMCR may also issue an emergency broadcast and/or wireless alert through the Alert Ready system to allow for the immediate and direct dissemination of critical information to protect individuals, families, friends, neighbours, and community members during the Extreme Heat Emergency.

The HARS plan was updated in May 2023 to address identified gaps and concerns, including "warning fatigue." The updated HARS accounts for the behavioural and physical adaptations that occur by extending the heat warning activation criteria by a day as the heat season progresses. This reduces unnecessary messaging and alerting in forecast regions that have already experienced three or more heat warnings in a given year and are likely well adapted to the heat at that point. Further consultations to inform ongoing plan development involve local authorities, Métis and First Nations leadership, NGOs, and individuals with heightened susceptibility to past heat events. This commitment to continuous development not only showcases iterative learning and adaptive management, but also demonstrates dedication to public health, resilience, and preparedness in the face of extreme heat events.

21 As of May 2023, after the first three heat events of the summer in a given forecast region, BC HEAT may recommend extending the minimum number of days for Heat Warning criteria in the region to be when three or more consecutive daytime temperatures are expected to meet or exceed the regional Tmax value, and the overnight low is expected to reach or exceed the regional Tmin value for two or more consecutive nights.

Regional extreme heat response plans

There are specific challenges to developing a HARS that addresses the needs of rural and/or remote communities. Refinement and reassessment are ongoing to more fully reflect these needs in the B.C. HARS [103]. An effective HARS in a rural setting requires drawing on existing social and community networks [103]. Since 2018, Interior Health has been leading a multi-year initiative to support planning and response to extreme heat in the communities it serves, recognizing the unique context of rural communities [246]. In 2018, Interior Health partnered with the Village of Ashcroft to develop a HARS for the community, and in 2020, the regional health authority developed a Heat Response Toolkit to support community partners, which was updated in 2023 [205]. The toolkit provides practical information and resources that support rural communities in developing strategies to prepare for and respond to extreme heat.

The Village of Ashcroft's Heat Alert and Response System [247], established in 2018, is an example of how rural heat preparedness and response can be developed in a locally relevant and strengths-based way. Drawing on the community's strong social cohesion, existing physical infrastructure, and communication channels, Ashcroft demonstrated several areas that were successful, such as designated cooling centres and outreach to older adult populations. Through this community-led strategy, a HARS was successfully integrated into municipal response plans and existing infrastructure, and proved to be a public health intervention capable of addressing the health impacts of extreme heat [246]. The learnings from Ashcroft are now shaping the planning processes of similar HARS initiatives in other rural communities across the province [246]. Since the 2021 heat season, Ashcroft has updated their HARS to include:

- Updated heat alert tiers and language to describe alert levels;
- New communication strategies, such as the Voyent Alert System; and
- Designating the Community Hub building (a central, well-known, and accessible community space) as the official cooling centre.

The BCCDC has also created guidance to support municipalities in developing heat response plans. In 2017, respondents in a small survey of regional health authorities and municipalities highlighted the need for guidance in developing heat-response plans for small and medium-sized municipalities lacking infrastructure and expertise [248]. A guide was developed, based on these consultations and a literature review, which aims to help B.C. municipalities integrate heat plans into existing emergency preparedness strategies [249].

Health-sector-specific guidance

Regional health authorities have actively incorporated extreme heat preparedness into their operations, notably through Community Care and Assisted Living licensing policy updates. For instance, Fraser Health now mandates long-term-care and assisted-living homes to have a written heat response plan, complete with standard escalation and emergency measures as temperatures rise, including requirements for temperature monitoring and regular check-ins. Resources developed by the regional health authority's community care licensing program include Community Care Facilities and Heat [250] and Preparation for Extreme Summer Heat in LTC and AL Facilities: Planning and Management for Residents and Employees [251]. They have also developed a comprehensive heat toolkit for all sites within the Fraser Health region. Similar efforts are taking place in Northern Health, which provides tailored guidance to childcare facilities to ensure the safety of children in their care [252].

Data and evidence-informed decision-making

Since 2009, the BCCDC and B.C. researchers have been engaged in an ongoing program to better understand and measure heat exposures and health impacts, and to improve heat early warning and surveillance systems. Studies have been conducted to:

- Develop more accurate methods for assessing human heat exposures in urban areas, such as
  - measures of air temperature *versus* apparent temperature, which accounts for humidity; and [111]
  - measures of urban greenness [253], which will improve exposure assessments in epidemiological studies.
- Identify temperatures where heat exposure leads to increases in death rates, with findings being used to identify thresholds for triggering heat warnings and heat emergencies [105,106,254];
- More accurately capture heat-related deaths and injuries in epidemiologic studies [159,255]; and
- Identify risk factors for heat-related illness and deaths in B.C. populations [160,161,184,196,218]

A number of data visualization dashboards also now enable the public to better prepare for extreme heat events:

- The B.C. Heat Impacts Prediction System is an interactive online mapping system, developed by the BCCDC, intended for use by members of the public to support health protection during hot weather [256]. It provides heat health risks for the current, next, and following two days, as well as a daily risk comparison using observed data from the hottest and coldest years. It is reported at the level of Local Health Area[22].
- Interactive heat mapping tools have been developed that enable communities to better understand neighbourhoods most at-risk during climate-related events, including extreme heat and others. Examples include maps created by Vancouver Coastal and Fraser Health[84] and the Interior Health[83].

Ensuring facilities and infrastructure are better prepared for extreme heat

The comprehensive review of the 2021 heat dome conducted by the BC Coroners Service noted that most deaths had occurred indoors in homes without adequate cooling, highlighting the need to update existing building codes.

22 Local Health Areas (LHAs) are administrative boundaries produced and maintained by BC Stats and the Ministry of Health. There are 89 LHAs geographically nested within 16 Health Service Selivery Areas spanning five regional health authorities in B.C. [257]

Actions are being taken by the Province to ensure homes and buildings are adapted, retrofitted, and designed to provide safer interior living environments. They include:

- Updating the BC Building Code to establish a summer design temperature using mechanical cooling, or, where possible, passive design measures. A proposed requirement is that all new residential buildings must include at least one living space designed to stay cool (below 26°C). Requirements may vary based on weather conditions and site-specific factors [208].
- Including heat considerations in renewal and expansion investments in health authority long-term care facilities. Several projects in the capital plan will include modern HVAC systems that meet standards for air circulation and temperature control, including individual room cooling [209]. Between 2021 and 2023, 47 facilities had air conditioning/HVAC installed for the first time, and 149 facilities received upgrades to existing capabilities [209].

Other provincial organizations serving priority populations in B.C. have conducted heat-readiness reviews of community-based facilities and infrastructure. After the 2021 heat dome, BC Housing completed a review of the 54 heat-related deaths that occurred in 46 of its facilities (including single-room-occupancy hotels, social housing, and supportive housing), to better understand which design features increased the risk of death for residents. While findings were inconsistent with regards to building design, all of the buildings were older and not designed for cooling. Learnings from this review informed the development of the Extreme Heat and Wildfire Smoke Action Plan for BC Housing facilities and residents, which includes updates to the BC Housing Design Guidelines and Construction Standards that incorporate passive cooling measures to address the risks of overheating.

Built environment adaptations to combat the urban heat island effect

Research conducted after the 2021 heat dome pointed to the protective effects of surrounding greenness, especially within 100 metres of living spaces [92]. Green spaces and tree canopy can reduce the impacts of the urban heat island effect through evaporative cooling and shading [112,253].

Interventions by the health system include developing guidance about the protective effects of urban greenness and the impacts of lacking green infrastructure. The Green Design for Climate Resilience & Well-being guide was developed by a multi-sector collaboration between B.C. health authorities, an advisory group, and an industry task force. It details different green-space strategies and their associated metrics to provide evidence-based guidance on integrating climate resilience and public health co-benefits[23] into urban green-space design and planning [258]. The resource is supplemented by a user-friendly checklist to help designers, engineers, facilities building owners, and health professionals assess if they have considered and applied the strategies into their design. These resources are being applied to health-facility designs and are used to support health professionals in responding to community land-use applications by, for example, advocating for expanding green elements across the built environment [259].

Social connection and check-ins

There is a need for a comprehensive approach to address adaptation to extreme heat that includes consideration for low-carbon resilience (e.g., integrating low-energy cooling solutions, such as heat pumps) and social connectedness as protective factors to extreme heat [66]. Research has demonstrated the protective benefits of supporting priority populations through check-ins—a social intervention for addressing isolation during climate emergencies [66,210,260]. For more details see the example (estimating climate-related health risks for priority populations) in Chapter 10.

23 Co-benefits are the positive effects that a policy or measure aimed at one objective might have on other objectives. For example, climate mitigation efforts across energy, infrastructure, agriculture, and transportation sectors can improve population health by way of cleaner air, improved housing standards, healthier diets, and increased physical activity [16].

Increasing access to cooling devices

Air conditioning is one of the most effective adaptation strategies to reduce heat-related mortality and morbidity [261]. Data from Statistics Canada also indicates that B.C. has had some of the lowest rates of air-conditioner use in Canada; in 2017, just 31 percent of B.C. households had air conditioning of any kind, versus 61 percent of households Canada-wide [261].

Since 2021, B.C. has been improving access to cooling devices, such as portable air-conditioning units, for individuals, communities, and within the health system. Examples include:

- During the 2021 heat dome, Fraser Health created a list of long-term-care homes with/without air conditioning, focusing efforts on high-risk sites without air conditioning in hotter subregions [56].
- In summer 2022, Fraser Health launched a 10-unit pilot program, providing air-conditioning devices to clients at highest risk for heat-related illness over a period of three months. The units were leased through a qualified vendor who managed their delivery, installation, and support. The pilot's effectiveness and scalability are currently being assessed [262].
- In June 2023, the Province allocated funding to BC Hydro to expand its Energy Conservation Assistance Program to include free, publicly funded portable air conditioners for low-income and medically at-risk individuals, with an anticipated 8,000 air-conditioning units installed over the next three years [209].
- BC Hydro partnered with Vancouver Coastal Health to invest in portable air-conditioning units for community organizations, such as seniors' centres and neighbourhood centres. BC Hydro also teamed up with Praxis Spinal Cord Institute and Technology for Living, allocating funds for portable cooling devices for individuals with spinal cord injuries and disabilities [209].
- The B.C. Ministry of Health invested in EquipCare BC through the BC Care Providers Association, supporting seniors' long-term care homes with cooling items, air conditioners, evaporative coolers, and heat pump replacements [263].

It's important to note that while air conditioning is important for providing immediate relief from extreme heat, its reliance on energy consumption has longer-term consequences for maladaptation, and experts have warned against becoming an air-conditioned society [264–266].

Community cooling spaces

During the 2021 heat dome, a lack of access to cooling spaces (or cooling centres) posed substantial health risks [92]. This was especially challenging in urban areas, where heat becomes trapped and intensified in areas that are densely populated or that have lower urban greenness. Many municipalities provided cooling spaces for people to take refuge from the heat, either with guidance from their municipal heat response plans and/or in consultation with health officials. To address the concurrent concerns of the COVID-19 pandemic and the need to safely distance from others, the BCCDC and B.C. Ministry of Health developed guidance about the safe operation of cooling centres that included infection prevention and control considerations [267], prioritizing the importance of staying cool.

The 2021 heat dome also highlighted the pressing need for additional cooling spaces in communities. In 2023, municipalities across the province reported more than 300 cooling facilities, including indoor facilities (e.g., community centres, libraries, etc.) and outdoor amenities (e.g., spray parks, public parks, drinking water fountains) [268]. EMCR established an online dashboard to share the locations of cooling spaces with the public during extreme heat conditions [269]. Access and transportation to cooling spaces was identified as a barrier during the 2021 heat dome [85].

Municipal heat response—setting up cooling spaces in Burnaby, B.C. [270,271]

The City of Burnaby activated its Extreme Heat Initial Responses Guideline in response to the 2021 heat dome. This enabled community cooling spaces to open, with complex considerations including:

- operating hours;
- being accessible to and welcoming of all members of the public;
- being reachable by pedestrians, transit, or vehicle;
- availability of amenities such as Wi-Fi, washrooms, water, seating, etc.;
- limiting disruptions to current programming at the facilities already constrained by COVID-19 restrictions;
- facility staff and security staff availability; and
- planning for occupational health and safety.

Almost 800 people visited Burnaby's cooling spaces during the heat dome. The city also opened an open-air pop-up cooling site for underhoused people, offering free water, food, juices, sunscreen, and harm-reduction supplies.

Public communications for preparing and adapting to extreme heat

Public guidance about ways to prepare and adapt to reduce the health impacts of heat has been a focus for the Province, health authorities, and other organizations since the 2021 heat dome. Examples include:

- The National Collaborating Centre for Environmental Health (NCCEH) and BCCDC created a guide for conducting heat check-ins, Health Checks During Extreme Heat Events. This resource is intended for community members without health training, and provides a plain-language description of how to check on people most at-risk during extreme heat events. To empower organizations to conduct heat check-ins, Vancouver Coastal Health developed resources complementary to the NCCEH/BCCDC guide. These include a public webinar series on extreme heat and smoke preparedness for NGOs. Fraser Health also developed a summer heat wallet card in multiple languages with tips about how to stay cool during heat and poor air quality events.
- The Province's PreparedBC Extreme Heat Preparedness Guide helps people prepare their residences for extreme heat, and includes advice on how to stay safe when temperatures rise. Created in partnership with the BCCDC, the guide is available in multiple languages.
- Additional documents have been created to target priority populations, such as:
  - People who use substances (Interior Health): Heat and Substance Use Fact Sheet
  - People who are underhoused (Fraser Health): Extreme heat and people experiencing homelessness – Fraser Health
  - Landlords and strata managers, targeting people living in rental or strata units (Fraser Health/ Vancouver Coastal Health): Summer Heat and Health: Recommended Actions for Owners and Managers of Rental and/or Strata Housing

Culturally appropriate and equity-informed

Disasters and emergencies can disproportionately impact certain populations more than others [102]. Adaptation strategies must be equity-informed and culturally safe to ensure populations have fair or enhanced opportunities to achieve good health. Examples include:

- **Translating documents**: Health authorities and the Province have been creating informational resources in multiple languages to increase accessibility for those with English-language barriers (e.g., Extreme Heat resources, BCCDC resources, the Extreme Heat Preparedness Guide, and HealthLinkBC's resources), as well as other accessibility considerations, such as reading level, visual impairment, and media (e.g. print vs social media).
- **Collaborating with Indigenous partners**: To create and deliver culturally safe messaging about heat, the First Nations Health Authority collaborated with key partners, such as Métis Nation BC, the BC Association of Aboriginal Friendship Centres, BCCDC, and the B.C. Ministry of Environment and Climate Change Strategy.
- **Community awareness**: Many First Nations communities, Métis Nation BC and other Indigenous organizations maintain newsletters and offer seasonal preparedness webinars that play a vital role in disseminating information. Band administrators are central to amplifying the reach of messages. Printed resources are also invaluable assets that enhance accessibility and inclusivity, particularly for Elders who may prefer physical materials. Trusted nurses in community are exceptional connectors who play a key role in disseminating messages to clients [56].

Community and Indigenous-led adaptations to increase resilience

Despite facing noted challenges of heat exposure, Indigenous communities are demonstrating resilience and strength-based community-centered strategies to address the impacts of extreme heat events. Many Indigenous communities have embraced adaptation solutions, such as opening cooling centres in Band offices; creating food security strategic plans that prepare for extreme heat; analyzing how Elders can mitigate heat risk in their own homes through enhanced check-ins; and/or activating kinship systems to house family members in homes with air conditioning [222]. One report found that several B.C. First Nations' experiences of the 2021 heat dome demonstrated the protective quality of culture, including respect and care for Elders, relationship to land and ecosystems, and collaborative community action [222,244].

Community-led adaptations to increase extreme heat resilience have also been developed in partnership with the B.C. health system. After the 2021 heat dome, public health and HEMBC staff collected data (e.g., questionnaires to municipal emergency managers), organized debriefs and after-action reports, and worked on special projects—such as the City of Vancouver's citizen science reporting system of indoor temperatures during subsequent heat events, supported by Vancouver Coastal Health.

First Nations-led response to extreme heat [205]

The ongoing work in the T'ít'q'et and Xeni Gwet'in First Nation communities related to heat preparedness and planning demonstrates successful local First Nations-led adaptation in B.C. These First Nations leaders and teams are taking action to protect their communities from climate risks and prioritize health and safety.

T'ít'q'et, a community that is part of the St'át'imc First Nation in B.C., has been impacted by extreme weather events that have disrupted traditional livelihoods such as fishing, hunting, and gardening. The local T'it'q'et Heat Team received funding from Health Canada to develop a heat response plan that integrates existing emergency plans and builds on local knowledge.

The Xeni Gwet'in First Nation is one of six communities that form the Tŝilhqot'in Nation, located in traditional Tŝilhqot'in territory approximately 200 kilometres west of Williams Lake, B.C. Xeni Gwet'in First Nation received funding from Health Canada to hire an Emergency Program Coordinator tasked with developing an emergency response plan with a focus on heat, and to provide educational opportunities for community members.

Both heat response plans include strategies such as:

- Regularly checking in on Elders and those most at-risk during heat events;
- Establishing cooling centres in community buildings through the installation of tinted windows and a heat pump;
- Delivering water and distributing air conditioners and fans;
- Ongoing engagement with community members about climate change, heat waves, and their health and safety needs;
- Building capacity locally through training for community members on responding to emergencies;
- Integrating heat into existing emergency response plans.

4.4 Opportunities for action

Some key opportunities for B.C. to better prepare for and mitigate the acts of extreme heat include:

Coordination

- Increase clarity on the respective roles of the health system, local governments, First Nations, Métis organizations, emergency management agencies, and community partners, in preparing for and responding to extreme heat events.
- Strengthen partnerships with community organizations that provide services to populations most at risk from extreme heat (e.g., socially isolated older adults; daycares; the unhoused), and enhance collaboration for outreach and guidance for check-ins.

Planning and interventions

- Continue to build on efforts for local seasonal readiness planning across multiple sectors in preparation for heat season.
- Take an all-hazard approach to explore strategies that could have co-benefits for extreme heat and other climate events, such as wildfire or drought.
- Tailor heat adaptations for populations and neighbourhoods that are most at risk, and adopt strategies that are accessible, inclusive, and culturally safe.
- Continue to work with local governments and Indigenous partners to promote and identify locally appropriate built and social environment interventions that aim to protect human health from extreme heat (e.g., cool housing and green infrastructure).

Communications

- Create aligned and coordinated heat messaging across the health system, and with partners and the media, using a variety of platforms to reach diverse populations.
- Develop guidance documents and targeted heat messages to specific sectors (e.g., non-profits, landlords, schools, daycares, and restaurants) and key populations in advance of the heat season.
- Deliver public health messaging for personal heat planning and advocating home heat preparedness.

Surveillance, Research and Evaluation

- Continue to conduct regional and local heat vulnerability mapping to determine populations most at-risk during extreme heat emergencies and identify priority areas for focused strategies.
- Continue to research the physical and mental health impacts of heat exposures on different populations, and with a focus on populations disproportionately impacted.
- Continue to explore the combined effects of heat and wildfire smoke on public health.
- Continue to work collaboratively across agencies to facilitate more accurate assessment of the burden of heat-attributable deaths and illnesses.
- Collaborate across the health system, local governments, and community partners to evaluate the effectiveness of heat-mitigation strategies and community-based adaptations (e.g., utilization of cooling centres, shade structures), and the differential effects of actions on different population groups.
- Evaluate the effectiveness of heat communications with target populations and sectors, being mindful of the potential for messaging fatigue.