

Public Health Adaptation to Climate Change in Canadian Jurisdictions

Appendix A: Key Terms and Concepts

The following definitions and descriptions of key terms and concepts guided our analysis and understanding of health adaptation initiatives:

(1) Vulnerability:

The following definition of vulnerability from the IPCC guides our understanding of how populations are vulnerable to climate change: “The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity” [1].

(2) Health Risks:

A full vulnerability assessment is outside the scope of this study, thus we examine instead the health *risks* posed by climate change addressed by health adaptation initiatives. We focus on any of the following ways health can be affected: food, water, physical harm/injury, illness or death [2]. We categorized health adaptation initiatives as addressing the following health risks posed by climate change, adapted from those identified by the IPCC Working Group II in the 5th Assessment Report [3]: heat-related, air quality, floods, storms, food security, UV radiation, infectious diseases and general health. The projected or possible health effects of these climate change risks are outlined in the table below.

We coded discrete health adaptation initiatives addressing infectious diseases as either addressing vector-borne infectious diseases or food- and water-borne infectious diseases, but some data sources did not provide enough information for this distinction. All infectious diseases were thus aggregated to the infectious disease category for analysis. The general health category includes vulnerability assessments, health adaptation initiatives planning a health adaptation strategy, initiatives addressing general emergency preparations, or initiatives intended to protect health as a whole from climate change risks. Examples of initiatives classified as general health include:

- “Raise awareness about health hazards of climate change: The Ministry of Health and Long-Term Care established a requirement for increasing public awareness of the health risk factors associated with climate change in the Ontario Public Health Standards and will be undertaking activities to raise awareness in boards of health about this requirement” (Ontario).
- “...providing support through the Northern Strategy Trust Fund to the Northern Climate ExChange to assist three Yukon communities to develop and implement community adaptation plans. ... We will continue to support community-level adaptation planning with technical advice and expertise as well as financial resources” (Yukon).

Health Risk	Projected/Possible Health Effects
Heat-Related Risks	<ul style="list-style-type: none"> • Heat-related morbidity and mortality • Respiratory and cardiovascular disorders
Air Quality	<ul style="list-style-type: none"> • Eye, nose and throat irritation, and shortness of breath • Acute and chronic damage to the respiratory system • Chronic obstructive pulmonary disease and asthma • Exacerbation of allergies and asthma • Increased risk of cardiovascular diseases (e.g., heart attacks and ischemic heart disease) • Respiratory and cardiovascular mortality
Floods	<ul style="list-style-type: none"> • Death, injury and illness • Psychological health effects, including mental health and stress-related illnesses • Health impacts due to food or water shortages • Illnesses related to drinking water contamination • Effects of the displacement of populations and crowding in emergency shelters • Indirect health impacts from ecological changes, infrastructure damages and interruptions in health services
Storms	<ul style="list-style-type: none"> • Death, injury and illness • Psychological health effects, including mental health and stress-related illnesses • Health impacts due to food or water shortages • Illnesses related to drinking water contamination • Effects of the displacement of populations and crowding in emergency shelters • Indirect health impacts from ecological changes, infrastructure damages and interruptions in health services
Food Security	<ul style="list-style-type: none"> • Impacts on nutrition due to availability of local and traditional foods from decreases in ice distribution, stability and duration of coverage in Northern communities
Vector-Borne Infectious Diseases	<ul style="list-style-type: none"> • Increased incidence of vector-borne infectious diseases native to Canada (e.g., eastern & western equine encephalitis, Rocky Mountain spotted fever) • Introduction of infectious diseases new to Canada • Possible emergence of new diseases, and re-emergence of those previously eradicated in Canada
Food- and Water-Borne Infectious Diseases	<ul style="list-style-type: none"> • Sporadic cases and outbreaks of disease from strains of water-borne pathogenic micro-organisms • Food-borne illnesses • Other diarrheal and intestinal diseases
UV Radiation	<ul style="list-style-type: none"> • Increased risks of skin cancers, eye damage (cataracts), immunosuppression, infectious diseases

Note: Adapted from Berry *et al.* 2014; Furgal & Séguin, 2006; and Séguin, 2008 [4–6].

(3) Adaptation Policy:

The following definition of adaptation policy guides our perspective on adaptation policies and initiatives: “The process leading to the production of outputs in forms of activities and decisions taken by purposeful public and private actors at different administrative levels and in different sectors, which deals intentionally with climate change impacts, and whose outcomes attempt to substantially impact actor groups, sectors, or geographical areas that are vulnerable to climate change” [7]. This definition is particularly helpful in this study focusing on various levels of government health adaptation.

Appendix B: Inclusion and Exclusion Criteria for Health Adaptation Documents

For documents to be included in our analysis they had to be a governmental document or website in English or French; have climate change as the overarching focus; address risks posed by climate change to human health; include jurisdictionally relevant initiatives; and be a technical document, adaptation plan, national report, adaptation assessment, vulnerability assessment or government website. The inclusion and exclusion criteria for health adaptation documents are summarized in the table below.

Inclusion and exclusion criteria for health adaptation documents.

Inclusion Criteria	Exclusion Criteria
English or French language	Non-English or French language
Climate change as the overarching reasoning	Climate change mitigation
Human adaptation to climate change	Non-human adaptation to climate change (e.g., biodiversity)
Jurisdictionally appropriate documents and initiatives	Jurisdictionally inappropriate documents and initiatives (e.g., municipal documents when searching for provincial documents)
Government documents, government websites, or documents by government-established research organizations/networks or consultants hired by the government	Documents by non-governmental organizations, unaffiliated institutions, private companies or professional associations
Technical documents, adaptation plans, national reports, adaptation assessments, vulnerability assessments, government webpages	Editorials, meetings, conferences, presentations, abstracts, financial evaluations of climate change adaptation
Addresses risks posed to human health by climate change (see Health Risks in Appendix A)	Addresses climate change risks unrelated to health (e.g., forest management)

Appendix C: Documents or Webpages Included

Canadian federal, provincial, territorial, regional and municipal adaptation documents or webpages included

Jurisdiction Name	Jurisdiction Type	Author	Year	Title (URL If Applicable)
Canada	Federal	Health Canada	2007	About Health Canada(http://www.hc-sc.gc.ca/ahc-asc/branch-dirgen/hecs-dgsesc/sep-psm/waccb-beacc-eng.php)
Canada	Federal	Health Canada	2008	Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity
Canada	Federal	Natural Resources Canada	2008	From Impacts to Adaptation: Canada in a Changing Climate
Canada	Federal	Aboriginal Affairs and Northern Development Canada	2009	Implementation Evaluation of INAC Climate Change Adaptation Program: Assist Northerners in Assessing Key Vulnerabilities and Opportunities (http://www.aadnc-aandc.gc.ca/eng/1307024581995/1307024620213)
Canada	Federal	Office of the Auditor General of Canada	2010	Report of the Commissioner of the Environment and Sustainable Development to the House of Commons
Canada	Federal	Health Canada	2010	What's Being Done about Climate Change and Health in Canada—Adaptive Actions (http://www.hc-sc.gc.ca/ewh-semt/climat/adapt/actions-eng.php)
Canada	Federal	Treasury Board of Canada Secretariat	2010	Environment Canada Adaptation Theme (http://www.tbs-sct.gc.ca/rpp/2010-2011/inst/doe/st-ts04-eng.asp#Theme:_Adaptation)
Canada	Federal	Environment Canada	2011	Evaluation of the Improved Climate Change Scenarios Program (http://www.ec.gc.ca/ae-ve/default.asp?lang=En&n=4CCFD0E2-1)
Canada	Federal	Health Canada	2011	Communicating the Health Risks of Extreme Heat Events: Toolkit for Public Health and Emergency Management Officials
Canada	Federal	Health Canada	2011	Extreme Heat Events Guidelines: Technical Guide for Health Care Workers
Canada	Federal	Health Canada	2011	Extreme Heat Events Guidelines: User Guide for Health Care Workers and Health Administrators
Canada	Federal	Aboriginal Affairs and Northern Development Canada	2012	Climate Change Adaptation Program (http://www.aadnc-aandc.gc.ca/eng/1329158189051/1329158264671)
Canada	Federal	Health Canada	2012	Heat Alert and Response Systems to Protect Health: Best Practices Guidebook

Jurisdiction Name	Jurisdiction Type	Author	Year	Title (URL If Applicable)
Canada	Federal	Public Health Agency of Canada, Government of Nunavut and Government of Northwest Territories	2012	NUNAVUT/NORTHWEST TERRITORIES: Healthy Foods North—A culturally appropriate and community-based program to promote healthy eating and lifestyle
Canada	Federal	Public Health Agency of Canada	2013	Preventative Public Health Systems and Adaptation to a Changing Climate Program (http://www.phac-aspc.gc.ca/hp-ps/eph-esp/pph-ppsp-eng.php)
British Columbia	Province	Government of British Columbia	2009	BC Air Action Plan (http://www.bcairsmart.ca/)
British Columbia	Province	BC Ministry of Forests, Lands and Natural Resource Operations	2012	Coastal Flood Hazard Areas In British Columbia (http://www.env.gov.bc.ca/wsd/public_safety/flood/pdf_drawings/index.html)
Manitoba	Province	Government of Manitoba	2008	Adapting to Climate Change: Preparing for the Future
New Brunswick	Province	Government of New Brunswick	2007	Climate Change Action Plan 2007–2012
New Brunswick	Province	Government of New Brunswick	2014	Climate Change Action Plan 2014–2020
Newfoundland & Labrador	Province	Department of Environment and Conservation	2005	Climate Change Action Plan
Newfoundland & Labrador	Province	Government of Newfoundland & Labrador	2006	Charting our Course: Climate Change Action Plan 2011
Newfoundland & Labrador	Province	Government of Newfoundland & Labrador	2013	Enhancing Resilience to Climate Change (http://www.turnbackthetide.ca/government-action/resilience-to-climate-change.shtml)
Newfoundland & Labrador	Province	Department of Environment and Conservation	2014	Flood risk mapping studies (http://www.env.gov.nl.ca/env/waterres/flooding/frm.html)
Northwest Territories	Territory	NWT Environment and Natural Resources	2008	NWT Climate Change Impacts and Adaptation Report
Nova Scotia	Province	Government of Nova Scotia	2005	Adapting to a Changing Climate in Nova Scotia: Vulnerability Assessment and Adaptation Options
Nova Scotia	Province	Department of Environment	2009	Toward a Greener Future: Nova Scotia's Climate Change Action Plan
Nova Scotia	Province	NS Health and Wellness	2012	Lyme Disease: A Report on Lyme Disease Epidemiology and Surveillance in Nova Scotia

Jurisdiction Name	Jurisdiction Type	Author	Year	Title (URL If Applicable)
Nunavut	Territory	Department of Environment	2011	Upagiatavut Setting the Course: Climate Change Impacts and Adaptation in Nunavut
Ontario	Province	Department of Environment	2011	Climate Ready: Ontario's Adaptation Strategy and Action Plan 2011–2014
Prairies	Region	Prairies Adaptation Research Collaborative	2001	Adaptability of Prairie Cities: The Role of Climate Current and Future Impacts and Adaptation Strategies
Prairies	Region	Prairies Adaptation Research Collaborative	2001	A Feasibility Assessment to Study Societal Adaptation and Human Health Impacts Under Various Future climate Scenarios Anticipated in the Canadian Prairies
Prairies	Region	Prairies Adaptation Research Collaborative	2001	Isi Askiwan—The State of the Land: Prince Albert Grand Council Elders' Forum on Climate Change
Prince Edward Island	Province	Department of Environment	2009	Prince Edward Island and Climate change: A Strategy for Reducing the Impacts of Global Warming
Quebec	Province	Ministère du Développement durable, de l'Environnement et des Parcs	2008	Quebec and Climate Change: A Challenge for the Future 2006-2012 Action Plan (Updated)
Quebec	Province	Ouranos	2008	Les effets des changements climatiques sur la santé au Québec
Quebec	Province	Ministère de la Santé et des Services Sociaux	2011	Changements climatiques: Vulnérabilité et adaptation des immeubles
Quebec	Province	Quebec National institute for Public Health	2011	SUPREME System (http://www.ij-healthgeographics.com/content/10/1/39)
Quebec	Province	Ministère de la Santé et des Services Sociaux	2012	Quebec in Action: Greener by 2020—2013–2020 Government Strategy for Climate Change Adaptation
Quebec	Province	Government of Quebec	2012	Quebec in Action: Greener by 2020—2013–2020 Climate Change Action Plan
Quebec	Province	Ministere de la Santé et des Services Sociaux	2013	Plan d'intervention gouvernemental 2013–2015 pour la protection de la population contre le virus du Nil occidental
Yukon	Territory	Environment Yukon	2009	Yukon Government Climate Change Action Plan
Edmonton, AB	Municipality	City of Edmonton	2011	The Way We Green: The City of Edmonton's Environmental Strategic Plan
Ottawa, ON	Municipality	City of Ottawa	2004	Air Quality & Climate Change Management Plan
Montreal, QC	Municipality	Ville de Montréal	Retrieved 2014	Adaptation aux changements climatiques (http://ville.montreal.qc.ca/portal/page?_pageid=7237,75085661&_dad=portal&_schema=PORTAL)

Jurisdiction Name	Jurisdiction Type	Author	Year	Title (URL If Applicable)
Ottawa, ON	Municipality	Planning and Growth Department	2004	Air Quality & Climate Change Management Plan
Toronto, ON	Municipality	City of Toronto	2011	Toronto's Adaptation Actions
Vancouver, BC	Municipality	City of Vancouver	2012	Climate Change Adaptation Strategy

Appendix D: Canadian Federal Departments

The following five Canadian federal departments are implementing or have implemented health adaptation initiatives: Health Canada, the Public Health Agency of Canada, Aboriginal Affairs and Northern Development Canada, Environment Canada and Natural Resources Canada. We outline the mission, objectives, mandates or visions of these federal departments below.

Department Name	Description
Health Canada (HC)	<p><i>Mission:</i> "Health Canada is the federal department responsible for helping the people of Canada maintain and improve their health" [8].</p> <p><i>Objectives:</i></p> <ul style="list-style-type: none"> • "Prevent and reduce risks to individual health and the overall environment; • Promote healthier lifestyles; • Ensure high quality health services that are efficient and accessible; • Integrate renewal of the health care system with longer term plans in the areas of prevention, health promotion and protection; • Reduce health inequalities in Canadian society; and • Provide health information to help Canadians make informed decisions" [8].
Public Health Agency of Canada (PHAC)	<p><i>Mission:</i> "To promote and protect the health of Canadians through leadership, partnership, innovation and action in public health" [9].</p> <p><i>Mandate:</i></p> <ul style="list-style-type: none"> • "Promote health; • Prevent and control chronic diseases and injuries; • Prevent and control infectious diseases; • Prepare for and respond to public health emergencies; • Serve as a central point for sharing Canada's expertise with the rest of the world; • Apply international research and development to Canada's public health programs; and • Strengthen intergovernmental collaboration on public health and facilitate national approaches to public health policy and planning" [9].

Department Name	Description
Aboriginal Affairs and Northern Development Canada (AANDC)	<p><i>Mandate:</i> “Aboriginal Affairs and Northern Development Canada (AANDC) supports Aboriginal people (First Nations, Inuit and Métis) and Northerners in their efforts to:</p> <ul style="list-style-type: none"> • improve social well-being and economic prosperity; • develop healthier, more sustainable communities; and • participate more fully in Canada’s political, social and economic development—to the benefit of all Canadians. <p>AANDC is one of the federal government departments responsible for meeting the Government of Canada’s obligations and commitments to First Nations, Inuit and Métis, and for fulfilling the federal government’s constitutional responsibilities in the North” [10].</p>
Environment Canada (EC)	<p><i>Mandate:</i></p> <ul style="list-style-type: none"> • “Preserve and enhance the quality of the natural environment, including water, air, soil, flora and fauna; • conserve Canada’s renewable resources; • conserve and protect Canada's water resources; • forecast daily weather conditions and warnings, and provide detailed meteorological information to all of Canada; • enforce rules relating to boundary waters; and • coordinate environmental policies and programs for the federal government” [11].
Natural Resources Canada (NRCan)	<p>“Natural Resources Canada (NRCan) seeks to enhance the responsible development and use of Canada’s natural resources and the competitiveness of Canada’s natural resources products. NRCan develops policies and programs that enhance the contribution of the natural resources sector to the economy and improve the quality of life for all Canadians” [12].</p> <p><i>Vision:</i> “Improving the quality of life of Canadians by creating a sustainable resource advantage” [12].</p>

Appendix E: Canadian Health Adaptation Data

Accompanying this supplementary materials is an Excel spreadsheet containing the data on discrete health adaptation initiatives used in this study. For each initiative, the jurisdiction, region, document year, implementing agency or body, adaptation type, health risk addressed, adaptation stage, consideration of vulnerable groups and source is provided. Searches and data collection were conducted between February and June 2014, and provincial and territorial searches were conducted again in September 2014.

Appendix F: Level of Health Adaptation by Province or Territory

To discern how provinces and territories are progressing in health adaptation compared to one another, we qualitatively assessed their level of health adaptation, shown in Figure 6. We determined the positioning of each province and territory in Figure 6 by creating an index from the number of health adaptation initiatives implemented combined with the percentage of regional risks addressed.

Finally, we added “points” to the index for: having a climate change adaptation plan; having a health section in the adaptation plan; the level of detail of the health section and of the health adaptation initiatives; and having information available on climate change and health on their government website. The results are not definitive, but provide an indication for the level of health adaptation in each province and territory. Figure 6 in the paper shows the results of this qualitative ranking.

References

1. McCarthy, J.J. *Climate Change 2001: Impacts, Adaptation, and Vulnerability: Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel On Climate Change*; Cambridge University Press: Cambridge, UK, 2001.
2. Lesnikowski, A.; Ford, J.; Berrang-Ford, L.; Paterson, J.; Barrera, M.; Heymann, S. Adapting to health impacts of climate change: A study of UNFCCC Annex I parties. *Environ. Res. Lett.* **2011**, *6*, doi:10.1088/1748-9326/6/4/044009.
3. Smith, K.R.; Woodward, A.; Campbell-Lendrum, D.; Chadee, D.D.; Honda, Y.; Liu, Q.; Olwoch, J.M.; Revich, B.; Sauerborn, R. Human health: Impacts, adaptation, and co-benefits. In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part a: Global and Sectoral Aspects. Contribution of Working Group ii to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change*; Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., *et al.* Eds.; Cambridge University Press: Cambridge, UK, 2014.
4. Berry, P.; Clarke, K.; Fleury, M.D.; Parker, S. Human health. In *Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation*; Warren, F.J., Lemmen, D.S., Eds.; Government of Canada: Ottawa, ON, Canada, 2014; pp. 191–232.
5. Furgal, C.; Seguin, J. Climate change, health, and vulnerability in canadian northern aboriginal communities. *Environ. Health Perspect.* **2006**, *114*, 1964–1970.
6. Séguin, J. *Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity*; Health Canada: Ottawa, ON, Canada, 2008.
7. Dupuis, J.; Biesbroek, R. Comparing apples and oranges: The dependent variable problem in comparing and evaluating climate change adaptation policies. *Glob. Environ. Chang.* **2013**, *23*, 1476–1487.
8. Health Canada. About Mission, Values, Activities. Available online: <http://www.hc-sc.gc.ca/ahc-asc/activit/about-apropos/index-eng.php> (accessed on 10 September 2014).
9. PHAC. About the Agency. Available online: http://www.phac-aspc.gc.ca/about_apropos/index-eng.php (accessed on 10 September 2014).
10. AANDC. About AANDC. Available online: <https://www.aadnc-aandc.gc.ca/eng/1100100010023/1100100010027> (accessed on 10 September 2014).
11. Environment Canada. About Environment Canada. Available online: <http://www.ec.gc.ca/default.asp?lang=En&n=BD3CE17D-1> (accessed on 10 September 2014).

12. Natural Resources Canada. Available online: <http://www.nrcan.gc.ca/department> (accessed on 10 September 2014).

© 2015 by the authors; licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>)