

Disruptions to the delivery of cancer services resulting from climate change: a British Columbia perspective

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Climate change represents a significant challenge to planetary health due to its impacts on ecosystems, biodiversity, and human communities. Extreme climate events are projected to increase in both frequency and severity, including unpredictable rainfall, storms, flooding, heatwaves, droughts, and wildfires. The impacts of these events on individuals' health, security, and survival are likely to be significant. However, the specific effects of climate change on cancer risk, quality of life, and mortality remain largely unquantified. Climate events are considered an important challenge to the burden on cancer patients because these events cause disruptions in the delivery and quality of care to cancer patients.

During 2021, British Columbia (BC) faced two record-breaking weather events. First, during the summer, a 'heat dome' occurred over the final ten days of June that caused an excess of 569 deaths. Later in the same year in the southwestern region of BC, severe floods devastated communities and key transportation routes, between November and December. These major climate events have had both substantial effects on individuals' day-to-day lives and long-term effects for many. These disruptions in healthcare services pose a risk to cancer patients; interruptions in cancer treatment of even one month represents a significant risk of lower quality of life and increased mortality.

We have yet to capture the full impact of the specific climate events such as the heat dome and flooding of 2021 on the delivery of cancer services and the corresponding patient outcomes in our province. The climate events that occurred in 2021 showed that further research is urgently needed for developing new protocols and guidelines in the Canadian healthcare system to adapt climate change.

The impact of climate change on health

Climate change represents a significant challenge to planetary health due to its impacts on ecosystems, biodiversity, and human communities.¹ Extreme climate events are projected to increase in both frequency and severity, including unpredictable rainfall, storms, flooding, heatwaves, droughts, and wildfires.¹⁻⁴ The impacts of these events on individuals' health are likely to be significant. Extreme weather events increase exposure to carcinogens and change infectious disease patterns, leading to disruptions in the healthcare system.^{2,5} The rise in temperature and precipitation, for example, has a direct effect on the epidemiology of vector-borne diseases, such as dengue and malaria.⁶ Higher temperatures and droughts lead to an increased risk of wildfires, which further increase air pollution.³ Exposure

to air pollution is associated with many respiratory and cardiovascular diseases, and some air pollutants, such as fine particulate matter (PM_{2.5}), can be carcinogenic.^{2,3}

The impact of climate change on cancer

The effect of climate change on cancer risk, mortality, and survival remains largely unquantified, although several pathways have been described.³ For example, changes in human exposure to environmental risk factors such as air pollution and ultraviolet radiation influence the risk of lung and skin cancers.³ As dietary factors influence cancer risk (i.e., fiber consumption and leafy green vegetables may protect against colon cancer), disruptions in the food supply (i.e., availability and affordability) may increase cancer risk.^{4,7} Climate change also has detrimental impacts on agricultural

systems that change food supply and prices, affecting food insecurity.^{2,3} Recent studies have shown that cancer risk is higher among individuals living in food-insecure households.⁸ The United States Department of Agriculture (USDA) found that the prevalence of cancer among low-income households is 3.9%, compared with 5.9% of 'very low' food-secure households.⁸

Extreme weather events also directly affect health systems by impacting infrastructure, power supply, and human resources.^{3,5} For example, cancer services are susceptible to power failure, flooding of cancer care facilities, or the loss of human resources due to evacuation of oncologists and other health providers.⁹ These events could indirectly impact health services by disabling transportation and communication systems.⁵ In Puerto Rico, for example, Hurricane Maria caused widespread devastation, including loss of power, potable water infrastructure, lack of communications, and the closing of ports and airports.¹⁰ As a result, the health system could not function normally, and patients were unable to travel to receive oncology care. A study conducted in the US showed that the flooding caused by Hurricane Katrina in the New Orleans area was associated with a 15% increase in mortality among adults with breast and lung cancer after six months of exposure, mostly due to the interruption associated with this major event.¹¹ Another case-control study in the US showed that interruption of cancer treatment is associated with increased mortality of around 11% among cancer patients who experienced hurricanes.¹²

Climate events can also cause severe acute disruptions, and even long-term effects in some cases, to health systems, leading to a reduced availability of services to affected communities. Cancer patients and survivors are especially vulnerable when services are disrupted by climate events.^{3,5} In particular, many cancer care services require delivery in a timely manner, and delays can cause negative impacts on patient outcomes. Data indicates that a disruption or delay in cancer screening, diagnosis, and treatment of even one month increases the mortality risk between 6-10%.¹³ Reduced access to cancer care and treatment services lasted several years after Hurricane Katrina, with substantial effects on the health of patients with cancer.³ Ten-year breast cancer specific survival was lower for people who experienced Hurricane Katrina than for those who did not.^{3,11} Climate events have significantly decreased survival rates and increased

emergency admissions among vulnerable populations, such as older adults, people living with lower access to financial resources, and medically fragile populations.¹⁴

Recent climate events in British Columbia, Canada

During 2021, British Columbia (BC) faced two record-breaking weather events. In the summer, a 'heat dome' occurred over the final ten days of June that caused an excess of 569 deaths.¹⁵ Later in the same year, there were severe floods between November and December that devastated communities and key transportation routes, especially in the southwestern part of province.^{16,17} Beyond the deaths caused by these events, the health impacts among those who were indirectly affected by these events due to a disruption in the provision of healthcare services are unknown.

Between June 20th and July 1st, southern B.C. faced an unprecedented heatwave with registered temperatures records of more than 40°C.¹⁵ Extreme heat temperatures have shown a significantly increased risk of emergency department admissions and mortality rates among medically fragile populations such as cancer patients.¹⁸ This is especially the case for patients receiving systemic treatment who experienced dehydration caused by cancer treatment-induced vomiting and diarrhea.^{18, 19}

On November 15th, 2021, the Tulameen and Similkameen rivers overflowed, causing the most expensive natural disaster in Canada and affecting the entire region of the Fraser Valley.¹⁶ The devastation through the province caused landslides and washouts of many BC highways, disabling transportation to cancer services.¹⁶ The BC Cancer centre located in Abbotsford is one of two regional centres in Fraser Valley. In 2021, the Abbotsford Cancer Centre provided services to roughly 3,000 patients for oncology management consultations, 1500 patients for chemotherapy visits, and 1345 patients for radiation treatment visits.²⁰ With road closures, BC Cancer Abbotsford was unable to deliver appropriate and timely health care to cancer patients in this region due to appointment delays and cancellations.²¹⁻²³

Final Remarks

Currently, we have not captured the full impact of the heat dome and major flooding of 2021 on the delivery of cancer services in BC. The impact of climate change on cancer services specifically is an area requiring further investigation in the coming years. We have recently started a new research project to address the need for this information with the aim to better understand these events to develop policies for adaptation. This study will leverage retrospective observational data in BC to better understand the impact in terms of the number of treatment visits, referrals, and cancer screening volume. Many countries do not have proper health emergency frameworks, leaving them unprepared to face climate-related health emergencies. The climate events that occurred last year in BC have shown that further research supporting new protocols and guidelines is urgently needed in the Canadian healthcare system to adapt to climate change. Climate resilient health systems can provide a better quality and continuity of care, particularly among cancer patients.

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24. However, the aggressive urbanization plan in the northern part of Canada will lead to a steep increase in energy consumption in future. Currently, Canada is the seventh country in terms of carbon emission (emitting 18.58 tons carbon per capita).
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