CHAPTER 9

Climate Change and Health Equity

Health Canada   Santé Canada

Canada

Lead Author

Rebekka Schnitter, Health Canada

Contributing Authors

Ericha Moores, Natural Resources Canada

Peter Berry, Health Canada

Marielle Verret, Health Canada

Chris Buse, University of British Columbia and University of Northern British Columbia

Catherine Macdonald, Alliance for Healthier Communities

Melissa Perri, Alliance for Healthier Communities and University of Toronto

Daniel Jubas-Malz, University Health Network

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Summary

Changes in climate are exacerbating existing health inequities and creating conditions for new inequities to emerge. The health effects associated with climate change will not be experienced uniformly. Vulnerability to health impacts of climate change is determined by the exposure to climate change hazards, the sensitivity to possible impacts, and the capacity to respond to, or cope with them. At the individual level, these three factors are influenced by determinants of health, such as socio-economic status, housing quality, and education. Determinants of health interact and intersect with inequities in complex ways that render the experiences of diverse groups and individuals unique. Structural systems of oppression, such as racism and colonialism, also influence an individual's vulnerability to climate-related health risks. Therefore, effective adaptation measures must be intersectional and equity-based. If adaptation efforts are not carefully planned, adaptation efforts may benefit only part of the population, and inadvertently worsen existing inequities. Resilience and asset mapping, vulnerability mapping, equity impact assessments, and meaningful and inclusive community engagement and communications can all contribute to equity-centred adaptation measures.

Key Messages

- Climate change can exacerbate existing health inequities, defined as avoidable and unjust differences in health. These inequities — for example, disproportionate impacts on health from extreme heat — can increase the health risks from climate change for some individuals and populations. Knowledge gaps and data limitations make it difficult to assess and measure how climate change has already affected, and will continue to affect, health equity in Canada.

- The pathways through which climate change affects health inequities are complex and dynamic. These pathways often involve the conditions and factors that affect a person's health, known as determinants of health (such as, income, education, employment, and working and living conditions), which can increase or decrease an individual's exposure or sensitivity to climate-related health hazards and can create barriers that limit their ability to take protective measures.

- Structural systems of oppression (such as, racism, heteronormativity, and ableism) that result in health inequities are underlying drivers of vulnerability to climate change.

- Health equity should be an important focus of climate change and health vulnerability and adaptation assessments and related knowledge development activities. Mapping tools (asset mapping, vulnerability mapping), enhanced data collection, and inclusive community engagement will help identify populations and regions at increased risk, and better inform adaptation measures.

- Climate change adaptation measures meant to protect human health are not experienced in the same way across populations and communities. In the absence of careful planning, adaptation efforts may benefit only part of the population and inadvertently worsen existing health inequities.

- Health equity can be increased and determinants of good health strengthened through adaptation. Public health authorities should ensure that adaptation measures are planned and implemented so that people who are disproportionately affected by a warming climate benefit from them.

- Ensuring inclusive, equitable, and community-based participation in the adaptation process is critical for designing and implementing effective adaptation actions that protect the health of all Canadians. Participation of racialized and marginalized individuals and communities that already experience a disproportionate burden of illness and health inequities is required.

- Climate change mitigation and adaptation measures implemented outside of the health sector may affect determinants of health and health outcomes, in either positive or negative ways. Public health authorities can ensure that climate action supports health equity and related positive health outcomes in Canada through collaboration across jurisdictions, sectors, and disciplines.

Climate change and health equity framework.
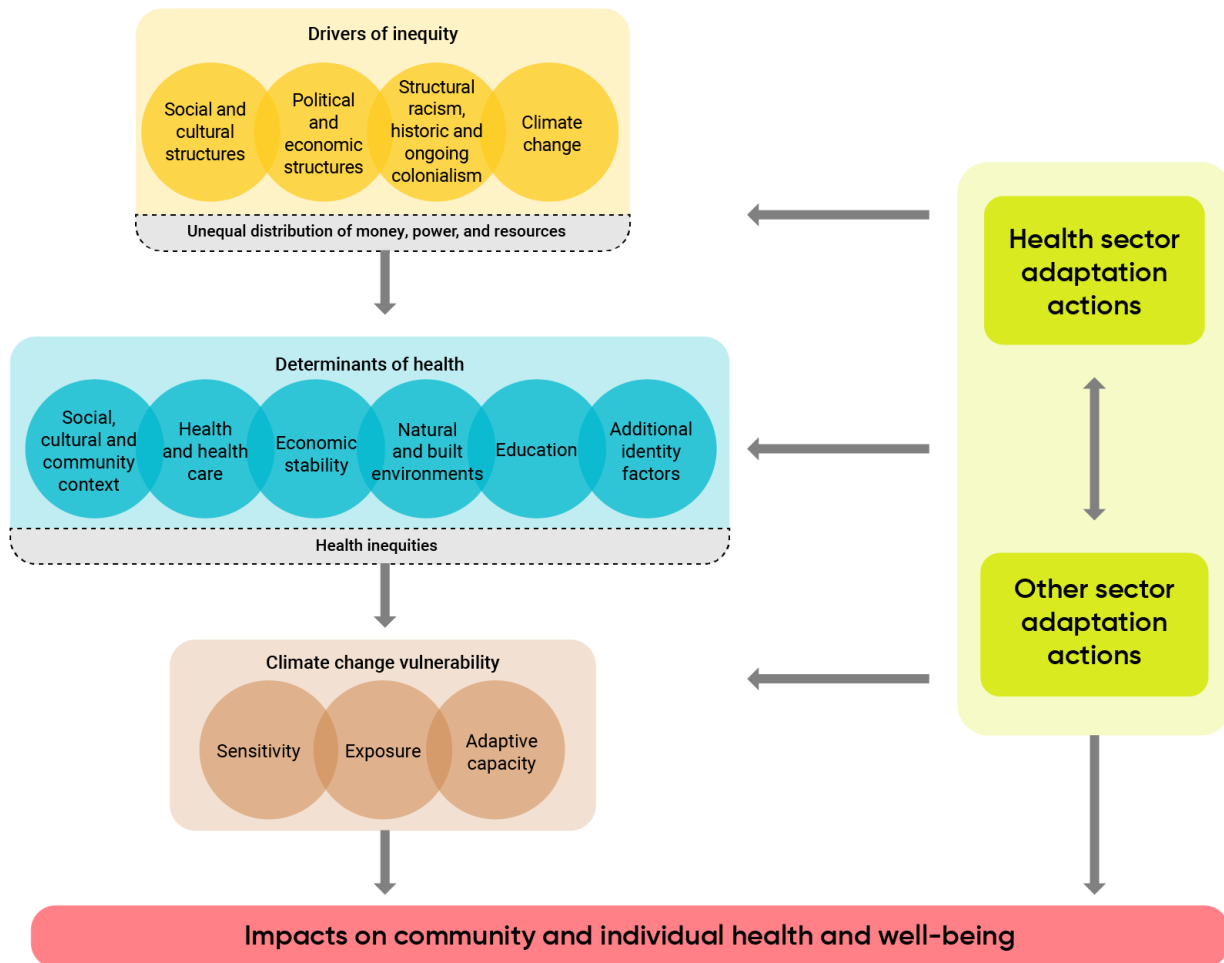
9.1 Introduction

Climate change impacts and related health risks are experienced in all regions of the world, including Canada. These impacts, however, are not distributed uniformly (Friel, 2019; Ebi, 2020). Globally, the greatest health risks are currently, and projected to be, experienced by regions already facing disproportionate burdens of illness and health inequities, and among populations that have contributed the least to climate change (Islam & Winkel, 2017; Friel, 2019). In Canada, there are large disparities related to current and projected climate change impacts. For example, communities in Nunavut are experiencing warming at an average rate twice that of the rest of Canada and are observing some of the most severe impacts (Bush & Lemmen, 2019), despite having the lowest household greenhouse gas (GHG) emissions per capita (Statistics Canada, 2016).

A dynamic and complex relationship exists between climate change and health equity. Upstream drivers of inequities — such as social, cultural, economic, and political structures and systems; structural racism and historic and ongoing colonialism; and climate change itself — result in the uneven distribution of power and resources across society. This shapes the status of determinants of health (e.g., socio-economic status, exposure to environmental hazards, access to health care), which varies across individuals, communities, and regions. The resulting relative disadvantages create new or exacerbate existing health inequities, which are understood as avoidable and unjust disparities in health status.

The effects of climate change can undermine the status of determinants of health, for example, by hampering access to clean air, livelihood, secure shelter, and sufficient and safe food and drinking water (WHO, 2018). The status of determinants of health can, in turn, increase or decrease an individual's exposure or sensitivity to climate-related hazards and can create barriers that limit adaptive capacity (Health Canada, 2005). Existing health inequities can make it more difficult for some people to prepare for, cope with, and adapt to climate change impacts.

In addition, the outcomes of climate change adaptation actions meant to protect human health are not experienced in the same way across populations and communities. These actions can include those by decision makers outside of the health sector, for example, in water, energy, or transportation sectors. In the absence of proper planning, the outcomes of adaptation actions may benefit some individuals, while inadvertently increasing inequities for others. Adaptation planning processes, from conception to implementation and evaluation, should include diverse voices and perspectives, particularly from those disproportionately affected by climate change impacts on health. In many cases, there is an opportunity to enhance meaningful engagement and equitable participation in adaptation processes in Canada.

It is important to consider health equity in all climate change and health activities, such as conducting vulnerability and adaptation assessments (V&As) and building climate resilient health systems (see Chapter 10: Adaptation and Health System Resilience). The absence of such considerations may result in negative outcomes, such as inadvertently aggravating existing health inequities and overlooking underlying drivers of climate change vulnerability. Public health decision makers can leverage various tools, frameworks, and activities to enhance climate change and health activities by giving explicit consideration to health equity during planning, implementation, and evaluation of measures. Benefits of such an approach include equitable planning processes, interventions with more equitable outcomes, and increased capacity for communities to

adapt (Deas et al., 2017; Rudolph et al., 2018; Cleveland et al., 2020). Adaptation actions offer the opportunity not only to protect health from risks posed by a changing climate, but also to strengthen determinants of health, support health equity, and build healthier, more climate resilient communities and health systems.

Strengthening determinants of health and redressing existing health inequities can help decrease vulnerability to health risks related to climate change and build adaptive capacity (WHO, 2015; Friel, 2019; Ebi & Hess, 2020). While downstream actions, such as those taken by public health actors, can contribute to redressing health inequities, dismantling the upstream drivers of inequities is necessary in order to achieve and sustain social and health equity (Rudolph et al., 2018). This will require actions beyond those of the public health sector. There is increasing recognition from policy leaders in and outside of Canada that responding to social and health inequities and related environmental issues requires collaborative, multisectoral policy action (Friel, 2019). However, it is out of the scope of this chapter to provide a detailed analysis of upstream policy interventions and options.

This chapter discusses the determinants of health and health equity, and their links to climate change, with specific attention to vulnerability and adaptation. A new framework for illustrating the dynamics that underlie relationships between climate change and health equity is presented to help understand how some populations and communities are experiencing disproportionate health impacts of climate change in Canada and may continue to do so without effective interventions. Then, tools and resources that support the integration of health equity considerations into climate change and health activities, such as V&As, are presented. This chapter also examines the relationship between health equity and climate change adaptation, focusing on the potentially positive or negative effects of adaptation action, and how measures can be designed to promote health equity. Examples of practical actions that can be taken to better integrate health equity considerations into climate change and health adaptation are then presented. The chapter closes with a discussion of knowledge gaps and research needs required to enable public health officials to take effective actions to protect all people in Canada from climate change.

9.2 Methods and Approach

A rigorous, flexible approach was used to identify literature and evidence relevant to climate change and health equity. Two databases, MEDLINE and Embase via Ovid, were searched for articles published between 2008 and 2020. English- and French-language literature was included in the search. The reference lists of relevant literature were also examined to identify articles not captured in the database search. Websites of key government, non-governmental, and international agencies (e.g., Public Health Agency of Canada, Health Canada, World Health Organization, provincial and territorial government websites, US Centers for Disease Control and Prevention, National Collaborating Centre for Determinants of Health) were examined to identify grey literature.

While Canadian research was prioritized, international research with results relevant to the Canadian context was also included. Not all population groups are represented equally in the climate change and health

literature; experiences specific to people with disabilities, newcomers to Canada, and two-spirit, lesbian, gay, bisexual, transgender, queer, questioning, intersex and asexual (2SLGBTQQIA+) populations are less frequently addressed than are experiences of others. While there is significant literature exploring the impacts of climate change on Indigenous Peoples who live on reserves or in rural, remote, or Northern communities, there is very little empirical work addressing the vulnerabilities experienced by Indigenous Peoples who live in urban settings. Further, research on Inuit and First Nation communities is much more common than for Métis communities (see Chapter 2: Climate Change and Indigenous Peoples' Health in Canada).

9.3 Determinants of Health and Health Equity

Health inequity refers to health inequalities that are avoidable, unjust, and systematic (CSDH, 2008; NCCDH, 2013). In contrast, health equity is the absence of unfair systems and policies that cause health inequalities, resulting in fair conditions and opportunities conducive to good health for all (Government of Canada, 2019a). In Canada, health inequities, including the inequitable distribution of the burdens of disease and poor health, exist. For example, evidence indicates a social gradient in health, in which individuals low on the socio-economic spectrum generally experience worse health than individuals high on the socio-economic spectrum (CSDH, 2008).

Health inequities arise from upstream drivers, commonly structural in nature, that result in the unequal distribution of power and resources (National Academies of Science, Engineering, and Medicine, 2017). These drivers include social, cultural, economic, and political structures (Commission of the Pan American Health Organization on Equity and Health Inequities in the Americas, 2019), such as powerful institutions and systems (e.g., governments, financial markets) as well as socially constructed systems of oppression (e.g., ableism, sexism, capitalism, cisnormativity, heteronormativity, classism, xenophobia), which play a significant role in shaping social norms and influencing how society is organized and functions (Rudolph & Gould, 2014; Rudolph et al., 2018; Cleveland et al., 2020).

Structural racism, including historic and ongoing colonialism, historic and cultural trauma, discrimination, and social exclusion, is also a significant driver of health inequities (Reading & Wien, 2009; Greenwood et al., 2018; CPHO, 2019; Commission of the Pan American Health Organization on Equity and Health Inequities in the Americas, 2019). The cumulative history of disenfranchisement and marginalization has created an inequitable distribution of power and resources and has shaped social, economic, political, and cultural norms and systems, which benefit parts of the population, while excluding others (Shi et al., 2016), particularly Indigenous Peoples and racialized communities. Take, for example, the history of colonization and the impact that discriminatory programs, policies, and legislation had, and continues to have, on Indigenous Peoples (Halseth & Murdock, 2020). First Nations, Inuit, and Métis peoples experience disproportionate burdens of ill health, including "higher rates of infant mortality, tuberculosis, child and youth injuries and death, obesity and diabetes, youth suicide, and exposure to environmental contaminants" (Greenwood et al., 2018). Compared to non-Indigenous communities in Canada, the average life expectancy at birth is lower in Indigenous

communities; the average life expectancy is 12 years lower for Inuit communities, 11.2 years lower for First Nations, and 6.9 years lower for Métis communities (PHAC, 2018).

Black people[1] also experience health inequities that are linked to processes of racism and discrimination, rooted in European colonization of Africa and the legacy of the transatlantic slave trade (PHAC, 2020). For example, between 2010 and 2013, 14.2% of Black people aged 18 years and older reported their health to be fair or poor, compared to 11.3% of White people in Canada (Pan-Canadian Health Inequalities Data Tool, 2017; PHAC, 2020). The history of colonization and its enduring effects demonstrates how inequities are systemic and intergenerational and can compound disadvantage and marginalization (Shi et al., 2016; Moser et al., 2017; Resurrección et al., 2019).

Upstream drivers that construct economic, political, environmental, and social factors and conditions are known as the determinants of health, which interact to shape an individual's ability to attain and maintain good health (PHAC, 2018; Government of Canada, 2019a). The relative disadvantages that result from unequal distribution of power and resources lead to variations in the status of determinants of health among individuals. Many determinants of health relate to individuals' positions in the societal hierarchy and the conditions in which they live, work, and age (e.g., income, education, employment) (Government of Canada, 2019a).

It is important to recognize that, while many common determinants of health frameworks have relevance for First Nations, Inuit, and Métis peoples, there are Indigenous-specific determinants of health that play a significant role in influencing health and well-being (Greenwood & de Leeuw, 2012; Commission of the Pan American Health Organization on Equity and Health Inequities in the Americas, 2019) (see Chapter 2: Climate Change and Indigenous Peoples' Health in Canada). Self-determination, for example, has been noted as an important determinant of health that can influence all other determinants (Reading & Wien, 2009). In Chapter 2: Climate Change and Indigenous Peoples' Health in Canada, the authors highlight that perspectives of health and well-being vary within and between First Nations, Inuit, and Métis peoples and include a selection of frameworks for determinants of health that articulate these perspectives.

Climate change can also be understood as a driver of health inequities (Commission of the Pan American Health Organization on Equity and Health Inequities in the Americas, 2019), given that the current and future impacts of climate change on health are not, and will not, be experienced uniformly. Those with more resources (e.g., financial, information, social networks) will be better placed to adapt to a changing climate and to take actions to protect their health. Climate change is understood as a "threat multiplier" that can exacerbate existing health inequities and create conditions for new ones to emerge.

Redressing health inequities is necessary to ensure all individuals in Canada have equal opportunity to reach their full health potential, despite their socio-economic or other socially determined circumstances (NCCDH, 2013). This is particularly important as the climate continues to warm and as impacts increase. Such action can also strengthen health systems, as health inequities result in significant health care costs. For example, between 2003 and 2006, the United States spent an estimated 230 billion USD in direct medical care costs and more than 1 trillion USD in indirect costs associated with health disparities experienced by minorities (Rudolph et al., 2015).

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1   Black people generally include diverse individuals, populations, and communities in Canada that identify as having African or Caribbean ancestry (PHAC, 2020).

9.4 Climate Change Impacts on Health Equity

There is limited knowledge of how health impacts of current and future climate change will affect health equity in Canada. Evidence suggests that climate change exacerbates health inequities (Ebi et al., 2016; Rudolph et al., 2018; Commission of the Pan American Health Organization on Equity and Health Inequities in the Americas, 2019; Friel, 2019); however, the magnitude of impacts on health equity, and extent to which climate change and health actions (e.g., adaptation measures) will strengthen or weaken health equity, are difficult to quantify. This section focuses on establishing linkages between climate change and health equity and provides examples relevant to the Canadian public health sector.

The pathways through which climate change impacts interact with upstream drivers of health inequities and determinants of health are complex. Many of these pathways and relationships are interrelated and dynamic, and they have implications for an individual's vulnerability to the health impacts from climate change. Compounding this complexity are climate change adaptation activities. Adaptation actions taken within the health system to protect human health from risks related to climate change, and those taken outside of the health system to address other climate change impacts on society, can have diverse effects on health equity. Figure 9.1 presents a framework that illustrates the relationships among climate change impacts, drivers of health inequities, determinants of health, and climate change adaptation activities.

The development of this framework was informed by a number of well-established frameworks for determinants of health (Dahlgren & Whitehead, 1991; Queensland Health, 2001; Solar & Irwin, 2010), as well as several conceptual frameworks that illustrate the relationship between climate change and health equity (Rudolph et al., 2015; Commission of the Pan American Health Organization on Equity and Health Inequities in the Americas, 2019). The framework presented in this chapter simplifies these complex relationships and situates them in a context relevant to Canadian public health.

Drivers of inequity

Social and cultural structures

Political and economic structures

Structural racism, historic and ongoing colonialism

Climate change

Unequal distribution of money, power, and resources

Determinants of health

Social, cultural and community context

Health and health care

Economic stability

Natural and built environments

Education

Additional identity factors

Health inequities

Climate change vulnerability

Sensitivity

Exposure

Adaptive capacity

Impacts on community and individual health and well-being

Health sector adaptation actions

Other sector adaptation actions

Figure 9.1 Climate change and health equity framework.

Upstream drivers of inequity result in the unequal distribution of power and resources, which shapes and influences the determinants of health. As previously noted, upstream drivers include social and cultural systems and structures (e.g., patriarchy, ableism, cisnormativity, and heteronormativity), political and economic systems, and structures (e.g., capitalism, political and educational institutions), structural racism, and historic and ongoing colonialism. Climate change is also a driver of inequity and can interact with other drivers to aggravate and enhance inequities, while also directly influencing the status of determinants of health. For example, impacts from climate change can cause "disturbances to livelihoods, reduced material resources, and a loss of a sense of control over one's life" (Friel, 2019, p.55). The differential status of determinants of health across a society (e.g., high-income versus low income, quality housing versus substandard housing), and the relative disadvantages this can result in, give rise to health inequities.

In many cases, determinants of health can drive vulnerability to climate-related health risks. For example, exposure to health risks, such as injury during an extreme weather event, is higher for individuals who live in substandard housing (Health Canada, 2005; Gamble et al., 2016; Munro et al., 2020; Raker et al., 2020). At the same time, climate change effects may also compound vulnerability to specific health risks, through their impact on determinants of health and existing health inequities. For example, low income households commonly spend a higher proportion of their income on energy costs and have difficulty investing in energy-efficiency measures for their homes (CER, 2020). The need to adopt protective measures (e.g., air conditioning, visiting cooling centres, purchasing light clothing) for increasing temperatures and extreme heat events can act as a financial burden for low income households, resulting in barriers to coping with heat.

Dimensions of health equity are also associated with climate change and health adaptation. In most cases, communities with more resources have higher adaptive capacity (UNEP, 2018; WHO, 2018). Because of this, they will likely be able to implement adaptation actions before, and more extensively than, disadvantaged communities, further increasing health disparities (Walpole et al., 2009). Many individuals and communities may face multiple risks and factors that compound vulnerability to climate change. For example, a number of First Nations communities lack access to safe drinking water in Canada. As of February 2020, there were 61 long-term drinking water advisories in effect for public water systems on reserves (Government of Canada, 2020). This inequity intersects with other challenges and inequities, such as a disproportionate burden of ill health (NCCAH, 2013) and high rates of food insecurity (FNFNES, 2019), which can compound vulnerability to climate change health risks in these communities. It is important to note that many marginalized communities have, and continue to demonstrate, significant adaptive capacity and resilience to climate change, despite challenges and barriers resulting from existing drivers of inequities (e.g., structural racism) and unequal distribution of power and resources.

The outcomes of adaptation actions are not always experienced in the same way across populations and communities, and, in the absence of careful planning, these outcomes can benefit some groups, while inadvertently causing adverse effects for others. However, adaptation measures present an opportunity to address underlying drivers of climate change vulnerability and promote health equity (see section 9.5.2 Adaptation Actions to Enhance Health Equity). Climate change adaptation measures implemented outside of the health sector may also affect determinants of health and health outcomes, highlighting the need for collaboration and partnerships across sectors to ensure that climate action supports positive health outcomes and health equity in Canada.

9.4.1 Dimensions of Equity in Climate Change and Health Vulnerability

In the context of climate change, vulnerability refers to the "degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes" (IPCC, 2007). The vulnerability of individuals or groups to the health impacts of climate change is determined by the exposure to climate change hazards, the sensitivity to possible impacts, and the capacity to respond or cope with them (Berry et al., 2008; Gamble et al., 2016).

Understanding the concept of vulnerability, and its primary components, is important for public health actors and decision makers, and can aid in understanding health outcomes related to climate change, as well as in identifying

where resources and adaptation measures are most needed. However, it is recognized that the term "vulnerability" can be highly stigmatizing when applied to individuals or population groups and has frequently perpetuated a narrative of victimization (see Box 9.1). The intent of the discussion in this section is not to label vulnerable populations, but, rather, to explore how health equity intersects with exposure, sensitivity, and adaptive capacity, to shape vulnerability to climate change. While this discussion focuses on determinants of health and health equity in the context of climate change vulnerability, it is important to recognize the systemic nature of health inequities that construct the conditions that ultimately shape vulnerability.

Box 9.1 Problematic narratives of "vulnerable populations"

Some research examining the heightened vulnerability of certain populations and communities has perpetuated a victimization narrative in which certain groups and communities are portrayed as passive and unable to take protective measures or respond to climate hazards. This narrative can be harmful to the populations and communities that it refers to, as there is increased risk of reinforcing damaging socially constructed ideas and existing stereotypes (Arora-Jonsson, 2011; Kaijser & Kronsell, 2014). Many communities and populations that are on the front lines of climate change have been, and continue to be, active drivers of change, demonstrating significant adaptive capacity and resilience despite unequal distribution of resources and capacity.

In addition, some literature has perpetuated another narrative that suggests that front-line communities, particularly Indigenous Peoples and women, have "special, almost divine, connection[s] to nature" (Kaijser & Kronsell, 2014). This narrative imposes and reinforces a problematic environmental caretaker role. This can result in additional labour and responsibilities for people and communities that are already strained for resources and capacity (Arora-Jonsson, 2011). Shifting the narrative from one that stereotypes people as victims and/or caretakers of the land to one that focuses on community assets and strengths could help to motivate and sustain climate action. Research activities must also become more inclusive. By framing climate change adaptation as a way to strengthen determinants of health and address drivers of health inequity, solutions can be co-developed and led by communities using local and traditional knowledge, culture, skills, and resources to plan, implement, and report on adaptation.

All individuals display some vulnerability factors to the health impacts of climate change; however, this vulnerability is not uniform. Disproportionate impacts and various experiences of adaptation and resilience have been observed across Canada (Wandel et al., 2010; Berry et al., 2014a; Sellers, 2018; Gouvernement du Québec, 2019). In many cases, the status of determinants of health plays an important role in influencing vulnerability (Kumar, 2018), can increase the risk of exposure or sensitivity to climate-related health risks, and can create barriers that limit adaptive capacity (see Figure 9.2). For example, while physiological processes (e.g., chronic diseases, decreased sense of thirst, reduced ability to sweat) can increase the vulnerability of seniors to heat-related health risks, the entire senior population does not experience the same degree of vulnerability. Some people may have greater access to air conditioning and cooling spaces, which have been

found to mitigate health risks during extreme temperatures, whereas such adaptations may be less available to some seniors because of economic or mobility challenges (Health Canada, 2012).

Exposure refers to the degree to which individuals or populations may come into contact with climate-related health hazards (McMichael et al., 2003). Inequitable exposure to particular climate hazards can result in parts of the population experiencing heightened vulnerability and negative health outcomes. For example, urban heat islands experience warmer temperatures compared to surrounding regions and can magnify health impacts during heat waves (Health Canada, 2020). A study of the 175 largest urbanized areas in the continental United States found that in 97% of cities racialized populations are disproportionately exposed to high surface urban heat island intensity (SUHI), compared to White residents. Black residents, followed by Hispanic residents, have the highest average SUHI exposure. In terms of income, in 70% of cities, people living below the poverty line had significantly higher exposure compared to those living at twice the poverty line (Hsu et al., 2021). Another study in the United States found that of 108 urban areas analyzed, 94% displayed consistent city-scale patterns of elevated land surface temperatures in formerly redlined[2] neighbourhoods compared to non-redlined neighbourhoods by as much as 7°C (Hoffman et al., 2020).

In Canada, during a heat wave in Montréal, Quebec, in 2018, 66% of people who died were located in urban heat islands. Low-income and social isolation were also determined to be important risk factors (Gouvernement du Quebéc, 2019). In Toronto, Ontario, low income and racialized communities have less access to tree canopy cover and public green spaces, which can mitigate the urban heat island effect and provide other health co-benefits (Greene et al., 2018; Conway & Scott, 2020).

Sensitivity refers to the degree to which individuals are affected by a climate-related health risk (Adger et al., 2004). Sensitivity to climate change health impacts can be shaped by biological traits, such as age, genetics, and chronic health conditions (Gamble et al., 2016) and influenced by determinants of health, such as socio-economic status and availability of and access to health services (Berry et al., 2008). Climate change impacts may affect the status of such determinants and increase sensitivity to health risks related to climate change for some individuals. For example, food security is a key determinant of health and contributes to positive health outcomes. In Canada, a higher prevalence of household food insecurity has been reported among households with children under the age of 18, with households headed by single women being most negatively affected (Statistics Canada, 2012). There is also a higher prevalence of food insecurity in the Canadian North compared to the rest of the country. Climate change may challenge the availability, accessibility, and/or use of food for individuals (see Chapter 8: Food Safety and Security). Such effects can increase the prevalence of food insecurity and contribute to adverse health impacts. Compromised health status, due to food insecurity, could increase sensitivity to other health risks related to climate change, particularly among population groups that already disproportionately experience negative health outcomes from a warming climate.

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2   "Redlining" is the historical practice in which neighborhoods were categorized ranging from "best" to "hazardous" for real estate investment. The categorization of neighborhoods was largely based on racial composition. The practice resulted in denial of loans and insurance, and subsequent disinvestment in racialized communities. Residents of redlined neighborhoods experienced increased segregation, lower home values and ownership, and lower personal credit scores. Despite the practice being banned in 1968, the majority of the neighborhoods previously categorized as "hazardous" in the US remain racialized communities and low-to-moderate income. The majority of neighborhoods categorized as favorable for investment remain predominantly White and above-average income (Hoffman et al., 2020).

Adaptive capacity refers to the ability of a system to adjust and manage climate change effectively, moderating or coping with adverse impacts (IPCC, 2007). Factors that contribute to adaptive capacity include access to economic resources, technology, information and skills, public health infrastructure, institutional arrangements, and the existing burden of disease (Grambsch & Menne, 2003; Berry et al., 2008). Existing social and health inequities contribute to the variation of adaptive capacity across individuals and communities in Canada. For example, it is well documented that those with limited access to and use of resources (e.g., financial, information, social networks) will experience the most difficulty adapting to climate change (UNEP, 2018; WHO, 2018; Friel, 2019). For example, low income households located in flood zones may not have the ability to relocate, which increases risk of exposure to flood hazards. In the absence of flood insurance, uninsured losses to property and belongings cannot be recovered, compounding economic disadvantage and further limiting individual adaptive capacity for future events (Islam & Winkel, 2017; Paavola, 2017).

Climate change impacts on determinants of health can further compound barriers to adaptive capacity of individuals and communities, which could result in increased vulnerability to poor health outcomes from a warming climate. The availability, accessibility, and acceptability[3] of public health and emergency management services and infrastructure is not only a determinant of health but can also support community resilience to climate change impacts on health (Séguin, 2008) and varies across communities in Canada. For example, experiences of inequitable availability, accessibility, and acceptability of health care services have been noted among First Nations, Inuit, and Métis peoples as a result of complex intersecting factors, including colonialism, geography, health systems, human resources, jurisdictional issues, cultural safety, communications, and the importance and use of traditional medicines (NCCIH, 2019). Thus, existing inequities related to health care services may limit adaptive capacity for some individuals, which could enhance vulnerability to climate change impacts on health.

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3   The acceptability of health care services is the willingness of individuals to seek these services because of the perception that they are effective and service providers are responsive and "free of social and cultural biases" (NCCIH, 2019).
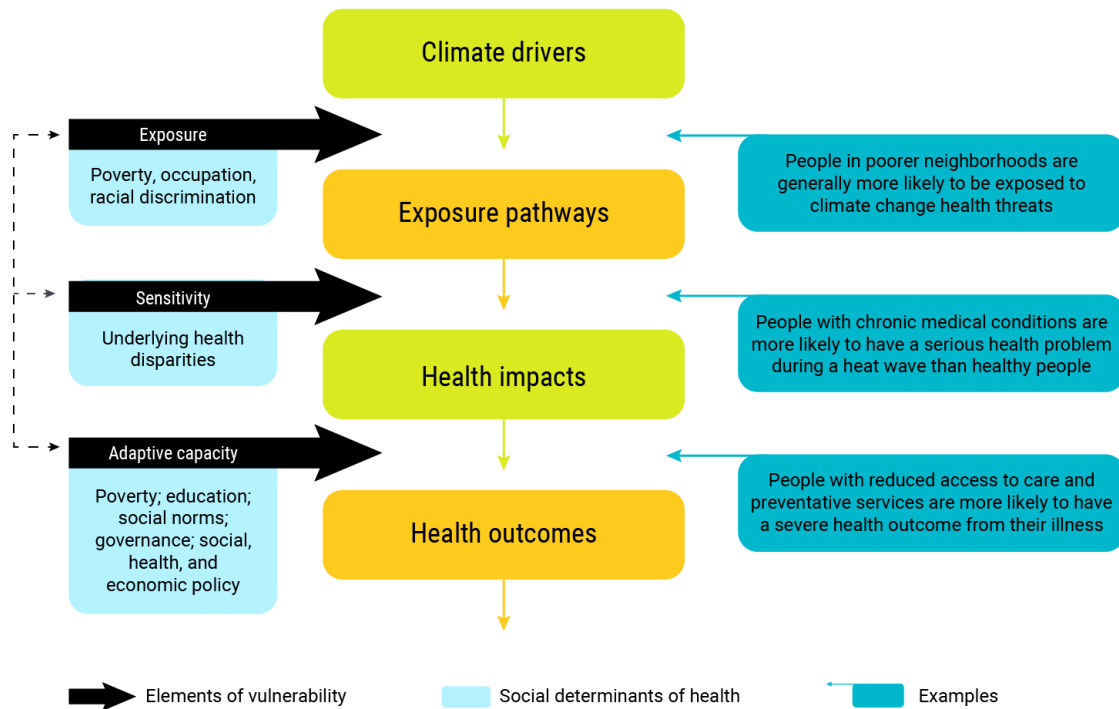
Figure 9.2 Social determinants of health interact with the three elements of vulnerability. Source: Gamble et al., 2016.

9.4.2 An Intersectional Approach to Understanding Climate Change and Health Vulnerability

In an effort to inform the development of adaptation measures to prepare for climate change, past Canadian climate change and health assessments have identified broad categorizations of "vulnerable populations" such as seniors and children, pregnant people, Indigenous Peoples, low income individuals, and immunocompromised or chronically ill people. Generalizations are often made regarding these populations' characteristics, conditions, and/or circumstances that increase vulnerability to particular health risks of climate change. However, such generalizations often fail to recognize the important heterogeneity of these population groups and may not adequately reflect how an individual or group understands themselves (Dhamoon & Hankivsky, 2011). They also often overlook how differences among and within populations may change over time in the face of climate change (Kaijser & Kronsell, 2014). This "universalizing" of various population groups disregards the multidimensional nature of vulnerability and may result in the unique needs of individuals being overlooked, creating barriers to effective adaptation. Further, it is common for climate change vulnerability research to focus on a single or limited number of discrete variables, such as economic status or sex (Kaijser & Kronsell, 2014; Bunce & Ford, 2015). As the understanding of climate change vulnerability evolves, there is increasing evidence that the characterization of vulnerability to the health

impacts of climate change must include considerations of how multiple existing inequities can interact, shaping and compounding experiences and responses to climate change (Gamble et al., 2016). Employing an intersectional lens can contribute to this analysis and enhance understanding of climate change vulnerability.

Intersectionality is understood as the complex and interdependent interaction between various individual identity factors (e.g., sex, gender, age, language, ability) (Figure 9.3), social norms and cultural practices, institutional processes and systems of power and oppression (Dhamoon & Hankivsky, 2011; Kaijser & Kronsell, 2014; Hankivsky & Mussell, 2018). It can help to understand and identify existing power dynamics in society (Kaijser & Kronsell, 2014) and "encourages a contextual analysis that probes beneath single identities, experiences and social locations to consider a range of axes of difference to better understand any situation of disadvantage" (Dhamoon & Hankivsky, 2011, p. 38). The relevance of applying an intersectional approach to public health action to improve health equity has been established, although practical uptake appears low in Canada (NCCDH & NCCHPP, 2016).
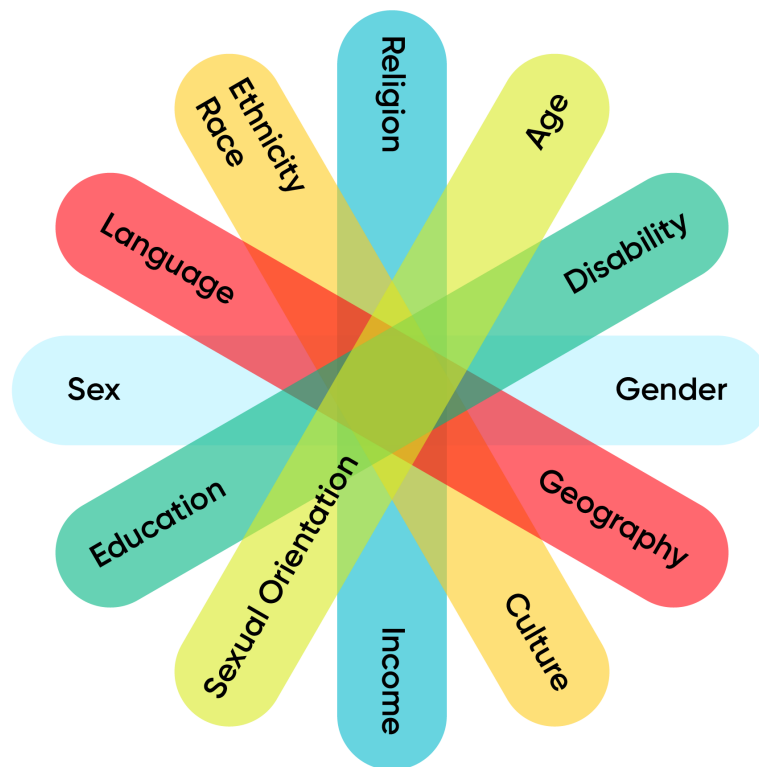
Figure 9.3 Examples of intersecting identity factors. Source: Adapted from Government of Canada, 2019b

Applying an intersectional approach to V&As, and to other climate change and health activities, can enhance understanding of the patterns of power, social conditions, and individual characteristics that contribute to health inequities and influence climate change vulnerability. Broadening this perspective of vulnerability also helps inform effective responses to climate change that can simultaneously address underlying drivers of inequity and broader social issues (Buse & Patrick, 2020). The application of intersectionality frameworks

and the demonstrated effectiveness of practical application in the context of climate change has been limited. Nonetheless, tools informed by an intersectional approach, meant to be applied to policy, research, and programs across all sectors, are emerging in Canada (Box 9.2). An exploration of tools and resources that can enhance integration of health equity considerations into assessments of climate change and health vulnerability, and application of an intersectional approach, is provided in section 9.4.5 Integrating Health Equity into Climate Change and Health Actions.

Box 9.2 Gender Based Analysis Plus (GBA+) in the Government of Canada

The Government of Canada recognizes that an intersectional approach is essential to the development and implementation of inclusive policy, services, and initiatives for all sectors, including health. Gender Based Analysis Plus (GBA+) is an analytical process, informed by an intersectional approach, used to assess how diverse groups of men, women, and gender-diverse people may experience government programming, policies, research, and initiatives differently (Government of Canada, 2019b). GBA+ goes beyond sex and gender differences to consider how gender intersects with other identity factors such as race, ethnicity, socio-economic status, and other structural conditions. The Government of Canada is committed to applying GBA+ to current and future policies, programs, and initiatives, and it is required for key government and budget processes.

When data are available, applying the GBA+ tool to climate change mitigation and adaptation activities can result in the identification of positive and negative implications of the activities on various groups in the population. Measures to minimize negative impacts and enhance positive effects can then be implemented. This may be particularly effective when applied to V&As and to development and implementation of adaptation measures and strategies.

9.4.3 Drivers of Vulnerability: Determinants of Health and Health Inequities

As previously discussed, upstream drivers of health inequities, including social, cultural, economic, and political structures, as well as structural racism, ongoing colonialism, and climate change, result in the unequal distribution of power and resources. This influences the conditions in which individuals live and work, shaping determinants of health and giving rise to health inequities. Increasingly, determinants of health are recognized as major drivers of climate change vulnerability (Watts et al., 2015; Gamble et al., 2016; Commission of the Pan American Health Organization on Equity and Health Inequities in the Americas, 2019). The determinants of health related to climate change can be grouped into six broad categories (Table 9.1). While not an exhaustive list, these determinants are commonly found in the climate change and public health literature. Although typically discussed as discrete factors, determinants of health interact with and influence each other. For example, income can determine the status of many other determinants of health, including stable and safe housing and economic access to nutritious food (Mikkonen & Raphael, 2010; CIHI, 2018).

Table 9.1 Examples of determinants of health related to climate change

Social and community context	• Social support and safety net • Social inclusion • Culture
Health and health care	• Access to primary care, including health care services • Healthy behaviours • Biology and genetic endowment
Economic stability	• Income • Housing stability • Food security • Employment and job security
Natural and physical environment	• Working conditions • Housing • Community and neighbourhood • Natural environment
Education	• Early childhood education and development • Language and literacy
Additional stratifiers/identity factors	• Gender and sex • Mobility • Race • Age • Ability/disability • Indigenous status

Source: Adapted from PHAC, 2008; Mikkonen & Raphael, 2010; Gamble et al., 2016; Ebi et al., 2017; Commission of the Pan American Health Organization on Equity and Health Inequities in the Americas, 2019; Government of Canada, 2019a; USDHHS, 2020

At an individual level, vulnerability to health risks related to climate change likely increases as the number of determinants of poor health (e.g., low income, poor housing quality, food insecurity) increases. Importantly, individuals and populations that experience health inequities and determinants of poor health are not homogeneous, and much variation exists in terms of the experience of health impacts and degree of vulnerability, across and among population groups (see Box 9.3). These combinations vary for each individual and for each specific health risk. Improving determinants of health and redressing health inequities can, therefore, aid in reducing vulnerability to the health impacts of climate change. A selection of key determinants of health are analyzed below, establishing the linkages to climate change vulnerability.

Box 9.3 The heterogeneous nature of climate change and health vulnerability

In addition to differential experiences of vulnerability, perceptions of vulnerability and perceived efficacy of interventions can also differ among and within populations disproportionately affected by climate change. Benmarhnia et al. (2017) conducted a qualitative study seeking to understand perceptions of vulnerability in populations typically classified as "vulnerable" and their experiences with health intervention measures related to Montréal's heat action plan (HAP).

Two focus groups were conducted — one with individuals diagnosed with schizophrenia and one with individuals who have alcohol or drug addictions. Participants discussed their experiences during the last heat wave in Montréal; perception of vulnerability to heat-related health risks; and understanding, experience, and suitability of the HAP interventions.

The study found that there were significant differences in perceptions of vulnerability to heat-related risks between the two focus groups. There were also contrasting opinions between the two groups in terms of the appropriateness of the targeted interventions in the HAP. One group supported the idea that public health interventions should target specific populations, while the other suggested that addressing the root causes of vulnerability, such as social exclusion and material deprivation, should be a focus of public health policies. Differences among people within each group were related to perceptions of individual vulnerability to extreme heat, and these were particularly pronounced in participants of the group with addictions.

The heterogeneity of vulnerability between and within the focus groups suggests that "vulnerability is not conceived of nor experienced homogeneously by all populations defined as 'vulnerable' in public health policies" (Benmarhian et al., 2017, p. 6). The authors recommend that, after populations disproportionately affected have been identified, policy implementation should involve meaningful consideration of a range of experiences and different needs for public health assistance to maximize the effectiveness of interventions aimed at protecting health (Benmarhnia et al., 2017).

9.4.3.1 Natural and Built Environments

Human health depends on conditions constructed within social systems, but also the natural environment and ecosystems (Hancock, 2015). The state of ecosystems we live within, and their ability to provide the ecosystem services upon which we rely — known as the ecological determinants of health — are fundamental to human health. Changes in the environment that compromise the ability of ecosystems to function optimally and provide important life-sustaining resources and supplies (e.g., food, water, and oxygen) — for example, those associated with climate change — can negatively affect human health and well-being (CPHA, 2015). Recognizing the important interactions between ecological determinants of health and social determinants of health, the Canadian Public Health Association (CPHA) suggested that an eco-social approach in population health promotion is needed. Such an approach provides health and other co-benefits of a more just and sustainable society (CPHA, 2015).

The design and condition of the built environment is a significant determinant of health and encapsulates the external built environment where individuals live, work, play, and study. This includes roads, public transit systems, buildings, parks, and other infrastructure (MOHLTC, 2012; PHAC, 2017). Working conditions may be a source of physical risks and psychosocial stress, both of which have implications for health and well-being (Mikkonen & Raphael, 2010). Certain occupations can increase exposure to natural hazards that are worsened by climate change. For example, outdoor workers (e.g., agriculture, landscape, and construction workers) may be at increased risk to the health impacts of extreme heat, while emergency responders have increased exposure to extreme weather events such as wildfires, flooding, and hurricanes (Berry et al., 2014a; Gamble et al., 2016).

Safe, adequate housing, and well-planned neighbourhoods and cities can promote healthy behaviours and contribute to positive health outcomes (Mikkonen & Raphael, 2010), even as the climate warms. Communities with aging infrastructure may have more difficulty coping with climate impacts; for example, aging water and sewage infrastructure may contribute to increased risk of flooding and water contamination (Rudolph et al., 2018). In contrast, robust and durable housing may reduce exposure to extreme weather events.

9.4.3.2 Economic Stability

Economic stability and, specifically, income and income distribution have been identified as among the most influential determinants of health (Commission of the Pan American Health Organization on Equity and Health Inequities in the Americas, 2019). Economic stability has close linkages with, and operates alongside, other determinants of health (CIHI, 2018). Income can determine the quality of other determinants of health, shaping an individual's overall living conditions (Mikkonen & Raphael, 2010; CIHI, 2018). For example, steady and adequate income can ensure stable and safe housing and access to food, which have important influences on human health.

In Canada, on average, low income individuals experience higher rates of chronic disease, heart attack, stroke, self-injury, and perceived poorer physical and mental health (CIHI, 2018). Low-income individuals and families may face increased challenges with accessing health care services, for example, prohibitive transportation costs, prohibitive costs of medication or medical treatments, and an inability to take time off work to go to appointments (CMA, n.d.). Inability to pay for out-of-pocket fees associated with health care can be a major barrier to accessing health care services (Whitehead & Dahlgren, 2007). The bottom 33% of Canadians, in

terms of income earned, are 50% less likely to see a specialist when necessary, 50% more likely to have difficulty accessing health care services on weekends or evenings, and 40% more likely to wait five or more days to see a physician (Mikkonen & Raphael, 2010). Evidence suggests that quality of care is also lower for those with low socio-economic status, and discrimination by health care workers associated with low socio-economic status has been recorded (CIHI, 2018).

Low-income status is commonly associated with material and social deprivation (Mikkonen & Raphael, 2010). This is especially important in the context of climate change. Evidence suggests that those with fewer resources are less able to protect themselves and adapt to climate change (WHO, 2003; IPCC, 2014; Gamble et al., 2016; Friel, 2019). The impacts of climate-driven natural hazards can trigger household financial distress (Bank of Canada, 2021) and push people into poverty (Hallegatte et al., 2016). It was estimated that, in the absence of natural disasters for the year 2018, 26 million fewer people would have been in extreme poverty (World Bank, 2017). Globally, it is estimated that between 3 million and 16 million people could be forced into extreme poverty, primarily through climate change impacts on agriculture and food prices (Hallegatte, 2016; Hallegatte & Rozenberg, 2017).

9.4.3.3 Health Care Services and Accessibility

Accessibility, acceptability, and availability of health care are also important determinants of health. Access to health care varies across the population as a result of various socio-economic, geographic, and cultural factors (WHO, 2008). In Canada, geographic access to health care facilities and services differs across regions. For example, those living in rural and remote areas may have difficulty accessing health care due to geographic remoteness, long travel distances to facilities, long wait times, and limited access to specialty and emergency services (CIHI, 2018).

Individuals and populations that experience discrimination and stigmatization often face difficulties obtaining resources necessary for good health and encounter barriers accessing health services (PHAC, 2019). Discrimination based on race, religion, ethnic origin, gender, or sexual orientation is common, with over one in four people in Canada reportedly experiencing at least one form of discrimination in their lifetime (Godley, 2018; PHAC, 2019). 2SLGBTQQIA+, African, Caribbean, and Black people, as well as Indigenous Peoples, were more likely to report being unfairly treated while accessing health services than the general population in Canada (PHAC, 2019).

As noted above, cultural acceptability of health care can also present challenges to accessibility. Language barriers and cultural practices may create challenges for some, such as newcomers to Canada and Indigenous Peoples, in accessing and accepting health care (Whitehead & Dahlgren, 2007). First Nations, Inuit, and Métis peoples across Canada experience inequitable access to health care, which contributes to the reinforcement of existing health disparities. For many rural and remote Indigenous communities, accessing health care involves travelling long distances, and extended periods of separation from family and social networks, which can lead to emotional stress and discourage Indigenous Peoples from seeking care (NCCIH, 2019). Experiences of anti-Indigenous racism and discrimination also represent a significant barrier to health care, leading to unsafe care, mistrust, and ultimately poorer health outcomes (Goodman, 2017; NCCIH, 2019).

Access to health care can also be more challenging for those with disabilities. A study of Canadian women with disabilities found multiple barriers to accessing health care services, including negative attitudes and discriminatory practices from some health care providers (Gibson & Mykitiuk, 2012). Timely access to quality health care services can play an important role in reducing morbidity and mortality associated with climate-related health risks.

Climate change impacts on health systems in Canada are already being observed (see Chapter 10: Adaptation and Health System Resilience). For example, melting permafrost in the North can damage health and transportation infrastructure important for supply routes and access to health services (Séguin, 2008). Given that First Nations, Inuit, and Métis peoples face unique challenges in accessing health care services, climate change impacts on health systems are of particular concern (see Chapter 2: Climate Change and Indigenous Peoples' Health in Canada).

9.4.3.4 Social and Community Context

Social exclusion refers to individuals and groups that are excluded from fully participating in society. This commonly arises from the marginalization of populations, such as racialized groups, to effectively limit access to economic, social, and cultural resources (Mikkonen & Raphael, 2010; PHAC, 2019). People who experience social exclusion are more likely to be unemployed and low income, have difficulty accessing health care services, and have limited opportunities to advance their education (Mikkonen & Raphael, 2010).

At an individual level, social support networks, that is, strong relationships with and support from family, friends, and the community, have been associated with positive health outcomes (PHAC, 2008). The broader social environment context can also influence human health. A supportive society, which includes social stability, recognition of diversity, safety, good working relationships, and cohesive communities, can aid in reducing potential risks and adverse impacts on health (MOHLTC, 2012), including mental health (see Chapter 4: Mental Health and Well-Being). Such networks can be very important for coping with and adapting to climate change impacts. For example, while Indigenous communities in the North are disproportionately impacted by climate change, strong social capital has contributed to adaptive capacity and climate change resilience (Ratelle & Paquette, 2019). Actions such as cutting wood for Elders and sharing meat from hunting with community members strengthen social capital (Ratelle & Paquette, 2019) and contribute to positive health outcomes.

9.4.3.5 Education and Childhood Development

Education is an important determinant of health and can increase opportunities for employment and income security (PHAC, 2008; MOHLTC, 2012), thus influencing other important determinants of health (CIHI, 2008; WHO, 2008; Mikkonen & Raphael, 2010). Lower levels of education are associated with difficulty accessing health care services, decreased ability to interpret and understand health messaging and labels, greater use of emergency care, and unhealthy behaviours, such as smoking (CIHI, 2018).

Evidence suggests that early childhood development and experiences have significant biological, psychological, and social effects on health; the quality of early childhood development is strongly associated

with social and economic gradients of advantage and disadvantage (PHAC, 2008; Mikkonen & Raphael, 2010; MOHLTC, 2012; Bennett & Friel, 2014). Existing inequities in child health outcomes can be exacerbated by climate change, which can limit adaptive capacity. For example, the ability of families to safely relocate when necessary, protect themselves from climate-related health risks, and recover from climate change impacts is enhanced as resources, power, and socio-economic status increase (Bennett & Friel, 2014).

Direct and indirect effects of climate change can affect the health of children (Helldén et al., 2021). For example, a study conducted in Southwestern Ontario found an association between extreme heat and increased emergency department visits among children (Wilk et al., 2020). Climate change impacts can also affect maternal, fetal, and infant health (Kuehn & McCormick, 2017; Bekkar et al., 2020). Canadian research has identified a positive association between heat exposure and gestational diabetes, sudden infant death syndrome, placental abruption, and early delivery (Auger et al., 2014; Auger et al., 2015; Booth et al., 2017; He et al., 2018). Existing inequities, variation in geographic region, and broader socio-economic conditions influence the impact of climate change on the health of children (Helldén et al., 2021).

Box 9.4 Human health, gender, and climate change in Canada

Gender is an important determinant of health and is also a factor influencing climate change vulnerability. Gender is understood as the socially constructed roles, norms, and values attributed to women and men (Preet et al., 2010). The relationship between climate change and gender has gained increasing attention in the climate change literature, complemented by global efforts to advance gender equality, human rights, and social equity (Sellers, 2018). However, existing studies often employ a narrow understanding of gender, examining the binary experiences of women and men (Bunce & Ford, 2015) and leaving out important consideration for other gender identities.

Individuals whose gender or gender expression do not fall within normative categories often experience marginalization, discrimination, and increased risk of violence, which may compound vulnerability to climate change. For example, international research finds that, following extreme weather events, 2SLGBTQQIA+ populations often face barriers to accessing disaster relief and recovery efforts. These barriers, often driven by social and religious stigma, can result in increased vulnerability to health impacts due to the lack of secure and safe shelter, medical care, food, and other unmet needs (Dominey-Howes et al., 2014; Gorman-Murrayet al., 2018; Resurrección et al., 2019). Importantly, 2SLGBTQQIA+ populations have demonstrated unique community-based coping strategies and adaptive actions during and after extreme events, such as hurricanes, despite their exclusion from response efforts (Dominey-Howes et al., 2014). The impact climate change currently has on 2SLGBTQQIA+ populations is a significant knowledge gap in international literature, as well as in Canadian research.

Understanding how gender roles may mediate health impacts across a population can aid in accurately assessing health vulnerabilities and developing effective adaptation measures. While there has been limited research on the gender-differentiated health impacts of climate change in Canada, some examples are provided below:

- Inuit women often take part in traditional livelihood activities, such as berry picking and sewing garments with sealskin. However, reduced opportunities and quality of traditionally harvested species have been observed, in part due to climate change effects, resulting in a reduction in earning potential and a shift in livelihood activities, which can have implications for health and well-being (Dowsley et al., 2010; Bunce et al., 2016).

- Inuit men are traditionally responsible for hunting activities. Given changing ice conditions and other hazards related to climate change (e.g., increased severe wind and flooding), the risk of injury for hunters is increasing (Ford et al., 2008).

- In Canada, men are more likely to hold jobs in resource sectors (e.g., agriculture and construction), where exposure to outdoor extreme heat can be high (Statistics Canada, 2018) (see Chapter 3: Natural Hazards).

- Gendered impacts associated with natural disasters, particularly on mental health and sexual violence, have been observed. For example, following the 2013 floods in High River, Alberta, a rise in anti-anxiety and sleep-aid prescriptions was reported among women. During this same period, a rise in sexual assault against women was also reported (Sahni et al., 2016).

9.4.4 Assessing Vulnerability to Climate Change Health Impacts

Health authorities across Canada and the world are increasingly using V&As as a tool to help individuals, communities, and health systems prepare for climate change (Berry et al., 2018). In Canada, 35% of public health authorities already have, or are in the process of conducting, a V&A (University of Waterloo Research Centre, 2019). They can be conducted at the local, regional, or national levels.

The primary objectives of a V&A are to understand the association between climate and health outcomes, identify current and future impacts on health, understand current conditions of vulnerability to climate-related health impacts, explore adaptation options that effectively reduce the current and future adverse health implications of climate change, and contribute to capacity-building within health organizations to respond to climate change (WHO, 2013; Ebi et al., 2016; Berry et al., 2018).

Results of V&As, supported by findings from academic literature, help public health authorities identify individuals and communities that experience disproportionate impacts on health associated with specific, discrete, individual and contextual characteristics (e.g., sex, gender, age, geographic isolation, low income) (Benmarhnia et al., 2017; Buse, 2018). When a health equity lens is applied in V&As, they can elucidate conditions that contribute to vulnerability specific to the geographic region assessed and determine how existing health inequities may be exacerbated with climate change. In the public health field, understanding which individuals and groups may face disproportionate impacts from climate change can be useful for prioritizing health adaptation measures and resources (Benmarhnia et al., 2017; Berry et al., 2018). Additionally, identifying existing health inequities and other local conditions that drive vulnerability in a V&A can promote the allocation of resources to address upstream drivers of negative health outcomes to strengthen health equity in a community (Buse, 2018).

According to a survey of Ontario health units in 2016, only 42% of respondents applied a health equity lens when identifying, prioritizing, and addressing climate change and health risks in their region (Doyle, 2017). Results of a 2019 survey of Canadian health units indicate that 85.1% of respondents consider implications for populations deemed to be at higher risk of climate change impacts in their climate change and health adaptation actions; however, only 37.3% consider implications for Indigenous Peoples, and 17.9% consider sex- and gender-based implications (University of Waterloo Survey Research Centre, 2019).

An intersectional approach can provide information on interacting variables, at an individual and structural level, that shape individual lives and health status (Dhamoon & Hankivsky, 2011) and that influence health inequities. When applied to a V&A process, this can be helpful in identifying which populations may be at higher risk of health impacts related to climate change. New V&A guidance from WHO (WHO, 2021) and from Health Canada (Health Canada, 2022) includes explicit consideration of health equity. Existing tools may complement V&A activities and adaptation actions. For example, the Ontario Ministry of Health and Long-Term Care's *Health Equity Impact Assessment* (HEIA) tool can be used to identify unintended — negative or positive — health impacts of a planned policy, program, or initiative on marginalized populations (MOHLTC, 2012). The HEIA workbook and templates allow users to identify unintended health impacts and develop recommendations for adjustments to mitigate adverse effects and maximize positive impacts among marginalized populations. They can also be used to increase the capacity of organizations to integrate health equity into decision making models and service design and delivery (MOHLTC, 2012). While the HEIA tool does not

explicitly include climate change, the tool could be useful in assessing the outcomes of climate change and health adaptation measures and policies, as part of a V&A process.

9.4.5 Integrating Health Equity into Climate Change and Health Actions

Climate change and health is an area of increasing interest and work for local and regional public health units (see Chapter 10: Adaptation and Health System Resilience). While the concept and promotion of health equity is not new for public health actors, challenges remain about how to most effectively integrate this into climate change and health activities. Building on the four primary roles identified in the *Public Health Roles for Health Equity Action Framework* (Region of Waterloo Public Health, 2009; NCCDH, 2013), Table 9.2 identifies a range of public health actions to address climate change and improve health equity. These actions should be accompanied by a recognition and understanding of how historic and ongoing colonialism and racism are central to the creation of inequities.

Table 9.2 Actions to address climate change through established public health roles to improve health equity

ROLE 1: ASSESS AND REPORT ON CLIMATE CHANGE IMPACTS AND RELATED HEALTH INEQUITIES

- Conduct a climate change and health V&A
    - » Devote time and resources to thoughtfully frame health equity in assessments, identify root causes of existing health inequities, and record data and knowledge gaps
    - » Conduct deep, respectful, and meaningful engagement with Indigenous and other racialized and marginalized communities, integrating local and traditional knowledge, expertise, and community solutions throughout the assessment process
    - » Internally, ask staff with a focus on health equity to inform the assessment
    - » Communicate findings to partners, stakeholders, and the community using products tailored to meet the needs of diverse populations (e.g., incorporating language and accessibility considerations)
- Contribute to the knowledge base on public health actions to address climate change and health equity
    - » Document case examples of adaptation activities, promising practices, and lessons learned after V&As are conducted
    - » Conduct community asset mapping to better understand existing assets in the community that contribute to climate change resilience (Rudolph et al., 2018; UCLA, n.d.)

ROLE 1: ASSESS AND REPORT ON CLIMATE CHANGE IMPACTS AND RELATED HEALTH INEQUITIES (CONTINUED)

- Collect data on the health impacts of climate change with an equity lens

  » For example, track deaths caused by extreme heat among racialized individuals living in low income communities or mental health impacts of climate change among socially disadvantaged populations

  » Whenever possible, enhance data collection efforts to capture sex-, race-, and gender-disaggregated data, as well as other demographic data (e.g., socio-economic status)

- Incorporate equity considerations into regular monitoring, surveillance, and reporting

ROLE 2: MODIFY AND ORIENT GHG MITIGATION AND ADAPTATION ACTIVITIES TO REDUCE HEALTH INEQUITIES

- Assess climate change actions for their implications for health equity before implementing them, to minimize negative outcomes and maximize benefits

  » For example, use the *Health Equity Impact Assessment Tool* (MOHLTC, 2012), conduct key stakeholder interviews with community organizations that work with populations at increased risk, and carry out meaningful engagement with populations that are disproportionately affected

- Identify opportunities to enhance co-benefits of GHG mitigation and adaptation actions, with particular attention to strengthening determinants of good health and addressing root causes of vulnerability

ROLE 3: PARTNER AND COLLABORATE WITH OTHERS TO BUILD CLIMATE-RESILIENT COMMUNITIES

- Engage in equitable, community-driven adaptation planning (Adaptation Clearinghouse, 2011; ITK, 2019)

- Contribute to municipal and regional plans for climate-resilient communities (PlanH, n.d.)

  » Support further understanding of the concept of unequal vulnerability (Salas et al., 2019)

  » Identify opportunities to address root causes of health inequities (Buse, 2018) and promote determinants of good health

- Identify and build collaborative partnerships within and outside of the health sector, and across all levels of government, to support multisectoral networks focused on climate change activities

- Engage with Indigenous and other racialized communities as partners and sources of expertise

- Embed health equity into all policy measures
  - » For example, explicitly include health equity in mission, vision, and value statements (The Greenlining Institute, 2019)
  - » Recognize the interconnected systems that drive health inequities and contribute to climate change vulnerability (e.g., racism, colonialism, economic structures, etc.)
- Raise awareness of needed policies that reduce carbon emissions, contribute to climate-resilient communities, and reduce health inequities
- Identify opportunities to mainstream climate change considerations into all proposed health policies and regularly evaluate impacts on populations who experience health inequities (PlanH, n.d.; The Greenlining Institute, 2019)

Source: Adapted from Muzumdar, 2020; NCCDH, 2021

For many local and regional health units, conducting a V&A is often the first step to protecting their communities from health impacts and adapting to future climate change. Such units can conduct practical activities and exercises to better understand the social context of their respective jurisdiction and identify drivers of climate change and health vulnerability. They can make the V&A more robust and support the development of tailored adaptation options for populations at higher risk of impacts. Examples of activities, described below, include resilience and asset mapping, vulnerability mapping, climate change and health projections, inclusive public engagement, and communications.

9.4.5.1 Resilience and Asset Mapping

Communities have many existing resources that play an important role in building climate resilience (e.g., social networks and cohesion). However, such assets and resources can be difficult to identify in common sources of data. Community surveys and community-based participatory asset mapping are exercises and tools that can identify people, organizations, spaces, and other "intangible factors" that contribute to community resilience (Rudolph et al., 2018; UCLA, n.d.). Such information is valuable for informing V&As and developing adaptive responses (Buse & Patrick, 2020).

Local initiatives that build an assets-based approach to mapping resilience to climate change and other hazards at the community level are increasing in Canada; many of these follow guidance outlined by Colussi (2000). For example, the Building Resilient Neighbourhoods (BRN) project (BRN, n.d.) has run applied projects across the Capital Regional District of British Columbia, in which local community members participate in assessing the resilience of their own neighbourhood to various shocks. The BRN project supplies a suite of online resources to support communities in undertaking such an assessment, including checklists for resilient neighbourhoods, workshop planning materials, and associated tools (e.g., scenario planning, asset

mapping, resilience assessment). The BRN initiatives guide communities through exercises that consider a range of issues often overlooked in traditional planning, such as consideration for determinants of health and well-being (Wipond et al., 2017).

The City of Vancouver's Resilient Neighbourhood Toolkit is employed in a similar initiative and includes a series of modules for neighbourhood climate resilience assessment activities, including asset mapping and development of resilience action plans (City of Vancouver, n.d.). These activities provide opportunities to strengthen relationships among people in different neighbourhoods and increase understanding of where risks may exist that would affect certain households or streets. They also examine the community's capacity to plan and respond to climate change impacts. Another innovative example includes a role-playing game called Resilientville Canada (CREW, n.d.), in which players take on the role of a community stakeholder facing a scenario of either a flood, windstorm, or earthquake. The game gets players to think about their social relationships within a neighbourhood and what assets will assist them in strengthening their ability to respond to climate-related shocks or stresses.

These examples of resilience and asset mapping focus more broadly on understanding the assets available in communities that contribute to, and enhance resilience to, a broad range of shocks and stressors, including extreme weather events and climate change impacts. Assets that contribute to resilience in the health sector and mitigate human health impacts are generally included in these exercises. While these activities can be modified to focus specifically on health system resilience, there is also benefit in focusing on resilience-building activities and asset mapping from a broader perspective. This facilitates multisectoral collaboration on climate change activities that include appropriate linkages to human health and the health system.

9.4.5.2 Vulnerability Mapping

Vulnerability mapping provides information on patterns of social conditions and climate change vulnerability in a particular region (Gamble et al., 2016; Foster et al., 2019), and can inform V&As. Mapping can be accomplished, for example, by developing a social vulnerability index, which uses social vulnerability indicators (e.g., socio-economic status, housing tenure, education, age, race, access to medical services, etc.) to elucidate the social conditions that drive vulnerability to health impacts or hazards related to climate change (Rudolph et al., 2018; Foster et al., 2019). Commonly, social vulnerability maps are combined with maps that display exposure to biophysical hazards related to climate change (e.g., wildfires, flooding, sea level rise, urban heat islands). The resulting maps aid in understanding the intersection of social and biophysical vulnerabilities and in identifying neighbourhoods and regions that experience disproportionate risk. Vulnerability maps can inform the V&A process by identifying populations and neighbourhoods that may be disproportionately affected by climate change hazards, such as extreme heat events or flooding, and help inform public health interventions (Rinner et al., 2010; Gamble et al., 2016; Foster et al., 2019).

Developing vulnerability indexes and frameworks are typically the first step in developing vulnerability maps. There are a variety of approaches to developing vulnerability indicators and indexes related to climate change impacts, and various Canadian examples exist (Rinner et al., 2010; Chakraborty et al., 2020; Yu et al., 2021). Raval et al. (2019) conducted a review of more than 40 existing climate change vulnerability frameworks that analyze community vulnerability to climate impacts in California. The review found a lack of frameworks that

adequately reflect the intersectional nature of climate vulnerability. Four frameworks were highlighted in the report, recognized for excelling in their ability to comprehensively integrate multiple exposures, population sensitivity, and adaptive capacity, as well as their breadth in terms of the number of indicators incorporated across exposures and other vulnerability factors and in terms of taking data accessibility into account (Raval et al., 2019). These frameworks included:

- Public Health Alliance of Southern California's *California Healthy Places Index* (PHASC, 2018)
- California Department of Public Health's *California Building Resilience Against Climate Effects: Climate Change and Health Vulnerability Indicators* (CalBRACE, 2018)
- California Energy Commission's *Social Vulnerability to Climate Change* (Mazur et al., 2010)
- *Climate Change Vulnerability Screening Index* (English et al., 2013)

These frameworks and indexes may be adapted by public health authorities to increase understanding of characteristics and conditions in their regions that may increase or decrease vulnerability to various climate change health risks. Such knowledge can be used to inform and enhance V&As.

Tools based on geographic information systems (GIS) and vulnerability mapping exercises can also be helpful in developing and implementing adaptation measures. For example, urban forests provide a number of environmental, social, and economic benefits that support health equity, including mitigating air pollution; mitigating urban heat island effects; contributing to the management of surface water quantity and quality; maintaining and enhancing natural heritage; enhancing economic value; providing direct cost savings; supporting improved physical health and emotional well-being; and strengthening communities and enhancing social equity (Morrison, 2017). Recognizing these benefits, the Region of Peel, Ontario, developed the *Peel Tree Planting Prioritization Tool*, which aids decision makers in determining where tree planting is most beneficial to the community (Richardson, n.d.). Accounting for 12 target benefits, which include supporting improved physical health and emotional well-being, strengthening communities, and enhancing social equity, the GIS-based tool generates maps at various geographic scales that identify areas in Peel Region for tree planting where benefits will be maximized (Richardson, n.d.).

Box 9.5 The surveillance and prevention of the impacts of extreme meteorological events on the public health system, Quebec

In 2010, the Surveillance and Prevention of the Impacts of Extreme Meteorological Events on the Public Health System (SUPREME) programme was developed by the Institut national de santé publique du Québec (INSPQ) in collaboration with the Ministry of Public Security (Québec), and the Meteorological Service of Environment Canada (now Environment and Climate Change Canada). Combining elements of early warning systems, vulnerability mapping, and monitoring and surveillance into a single, real-time, integrated system, SUPREME provides public health officials and emergency responders with provincial-level information during extreme weather events, informing the implementation of preventive measures and response plans (Toutant et al., 2011; Gosselin et al., 2018; INSPQ, 2020).

The SUPREME system has three primary components. First, when weather forecasts report a possible extreme weather event, warnings are sent via email to alert health authorities in real time. Second, SUPREME's online portal provides surveillance and monitoring of six weather hazards: extreme heat, flooding, extreme cold, heavy snowfall events, wildfires, and ice storms. Estimated impacts of these hazards to human health are also provided, including mortality rates, hospitalizations, emergency department visits, ambulance transport, and calls to Info-Santé (INSPQ, 2020). Finally, the online portal includes a GIS-based application that displays geographic data on health risks (e.g., urban heat islands), protection factors (e.g., medical services, infrastructure, green spaces, and buildings with air conditioning), and the location of vulnerable regions. For example, socio-demographic data and other indicators, including a regional deprivation index, housing conditions, and language, are used to provide maps that identify communities and regions that may experience increased vulnerability to extreme heat events (Toutant et al., 2011; INSPQ, 2021).

Since its creation, SUPREME has been evaluated twice for level of use, effectiveness, and overall user satisfaction. Assessment results indicate user satisfaction is high, and the system is very useful for public health authorities (Bustinza et al., 2016; Gosselin et al., 2018). Further, when evaluating SUPREME following an extreme heat event in 2010, it was found that the system mitigated the effects of the event on population health compared to previous heat events (Toutant et al., 2011).

9.4.5.3 Climate Change and Health Projections

Climate change projections can provide useful information on how mortality, morbidity, and/or other health outcomes related to climate warming may change in the future. This information can help inform adaptation and response plans and aid policy makers in understanding long-term impacts of climate change and needed resources (Sellers & Ebi, 2017; Rudolph et al., 2018).

Changes in demographic and socio-economic conditions, urbanization, land use, investments in new technologies, governance, the extent to which equity issues are addressed, and other factors can influence vulnerability to future health impacts of climate change (Ebi et al., 2016). For example, knowledge of how populations exposed to various climate hazards may change (e.g., aging, health status, migration) can assist

decision makers to plan adaptation measures to protect populations from health risks (Rudolph et al., 2018). Further, considering how health care service and delivery is expected to evolve over the coming decades and how they may need to be altered to adapt to climate change is important for health sector decision makers to include in iterative planning processes to plan for climate change (Sellers & Ebi, 2017).

9.4.5.4 Inclusive Community Engagement

Health equity cannot be realized without transparent and accountable inclusion and meaningful engagement that provides individuals and groups with agency to represent their interests and experiences (USDN, 2017; Rudolph et al., 2018; Friel, 2019). An effective way of including diverse groups and perspectives is through broad community engagement when undertaking a V&A. Residents and community-based organizations (CBOs) can provide valuable information related to the history and social context of a neighbourhood, past experiences with climate events, existing assets and resources that contribute to adaptive capacity, and the success and/or challenges of previous public health adaptations (Rudolph et al., 2018). Community residents, particularly through CBOs, can provide assistance with data collection and support communication and outreach activities with individuals and populations in their respective networks (USDN, 2017). There are a number of public engagement strategies and frameworks, and each have their own strengths and benefits (NCCDH, 2013; Oickle, 2020). Public health authorities may establish various engagement strategies throughout a V&A process, choosing specific activities that align with the objectives of each step in the process.

9.5 Adaptation

Adaptation is the response that an individual, community, or system takes to better cope with, manage, or adjust to changing conditions (Smit & Wandel, 2006) (see Chapter 10: Adaptation and Health System Resilience). Over the past decade, the field of climate change and health adaptation has grown significantly in Canada, with an increasing number of diverse actors, available resources, and adaptation strategies (Berry et al., 2014a). There are multiple dimensions of health equity associated with climate change adaptation. Individuals have varying capacity to adapt to climate-related health risks, given differences in determinants of health and related contextual factors, such as distribution of resources (Lynn et al., 2011; Ebi et al., 2016). The outcomes of adaptation measures are not always uniform or experienced in the same way, and the planning and design process of adaptation activities have sometimes left out important voices and partners, such as low income communities, racialized populations, and Indigenous Peoples (USDN, 2017; Foster et al., 2019).

Increasingly, public health actors are recognizing the dimensions of health equity associated with adaptation actions and strategies. However, efforts to account for and address health equity in adaptation interventions have been limited in Canada and globally. Existing climate change and health equity literature commonly analyzes dimensions of equity from the perspective of unequal distribution of climate change impacts and vulnerability (Bennette & King, 2018), with significantly less information on how to ensure that the adaptation design and implementation process is equitable, that outcomes are fair, and that equity is protected and

promoted effectively (Deas et al., 2017; Schlosberg et al., 2017). Despite this knowledge gap, opportunities to better account for and integrate health equity in climate change adaptation exist. Additionally, adaptation policies and measures offer the opportunity to address multiple issues simultaneously, such as protecting health from a changing climate, while strengthening determinants of health and redressing drivers of health inequity.

9.5.1 Adaptation Measures and Equitable Outcomes

Adaptation actions should provide benefits to those most in need; however, outcomes from these measures are not experienced in the same way across populations and communities. In the absence of careful planning and implementation, adaptation measures may have unintended outcomes that adversely impact some population groups or exacerbate existing inequities (Levy & Patz, 2015; Boeckmann & Zeeb, 2016). For example, while air conditioning units can be effective adaptation measures for extreme heat, prohibitive energy bills may keep some households from using air conditioning, which may increase their risk of health impacts related to heat (EPA, 2008). In addition, air conditioning can generate a significant amount of waste energy, further increasing outdoor air temperatures (Salamanca et al., 2014), exacerbating the urban heat island effect, and increasing cooling demands, which can increase heat-related health risks for those who do not have access to air conditioners.

Increasing green spaces in an urban centre can reduce health risks associated with urban heat islands and has a number of associated health co-benefits (Friel, 2019; Health Canada, 2020). However, an increase in green spaces could also result in unintended consequences. For example, new green spaces could perpetuate gentrification and increase property values in the neighbourhood, which may lead to the displacement of low income residents and small local businesses (USDN, 2017; Kreslake, 2019; Cleveland et al., 2020). A literature review on the creation of green spaces in urban centres concluded that these spaces generally benefited communities that are predominantly high-income and White (Wolch et al., 2014). To address these concerns, adaptation plans may involve instituting rent-control policies and other strategies to maintain housing affordability when creating green spaces (USDN, 2017).

When adaptation programs are put in place, individuals and population groups may face barriers to accessing and using the measures effectively. In efforts to reduce risks from extreme heat, cooling centres are often established for residents to get relief. However, an individual who has challenges with mobility (e.g., due to low income, disability, and/or social isolation) may have difficulty gaining access to a centre unless appropriate supportive measures are put in place (Health Canada, 2012). The City of Greater Sudbury partnered with Greater Sudbury Transit to make all transit trips free of charge during extreme heat events to ensure equitable access to cooling centres (Evergreen, 2020). Such considerations are needed to ensure that adaptation measures can be accessed and used by all, particularly those who face disproportionate risk of health impacts related to climate change. Considerations of equity should guide intervention strategies, and strategies will be most effective when they are developed in partnership with the community and decision makers from across a variety of sectors.

9.5.2 Adaptation Actions to Enhance Health Equity

Public health officials can leverage adaptation actions and climate change resilience-building efforts to improve health equity and strengthen determinants of health (Boeckmann & Zeeb, 2014; Gould & Rudolph, 2015; Deas et al., 2017; Rudolph et al., 2018). This is important given that, in Canada, some health disparities continue to increase (PHAC, 2018), as does income inequality, particularly in urban centres (Hankivsky, 2014; CPA, 2017).

An example of a collaborative project for climate change adaptation that simultaneously strengthened determinants of health is the InosiKatigeKagiamik Illumi: Healthy Homes in Nunatsiavut initiative in Nain, Nunatsiavut, Newfoundland and Labrador. It is estimated that 38% of children in Nunatsiavut live in a home that is in need of major repairs, and 86% of homes show signs of damage from permafrost melt and ground subsidence (ISC, 2019). Homelessness, overcrowding, and difficulties with keeping homes warm due to poor quality of structures and/or a lack of economic resources for heating needs were identified as undermining health and well-being in the community (Bennett, 2015). Additionally, a lack of land suitable for building, the high cost of development, and a frequent need to repair or replace existing homes created a number of difficulties meeting housing needs in rapidly expanding communities. The aim of the project was to develop climate-resilient housing infrastructure that was also culturally relevant, affordable, energy efficient, and reduced the health impacts from overcrowded dwellings and mould. Upon a thorough assessment of existing homes in Nain and the surrounding region, residents were engaged in a community-driven process for housing design in which they shared existing housing challenges and design preferences, which allowed for important cultural values to inform the design of a prototype multi-unit, climate-adapted housing development (ISC, 2019). Space to store hunting equipment, a large steel sink for cleaning fish and preparing sealskins, and large open-concept living spaces to allow for gathering were all features proposed by residents that were incorporated into the final design (Bennett, 2015).

Another example is the Nunamin Illihakvia Learning from the Land (phase 1) and TUMIVUT: Tracks of Our Ancestors Towards a Healthy Future (phase 2) project implemented in Ulukhaktok, Inuvialuit Settlement Region, Northwest Territories. This two-phase project focused on strengthening community health and food security through increased transmission of Inuit traditional knowledge and promotion of the Inuinnaqtun language (ISC, 2019). The program brought together Inuit youth, experienced hunters and sewers, and Elders; through a series of activities, knowledge was shared and skills were built around caribou hunting, traditional sewing skills, and language. These skill sets and values are important to Inuit in Ulukhaktok, contributing to a healthy lifestyle, physically, mentally, and culturally (ISC, 2019). Many benefits were observed as a result of the program. Inuit youth gained practical skills that have economic and social value, which was particularly beneficial for those who did not have family members who could teach them these traditional skills, or who lacked equipment or economic resources to participate in such activities. Participants also noted an increased sense of well-being, reduced stress, and strengthened cultural identity (ISC, 2019). The project supported values and skills that are important for individual and community health, while also strengthening determinants of health (e.g., food security) and building capacity to adapt to increasing climate and societal change.

BlueLA Carshare program is an example of an initiative that combines climate change action with health-equity objectives. To reduce air pollution and mitigate GHG emissions associated with personal vehicles, the City of Los Angeles, California, collaborated with partners to develop an electric vehicle (EV) carsharing pilot

project — BlueLA — which was funded through a grant from the California Air Resources Board. Launched in 2018, BlueLA prioritized service to disadvantaged communities, accounting for low income residents in areas with high exposure to air pollution to redress existing health and social inequities. Carshare memberships were provided to low income residents at a discounted cost. The EV fleet simultaneously reduced local air pollution from gas-fuelled vehicles and mitigated GHG emissions (SUMC, 2019a).

In the first year of the project, 80 EVs were introduced to the community, 130 charging points and 26 charging stations were installed, nearly 2000 residents registered as BlueLA members, and more than 12,000 trips were made. Approximately 260 t of CO_2 were avoided as a result (SUMC, 2019b). Given the success of the program, BlueLA was awarded a grant of $3 million dollars from California Air Resources Board to initiate phase 2, which will involve scaling up the project to expand into three additional regions: South Los Angeles, East Los Angeles, and East Hollywood (SUMC, 2019b).

9.5.3 Planning Adaptation Measures with Equity in Mind

Adaptation measures that result in equitable outcomes emerge from equitable adaptation processes. Ensuring equitable participation and the inclusion of diverse voices at all stages of the adaptation process results in better planning and policy making (Race Forward, 2018). While common engagement practices and strategies involve many community members, important voices may be missed. Deliberate efforts must be made to ensure participation by those who are most at risk of health impacts related to climate change. Meaningful engagement can provide valuable information concerning the unique context and social conditions of the target community, including current power dynamics and existing inequities. This information is required to develop transformative, effective, and equitable adaptation measures that reflect the expertise and perspectives of those most affected (Drolet & Sampson, 2017; Schlosberg et al., 2017; Race Forward, 2018).

There are significant challenges with meaningful public engagement in the adaptation process. For example, engagement opportunities may be reactive and conducted only after a planning process has been initiated and/or after major decisions have already been made. Budget and timeline constraints can also limit the effectiveness of engagement processes (USDN, 2017; Foster et al., 2019; Evergreen, 2020). Decision makers can ensure more comprehensive participation by ensuring that an appropriate timeline and budget for engagement is included in the plan from the outset, engaging community members from the beginning of the development and design process, and incorporating input from community members into the adaptation strategy to more effectively reflect the needs and unique vulnerabilities of the community (Foster et al., 2019). This would ensure that interventions address the specific conditions, health risks, and challenges in the community (Ebi, 2009). Other benefits of broad community engagement include increased "buy-in" of the final adaptation actions, enhanced reach of information dissemination activities, and greater capacity to participate in future decision making and planning activities in neighbourhoods (USDN, 2017).

In Canada, there are examples of effective, broad community and stakeholder engagement during adaptation design processes. For example, as part of Middlesex-London Health Unit's V&A process, a workshop was conducted with more than 100 people from various community groups, government agencies, and the health sector. In addition to validating preliminary findings from the vulnerability assessment, participants were

also provided the opportunity to discuss concerns about climate change impacts on health already observed in the community, and identify collaborative efforts needed for effective adaptation. Additionally, workshop participants provided their views on (Berry et al., 2014b):

- options for reducing current and future risks to health through adaptation;
- challenges for current and future adaptation efforts to protect health;
- willingness of organizations to participate in strategies for climate change and health adaptation; and
- effective avenues for communicating the results of the V&A.

Perceptions of needed or appropriate climate interventions may differ between the public and decision makers. For example, Schlosberg et al. (2017) reviewed local council climate adaptation plans in Australia and compared them to concerns related to climate change and proposed adaptation efforts posted on local environmental groups' websites and social media accounts. The analysis found that there was often little correlation between the climate adaptation plans and the concerns expressed by public and environmental groups regarding impacts and their suggested adaptation measures. Local government plans largely followed a risk- or resilience-based approach, while public interest groups were much more focused on climate change impacts on "basic needs and capabilities of everyday life" (e.g., health, food security, housing, etc.), which are required to achieve social justice (Nussbaum, 2011; Schlosberg et al., 2017) and support health equity. Participatory and community engagement approaches are an opportunity to reduce this disconnect between decision makers and public needs and perceptions, and thereby develop effective adaptations that support health equity.

A 2018 U.S. study highlighted the importance of engaging with and understanding the views and perceptions of community members to support the development of climate change measures (Kreslake, 2019). To gain insight into the perceived importance of adaptation and GHG mitigation measures, residents from three regions in the United States (Southern California, Florida, and Arizona) recently affected by extreme weather events were surveyed. Participants were categorized using individual-level indicators of vulnerability to the health impacts of climate change. The study revealed that perceptions varied across population groups, with differences in the types of adaptation and GHG mitigation interventions considered most important. For example, there was greater perceived importance of enhanced emergency alert systems among individuals with chronic illness (Kreslake, 2019). In addition, racialized groups prioritized communication activities from local government regarding climate change impacts and GHG mitigation efforts. Low-income residents were among those who indicated the greatest support for actions that would strengthen social services during extreme weather events (Kreslake, 2019).

The differences in perceptions across these groups illustrate the important role public engagement can play in developing climate change and health actions. Working with community members and stakeholders ensures that adaptation interventions reach those who are disproportionately affected, provide information in an accessible way, and motivate and empower individuals to make appropriate choices (Ebi & Semenza, 2008). Participatory approaches to developing adaptation measures can create the space and opportunity for front-line and disadvantaged communities to actively participate in decision making processes that result in policies and programs that will directly affect their lives (Ebi & Semenza, 2008; MSC, 2015; USDN, 2017, The Greenlining Institute, 2019).

Box 9.6 Inuit-led community-based adaptation approach

Community-based adaptation processes enable the local community to determine the methods and objectives of measures for climate change adaptation. These often involve a partnership between communities and institutions and build on existing local and traditional knowledge, skills, networks, technologies, practices, and social and cultural norms to produce adaptation measures that address the unique needs of local residents (Kirkby et al., n.d.).

For example, Siku, the Inukitut word for sea ice, is a newly developed mobile application and web platform designed by and for Inuit. The app seeks to increase the safety of Inuit hunters from weather and climate-related hazards, while revitalizing traditional knowledge by sharing practices in their own language (Arctic Elder Society, 2019).

With the loss of permafrost and melting sea ice, the safety of hunters has been a prominent concern for Northern communities. The app attempts to address these concerns by integrating modern weather forecasting, sea ice data, and satellite imagery with first-hand accounts of conditions and wildlife sightings using traditional place names in multiple dialects (Arctic Elder Society, 2019). This technology allows hunters to share changing and dangerous conditions with their communities using their own language and knowledge systems. For example, in one instance, a hunter marked an ice field with a warning sign on the map in the app, using the Inuit language to describe the condition (Tutton, 2019). Hours later, the map had been updated by other hunters to show that a crack had widened to the point that, if hunters had crossed it, they would have been unable to return (Tutton, 2019).

The Arctic Elder Society, a charity-based organization in Sanikiluaq, Nunavut, supported the app as a way to increase the safety of community hunters, as well as to revitalize traditional practices and mobilize Inuit knowledge and dialects (Arctic Elder Society, 2019). The community-based approach empowers the hunters and citizens as active determinants of community well-being, while increasing social cohesion and knowledge of language and cultural practices. This app is a unique project that highlights the right to self-determination of Indigenous communities and draws on the strengths of a community to address climate change challenges in an innovative and culturally relevant manner.

Engaging with community members who are at higher risk of climate change impacts on health can also enhance existing strategies for climate change adaptation. In a project to better address equity in its climate change adaptation work, the City of Vancouver partnered with a non-profit organization, Evergreen, to conduct engagement activities among populations whose "voices are not often heard in public decision making on climate change" (FCM, 2021). In total, more than 500 community members participated in the engagement process, and 21 key stakeholders from community service organizations were interviewed. Engagement activities were tailored to meet specific socio-cultural needs and interests of particular population groups (e.g., activities were offered in five different languages), designed to reflect the populations' interests and activities (e.g., a senior walking group was engaged in an urban forest walk, where their observations of climate change and coping behaviours during extreme heat were collected) and held at familiar, safe locations (Evergreen, 2020; FCM, 2021). By sharing their lived experiences, community members provided

significant information on the current climate change and health challenges they face, specifically in relation to extreme heat and air quality. Feedback on the effectiveness of existing adaptation measures and strategies was collected, along with particular needs related to cooling centres, climate change education and awareness, transportation, and access to water. As a result, recommendations for enhanced and additional adaptation measures were developed, and will be incorporated into the city's adaptation strategy (Evergreen, 2020).

A number of frameworks provide guidance and promising practices for inclusive and equitable community engagement for planning for climate change resilience and adaptation, including:

- *Community-Based Adaptation to Climate-Related Health Impacts Framework* (Ebi & Semenza, 2008)
- *Making Equity Real in Climate Adaptation and Community Resilience Policies and Programs: A Guidebook* (The Greenlining Institute, 2019)
- *Equitable, Community-Driven Climate Preparedness Planning Framework* (USDN, 2017)
- *Community-Driven Climate Resilience Planning Framework* (Movement Strategy Centre, 2015)
- *Working Better Together: Collaborating with Inuit on Climate Actions in Inuit Nunangat: A Framework for Governmental and Non-Governmental Bodies* (ITK, 2019)

To appropriately increase the representation and participation of groups that have often been excluded from developing and shaping climate change and health adaptation measures, it is important for decision making organizations and actors to recognize, acknowledge, and remove barriers to participation (such as financial burdens, travel requirements, language, child care, etc.), as well as to demonstrate sensitivity to the context in which engagement is taking place (Dhamoon & Hankivsky, 2011). Prioritizing time and resources to invest in relationship-building and cultivating trust is key to this process, as is creating spaces and engagement processes that are culturally relevant, inclusive, and safe for marginalized populations.

Key considerations and actions that can guide decision makers as they seek to address climate change and health risks through community engagement and community-based approaches include the following:

- Engage communities and residents at the beginning of and throughout the process of climate change assessment and adaptation (Moser et al., 2017).
- Recognize the power dynamics between decision-making actors and community members, specifically with groups that experience discrimination (Dhamoon & Hankivsky, 2011; Hankivsky, 2014).
- Address and replace patterns of behaviours that perpetuate inequities, for example, dominance of Western science versus Indigenous knowledge(s) and uneven patterns of participation in decision-making processes.
- Work with the community to identify current priorities, concerns, challenges, and existing inequities (Dhamoon & Hankivsky, 2011).
- Identify the level of literacy about climate change and health in the community, and tailor engagement activities appropriately.
- Acknowledge communities and marginalized members as active agents of change and determine community strengths and assets — avoiding victimization narratives.

- Listen to community members and incorporate their local knowledge and assets.
- Meet partners where they are and where they are coming from (Shi et al., 2016; Moser et al., 2017); for example, conduct engagement activities and speak with residents where they are most comfortable, such as traditional community gathering places.

Recognizing the importance of community input into the development of climate change action plans and adaptation strategies, local and regional decision makers are developing innovative, community-based approaches to collect input. In 2012, the City of Portland, Oregon, began the process of updating its climate action plan. Aware that considerations for social equity were absent in prior climate change strategies, the City administration took intentional action to integrate equity in every stage of the process and ensured that the plan featured an equity lens (Williams-Rajee & Evans, 2016). An Equity Working Group was created, made up of six CBOs that represented low income populations and racialized communities. Funding was provided to these CBOs to support participation in the working group. The Equity Working Group collaborated with the Climate Action Plan Steering Committee to finalize an equity considerations framework, which staff used to assess every action proposed in the draft climate action plan. The Equity Working Group then reviewed the updated plan to ensure its input had been incorporated effectively. An *Equity Implementation Guide* was also developed by the Equity Working Group as a companion piece to the final *2015 Climate Action Plan*, and the guide included an implementation approach and further recommendations for incorporating equity into climate change actions (Williams-Rajee & Evans, 2016).

The outcomes of adaptation measures are borne by individuals and organizations at the local level, which may foster the perception that adaptation actions are the sole responsibility of local decision makers (Pelling & Garschagen, 2019). However, it is important that health equity aspects of adaptation are considered at all scales of decision making, given that national, provincial, and territorial policies, standards, and regulations, such as land-use planning, building codes, taxation, financial incentives, environmental regulation, and related measures influence local conditions and livelihoods and affect many important determinants of health (Pelling & Garschagen, 2019).

In addition to working with a broad range of community members and organizations, stakeholders in and outside of the health sector should be engaged in planning for climate change and health adaptation. Climate change impacts and conditions that affect determinants of health cross multiple sectors and do not fall neatly into defined jurisdictions and mandates, making it difficult to allocate responsibility to one particular sector (Friel, 2019). To maximize the opportunity adaptation measures offer to strengthen determinants of health and address drivers of health inequity, collaboration, across a range of disciplines (science, social sciences, humanities, etc.) and sectors is key (CSDH, 2008; Friel, 2019).

9.5.4 Evaluating Adaptation Measures for Health Equity

The complex interactions among determinants of health, current and projected health inequities, and climate change adaptation measures makes it challenging to assess the immediate and long-term effects of climate change interventions on human health and health equity (Boeckmann & Zeeb, 2016). Given the urgency of climate change, particularly in relation to effects on the severity and frequency of extreme weather events,

decision makers must often design and implement adaptation actions in the absence of this information. Evaluating adaptation measures for their effectiveness in protecting health, including the promotion of health equity, can provide important information about their benefits and identify where modifications may be necessary.

Frameworks that specifically evaluate the impact of climate change adaptation actions on health equity are limited, and few have been evaluated or implemented in practice. Nevertheless, they may be useful in guiding public health authorities in their efforts to prepare for climate change impacts. For example, Boeckmann and Zeeb's (2016) framework assesses the effectiveness of an adaptation measure by evaluating its effect on seven domains of health determinants (e.g., infrastructure, social, economic, community, environmental) (Figure 9.4). Indicators and guiding questions related to access to information, cultural values, health services, and civic engagement, are provided to assist users in conceptualizing the positive and negative implications of their adaptation measures.
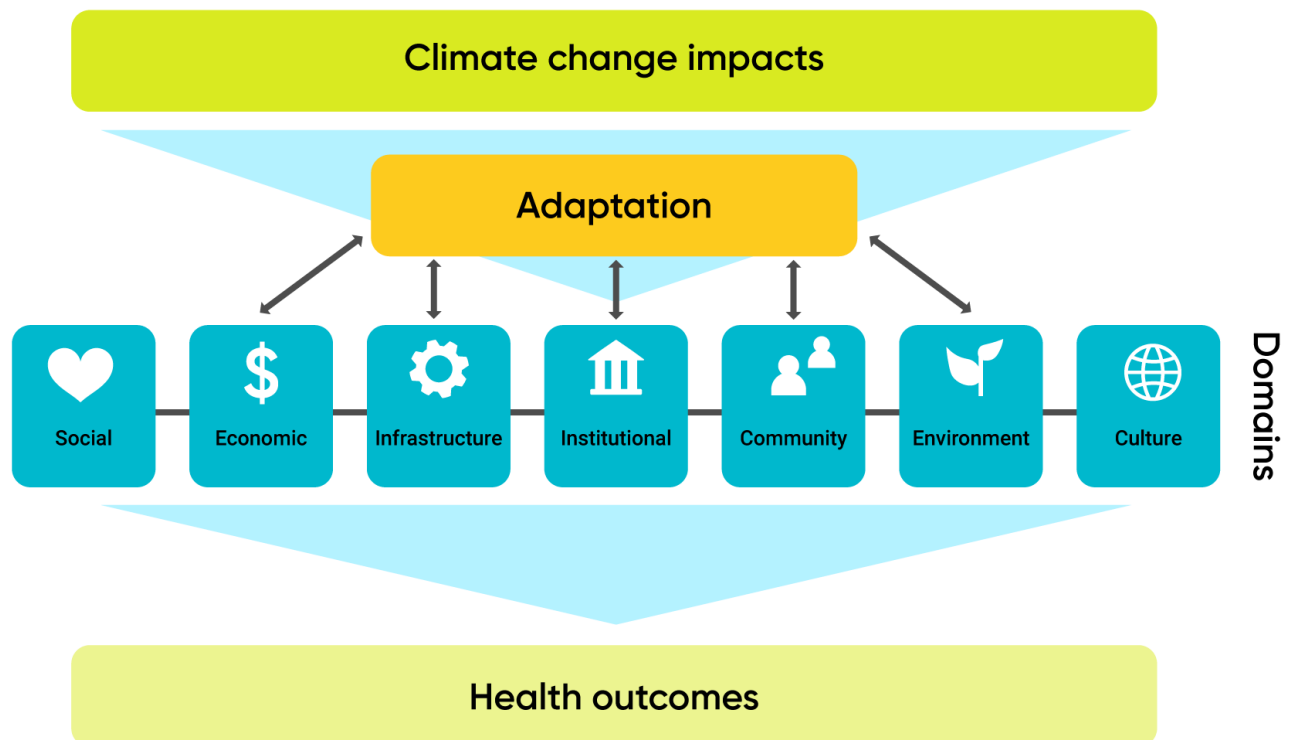

Figure 9.4 Domain-driven theoretical framework to evaluate adaptation based on justice concerns. Source: Boeckmann & Zeeb, 2016.

Recognizing the difficulties associated with attributing health outcomes with specific adaptation measures in many cases, this framework highlights the linkages between adaptation and the broader social domains associated with determinants of health (Boeckmann & Zeeb, 2016). This provides a much broader conceptualization of how adaptation measures fit into various social contexts and can advance understanding of possible short- and long-term impacts of adaptation measures on health equity as well as related concepts of environmental justice. The framework indicators and guiding questions could be

applied in V&As conducted by health authorities to evaluate health adaptation strategies as well as measures implemented in other sectors that may have direct and/or indirect impacts on human health. Given that a variety of actors are involved in each of the seven domains, the framework also promotes a multisectoral approach to adaptation development and evaluation. The practical use of the framework depends on the data available (Boeckmann & Zeeb, 2016); however, collaboration among practitioners, academia, and other stakeholders can facilitate acquisition of needed research and data.

As noted previously, the HEIA tool (MOHLTC, 2012), and GBA+ tool (Government of Canada, 2019b), although not designed specifically in the context of climate change, could be useful for considering health equity in climate change actions when applied to V&A processes and adaptation actions. The *Equity Assessment Tool* (Race Forward, 2018) can also be applied to climate change and health activities; it proved to be effective in identifying opportunities to enhance racial equity in planning and community-engagement activities in a pilot project in Seattle, Washington, based on an extreme heat scenario (Equity Matters, 2015).

9.6 Knowledge Gaps

In Canada, many knowledge gaps exist about the current impact of climate change on health equity, and how this might be exacerbated with future warming. There is increasing recognition that health equity must guide adaptation plans; however, there are limited Canadian examples and resources to assist public health actors in these activities, and specific examples of health adaptation measures that promote health equity are sparse. In many cases, advancing the research and knowledge in this field will require collaboration across different levels of government (from local to national scale), sectors, and disciplines. Important knowledge needs include:

- Enhanced understanding of how the status of determinants of health and multiple existing health inequities can influence current and future climate change and health vulnerability in Canada. This includes:

    - Increased analysis of upstream drivers of inequities, including social, cultural, economic, and political structures and systems, and how these interact with climate change to create and exacerbate differential health risks and impacts.

    - Enhanced understanding of how determinants of health and other identity factors individually influence vulnerability to climate change impacts on health, and the compounding effect they may have when taken together. For example, sex-based differences are often identified when examining climate change impacts on particular populations, but analysis of vulnerability as a result of gender is rare (Bunce & Ford, 2015).

    - Enhanced data collection, including sex-, race-, and gender-disaggregated data, as well as other demographic data (e.g., socio-economic status) is required to better analyze how various identity factors and existing inequities intersect to shape climate change vulnerability.

- As the understanding of the multidimensional nature of vulnerability evolves, new frameworks and tools for assessing individual and community health impacts of climate change that account for multiple, simultaneous drivers of vulnerability are required. They should include methods to capture information on the broader social, cultural, political, and economic conditions and systems that construct inequities, and allow for analysis of how these may further compound vulnerability.

- In Canada, there is very little understanding of the relationship between the geographic distribution of populations disproportionately affected by climate change, and health system capacity. For example, studies that analyze health system capacity relative to where disproportionately affected populations live is needed to better inform V&As and develop effective adaptation strategies.

- The gap between theoretical approaches (e.g., intersectionality) and practice should be bridged to enhance knowledge of how to better account for and integrate health equity considerations into climate change and health activities, such as V&As and adaptation plans.

- Enhanced understanding of how various GHG mitigation and adaptation strategies led by the health sector as well as other sectors, can affect determinants of health and existing health inequities, in a positive or negative way, is needed (Paavola, 2017). Rigorous adaptation evaluation and monitoring frameworks and tools are required to better understand this relationship.

- Enhanced guidance and examples of cross-jurisdictional, cross-discipline, and multisectoral adaptation measures to protect health and promote health equity are needed.

9.7 Conclusion

This chapter explores the linkages among climate change, determinants of health, and health equity, with a particular focus on the dimensions of health equity in climate change vulnerability and adaptation. The drivers of climate change and of health inequities are very similar. Large systems, such as transportation, energy, and food systems, are significant sources of GHG emissions, but also shape living and working conditions and influence other determinants of health (Rudolph et al., 2018). The status of determinants of health can mediate the impacts of climate change on health and has a significant effect on vulnerability to such impacts and on the ability to adapt. Evidence suggests that climate change impacts can result in new health inequities in Canada, and increase existing ones. This is being observed now and is expected to continue in the future in the absence of future adaptations that address inequities.

As understanding of vulnerability continues to evolve, an intersectional approach to conducting V&As and adaptation development can capture the complexities of the intersecting drivers of vulnerability and the heterogeneous nature of disproportionately affected populations. Greater application of intersectional approaches and practices in climate change and health research will provide learnings that public health officials can use in their efforts to plan for climate change.

Given the variation in the status of determinants of health, and thus climate change vulnerability, the efficacy of adaptation and response measures to health risks related to climate will vary across individuals, communities, and regions. The outcomes of adaptation actions are not always equitable and can inadvertently increase health inequities, further reducing adaptive capacity.

Disadvantaged and marginalized populations commonly experience disproportionate climate change impacts on health and often have limited ability to cope or adapt. Thus, it is important that public health actors consider health equity in their climate change and health actions. To date, the degree to which health equity has been integrated and promoted in climate change and health activities, both globally, and in Canada, has been limited. While key knowledge gaps remain, opportunities exist to better account for and integrate considerations of health equity into V&As, and adaptation actions to ensure equitable outcomes. Asset mapping, vulnerability mapping, and health equity frameworks can complement V&A processes. Enhanced community engagement, multisectoral collaboration, and evaluating adaptation measures for impacts on health equity can ensure needs are met and outcomes are equitable.

Climate change adaptation and mitigation measures can be leveraged to address systemic drivers of health inequities and other social injustices, which can increase positive health outcomes, social cohesion, and resilience to climate change (Rudolph et al., 2018; Kreslake, 2019). Broad multisectoral collaboration and cooperation on policy development are needed to advance this work. Public health actors and decision makers from all sectors and disciplinary fields have an important opportunity to protect Canadians from climate change impacts while concurrently redressing existing inequities and strengthening determinants of health.

9.8 References

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