

**Climate change and global health:
Training future physicians to act and mitigate**

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Executive Summary

Our changing global climate poses both direct and indirect risks to the health of individuals and Canadian society at large. Direct effects of climate change on health include increased accidents and trauma, psychosocial stress, and death from extreme weather events, including damage to housing and basic infrastructure [1, 2]. Indirect effects include: increasing incidence of vector-borne infectious disease; diminishing air quality leading to increased asthma-exacerbations, cardiovascular and respiratory-related deaths and other non-communicable diseases [3]; retreating ice and rising sea levels leading to population displacement; increased risk of food and waterborne illnesses; and drought and floods affecting food security and water systems [4, 5]. There is widespread consensus in the scientific community that climate change poses both current and future threats to human health.

Canada's vulnerable populations will be disproportionately affected by these environmental hazards [6]. In particular, Indigenous populations in Canada's North are currently facing the health consequences of climate change due to melting permafrost, changing hunting patterns and food insecurity, increased exposure to vector-borne infectious disease, emergence of new diarrheal diseases and water shortages due to loss of traditional water sources [6].

Health Canada recognizes that climate change is affecting the health and well-being of Canadians [7]. To combat the health impacts of climate change, four adaptations are being undertaken by public and private institutions: 1) research on the health effects of climate change by Health Canada, Canadian universities, and other organizations [8, 9]; 2) activities at the federal, regional and health institutional level that directly or indirectly protect health [8, 10], such as the implementation of heat alert response systems in some provinces [7]; 3) assessment of current levels of health adaptations in response to climate change [8]; and 4) communication of climate change health risks to the public [8].

A 2015 survey conducted by the authors and sent to student representatives at all CFMS member medical schools found no time dedicated to the topic of climate change and its effects on human health, nor its impact on the future practice of medicine (12 of 14 schools; 86% response rate). One school offered a non-mandatory session in this area while another school was adding a session covering this topic for the academic year starting in 2015. This suggests inadequate levels of education to prepare for these medical challenges.

Given the pressing reality of climate change, the CFMS needs to act and compel others to act as well. We recommend the following actions:

1. Launch educational campaigns to increase medical student and public knowledge of the health effects from climate change.
2. Canadian medical schools need to comprehensively address the topic of climate change as it pertains to human health in the curriculum of Undergraduate and Postgraduate Medical Education programs.

3. Form a CFMS Taskforce to promote the principles of this paper and implement recommendations 1 and 2.

Background

The Impacts of Climate Change on the Health of Individuals and Populations

There is considerable evidence to indicate that climate change poses both direct and indirect risks to the health of individuals and Canadian society at large [11-13]. Direct effects of climate change on health include trauma, increased accidents, psychosocial stress, and death from extreme weather such as heat waves, cold snaps, violent storms, mudslides and floods [11, 13, 14]. Indirect effects include increasing incidence of vector-borne infectious disease [11, 13]; diminishing air quality leading to increased asthma exacerbations and associated economic costs [15, 16], cardio-respiratory related deaths, and other non-communicable diseases [15, 17]; retreating ice and rising sea levels leading to population displacement [11, 13]; extreme weather damaging housing and basic infrastructure [18]; increasing diarrheal, food- and water-borne illnesses, and major disturbances (e.g. drought and floods) to food and water systems [11, 12]. Vulnerable populations such as infants, children, the elderly, Indigenous populations, socially disadvantaged groups and those with pre-existing medical conditions will be disproportionately impacted by these environmental hazards [18].

Climate change effects in Canada disproportionately affect Indigenous communities. Indigenous Peoples' traditions and livelihoods are often closely intertwined with some of the world's most vulnerable ecosystems, and thus the rights of Indigenous populations are particularly threatened in the face of environmental degradation [19]. This is especially true of Indigenous populations in Canadian Arctic communities. These communities not only experience some of the most severe effects of climate change [melting sea ice, rising sea levels, increased floods, storm surges, impacts on housing and food availability] at an earlier time, but also suffer from the complex and lasting effects of climate change as their traditional territories and sources of livelihood are threatened [19]. They are confronted with greater trauma-related physical hazards due to melting ice, decreased stability of housing and community infrastructure due to melting permafrost, changing hunting patterns and food insecurity, increased exposure to infectious disease (e.g. 'biting' flies), emergence of new diarrheal diseases, and water shortages due to loss of traditional water sources [20].

Economic Implications of Climate Change

The economic impact of climate change is best understood according to its effects on industry, property, and human health costs, which will be unevenly distributed across Canada [21]. If emissions are not significantly curbed by 2050, it is estimated that climate change will cost the Canadian economy at least \$43 billion dollars annually, with a 5% chance of costing \$91 billion [21]. British Columbia's economy will be disproportionately affected by changes in pest population and fire regimes impacting the logging industry, for instance, while the cost due to property damage from flooding, extreme weather, and rising sea levels will be most severe in Prince Edward Island, British Columbia, and Nunavut. Human health costs due to the direct impact of heat and air quality will likely be highest in Vancouver and Toronto, where the annual

cost of premature mortality risk attributable to heat and air quality from climate change will be up to an additional \$6.2 billion annually [21]. In these two cities, climate change's effect on respiratory illness is estimated to cost the health care system up to an additional \$17 million per year by 2050 [21]. Given that climate change exacerbates many other health risks in addition to respiratory illness [22], the total increase in healthcare costs due to climate change is presumed to be much greater. A comprehensive assessment on the costs of climate change to the Canadian health care system has yet to be conducted.

Benefits to Health from Mitigation Strategies

Mitigation strategies aim to minimize the environmental impact of climate change. These measures will produce net economic benefits, including increased labour productivity and decreased healthcare costs [23]. In the United States, health co-benefits of air quality improvement were predicted to offset the cost of carbon policies by up to 1050%. Globally, economic gains from avoided mortality as a result of mitigation strategies were estimated to range from \$50-380 per ton of carbon dioxide removed [24]. Several categories of mitigation measures with health co-benefits have been documented in the literature [23, 25, 26]:

- Using low-carbon fuel as household fuel reduces co-pollutants, which in turn reduces risks of asthma, lung cancer, and tuberculosis [25, 27];
- Using low-carbon alternatives in industrial power plants decreases outdoor air pollution, which may prevent cardiovascular diseases, lung cancer, respiratory illnesses, and premature births [26, 27];
- Built environment modifications such as public transport and urban settlement encourage physical activity, which decreases the risks of chronic diseases such as obesity, diabetes, cardiovascular diseases [28, 25, 27];
- Increasing urban green space not only enhances carbon sequestration by plants and soil, but also decreases heat intense areas and noise [25, 27]; and
- Reducing deforestation and land degradation protect arable land prevents droughts, which may reduce malnutrition [29].

Health Professionals' Roles in Responding to Climate Change

The role of health professionals in climate change mitigation has been highlighted by the Canadian Medical Association [CMA], which adopted climate change focused resolutions in 2015 [30, 31]. Participation of health professionals in climate change advocacy has led to important policy changes [32, 33], such as air pollution research led by the CMA leading to the decision to phase out coal-fired electricity in Ontario, Quebec and Alberta [34-37]. At the local level, medical student groups are promoting initiatives such as reducing health waste, using public transportation, and opening dialogue about institutional investments [38-40]. Medical curricula should equip future physicians with familiarity and literacy about the array of strategies to treat and prevent the effects of climate change on human health [41].

Public Health Adaptations to a Changing Climate

Health Canada recognizes that climate change impacts the health and well-being of Canadians [42]. To respond to these associated health effects, four adaptations are being undertaken by public and private institutions: 1) research on the health effects of climate change by Health Canada, Canadian universities, and other organizations [43, 44]; 2) activities at the federal, regional and health institutional level that directly or indirectly protect health [43, 45]; 3) assessment of current levels of health adaptations in response to climate change [43]; and 4) communication of climate change health risks to the public [43]. Although some of these adaptations have already been implemented in Canada, such as the Air Quality Health Index (AQHI) [46], heat alert response systems [47] and health vulnerability assessments [45], the effectiveness of these adaptations have yet to be assessed.

Environmental Sustainability in Health Care

Health care delivery has a measurable impact on environmental health and climate change. Studies have shown a carbon footprint that can be traced from health-care specific activities such as the release of anaesthetic gases into the atmosphere (1100-3766 times the greenhouse warming potential of CO₂) [48] and the use of disposable sharps containers [49], to general activities such as facilities energy use [50], food services [51] and personal transportation by physicians between sites [52]. Mitigation measures include anaesthetic gas recovery [48], use of reusable sharps containers [49] and telemedicine [53], in addition to local food sourcing [51] and facilities energy efficiency measures [54]. The Canadian Coalition for Green Health Care is working towards increasing the environmental sustainability of health care in Canada, including mitigation measures for climate change [55].

Medical Education

Environmental health is one of the learning objectives in Canadian medical education [56], however in practice, topics such as the implications of climate change on public health are not comprehensively explored. A 2015 survey sent to student society representatives at all CFMS member medical schools revealed that there was no class time dedicated to the topic of climate change and its effects on human health, nor its impact on the future practice of medicine (86% response rate from 12 of 14 schools). One school offered a non-mandatory session in this area while another school was adding a session covering this topic for the academic year starting in 2015 (Appendix).

Education of Other Health Professionals

Climate change education is essential for all healthcare practitioners, including nursing, social work, and pharmacy, given their particular abilities to predict and respond to the needs of vulnerable persons impacted by climate change. There is an overwhelming call for education of emerging health care professionals from the World Medical Association [57]; Climate & Health Council [58]; and the United Kingdom's Royal College of Nursing [59]. In the nursing education programs in Canada that have included environmental health topics, the content matter and number of hours of teaching are variable, resulting in the inconsistent delivery of climate change education to health professionals as a group [60]. However, an example of successful integration of climate education is the work of the Sustainable Healthcare Education

Network, a group of clinicians, students and academics in the UK dedicated to preparing health professionals for the risks associated with climate change as well as working in a low carbon health system. [61].

Principles

- 1. CFMS recognizes that all persons should have the right to a healthy environment.**
- 2. CFMS recognizes that climate change negatively impacts the environment and human health.**
- 3. CFMS recognizes that climate change exacerbates existing inequities and injustices.**
- 4. CFMS believes that health professionals have a responsibility to maintain a healthy environment for current and future generations.**
- 5. CFMS believes that health professionals must consider all determinants of health, including environmental determinants affected by climate change.**
- 6. CFMS believes that health professionals must take an active role in communicating climate change related health risks and the strategies to mitigate these health risks to the public.**
- 7. CFMS supports the development of environmental health education, as it pertains to climate change, in Canadian medical schools.**

Recommendations

- 1. Launch educational campaigns to increase medical student and public knowledge of the health effects from climate change.**

We, the CFMS, should advocate for current and future physicians to be educated on the health effects of climate change. Through an information-sharing campaign, the CFMS would advocate not only for informed physicians but for an informed and sustainable health care system in mitigating and adapting to climate change. These actions will demonstrate that the CFMS and its members are leaders on major issues affecting human health, as well as advocates willing to collaborate with others to communicate and act on climate change.

- 2. Canadian medical schools need to comprehensively address the topic of climate change as it pertains to human health in the curriculum of Undergraduate and Postgraduate Medical Education programs.**

The health implications of climate change should be accounted for in all Canadian medical curricula so that future physicians can be adequately prepared to recognize and respond to the health implications of climate change in their clinical practice. Curricula inclusions can take many forms, and be adapted to the specific needs of each medical

school. These learning opportunities should be available to all Canadian medical students. To ensure access, the CFMS should collaborate with the Association of Faculties of Medicine of Canada to ensure all medical education programs across Canada incorporate, and develop further educational opportunities, on the impact of climate change to human health.

3. Form a CFMS Taskforce to promote the principles of this paper and implement recommendations 1 and 2.

A CFMS Taskforce will provide continuity and sustained attention to an issue on which CFMS needs to act. The subcommittee could be composed of Government Affairs and Advocacy Committee, Global Health, and Education committee members, and shall be tasked with promoting the principles of this paper and ensuring implementation of recommendations 1 and 2 on a regional, provincial, and national level through advocacy and educational initiatives within and beyond the medical profession.

Conclusions

Implementation of these three recommendations on the basis of the principles outlined above will serve to strengthen our commitment to furthering the expertise of CFMS members in issues affecting wellbeing and promoting the health of Canadian society. Furthermore, by ensuring the training of medical professionals in climate change's influence on health, Canada's future physicians will be able to recognize, treat and prevent the effects of climate change on human health.

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Appendix

Results of Survey of CFMS Member Schools (Feb 2015): Climate Change in Curriculum

1. How many hours does your medical school curriculum currently dedicate to covering the topic of climate change and its potential future impact on the practice of medicine?
2. How many hours does your medical school curriculum currently dedicate to covering the topic of climate change and its effects on human health?

School	Question 1 Response	Question 2 Response	Other Comments
Alberta	No response		
BC	0 hours	0 hours	
Calgary	No response		
Dalhousie	0 hours	0 hours	
McGill	0 hours	0 hours	No dedicated lecture time; coverage through optional courses.
Manitoba	0 hours	0 hours	
McMaster	0 hours	0 hours	
Memorial	0 hours	0 hours	
NOSM	0 hours	0 hours	
Ottawa	0 hours	0 hours	
Queens	0 hours	0 hours	Session in population health course (1-3 hours) starting in Fall 2015.
Saskatchewan	0 hours	0 hours	
Toronto	0 hours	0 hours	"I don't recall much time being devoted to the topic of climate change".
Western	0 hours	< 1 hour	Topic was "brushed upon in one lecture" as "part of a larger spectrum of topics".