CLIMATE CHANGE AND HEALTH VULNERABILITY AND ADAPTATION ASSESSMENT: WORKBOOK FOR THE CANADIAN HEALTH SECTOR

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This workbook provides step-by-step information on how to conduct a climate change and health vulnerability and adaptation assessment. This workbook is intended for use by health officials to develop health vulnerability assessments and adaptation plans through participatory processes that engage partners from multiple sectors and organizations. Overall, it is intended to develop capacity among Canadian health authorities to assess and adapt to the health impacts of climate change.

INTRODUCTION

Climate variability and change are increasing risks to the health of Canadians. Impacts can be direct or indirect and include increased morbidity and mortality related to a greater frequency and severity of extreme weather events (e.g. extreme heat, floods, hurricanes, ice storms, droughts); increased ambient and indoor air pollution; reduced recreational and drinking water quality; increased food contamination; the spread of vectors that cause disease and greater exposure to UV radiation. Recent evidence suggests that climate change can pose long lasting threats to mental health from climate-related disasters and can result in greater food insecurity for some populations, particularly those living in Northern communities.

Addressing the challenges posed by climate change requires a robust understanding of the risks posed by current climate variability, the possible impacts associated with future climate change, the unique vulnerabilities facing specific populations, communities or regions, and of effective measures to protect health. Health authorities in communities across Canada need to prepare for threats both familiar—which may present themselves at an increased frequency and/or severity (e.g. flooding, drought, extreme heat, vector-borne disease, air pollution, wildfires) and unfamiliar (e.g. exotic infectious diseases, catastrophic impacts from multiple events) which may impact both individuals and health systems.

HEALTH EQUITY

Population level vulnerabilities, as well as adaptive capacities, to climate change impacts are influenced not only by biological but also social and environmental factors like employment, education, housing, culture, gender, physical environment, and income. Effective measures to protect populations of concern acknowledge and address social and environmental factors that influence health outcomes so that all people have the opportunity to experience their highest level of health.

Population features that influence both vulnerability and adaptive capacity, as well as populations of concern from climate change impacts on health include:

- Gender and sex
- Race and ethnicity
- Age (including: elderly people and children)
- People with pre-existing conditions (e.g. physical and mental conditions)
- People who are unemployed or underemployed
- People with lower levels of formal education
- People who are socially isolated
- People with low socio-economic status
- Occupational groups (e.g. outdoor labourers and first-responders)

- Minority linguistic communities
- Rural, urban, and suburban communities
- People who are underinsured or uninsured
- People who live in high-risk geographic environments (e.g. flood plains, coastal communities)
- Newcomers to Canada
- Indigenous Peoples

The Ontario Ministry of Health and Long-Term Care Health Equity Impact Assessment guide[1] provides useful information on approaches for considering unique population level vulnerabilities that may be relevant for understanding the differential risks posed by climate change on Canadians.

Indigenous Peoples are diverse and confront equally diverse issues with a range of adaptive capacities. However, due to both long-seeded systemic inequalities and changing environmental conditions, many Indigenous Peoples, particularly those in more northern and remote locations, are experiencing disproportionate impacts from climate change on wide-ranging issues. Indigenous knowledge can be a critical source of information for understanding and communicating these risks to health.

This workbook was designed primarily for use by provincial/territorial ministries of health and regional health authorities; however information within the workbook may be beneficial to Indigenous communities. Additionally, non-Indigenous communities may benefit greatly from partnering with Indigenous communities in their climate change and health work and by working to equitably incorporate the knowledge held by Indigenous residents and partners into their V&A assessment.

WHY COMPLETE A CLIMATE CHANGE AND HEALTH VULNERABILITY AND ADAPTATION ASSESSMENT?

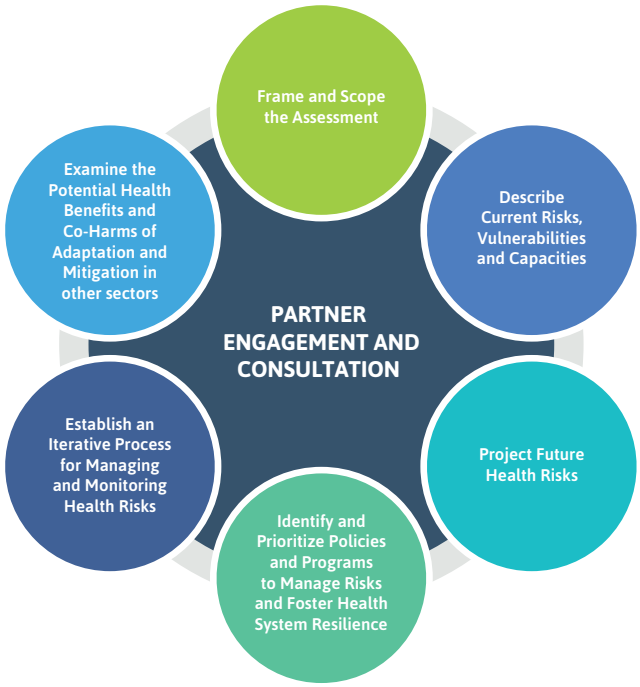
Completing a climate change and health vulnerability and adaptation assessment (V&A) can assist health authorities in identifying and interpreting information needed to prepare their health systems for the impacts of climate change. These assessments may be completed at local, regional, provincial/territorial and international scales. V&As may serve to:

- Identify resources and assess knowledge leading to a better understanding of the relationship between weather/climate and health outcomes—with emphasis on populations of concern
- Provide information on the expected distribution and severity of future climate change and health impacts to health and emergency management officials, stakeholders and the public
- Provide insight into effective means of incorporating information on the health impacts of climate change into existing policies and programs or, where needed, into the formation of new policies and programs to either reduce or prevent the health impacts of climate change
- Provide a baseline of information against which future changes in health risks related to climate change and the effectiveness of associated policies and programs may be measured
- Facilitate the development of inter-sectoral relationships and collaborations with the goal of protecting and improving health (e.g. collaborate with land-use planners to reduce the urban heat island effect)

[1] Ontario Ministry of Health and Long-Term Care, 2013. "Health Equity Impact Assessment"

The six steps of the assessment process, as presented in figure 1, are described further in the following sections.

FIGURE 1. The six steps of a climate change and health vulnerability and adaptation assessment



This workbook is intended for use by health officials to develop health vulnerability assessments and adaptation plans through participatory processes that engage partners from multiple sectors and organizations. Users of the document are referred to more detailed guidance for conducting assessments available in the World Health Organization (WHO) report Protecting Health from Climate Change: Vulnerability and Adaptation Assessment.[2]

This workbook draws upon learnings from the first local assessments undertaken by public health authorities in Canada[3] as pilots of the WHO guidelines and from recent research identifying key factors that increase the resilience of health systems to the impacts of climate change.[4,5]

[2] WHO. 2013. "Protecting health from climate change: vulnerability and adaptation assessment" www.who.int/globalchange/publications/vulnerability-adaptation/en

[3] See Berry et al. 2014. "Assessment of Vulnerability to the Health Impacts of Climate Change in Middlesex-London." www.healthunit.com/climate-change

[4] WHO. 2015. "Operational framework for building climate resilient health systems." http://apps.who.int/iris/bitstream/10665/189951/1/9789241565073_eng.pdf?ua=1

[5] Balbus et al. 2016. "Enhancing the sustainability and climate resiliency of health care facilities: a comparison of initiatives and toolkits." www.scielosp.org/scielo.php?script=sci_arttext&pid=S1020-49892016000900174&lng=en&nrm=iso&tlng=en

HOW TO USE THIS WORKBOOK

This workbook represents a first edition of a living document developed as part of a pilot program intended to develop capacity among Canadian health authorities to assess and adapt to the health impacts of climate change. The steps in the workbook constitute an approach to climate change and health vulnerability and adaptation assessment that is based on the latest knowledge of climate change and health and has been tailored to the Canadian health sector. The steps are presented in a manner that facilitates the inclusion of key partners from outside the health sector while maintaining a rigorous assessment process. The assessment may be completed in full, as presented, or in a modified fashion to meet the unique needs of your jurisdiction. However, it is recommended that all steps be considered to allow for the most thorough assessment possible. As new research becomes available current understanding on the severity and distribution of the health impacts of climate change may shift. Therefore, climate change and health vulnerability and adaptation assessments are iterative in nature; they should be revisited on a regular basis and updated with the most current information available.

Climate change and health vulnerability and adaptation assessments are commonly completed by a lead organization (e.g. a local public health authority) and a lead research team made up of health professionals that reflect a diverse range of backgrounds (e.g. epidemiologists, health promotion experts, health policy experts, etc.). This is typically done in collaboration with an advisory group made up of key stakeholders.

This workbook provides step-by-step information on how to conduct a climate change and health vulnerability and adaptation assessment in a manner that can be shared and followed by all those involved in the assessment process. In an attempt to increase the ease of use and streamline the organization and analysis of information, the material in each step has been supplemented with a fillable template which can either be used directly as part of the assessment process or presented at meetings and workshops to help facilitate data gathering. Though these templates include example indicators and data sources, they should not be viewed as comprehensive, exhaustive, or prescriptive but rather as examples to help stimulate the assessment process. The possible health impacts of climate change differ considerably from region to region and therefore, through consultation with experts, effort should be made to use locally relevant indicators and processes.

At the onset of the assessment process it is important to devote the necessary time and effort to identify the priority climate change and health impacts in your jurisdiction. Though the impacts of climate change will be diverse, and understanding them as thoroughly as possible is desirable, it is likely that resource constraints will limit the scope of any assessment. Therefore, the possible health impacts may need to be prioritized. This can be done through a review of the relevant literature as well as through consultation with climate change and health experts. The priority health impacts identified will likely influence the diversity of stakeholders and professional backgrounds included in the assessment team.

The ultimate purpose of any climate change and health vulnerability and adaptation assessment is to provide up-to-date information to support health policymakers in taking action to reduce the threat posed by climate change and to build climate-resilience within health systems. However, beyond this it is important to communicate the threats posed by climate change, as well as any possible protective actions, to those at risk, including the general public, but most importantly, populations of concern. For this reason the assessment should include communications materials designed to inform those at risk. This can be done most effectively if communications activities are considered throughout the assessment process.

STEP 1: FRAME AND SCOPE THE ASSESSMENT

STEP 1: OVERVIEW

Before an assessment is initiated, the assessment needs to be framed and scoped. The project leads should identify:

- The assessment timeframe
- Available resources
- Climate-related health risks of most interest
- Populations of concern
- Future time periods to assess risks
- Adaptation needs to be considered
- How the assessment will be managed
- A communication plan for informing partners and stakeholders.

Prior to beginning an assessment it may be beneficial to hold informal brainstorming sessions where participants (who will ideally be representative of the community and include experts in climate change and health) will scope possible priority areas for the assessment and identify possible data sources (e.g. recently completed surveys or health equity assessments).

STEP 1A: IDENTIFY PRIORITY HEALTH HAZARDS AND CONCERNS

The first decision to be made is which climate change-related health hazards to include as priority concerns for your assessment area. These are the hazards and concerns that should be focused on in the assessment. Use the 'Priority health hazards' template to compile preliminary information on health outcomes and climate-related hazards of concern to identify which should be the focus for the assessment. In the template, record information on morbidity and mortality in your jurisdiction from extreme weather and climate events (e.g. heat events, floods), changes in air quality arising from changing concentrations of ground-level ozone, particulate matter or aeroallergens, and water-, food-, and vector-borne risks that can be made worse by climate change (e.g. Lyme disease and West Nile Virus).

When considering priority health hazards be sure to consider ramifications not just for individual and population health, but also for the health system itself. Table 6 presented in Step 2b may be helpful when considering who to consult on various components of the health system and their potential climatic vulnerabilities and capabilities.

When compiling this information, pose the following questions to help prioritize health concerns:

- What are the priority climate-sensitive health outcomes of concern in the study area, including both mental and physical health outcomes?
- What socio-cultural or biological factors (e.g. sex, gender, diet, age, occupation, livelihoods, reliance on the land? etc.) could contribute to making some groups more vulnerable than others?
- What are some of the differential impacts of climate change on populations of concern?
- Which climate-sensitive health outcomes are of greatest concern for stakeholders and the public?
- What are some of the possible climate change impacts on health systems related to each health hazard (e.g. health facilities, health workforce, etc.)?
- Did recent extreme weather and climate events raise concerns about specific health risks facing individuals in your community or region?
- Were recent assessments conducted in the region in other sectors that highlighted issues affecting health?
- Are neighbouring health jurisdictions also conducting a health vulnerability and adaptation assessment that you might learn from?

STEP 1B: IDENTIFY PROJECT TEAM

Once the health outcomes to be considered are identified, a project team with relevant expertise can be created and an assessment work plan developed. Use the 'Project team' template to list project team members and other relevant information such as their respective areas of responsibility. This would likely include health officials currently managing the impacts of the identified priority health hazards from Step 1a, along with officials from other sectors whose activities can affect the health hazard. It is also useful to include information on areas of expertise for the identified officials and/or whom they represent (individuals or organizations) and their roles in the assessment.

When identifying potential project team members include the following stakeholders and considerations:

- Officials from local authorities whose activities can affect the burden and pattern of climate-sensitive health outcomes
- Representative healthcare providers who would diagnose and treat any identified cases
- Core members of the project team who stay for the entire project
- Project team members that are representative of the local community in terms of both cultural background and gender
- Project team members that are familiar with the health concerns of segments of the population who are unlikely to be represented on the project team (e.g. the elderly or very young)
- Indigenous Peoples and holders of traditional and local knowledge should be involved in the project (if possible as project team members) from an early stage
- Individuals that are working on issues relevant to the mandate of the assessment in other departments or organizations (e.g. experts in disease transmission, experts on sources of ground-level ozone)
- Communication experts to discuss how to present the results of the assessment to the public in ways that empower appropriate behavioural adaptation actions
- Ensuring a high degree of stakeholder inclusivity while having a small enough team to direct the study most effectively

Consider adding to the team additional resource persons with targeted expertise on specific topics, for example, those with knowledge on the operations of health systems. This table provides suggestions on which groups to consider consulting for each component of the health system as outlined in the WHO Operational Framework for Climate Resilient Health Systems.[6] See Step 4 for more information on health systems and climate-resilience.

[6] For more information on building climate-resilient health systems see Step 4.

TABLE 1. Example health system and health system aligned stakeholders

HEALTH SYSTEM BUILDING BLOCK	STAKEHOLDER GROUPS
Service delivery	• Public health specialists and programs (including: environmental health, communications and health promotion, mental health, infectious diseases, food safety and security, emergency management, travel health, prenatal health, chronic diseases, health Inspectors, etc.) • Emergency responders • Indigenous partners (including Elders, community leaders, Indigenous healthcare service providers, emergency managers, community members, etc.) • Regional emergency management Co-ordinators • Social support groups that support the health system (e.g. food banks, Red Cross, Meals on Wheels, local shelters, etc.) • Community outreach centres (e.g. senior resource centres, rural outreach centres, etc.)
Financing	• Provincial/territorial Ministry of Health • Organizational leadership • Municipal, provincial/territorial and federal partners • Indigenous partners (e.g. Indigenous healthcare service providers, community leaders, etc.) • Private sector and non-governmental support (e.g. research support, technology development, emergency response coordination, etc.)
Leadership and governance	• Public health management • Health facilities management • Indigenous partners (including Elders, community leaders, Indigenous healthcare service providers, etc.) • Long-term care management • Provincial/Territorial strategic policy specialists
Health workforce	• Physicians • Nurses • Pharmacists • Health inspectors • Indigenous healthcare service providers • Mental health specialists • Personal support workers • Health workforce educators (e.g. medical schools, colleges, etc.) • Organization professional development and training co-ordinators
Health information systems	• Regional researchers specializing in relevant subjects such as climate change, environmental health, health equity, public health promotion, etc. • Indigenous partners (including Indigenous healthcare service providers, Elders, community leaders, etc.) • Regional climate change research consortia • Canadian Centre for Climate Services
Essential medical products and technologies (including infrastructure)	• Facilities' operations departments • Municipal and regional infrastructure planners • Indigenous partners (including Elders, community leaders, Indigenous healthcare service providers, infrastructure specialists, community members, etc.) • Provincial/Territorial Ministry of Health real assets managers • Utility providers (e.g. water, electricity, etc.)

STEP 1C: DEVELOP A VULNERABILITY AND ADAPTATION ASSESSMENT WORK PLAN

The work plan needs to consider the extent to which steps in the vulnerability and adaptation assessment are necessary to achieve the desired results. Time and financial resources may call for a delay in the implementation or removal of a particular step; this should be noted in the work plan. For example, the examination of potential health benefits and co-harms of adaptation and mitigation options implemented in other sectors might be omitted or could be undertaken when the next assessment is carried out. Reasons for not undertaking a certain step should be included in the final report to inform the framing and scoping of subsequent assessments.

The work plan should specify the management plan, key responsibilities, activities, timeline, major stakeholders and resources needed for the assessment. In this stage it is also beneficial to take stock of any activities that have been or could be conducted prior to the assessment that may benefit the assessment process. For instance, the assessment process could benefit greatly from the prior completion of a health equity assessment, if time and resources allow. A health equity assessment will foster a better understanding of the possible inequities of the impacts of climate change, existing policies and programs, and potential adaptation options on different populations groups. For more information on health equity assessments, as well as a toolkit for completing them, refer to the Ontario Ministry of Health and Long-term Care's Health Equity Impact Assessment tool.[7]

Use the 'Work plan' template to develop your assessment work plan.

STEP 1D: DEVELOP A COMMUNICATION PLAN

Developing a communication plan early in the process is important to ensure that the assessment is structured from the beginning to communicate identified risks effectively to those who will manage the risks and those who could be affected. The plan should specify the primary assessment outputs (e.g. technical report), to whom it will be communicated, mechanisms for sharing the results (e.g. webinars, workshops), and if outreach materials will be developed to communicate results (e.g. factsheets, slide show presentations, posters). Some things to consider in your communications plan are how you will reach populations of concern, including marginalized populations and hard-to-reach audiences (e.g. remote communities, people experiencing homelessness, minority linguistic communities, Indigenous Populations etc.). Post-assessment engagement efforts should be constructed in a manner that they reach a wide audience but also key stakeholders (e.g. healthcare providers and community partners). This may mean adopting a variety of outreach strategies (e.g. written reports, short videos that can be shared on social media and community consultations) and partnering with community groups that have developed relationships with populations of concern. Refer to the 'Communication plan' template to document relevant information.

ASSESSMENT TEMPLATES

The following templates are available to help complete Step 1 of the Vulnerability and Adaptation Assessment:

1a) Priority health hazards

1b) Project team

1c) Work plan

1d) Communication plan

[7] Ontario Ministry of Health and Long-Term Care, 2013. "Health Equity Impact Assessment."

Step 1a: Priority health hazards template

Use this template to compile preliminary information on climate change-related health hazards in order to identify which ones should be the focus for the assessment. The template lists examples of health hazards and associated health outcomes, populations of concern and health system impacts. You may have more or different indicators to include. Health hazards with more serious health outcomes, health system impacts, and impacts that are felt by populations of concern are higher priority for inclusion on the assessment. When working to identify priority hazards, keep in mind that the impacts of climate change may vary in severity between population groups. Many factors may increase vulnerability to health impacts. For example, socio-cultural and biological factors (e.g. sex, gender, diet, age, occupation, livelihoods, reliance on the land, etc.) contribute to how vulnerable a person or group is to a specific hazard; be cognisant of this and any knowledge gaps that may exist in your area on populations of concern when completing this and other assessment steps. Information such as sex-disaggregated health data and previously completed health equity assessments are valuable in helping to fill-in these knowledge gaps.

Use this template to document information related to each health hazard and knowledge gaps of interest to help in prioritization. When compiling this information, pose the following questions to help in the analysis:

- What are the priority climate-sensitive health outcomes of concern for each climate change-related health hazard, including both mental and physical health outcomes?
- What socio-cultural or biological factors (e.g. sex, gender, diet, age, occupation, livelihoods, reliance on the land? etc.) could contribute to making some groups more vulnerable than others?
- What are some of the differential impacts of climate change on populations of concern?
- Which climate-sensitive health outcomes are of greatest concern for stakeholders and the public?
- What are some of the possible climate change impacts on health systems related to each health hazard (e.g. health facilities)?
- Did recent extreme weather and climate events raise concerns about specific health risks facing individuals in your community or region?
- Were recent assessments conducted in the region in other sectors that highlighted issues affecting health?
- Are neighbouring health jurisdictions also conducting a health vulnerability and adaptation assessment that you might learn from?

TABLE 2. Template for Step 1a: Priority health hazards

HEALTH HAZARD EXAMPLES	HEALTH OUTCOME INDICATOR EXAMPLES	POPULATIONS OF CONCERN	HEALTH SYSTEM IMPACTS	DATA AND INFORMATION*	KNOWLEDGE GAPS
Extreme temperature (heat, cold) events	• Heat-related morbidity and mortality • Cold-related morbidity and mortality	Example for consideration: Elderly people may be at higher risk to extreme temperatures due to poor thermoregulation.	E.g. potential for rolling blackouts at healthcare facilities during heat waves		
Other extreme weather events (e.g. storms, floods, drought)	• Morbidity and mortality from extreme weather events (e.g. injuries, infections, mental health outcomes)	Example for consideration: People who are under-housed and/or underinsured may be at greater risk to extreme weather impacts and subsequent morbidity and mortality.	E.g. surge capacity at healthcare and mental health care facilities during and after extreme weather events and/or damage to health care facilities		
Air quality (aeroallergens, air pollution—ground-level ozone, particulate matter)	• Cardiovascular or respiratory health outcomes from aeroallergens or poor air quality (ground-level ozone, particulate matter)	Example for consideration: People with pre-existing physical health issues, like asthma, may be at greater risk for respiratory outcomes.	E.g. are health facilities adequately safeguarded from wildfire smoke		
Food and water security (including access to traditional foods)	• Proportion of community members with nutritionally and culturally adequate diets • Per capita water use	Example for consideration: Indigenous community members who may not have adequate access to safe traditional foods.	E.g. are psychosocial supports in place for those reliant on predictable weather and climate conditions, such as farmers, foresters, fishers, etc.		

HEALTH HAZARD EXAMPLES	HEALTH OUTCOME INDICATOR EXAMPLES	POPULATIONS OF CONCERN	HEALTH SYSTEM IMPACTS	DATA AND INFORMATION*	KNOWLEDGE GAPS
Food- and water-borne illnesses	• Illnesses or outbreaks due to food-, or water-borne diseases	Example for consideration: Minority linguistic communities may not have access to warnings about food and water-borne outbreaks. Pregnant women and children are at greater risk of food-and water-borne disease outcomes.	E.g. surge capacity at healthcare facilities		
Vector-borne diseases (Lyme disease, West Nile Virus)	• West Nile Virus incidence • Lyme disease incidence • Other vector-borne disease incidence	Example for consideration: People who work outdoors or people experiencing homelessness may be at greater risk for exposure.	E.g. access to appropriate diagnostic and treatment options in your region		
Stratospheric ozone depletion	• Cases of sunburns, skin cancers, cataracts and eye damage	Example for consideration: People who work outdoors	E.g. access to appropriate diagnostic and treatment options in your region		

* E.g. datasets, departmental documents, peer-reviewed publications, and internet sources

Step 1b: Project team template

Use this template to list project team members and other relevant information such as their area of responsibility (e.g. health departments managing the health outcome of interest, other sectors whose activities can affect the health outcome), expertise and/or whom they represent (individuals or organizations) and roles in the assessment.

When identifying potential project team members, include the following stakeholders, member types, and considerations:

- Representatives of healthcare providers who would diagnose and treat any identified cases
- Core members of the project team who stay for the entire project
- Ensure a high degree of stakeholder inclusivity while having a small enough team to direct the study most effectively
- Individuals that are working on issues relevant to the mandate of the assessment in other departments or organizations (e.g. experts in disease transmission, experts on sources of ground-level ozone)
- Communication experts to discuss how to present the results to the public in ways that empower appropriate behavioural changes
- Additional resource persons with targeted expertise on specific topics, such as health systems operations
- Indigenous and local knowledge holders
- Project team members that are representative of the local community in terms of both cultural background and gender
- Project team members that are familiar with the health concerns of segments of the population who are unlikely to be represented on the project team (e.g. the elderly or very young)

TABLE 3. Template for Step 1b: Project team

This workplan should specify the management plan, key responsibilities, activities, timeline and resources needed for the assessment. Use this template to document key milestones or deliverables, deadlines, resources, major stakeholders and key contacts for undertaking the assessment steps. Adapt the work plan template to suite the specific information needs of the assessment.

PROJECT TEAM MEMBER	CONTACT INFORMATION	AREA OF EXPERTISE	ROLES AND RESPONSIBILITIES (e.g. write report, conduct literature review, conduct statistical analysis, provide perspectives on health outcomes of populations of concern, organize meetings and stakeholder workshops etc.)

Step 1c: Work plan template

TABLE 4. Template for Step 1c: Work plan

Use this template to specify the primary assessment output (e.g. technical report), to whom it will be communicated, mechanisms for sharing the results (e.g. webinars, workshops), and if outreach materials (e.g. factsheets, slide show presentations, posters) will be developed to communicate results.

ASSESSMENT STEP	MILESTONE OR DELIVERABLE	DEADLINE	RESOURCES	MAJOR STAKEHOLDERS	LEAD OR KEY CONTACT
1. Frame and scope the assessment					
2. Describe current risks including vulnerabilities and capacities					
3. Project future health risks (Including both mental and physical health risks)					
4. Identify and prioritize policies and programs to increase climate-resilience of health systems					
5. Establish an iterative process for managing and monitoring health risks					
6. Examine potential health benefits and co-harms of adaptation and mitigation options implemented in other sectors					

Step 1d: Communication plan template

TABLE 5. Template for Step 1d: Communication plan

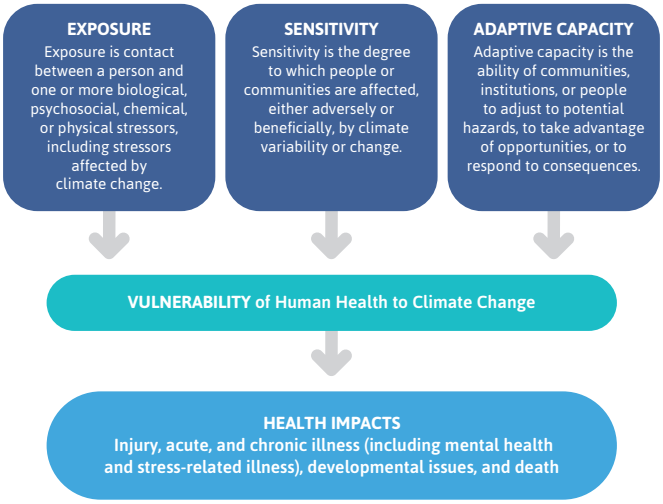
ASSESSMENT MILESTONE/OR EVENT	OUTPUT/OUTCOME	TARGET AUDIENCE (e.g. decision-makers, public, populations of concern)	COMMUNICATION MECHANISM (e.g. webinar, outreach materials)
1. Assessment launch			
2. Assessment awareness and engagement			
3. Draft report release for review			
4. Final report release			
5. Post assessment engagement			

STEP 2: DESCRIBE CURRENT RISKS INCLUDING VULNERABILITIES AND CAPACITIES

STEP 2: OVERVIEW

This step is undertaken to describe current climate-related health risks. Describing current climate-related health risks involves understanding the past and current climate, and measuring individual and community level vulnerabilities. Vulnerability is determined by measuring the exposure of individuals to the climate-related hazard, their sensitivities, as well as capacity of individuals, communities, and health systems to cope with exposure risks.

FIGURE 2. Determinants of vulnerability[8]



This information provides the context for understanding where modifications to current programs could help protect health as the climate continues to change. The knowledge gained by completing this step will help inform an assessment of health system resilience to be completed in Step 4.

STEP 2A: REVIEW QUALITATIVE AND QUANTITATIVE INFORMATION

The datasets, departmental documents, peer-reviewed publications, and internet sources identified during step 1 should be reviewed for relevant information on the priority health hazards, risks and vulnerabilities. Where necessary, further research should be conducted. Gaps in knowledge can be filled, to some extent, by interviewing subject matter experts to describe vulnerabilities and by consulting populations of concern (e.g. through focus groups). Keep track of the information collected in order to quickly reference and analyze the data and to inform the assessment report.

STEP 2B: ESTIMATE CURRENT RELATIONSHIPS BETWEEN WEATHER PATTERNS AND CLIMATE-SENSITIVE HEALTH OUTCOMES

Determine the associations (if any) between the exposures and the incidence, seasonality, and geographic range of the climate-sensitive health outcomes under consideration.

[8] US Global Change Research Program. 2016.

Graphing the data may prove useful for identifying patterns, particularly with limited time series. It is important to consider factors that could influence any observed trends in health outcomes such as changes in disease control programs and changes in land use. There will be more confidence in analyses conducted using longer and larger health data sets.

When sufficient data are not available, estimates of the strength of associations can be gathered from the published literature or from interviews with subject matter experts. This information can be used to describe exposure-response relationships. Survey questionnaires may be useful for obtaining useful information. Refer to the 'Estimating current relationships' template to help document relevant information.

STEP 2C: DESCRIBE HISTORICAL TRENDS IN THE CLIMATE-RELATED HAZARDS OF INTEREST

Collect data and maps on recent weather and climatic trends for priority hazards of interest. Data can be obtained from provincial/territorial agencies, Natural Resources Canada (the atlas of Canada), Environment and Climate Change Canada's Canadian Centre for Climate Services and Climate Data Canada, among other places.

Document how the geographic range, intensity, and duration of particular weather events important to health outcomes have changed over recent decades. Consulting a meteorologist or climatologist can be helpful to ensure data are interpreted appropriately.

STEP 2D: CHARACTERIZE THE CURRENT VULNERABILITY OF INDIVIDUALS AND COMMUNITIES

The extent to which a particular group is impacted by a specific health hazard reflects the balance between factors that increase sensitivity and the adaptive capacity to reduce exposures.

Sensitivity is an expression of the increased responsiveness of an individual or community to an exposure, generally for biological reasons (e.g. age or the presence of pre-existing medical conditions), social factors (e.g. marginalized due to race, gender, socioeconomics) and geographic factors (e.g. living on flood plains or in coastal communities).

Health systems may be susceptible to exposure due to: poor infrastructure, geographic location (e.g. located in floodplains); and/or being under-resourced (e.g. understaffed or underfinanced).

Adaptive capacity refers to the ability of an individual or community to reduce the health effects of climate change including efforts to plan for, respond to, and recover from exposures to climate change-related hazards.

Use vulnerability indicators for each climate hazard and pose questions to obtain indicator data. When collecting data, consider those individuals and communities that are of most concern. Refer to the 'Vulnerability indicators' template for examples and to record relevant information.

STEP 2E: DESCRIBE AND ASSESS THE EFFECTIVENESS OF POLICIES AND PROGRAMS TO MANAGE CURRENT VULNERABILITIES AND HEALTH BURDENS

Generate a list of all existing policies and programs at all governance levels (i.e. community/neighbourhood, municipal, county/regional, provincial/territorial and federal) that affect the climate-sensitive health outcomes considered in the assessment. Using evaluations or expert judgement determine how well policies and programs are protecting individuals and communities against climate-related hazards. Consider the effectiveness of current programs/systems in reducing morbidity and mortality (particularly for populations of concern), the quality of program management and delivery, (e.g. infectious disease monitoring and surveillance) and whether existing measures are sufficient for reducing risks. If there are planned changes to any of these policies or programs it may be worthwhile to evaluate them in both their current and future form. Refer to the 'Effectiveness of policies and programs' template to help document relevant information.

ASSESSMENT TEMPLATES

The following templates are available to help complete Step 2 of the Vulnerability and Adaptation Assessment:

2b) Estimating current relationships

2d) Vulnerability indicators

2e) Effectiveness of policies and programs

Step 2b: Estimating current relationships between weather patterns and climate-sensitive health outcomes template

Determine the associations (if any) between the exposures and the incidence, seasonality, and geographic range of the climate-sensitive health outcomes under consideration. The estimating current relationships template includes guiding questions and examples of key relationships that could be examined. In the last column of the template, indicate if the information is available and accessible. If it is not readily available or accessible, indicate how the data could be obtained (e.g. conduct a literature search, conduct interviews with subject matter experts, conduct focus groups with populations of concern and access Indigenous and local knowledge by partnering with Indigenous Peoples and community members). Experts can provide estimates of the impacts of extreme weather, such as the impact of extreme heat events on excess mortality or of heavy precipitation events on episodes of gastrointestinal diseases, which can be used to describe exposure-response relationships. If interviews with experts will be conducted, identify key respondents who have carried out other assessments or studies. Create survey questionnaires and keep track of the information collected in order to quickly reference and analyze the data. Where relevant indicate if sex-disaggregated data is available. If it is not, consider how it may be obtained.

TABLE 6. Template for Step 2b: Estimating current relationships

EXAMPLES OF HEALTH HAZARDS	EXAMPLES OF GUIDING QUESTIONS	INDICATORS OF DURATION, INTENSITY, FREQUENCY, SEASONALITY AND GEOGRAPHIC RANGE FOR HAZARD OF INTEREST	INDICATORS OF MORTALITY OR MORBIDITY	IS THIS INFORMATION AVAILABLE/ACCESSIBLE? IF SO RECORD THIS INFORMATION. IF NOT, HOW CAN IT BE OBTAINED?
Extreme temperature (heat and cold events)	• Is the population widely exposed to extreme heat or cold? If so, which populations are exposed (e.g. populations of concern)? • What is the incidence of heat- or cold-related illnesses or deaths? • Is there a particular seasonality that characterizes the heat- or cold related health outcomes? • What is the geographic range within which heat- or cold related health hazards pose health risks to individuals? • What is the current impact of *insert health hazard* on morbidity and/or mortality? How does this vary with changes in duration, intensity and frequency of the hazard?	• Number of extreme heat and/or cold days • Number of extreme heat and/or cold events • Number of heat alerts called	• Number of heat or cold related hospital visits • Number of deaths attributable to heat or cold • Number of heat or cold-related illnesses	

EXAMPLES OF HEALTH HAZARDS	EXAMPLES OF GUIDING QUESTIONS	INDICATORS OF DURATION, INTENSITY, FREQUENCY, SEASONALITY AND GEOGRAPHIC RANGE FOR HAZARD OF INTEREST	INDICATORS OF MORTALITY OR MORBIDITY	IS THIS INFORMATION AVAILABLE/ACCESSIBLE? IF SO RECORD THIS INFORMATION. IF NOT, HOW CAN IT BE OBTAINED?
Air quality (aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)	• Is the population exposed to air pollution, aeroallergens or wildfire smoke? If so, which populations are exposed (e.g. populations of concern)? • What is the incidence of respiratory conditions attributable to air pollution, aeroallergens or wildfire smoke? • Are there certain times of the year when air pollution, aeroallergens and wildfire smoke pose the greatest human health risks? • What is the geographic range within which air pollution, aeroallergens and wildfire smoke poses health risks to individuals? • What is the current impact of *insert health hazard* on morbidity and/or mortality? How does this vary with changes in duration, intensity and frequency?	• Number of smog days • Number of high allergen days • Duration of allergy season • Number of poor air quality days due to wildfire smoke • Geographic range of poor air quality	• Number of hospital visits attributable to smog • Number of hospital visits due to exposure to wildfire smoke • Number of hospital visits attributable to allergies • Number of deaths attributable to poor air quality	
Other extreme weather events (e.g. storms, floods, drought)				
Food and water security (including access to traditional foods)				

EXAMPLES OF HEALTH HAZARDS	EXAMPLES OF GUIDING QUESTIONS	INDICATORS OF DURATION, INTENSITY, FREQUENCY, SEASONALITY AND GEOGRAPHIC RANGE FOR HAZARD OF INTEREST	INDICATORS OF MORTALITY OR MORBIDITY	IS THIS INFORMATION AVAILABLE/ACCESSIBLE? IF SO RECORD THIS INFORMATION. IF NOT, HOW CAN IT BE OBTAINED?
Food- and water-borne illnesses				
Vector-borne diseases (Lyme disease, West Nile Virus)				
Stratospheric ozone depletion				

Step 2d: Vulnerability indicators template

Use this template to document information on the sensitivity and adaptive capacity of individuals and communities to climate-related health hazards. Many indicators are relevant for all climate-related health hazards (i.e. they provide useful information about vulnerability for many or all hazards), while others are specific to one or a few. Examples of vulnerability indicators are provided in the template to help guide data collection. Data from these indicators will also be useful for monitoring adaptation success.
See Step 5b: 'Monitoring indicators' template.

TABLE 7. Template for Step 2d: Vulnerability indicators

HEALTH HAZARD EXAMPLES	VULNERABILITY CATEGORY	EXAMPLES OF VULNERABILITY INDICATORS	DATA SOURCE	VULNERABILITY RANKING (LOW-MEDIUM-HIGH)	EXPLANATION FOR VULNERABILITY RANKING
Extreme temperature (heat, cold) events	Exposure	• Maximum and minimum temperatures, heat index • Increase in heat alerts/warnings • Projected hot days and warm nights • Projected cold days • Projected air temperature seasonal changes and extremes • Proportion of the population living in an urban heat island			
	Sensitivity	• Socially and economically disadvantaged populations (including the under-housed) • Number of people with conditions that inhibit temperature regulation, including mental health conditions (e.g. schizophrenia) • Number of elderly people in the geographic area(s) exposed to the hazard • Number of children in the geographic area(s) exposed to the hazard • Heat-related morbidity and mortality • Cold-related morbidity and mortality • Number of people who work outdoors in the geographic area(s) exposed to the hazard • Number of pregnant and nursing women in the geographic area(s) exposed to the hazard • Number of people who may practice activities that increase their sensitivity to health hazards (e.g. fasting) in the geographic area(s) exposed to the hazard • Physical illness and/or impairment • Mental illness and/or impairment			
	Adaptive capacity	• Health and social services available and accessible • Proportion of the population without air conditioning • Social and financial capital • Access to cooling centers • Number of heat wave early warning systems • Number of municipal heat island mitigation plans			

HEALTH HAZARD EXAMPLES	VULNERABILITY CATEGORY	EXAMPLES OF VULNERABILITY INDICATORS	DATA SOURCE	VULNERABILITY RANKING (LOW-MEDIUM-HIGH)	EXPLANATION FOR VULNERABILITY RANKING
Other extreme weather events (e.g. storms, floods, drought)	Exposure	• Historical precipitation intensity, duration and frequency patterns • Projected precipitation intensity, duration and frequency patterns • Historical frequency, severity, distribution, and duration of wildfires, flooding, droughts and other extremes • Projected frequency, severity, distribution, and duration of wildfires, flooding, droughts and other extremes • Proportion of the population living on or near flood plains			
	Sensitivity	• Socially and economically disadvantaged populations • Number of people with mobility limitations in the geographic area(s) exposed to the hazard • Number of elderly people in the geographic area(s) exposed to the hazard • Number of pregnant and nursing women in the geographic area(s) exposed to the hazard • Number of children in the geographic area(s) exposed to the hazard • Number of people who drink alcohol, use illicit substances or take medication in the geographic area(s) exposed to the hazard • Morbidity and mortality from extreme weather events (e.g. injuries, infections, mental health outcomes) • Number of people with pre-existing mental health problems or illnesses in the geographic area(s) exposed to the hazard • Number of under and uninsured people/families/ households in the geographic area(s) exposed to the hazard • First-responders are adequately prepared and equipped (including being equipped with mental health first-aid and access to psychosocial supports) • Those who work outdoors (e.g. utility workers, farmers and agricultural workers)			

HEALTH HAZARD EXAMPLES	VULNERABILITY CATEGORY	EXAMPLES OF VULNERABILITY INDICATORS	DATA SOURCE	VULNERABILITY RANKING (LOW-MEDIUM-HIGH)	EXPLANATION FOR VULNERABILITY RANKING
	Adaptive capacity	• Health and social services available and accessible (including culturally relevant services) • Emergency management programs • Mental health programs focused on reducing negative mental health outcomes from floods, droughts and other extremes (e.g. mental health first aid)			
Air quality (aero-allergens, air pollution from ozone, particulate matter and/ or wildfire smoke)	Exposure	• Stagnation air mass events • Projected ground-level ozone and particulate matter estimates due to climate change • Pollen counts, ragweed presence • Number and duration of smog advisories • Ground-level ozone and particulate matter concentrations and exceedance			
	Sensitivity	• Socially and economically disadvantaged populations • Number of elderly people • Number of children • Number of people with chronic diseases and who smoke tobacco • Cardiovascular or respiratory health outcomes from aeroallergens or poor air quality (ground-level ozone, particulate matter) • Number of persons working outdoors • Daily all-cause mortality (trends associated with air pollution) • Daily non-accidental mortality (trends associated with air pollution)			
	Adaptive capacity	• Health and social services available and accessible (including culturally relevant services) • Health promotion activities on air pollution prevention and protection from air pollutants, aeroallergens or wildfire smoke • Air quality regulations • Proportion of people who use public transportation/ active transportation • Air quality monitoring capabilities			

HEALTH HAZARD EXAMPLES	VULNERABILITY CATEGORY	EXAMPLES OF VULNERABILITY INDICATORS	DATA SOURCE	VULNERABILITY RANKING (LOW-MEDIUM-HIGH)	EXPLANATION FOR VULNERABILITY RANKING
Food and water security (including access to traditional foods)	Exposure	• Availability of nutritious food • Availability of culturally appropriate food • Access to grocery stores that stock fresh foods (including fruits and vegetables) › Distance that must be travelled to access fresh foods • Number of people who rely on small water systems and private wells			
	Sensitivity	• Socially and economically disadvantaged populations • Percentage of household income spent on food • Indigenous populations relying on traditional foods and/or gathered water • Percentage of households that rely primarily on food/grocery retailers that do not stock fresh foods (e.g. convenience stores, quick service restaurants)			
	Adaptive capacity	• Health and social services available and accessible • Number of meal programs and food banks • Local community ability to grow or harvest nutritious and culturally appropriate food			
Food- and water-borne illnesses	Exposure	• Number of people who rely on small water systems and private wells • Those who sometimes use gathered or wilderness water (e.g. water gathered from melt ponds while hunting or camping) • Number of people (including populations of concern e.g. children < 5 years of age) using natural outdoor recreational facilities (e.g. beaches) • Number of people on flood plains • Those who handle raw meat • Those with poor nutrition • Those who work or recreate near harmful algal blooms • Number of outdoor events where food is consumed (e.g. farmers markets) during warm weather			

HEALTH HAZARD EXAMPLES	VULNERABILITY CATEGORY	EXAMPLES OF VULNERABILITY INDICATORS	DATA SOURCE	VULNERABILITY RANKING (LOW-MEDIUM-HIGH)	EXPLANATION FOR VULNERABILITY RANKING
	Sensitivity	• Socially and economically disadvantaged populations • Indigenous populations relying on traditional foods and/or gathered water • People with suppressed or developing immune systems • Those with pre-existing medical conditions (e.g. AIDS, cancer, immune-deficiencies etc.) or who are recovering transplant recipients • Those with asthma • Proportion of population who have been immunized for Rotavirus • Those who use proton pump inhibitors • Those who use corticosteroids			
	Adaptive capacity	• Health and social services available and accessible • Food safety regulations for food processing activities and food premises • Drinking and recreational water quality guidelines and regulations • Water quality advisories and programs • Surveillance of water- and food-borne diseases • Health promotion activities on food safety and drinking water safety			
Vector-borne diseases (Lyme disease, West Nile Virus)	Exposure	• West Nile Virus incidence • Lyme disease incidence • Other vector-borne disease incidence • West Nile disease incidence in humans • *Lyme borreliolis* incidence in humans • Number of positive test results in reservoirs/ sentinels/vectors			

HEALTH HAZARD EXAMPLES	VULNERABILITY CATEGORY	EXAMPLES OF VULNERABILITY INDICATORS	DATA SOURCE	VULNERABILITY RANKING (LOW-MEDIUM-HIGH)	EXPLANATION FOR VULNERABILITY RANKING
	Sensitivity	• Number of elderly people • Number of children • People with suppressed or developing immune systems • Number of persons spending greater time outdoors for recreation • Number of persons working outdoors • Number of persons travelling to other parts of the world where other vector-borne diseases may be endemic			
	Adaptive capacity	• Health and social services • Integrated vector-borne diseases programs (e.g. surveillance and monitoring, larviciding, adulticiding, public awareness campaigns) • Pest management			
Stratospheric ozone depletion (health impacts may include: cases of sunburns, skin cancers, cataracts and eye damage, etc.)	Exposure	• Proportion of the population that does not take protective measures during sunniest parts of the day • Extension of warm season due to climate change			
	Sensitivity	• Number of children • Number of persons working outdoors • Number of persons with skin conditions that increase sun damage risks			
	Adaptive capacity	• Health and social services available and accessible (including culturally relevant services) • Health promotion activities on sun safety/sun damage prevention/cancer prevention • Urban greening/shade policies			

Step 2e: Effectiveness of policies and programs template

Use Table 8 in this template to generate a list of all existing policies and programs that affect the climate-sensitive health outcomes considered in the assessment. Use Table 9 and existing evaluations and/or expert judgement to evaluate the effectiveness of key policies and programs for reducing the relevant climate-related health risks. Two main categories of investigation process and outcome—should be considered when conducting an evaluation. If there are planned changes to any of these policies or programs it may be worthwhile to evaluate them in both their current and future form.

Process and Outcome Evaluations*

Process evaluation determines if the policy or program has been carried out as planned and whether each component of the policy or program has been operating effectively. It involves gathering data during implementation to assess program-specific issues of relevance and performance as well as design and delivery. The evaluation should address pre-identified questions using a set of indicators. Data sources could include: financial reporting information, interviews, meeting summaries, website usage statistics and other inquiries received and table-top exercises.

Outcome evaluation focuses on the impact of the policy or program based upon the policy or program goals and objectives. An evaluation should be focussed on issues of greatest concern to partners and stakeholders, while being as simple and cost-effective as possible. It is most appropriate for well-developed policies or programs that have made progress towards achieving intermediate objectives and ultimate goals. This type of evaluation should focus on policy or program effectiveness by measuring changes in morbidity and mortality and the impact of the public health interventions on awareness, knowledge, understanding and behavioural change. Outcome evaluations may need more resources because they require several years of observation, the establishment of baseline data, access to hospitalization and annual mortality data, and the expertise of an epidemiologist to conduct the analysis. A detailed analysis of health outcomes based on only a few years of implementation of the program or policy will likely convey a limited understanding of program impact and effectiveness.

* *Adapted from Heat Alert and Response Systems to Protect Health: Best Practices Guidebook*. Health Canada. Ottawa, Ontario: Her Majesty the Queen in Right of Canada represented by the Minister of Health. 2012. www.hc-sc.gc.ca/ewh-semt/alt_formats/pdf/pubs/climat/response-intervention/response-intervention-eng.pdf

TABLE 8. Template for generating a list of existing policies or programs that affect climate-sensitive health outcomes

EXAMPLES OF HEALTH HAZARDS	POLICIES OR PROGRAMS	EVALUATION DATA SOURCES
General	1.	
	2.	
	3.	
	4.	
	5.	
Extreme temperature (heat, cold) events	1.	
	2.	
	3.	
	4.	
	5.	
Other extreme weather events (e.g. storms, floods, drought)	1.	
	2.	
	3.	
	4.	
	5.	
Air quality (aero-allergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)	1.	
	2.	
	3.	
	4.	
	5.	
Food and water security (including access to traditional foods)	1.	
	2.	
	3.	
	4.	
	5.	
Food- and water-borne illnesses	1.	
	2.	
	3.	
	4.	
	5.	

EXAMPLES OF HEALTH HAZARDS	POLICIES OR PROGRAMS	EVALUATION DATA SOURCES
Vector-borne diseases (e.g. Lyme disease, West Nile Virus)	1.	
	2.	
	3.	
	4.	
	5.	
Stratospheric ozone depletion (health impacts may include: cases of sunburns, skin cancers, cataracts and eye damage, etc.)	1.	
	2.	
	3.	
	4.	
	5.	

TABLE 9. Template for conducting a process and/or outcome evaluation of a climate change and health policy or program

Policy or program name: **Completed by:**

Date template completed:

* *1 = Highly effective, 2 = Somewhat effective, 3 = Not effective, 4 = Unknown*

EVALUATION TYPE	EXAMPLE EVALUATION QUESTIONS	INDICATOR EXAMPLES	EVALUATION DATA	UNINTENDED CONSEQUENCES†	EVALUATION RESULT*
Process	Operational Costs				
	• Has the policy or program been carried out as planned? • Has each component of the policy or program been operating effectively? • What are the operational costs (resources used)? • Were processes involved in implementing the policy/ program efficient?	• Resources used by each partner to implement program • Resources required for collecting and monitoring surveillance data • Staff time spent on the implementing the policy or program at various stages • Costs to communicate messages to stakeholders and the public • Costs of maintaining the policy or program			
	Protocols/processes				
	• Was information provided to stakeholders accurate? • Were relevant stakeholders engaged? • Did stakeholders find the process useful and helpful? • Are intended responses being followed through by the public or other stakeholders?	• Frequency of partner notification and public alerts • Timeliness of alert information received • Timeliness and efficiency of message delivery to the public • Quality of surveillance data • Frequency of warnings and alerts issued in relation to actual weather conditions occurring • Capacity of participating agencies to monitor and deliver surveillance and weather data			

EVALUATION TYPE	EXAMPLE EVALUATION QUESTIONS	INDICATOR EXAMPLES	EVALUATION DATA	UNINTENDED CONSEQUENCES†	EVALUATION RESULT*
	Stakeholder engagement				
	• Were relevant and key messages being provided to the public in a timely manner? • Do messages consider populations of concern? • Is the target population aware of the policy/ program and do they comprehend the messages? • Are hard-to-reach populations included in awareness-raising efforts for policies/programs?	• Level of participation of agencies and other community groups in education activities • Number and types of response measures delivered by stakeholders • Number and diversity of engaged stakeholders and meeting frequency • Partners' views on the degree of coordination of activities • Stakeholders' views on the adequacy of support offered • Level of stakeholder satisfaction • Number of people identified as belonging to a population of concern who took preventive actions • Number of people, their demographic makeup (e.g. sex, gender, age, ethnicity, socioeconomic status, etc.), and degree of compliance with intended responses • Number of people and their demographic makeup (e.g. sex, gender, age, ethnicity, socioeconomic status, etc.), who took advantage of other response measures			

EVALUATION TYPE	EXAMPLE EVALUATION QUESTIONS	INDICATOR EXAMPLES	EVALUATION DATA	UNINTENDED CONSEQUENCES†	EVALUATION RESULT*
	Communication				
	• Was communication effective?	• Number of planned communication elements delivered • General populations and populations of concern reached by each communication element • Number and types of inquiries received • Number and types of resources distributed • Promotion and publicity received through media activities • Number of media and information sources engaged as part of the outreach campaign • Reach of key messages into media • Accessibility of information to the public • Number of at-risk people who perceive the hazard(s) to be a health risk • Number of at-risk people who can identify preventive measures • Capacity of targeted population to recall accurate messaging			

EVALUATION TYPE	EXAMPLE EVALUATION QUESTIONS	INDICATOR EXAMPLES	EVALUATION DATA	UNINTENDED CONSEQUENCES[†]	EVALUATION RESULT*
Outcome	• Has progress been made towards achieving intermediate objectives and ultimate policy or program goals? • Has the policy or program been effective in reducing health risks or negative health outcomes as intended? • Has morbidity or mortality decreased due to the public health intervention? • Does the public health intervention address health equity? If so, in what capacities? • Has the public health intervention lead to a desired change in awareness, knowledge, understanding and behavioural change?	• Number of daily deaths relative to historical baseline • Number of daily emergency calls attributable to the hazard(s) • Number of daily emergency room visits and hospitalizations attributable to the hazard(s) • Changes in health protective behaviours of at-risk population • Changes in public awareness, knowledge, beliefs and changes in service utilization			

[†] Did the process or outcome result in unintended outcomes for specific population groups, especially for populations of concern?

STEP 3: PROJECT FUTURE HEALTH RISKS

STEP 3: OVERVIEW

This step requires consideration of how the current magnitude and pattern of climate-sensitive health burdens could change in a changing climate. For this step, build on information that was collected in Step 2b (refer to the 'Estimating current relationships' template).

This step requires input from experts as well as access to both significant quantities of data and sources of relevant literature. This should be noted when planning how to best approach this step.

STEP 3A: REVIEW QUALITATIVE AND QUANTITATIVE INFORMATION

Explore datasets, department documents, peer-reviewed publications, and internet sources to identify relevant information. Collect information to answer questions about projected health burdens from climate change such as: how could climate change affect air pollution or the frequency, intensity, and duration of future extreme heat events? When information is unavailable, seek insight from experts.

STEP 3B: DESCRIBE HOW CURRENT RISKS COULD CHANGE UNDER DIFFERENT WEATHER AND DEVELOPMENT PATTERNS

Determine the time frame for projecting future health risks. Confidence in climate projections over the next few decades (up to 2040's) is greatest. To project future health risks, a common approach is to multiply current exposure-response relationships by the projected change in the relevant weather variable(s) over the time periods of interest. This approach assumes that current vulnerability will remain the same over the coming decade; which is unlikely. Vulnerability is expected to change as socio-economic, demographic, health system and environmental factors change over time (e.g. impacts of extreme heat on an aging population).

Consider also how weather affects the evolution of climate-sensitive health risks. Aim to estimate how morbidity and mortality associated with climate hazards identified in the assessment could be altered both by climate change and non-climate factors that affect vulnerability of individuals and communities.

Use the following approaches to obtain relevant information:

- Work with modeling experts to obtain quantitative projections of health risks.
- Host an expert meeting (including experts from or familiar with issues relevant to populations of concern) with the goal of describing several possible different pathways affecting vulnerability based on socio-economic, demographic, health system and environmental changes over the next few decades. Efforts should be made to select experts whose experience is reflective of the community being assessed and of populations of concern.
- Use local and regional climate projections from available sources. Scenarios can be created that combine socio-economic and demographic development pathways with climate change projections to facilitate projections that cover a wider range of possible futures.
- Use a qualitative approach, through expert interviews and facilitated discussions, to estimate health risks in the next few decades.
- Engage with Indigenous and local knowledge holders to explore traditional and local knowledge of climate change risks and impacts.
- The projected risks will have several sources of uncertainty. Describe climate uncertainties in the assessment report and the extent to which they could influence projected health risks. Refer to the 'Project future health risks' template to document relevant information for this step.

ASSESSMENT TEMPLATES

The following template is available to help complete Step 3 of the Vulnerability and Adaptation Assessment:

3b) Project future health risks

Step 3b: Project future health risks template

Use this template to document projections of future climate change risks to health. To project future health risks, a common approach is to multiply current exposure-response relationships by the projected change in the relevant weather variable(s) over the time periods of interest. Keep in mind that vulnerability including key aspects of adaptive capacity will also evolve over time. For each climate health hazard of interest, use the guiding questions in this template to collect and document information. Add to the list of questions to focus inquiries and to obtain relevant information for the assessment. It is important to keep in mind that projected changes in climate may or may not take place in the timeframe or to the scale anticipated. Projected changes should influence adaptive responses in relation to the likelihood in which they will occur and the severity of possible health outcomes. To obtain data, employ literature searches, expert interviews (including experts with knowledge on the vulnerability of populations of concern), workshops, consultations with modelling experts, and other approaches. Document uncertainties and underlying assumptions (e.g. expected demographic changes) and how they could affect projected health risks in the template.

TABLE 10. Template for Step 3b: Project future health risks

HEALTH HAZARD EXAMPLES	GUIDING QUESTIONS	TIME PERIOD	PROJECTED CHANGES IN HAZARDS	BASELINE HEALTH RISKS	PROJECTED CHANGES TO HEALTH RISKS	UNCERTAINTIES
Extreme temperatures (heat and cold events)	1. How is climate change expected to affect the hazard (e.g. range of the hazard, intensity of the hazard, frequency of the hazard etc.)?					
	2. How are vulnerability and adaptive capacity expected to change?					
Other extreme weather events (e.g. storms, floods, drought)	1. How is climate change expected to affect the hazard (e.g. range of the hazard, intensity of the hazard, frequency of the hazard etc.)?					
	2. How are vulnerability and adaptive capacity expected to change?					
Air quality (aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)	1. How is climate change expected to affect the hazard (e.g. range of the hazard, intensity of the hazard, frequency of the hazard etc.)?					
	2. How are vulnerability and adaptive capacity expected to change?					
Food and water security (including access to traditional foods)	1. How is climate change expected to affect the hazard (e.g. range of the hazard, intensity of the hazard, frequency of the hazard etc.)?					
	2. How are vulnerability and adaptive capacity expected to change?					

HEALTH HAZARD EXAMPLES	GUIDING QUESTIONS	TIME PERIOD	PROJECTED CHANGES IN HAZARDS	BASELINE HEALTH RISKS	PROJECTED CHANGES TO HEALTH RISKS	UNCERTAINTIES
Food- and water-borne illness	1. How is climate change expected to affect the hazard (e.g. range of the hazard, intensity of the hazard, frequency of the hazard etc.)?					
	2. How are vulnerability and adaptive capacity expected to change?					
Disease vectors (e.g. vectors for Lyme disease and West Nile Virus)	1. How is climate change expected to affect the hazard (e.g. range of the hazard, intensity of the hazard, frequency of the hazard etc.)?					
	2. How are vulnerability and adaptive capacity expected to change?					
Stratospheric ozone depletion (health impacts may include: cases of sunburns, skin cancers, cataracts and eye damage, etc.)	1. How is climate change expected to affect the hazard (e.g. range of the hazard, intensity of the hazard, frequency of the hazard etc.)?					
	2. How are vulnerability and adaptive capacity expected to change?					

STEP 4: IDENTIFY AND PRIORITIZE POLICIES AND PROGRAMS TO INCREASE CLIMATE-RESILIENCE OF HEALTH SYSTEMS

STEP 4: OVERVIEW

The purpose of this step is to identify and recommend options to modify current policies and programs and to assess and foster climate-resilience within health systems. When completing this step, as well all others, it is important to adopt a holistic understanding of health and health equity. Both physical and mental health and the many components of the health system responsible for their promotion, attainment and protection should be considered.

This step involves assessing the current resilience of the health system in question (i.e. a local or provincial/territorial health system) and prioritizing options for modifications and adaptations to address both system-wide issues as well as issues specific to priority health concerns. These options for modifications and adaptations should include considerations for short, medium and long-term needs. The resilience of health systems and the issues they face may change over time. This should be considered when completing this step. Some modifications or adaptations will not lead to immediate results, while others may not be feasible in the short or medium term. These modifications or adaptations should still be considered and may be evaluated further as part of follow-up V&A assessments in the future.

Examples of possible modifications include:

- Strengthening physical health, mental health and environmental health services
- Strengthening early warning systems, disaster risk management and integrated disease surveillance programs
- Improving information sharing (including that attained from early warning systems) amongst the various components of the health system
- Mainstreaming climate change into health policy
- Improving infrastructure and built environment initiatives to include climate change and health considerations
- Strengthening connections between climate-sensitive components of the health system (e.g. healthcare facilities, local disease surveillance units, and provincial/territorial public health agencies)

This step does not present an exhaustive approach to assessing climate-resilience and should be viewed primarily as a means through which to ensure broad health system considerations are incorporated into your assessment. The completion of a V&A is one component of building a climate-resilient health system and can help inform resilience building actions throughout your organization.

STEP 4A: ASSESS HEALTH SYSTEM CLIMATE-RESILIENCE

Where previous steps have focused primarily on evaluating vulnerability and enhancing capacity to deal with priority health hazards facing individuals and communities, this step focuses on health system-wide risks.

Climate-resilience refers to the health system's capacity to[9]:

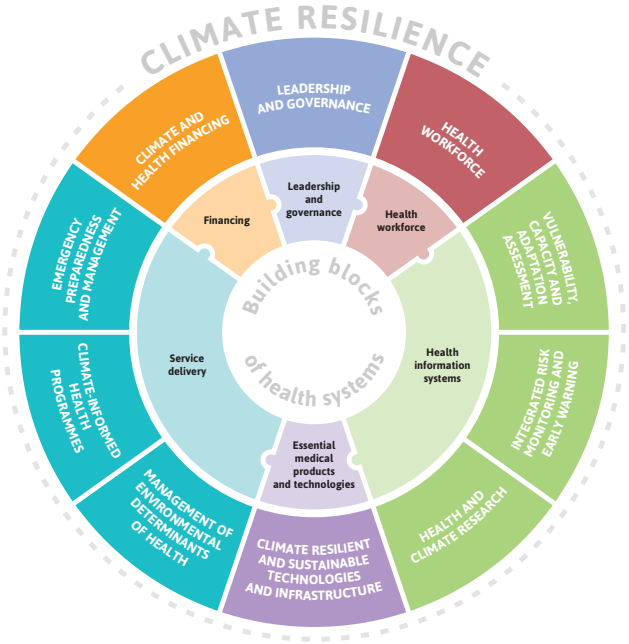
1. Anticipate the impacts of climate change
2. Respond to the impacts of climate change
3. Cope with the impacts of climate change
4. Recover from the impacts of climate change
5. Adapt to the complex challenges brought on by climate change

[9] WHO. 2015. "Operational framework for building climate resilient health systems." http://apps.who.int/iris/bitstream/10665/189951/1/9789241565073_eng.pdf?ua=1

Health systems are made up of a variety of people (patients, healthcare workers, public health representatives, supply-chain workers, etc.), organizations (health ministries, health services organizations, public health organizations, pharmaceutical organizations, health management groups, health research organizations, etc.), and facilities (hospitals, long-term care facilities, clinics, public health units, pharmacies, etc.) that interact to support individual and population-level health. For examples of the components of and actors that operate within or in support of health systems review Table 6 presented in Step 2b.

Climate change threatens the safety and integrity of these people, organizations and facilities and has the potential to disrupt the established arrangements that govern the functioning of health systems. This may result in direct and indirect impacts to the health of Canadians. The WHO has developed an operational framework[10], illustrated in Figure 3, to assist health systems with fostering resilience to climate change within their programing and planning. This step incorporates information presented as part of this framework, as well as information tailored to the Canadian context, such as information that may help public health authorities better serve Indigenous Peoples[11]. Completing this step will help assess how climate change may impact your health system as whole and assist in identifying possible adaptation options to reduce or prevent these impacts.

FIGURE 3. WHO operational framework for building climate resilient health systems.[12]



[10] WHO. 2015. "Operational framework for building climate resilient health systems." http://apps.who.int/iris/bitstream/10665/189951/1/9789241565073_eng.pdf?ua=1

[11] Elliot et al. 2017. "Assessing Resilience of the Canadian Health System to the Impacts of Climate Change: A Proposed Analytical Framework." Report Completed for Health Canada.

[12] WHO. 2015. "Operational framework for building climate resilient health systems." http://apps.who.int/iris/bitstream/10665/189951/1/9789241565073_eng.pdf?ua=1

Use Table 11 of Step 4a for local/regional V&As to gauge the preparedness of local and regional health systems and facilities to the impacts of climate change. Use Table 12 of Step 4a for provincial/territorial analysis. The indicators in the templates are examples for consideration and should be tailored to the needs of specific jurisdictions. Additional indicators may be identified by referring to the academic literature or through discussions with experts and community members. Indicators should be reflective of your vision for a climate-resilient health system in your community or region.

Linkages and interconnections among health systems and health partners at local to national levels are an important aspect of resilience and should be included in the analysis.

STEP 4B: REVIEW QUALITATIVE AND QUANTITATIVE INFORMATION

Build on Step 2e (refer to the 'Effectiveness of policies and programs' template) and Step 4a by collecting information that can be used to identify needed modifications to current policies and programs and new actions to manage climate-related health risks to individuals and increase resilience of the health system.

Collect information by:

- Holding focus groups with health authorities, scientists, researchers, practitioners, and stakeholders within and outside the health sector about the adaptations they have implemented and possible new actions that can address health vulnerabilities
- Conducting a literature review (e.g. peer-reviewed publications, gray literature and other internet sources)

Use the 'Sources for identifying adaptation options' template to document relevant information.

STEP 4C: INVENTORY OPTIONS TO IMPROVE OR IMPLEMENT POLICIES AND PROGRAMS TO MANAGE THE HEALTH RISKS OF CLIMATE CHANGE

Use the information collected from Step 4b to develop an adaptation inventory listing all options irrespective of resource requirements (economic cost, required staff and time). Include potential adaptations to address risks from specific climate hazards (e.g. air pollution, heat waves, vector-borne diseases, etc.) and also to increase the general resilience of the health system (e.g. climate and health financing, leadership, technology development, health professional training, health facility preparedness, etc.). Consider actions to be taken by the health sector and those to be taken by officials in other sectors (e.g. agriculture, transportation, water, urban planning, energy, etc.). Include diverse perspectives, particularly those of Indigenous Peoples and other populations of concern.

When developing the list, include key stakeholders that need to be engaged. For example, when considering strategies to reduce risks from frequent heavy precipitation events or heat waves, representatives from the provincial/territorial environment agency could be involved. Use the 'Options inventory' template to document relevant information.

STEP 4D: PRIORITIZE OPTIONS AND DEVELOP RESOURCE NEEDS

Identify which policies and programs are possible to implement now and in the future based on existing resource constraints (technological, human, and financial). Generate a priority list of options from which policymakers can choose. These options should consider the diversity of the population and adaptation needs that address challenges they may face. They should also include opportunities to increase climate-resilience within the health system and equity of the expected outcomes.

Equity should be defined broadly to include considerations for sex, gender, age, socioeconomic status, and culture.

Use one or more prioritization approaches to identify when adaptation options should be implemented. Ensure that criteria used to identify the priorities are explicitly described. The best options reduce negative health outcomes, support health equity, and increase health system climate-resilience. Examples of criteria for prioritising options include:

- What constraints would need to be addressed so the option(s) are more feasible?
- What options are most effective in reducing health risks?
- What options promote health equity?
- Do any options have unintended negative outcomes and could these impact populations of concern? Consider how best to monitor consequences and potential corrective actions to help minimize any unintended negative outcomes.
- Are adequate financial resources available for implementing and sustaining the option?
- Are some options more socially acceptable and culturally appropriate?

Key considerations when prioritizing options are the current morbidity and mortality from the health outcome of concern, projections of future impacts and how well it is managed with current policies and programs. Use the 'Prioritize options and develop resource needs' template to document relevant information.

STEP 4E: ASSESS POSSIBLE CONSTRAINTS TO IMPLEMENTING OPTIONS AND HOW TO OVERCOME THEM

For each priority policy and program, list possible constraints or barriers to implementing the options by considering the following:

- Technological, human, and financial resources required for implementation
- Expected time frame for implementation
- Other possible implementation requirements

Differentiate constraints (i.e. which can be overcome) from limits (i.e. no adaptation option is possible or available options are too difficult or expensive to implement). Working with other sectors can help overcome adaptation barriers. Include officials from other sectors in discussions of adaptation constraints to identify non-health sector opportunities to advance adaptations, promote population health and enhance the resilience of the health system. List possible constraints, barriers and limits as well as explore how they might be overcome using the 'Possible constraints' template.

STEP 4F: DEVELOP A CLIMATE CHANGE AND HEALTH ADAPTATION PLAN OF ACTION

The information generated in previous steps can be synthesized to develop a climate change and health adaptation plan of action that considers shorter and longer time scales and that facilitates coordination and collaboration with other sectors to promote climate-resilience. The adaptation plan of action does not have to be extensive, but should provide sufficient information so that those not involved in its development can understand it and use it to implement the recommended actions. Therefore, differences in the language and jargon used between sectors should be kept in mind and the clearest terms should be used (e.g. disaster mitigation can also be considered climate change adaptation). When developing the plan it is important to include adaptation options that support health equity (including both gender and cultural) and increased health system resilience.

The plan should link with initiatives to address the risks of climate change in other sectors, and include specific goals and the time frame over which key actions will be accomplished. The plan should include the perspectives and needs of populations of concern, such as Indigenous Peoples and others in the broader community. Depending on the context, the plan may include:

- Expected results
- Specific goals to address populations of concern
- Specific goals for increasing health system resilience
- Milestones

- Sequencing of activities
- Clear responsibilities for implementation
- Required human and financial resources
- Costs and benefits of interventions
- Financing options

The plan should promote coordination and synergies with city and provincial/territorial goals that may be captured in other climate change strategies. Including someone with knowledge of such goals on the project team would be an effective approach to making these linkages.

ASSESSMENT TEMPLATES

The following templates are available to help complete Step 4 of the Vulnerability and Adaptation Assessment:

4a) Assess health system climate- resilience
- Table 11: Local/regional health systems
- Table 12: Provincial/territorial health systems

4b) Sources for identifying adaptation options

4c) Options inventory

4d) Prioritize options and develop resource needs

4e) Possible constraints

Step 4a: Assess health system climate-resilience template—local/regional health systems

Use this template to help assess the resilience of a local or regional health system. The indicators included here are not exhaustive and may not be suitable to your health system. Additional indicators may be identified by referring to the academic literature or through discussions with experts and community members. The indicators used should be reflective of what a climate-resilient health system would look like for your community. Elements of climate-resilience may be similar across health systems (e.g. access to diagnosis and treatment of climate-sensitive health conditions in your region) while others may be specific to the realities of the communities your health system serves.

It is important to be cognisant of the fact that health systems have linkages beyond their local areas to larger provincial/territorial or neighbouring health systems and therefore considering issues beyond your mandate and geographic area may be a valuable exercise.

TABLE 11. Template for Step 4a: Assess health system climate-resilience—local/regional health systems

RELEVANT LEVEL OF GOVERNANCE	EXAMPLE INDICATORS[13]	EXAMPLE METRICS	EXAMPLE RELEVANT STAKEHOLDERS/DATA AND KNOWLEDGE OWNERS	POTENTIAL DATA SOURCES	RESULTS
Local	1. Proportion of health facilities that have completed a resiliency assessment (e.g. the Health Care Facility Climate Change Resiliency Toolkit[14])?	• Proportion of health facilities that have completed a resiliency assessment • Data can be collected via a survey of health facility administrators	• Health facility administrators		
	2. Have populations of concern/climate-sensitive populations been identified in your region?	• Opinions of researchers, public health professionals, and social support professionals › Opinions may be collected via focus groups or surveys	• Researchers • Public health professionals • Social support professionals • Relevant supporting data may be found in census data, community health surveys, data collected by social support groups (e.g. community housing agencies, food banks, etc.), etc.		
	3. What is the knowledge level and perceptions on highly climate-sensitive populations in the region (e.g. the elderly, those that rely on country/traditional foods, etc.)?	• Opinions of expert participants in focus groups › Opinions may be gathered using Likert-like questionnaires	• Public health professionals (including mental health professionals) • Community groups • Local or regional Indigenous organizations		
	4. Is there a climate change and health office in the region?	• Yes or no	• Local public health authority		

[13] Some indicators adapted from Elliot et al. 2017. "Assessing Resilience of the Canadian Health System to the Impacts of Climate Change: AProposed Analytical Framework." Report Completed for Health Canada.

[14] Canadian Coalition for Green Healthcare. 2017. "Health Care Facility Climate Change Resiliency Toolkit." http://greenhealthcare.ca/mentoring/#toolkit

RELEVANT LEVEL OF GOVERNANCE	EXAMPLE INDICATORS[13]	EXAMPLE METRICS	EXAMPLE RELEVANT STAKEHOLDERS/DATA AND KNOWLEDGE OWNERS	POTENTIAL DATA SOURCES	RESULTS
	5. Does your province/ territory have extreme weather warning systems (e.g. heat alert response systems, flood forecasting systems, etc.)? If so, are they established in your region?	• Are extreme weather warning systems present in your province/territory and if so are they established in your region? › If applicable, are extreme weather warning systems established in your region for primary health hazards of concern? • Data could be collected using a focus group	• Provincial/territorial emergency management officials › Local health and emergency management officials		
	6. How dependent on air/ sea/rail links are the supply lines of local pharmacies, health facilities, grocery stores, heating fuel suppliers and energy producers, particularly those located in remote areas?	• How many disruptions of service greater than 3 days in length have taken place in the previous 5 years? • What impact would a 7-day disruption of transportation links have on service providers?	• Local and regional transport operators • Local and regional health-relevant service providers (e.g. pharmacies, health facilities, grocery stores, heating fuel suppliers and energy producers)		
	7. Are dedicated public cool spaces accessible throughout your region during heat waves?	• Perceived level of accessibility to dedicated public cooling spaces • Data may be gathered through focus groups/ questionnaires of community representatives and public health professionals	• Local residents • Community groups • Public health professionals		
	8. Are comprehensive, reliable, and culturally specific health (both physical and mental) indicators available?	• Perceived quality of available indicators by residents and health professionals • Survey of health professionals and community representatives with a series of Likert-scale questions (e.g. quality of indicators on a scale from 1 to 5)	• Public health professionals • Indigenous organizations • Community representatives		

RELEVANT LEVEL OF GOVERNANCE	EXAMPLE INDICATORS[13]	EXAMPLE METRICS	EXAMPLE RELEVANT STAKEHOLDERS/DATA AND KNOWLEDGE OWNERS	POTENTIAL DATA SOURCES	RESULTS
	9. Is there access to diagnosis and treatment of climate-sensitive health conditions in your region (including mental health conditions)?	• How far must the most remote resident of your region travel in order to access diagnosis/ treatment for climate-sensitive conditions (e.g. Lyme disease, West-Nile Virus, gastro-intestinal illness, climate-sensitive mental health conditions such as post-traumatic stress following an extreme weather event, etc.)	• Public health professionals • Health facility administrators • Ministry/Ministries responsible for healthcare • Indigenous organizations • Non-governmental organizations that work with populations of concern (e.g. groups that transport rural patients to health facilities)		
	10. Is the local health work force (including public health professionals, mental health professionals, physicians, nurses and pharmacists, etc.) trained in culturally appropriate climate change research/ surveillance/ treatment?	• Proportion of health workforce that has received training in climate change and health research/ surveillance/ treatment	• Local health workforce • Indigenous organizations • Community groups that work with or represent cultural minorities		
	11. What is the regional uptake of seasonal influenza vaccines?	• Percentage of population that has received an influenza vaccine	• Local public health authority		
	12. Perceived co-ordination with other health sector actors (e.g. disease surveillance units, hospitals, long-term care facilities, public health laboratories, federal and provincial/ territorial partners) on climate change and health?	• Perceived quality of co-ordination with other health sector actors • Survey of local public heath workforce	• Public health workforce		

RELEVANT LEVEL OF GOVERNANCE	EXAMPLE INDICATORS[13]	EXAMPLE METRICS	EXAMPLE RELEVANT STAKEHOLDERS/DATA AND KNOWLEDGE OWNERS	POTENTIAL DATA SOURCES	RESULTS
	13. Perceived co-ordination between health sector and other climate change sensitive units outside of the health sector (e.g. disaster risk reduction, agriculture, water and sanitation, and energy)?	• Perceived quality of co-ordination with non-health sector climate change units • Survey of local public heath workforce	• Public health workforce		
	14. Community knowledge and awareness of climate health impacts?	• Proportion of local residents with knowledge on the health impacts of climate change • Can be gathered through a survey or focus groups (which could target populations of concern)	• Local residents • Members of populations of concern (e.g. elderly residents, members of minority linguistic groups, etc.)		
	15. Perceptions of available social supports during times of emergency?	• Perceived availability and quality of available social supports (including personal support networks) by residents and health professionals • Survey of residents and health professionals with a series of Likert-scale questions (e.g. How comfortable would you be asking your neighbour for help in an emergency on a scale from 1 to 5)	• Local residents • Members of populations of concern • Community groups		
	16. Does your health system use effective risk communication (impact vs. event communication)? Is this communication targeted at populations of concern?	• Perceived effectiveness of communications as perceived by local health professionals, key stakeholders and targeted community members • Data can be collected via focus groups or surveys	• Public health professionals • Key stakeholders and targeted community members		

RELEVANT LEVEL OF GOVERNANCE	EXAMPLE INDICATORS[13]	EXAMPLE METRICS	EXAMPLE RELEVANT STAKEHOLDERS/DATA AND KNOWLEDGE OWNERS	POTENTIAL DATA SOURCES	RESULTS
	17. Has your organization organized training on effective climate change and health communication for stakeholders (e.g. food banks, social support groups, community housing, assisted-living facilities, etc.)?	• Yes or no	• Local public health authority		
	18. Have risk maps been developed for health impacts of concern (e.g. flooding, urban heat, disease vector distribution, etc.)? If so, are they publicly accessible?	• Yes or no	• Public health professionals • Researchers • Municipal environment/ planning departments		
	19. Status of water and food security and food sovereignty amongst populations of concern?	• Proportion of water and food secure households amongst identified populations of concern • Perceptions of the status food sovereignty amongst target populations	• Community members • Social support professionals		
	20. Vulnerability of local communities to climate change driven cultural loss (e.g. loss of cultural sites/ structures, demise of culturally important species, impacts to culturally significant events due to extreme weather such as heat, storms or wildfires, etc.)?	• Perceptions of community members and experts (to establish cultural importance) compares against the anticipated impacts of climate change in scenario-based exercises	• Community members • Climate scientists • Local historians, elders and cultural experts		

RELEVANT LEVEL OF GOVERNANCE	EXAMPLE INDICATORS[13]	EXAMPLE METRICS	EXAMPLE RELEVANT STAKEHOLDERS/DATA AND KNOWLEDGE OWNERS	POTENTIAL DATA SOURCES	RESULTS
	21. Are key community stakeholders (e.g. water authorities, community housing groups, assisted-living facilities, school boards, etc.) including climate projects in future risk assessments?	• Yes or no from key community stakeholders • Data can be gathered via surveys or focus groups	• Key stakeholders		
	22. Does your health authority and/or facilities within your jurisdiction have adequate healthcare surge capacity following extreme weather events (e.g. storms, extreme heat, floods, wildfires, etc.)?	• Is there adequate healthcare surge capacity in your jurisdiction? • Data can be collected through focus groups made-up of key stakeholders, researchers, other experts and community representatives	• Local health authorities • Ministry/Ministries responsible for healthcare • Health facility administrators • Key community organizations and stakeholders (e.g. assisted living organizations)		
	23. Does your health authorities and/or facilities within your jurisdiction have adequate mental healthcare surge capacity following extreme weather events (e.g. storms, extreme heat, floods, droughts, wildfires, etc.)?	• Is there adequate mental health surge capacity within your jurisdiction • Data can be collected through focus groups made-up of key stakeholders, researchers, other experts and community representatives	• Local health authorities • Ministry/Ministries responsible for healthcare • Health facility administrators • Key community organizations and stakeholders (e.g. mental healthcare advocates)		

Step 4a: Assess health system climate-resilience template—provincial/ territorial health systems

Use this template to help assess the resilience of a provincial/territorial health system. The indicators included here are not exhaustive and may not be suitable to your health system. Additional indicators may be identified by referring to the academic literature or through discussions with experts. The indicators used should be reflective of what a climate-resilient health system would look like for your province/territory. Elements of climate-resilience may be similar across health systems (e.g. accessibility of key components of environmental health) while others may be specific to the realities of your health system.

It is important to be cognisant of the fact that health systems have linkages across jurisdictional boundaries actions or impacts felt at, for example, a provincial/ territorial level may be felt both at local and national levels. Therefore considering issues beyond your mandate or geographic area may be a valuable exercise.

TABLE 12. Step 4a: Assess health system climate-resilience—provincial/territorial health systems

RELEVANT LEVEL OF GOVERNANCE	EXAMPLE INDICATORS[15]	EXAMPLE METRICS	EXAMPLE RELEVANT STAKEHOLDERS/DATA AND KNOWLEDGE OWNERS	POTENTIAL DATA SOURCES	RESULTS
Provincial/ Territorial	1. Is there a climate change and health focal point?	• Yes or no	• Ministry/Ministries responsible for public health		
	2. Is there a climate change action plan that includes measures to support health systems?	• Existence of a climate change action plan › Perceived quality of measures and their support for health systems (including considerations for mental health)	• Staff of ministry/ ministries responsible for public health • Researchers • Representatives of local level users (e.g. public health professionals and health facility administrators)		
	3. Has a climate change and health vulnerability and adaptation assessment been completed in your province/territory?	• Yes or no › If yes, when was the last assessment completed?	• Ministry/Ministries responsible for healthcare and public health		
	4. What proportion of key adaptation and mitigation policies have had health impact assessments at the provincial/territorial level?	• Key policies may be identified through expert consultation and the proportion of these that underwent health impact assessments then determined	• Ministry/Ministries responsible for climate change adaptation and mitigation • Climate change adaptation and mitigation researchers		
	5. Proportion of municipalities in your province/territory that have completed climate-related resilience plans?	• Proportion of municipalities that have completed climate-related resilience plans	• Municipalities › Local level emergency managers, business continuity professionals, public health professionals, etc.		

[15] Indicators adapted from Elliot et al. 2017. "Assessing Resilience of the Canadian Health System to the Impacts of Climate Change: A Proposed Analytical Framework." Report Completed for Health Canada.

RELEVANT LEVEL OF GOVERNANCE	EXAMPLE INDICATORS[15]	EXAMPLE METRICS	EXAMPLE RELEVANT STAKEHOLDERS/DATA AND KNOWLEDGE OWNERS	POTENTIAL DATA SOURCES	RESULTS
	6. How accessible are key components of environmental health (e.g. clean drinking water, adequate housing, affordable energy and food security) to those within populations of concern (particularly remote and/or Indigenous populations)?	• Proportion of populations (by region and other relevant delimiters) with access to key components of environmental health	• Ministry/Ministries responsible for public health • Local level public health authorities • Indigenous organizations • Community groups (e.g. homeless shelters) and provincial/territorial community group associations		
	7. Number of academic publications on health and climate compared to other jurisdictions (provinces and U.S. states)?	• Number of academic publications relative to pre-selected peer jurisdictions (e.g. Ontario, Quebec and Michigan)	• Researchers • Universities • Research networks and organizations		
	8. Proportion of local public health agencies that have completed climate change and health vulnerability and adaptation assessments?	• Number of local public health agencies that have completed climate change and health vulnerability and adaptation assessments	• Local level public health professionals • Ministry/Ministries responsible for public health		
	9. Proportion of municipalities with established early warning systems and communication strategies?	• Proportion of municipalities with established early warning systems and communication strategies	• Municipalities › Local level emergency managers, business continuity professionals, public health professionals, etc.		
	10. Proportion of provinces/ territories with (or does your province have) models on climate change-related health impacts under different climatic and demographic scenarios?	• Number of provinces Or • Yes or no	• Ministry/Ministries responsible for public health • Researchers • Climate modelling organizations • Provincial/territorial/ federal statistics agencies		

RELEVANT LEVEL OF GOVERNANCE	EXAMPLE INDICATORS[15]	EXAMPLE METRICS	EXAMPLE RELEVANT STAKEHOLDERS/DATA AND KNOWLEDGE OWNERS	POTENTIAL DATA SOURCES	RESULTS
	11. Proportion of health units with climate change and health offices?	• Proportion of health units with a climate change and health office	• Health units		
	12. Knowledge of the make-up and spatial distribution of populations of concern (e.g. how many elderly people with mobility issues live in remote communities or in areas physically exposed to a hazard?)?	• Number of individuals who are part of a population of concern who live in what is deemed to be a remote area or in an area physically exposed to a hazard (e.g. in a flood plain)	• Statistics agencies • Local health authorities • Indigenous organizations • Municipalities • Community groups that work with populations of concern		
	13. Proportion of health units with established early warning information systems and communication strategies?	• Proportion of health units with established early warning information systems and communication strategies	• Local health authorities		
	14. Proportion of health facilities that have completed a climate change and health resilience assessment (e.g. the Health Care Facility Climate Change Resiliency Toolkit[16])?	• Proportion of health facilities in the assessment area that have completed a climate change and health resilience assessment	• Local health authorities • Health facility administrators • Ministry/Ministries responsible for health facilities		
	15. Proportion of health authorities with climate-focused disease vector control programs?	• Proportion of health authorities with climate-focused disease vector control programs	• Local health authorities • Provincial/Territorial public health agency		

[16] Canadian Coalition for Green Healthcare. 2017. "Health Care Facility Climate Change Resiliency Toolkit." http://greenhealthcare.ca/mentoring/#toolkit

RELEVANT LEVEL OF GOVERNANCE	EXAMPLE INDICATORS[15]	EXAMPLE METRICS	EXAMPLE RELEVANT STAKEHOLDERS/DATA AND KNOWLEDGE OWNERS	POTENTIAL DATA SOURCES	RESULTS
	16. Proportion of health authorities with climate change focused programs targeted at populations of concern?	• Survey of local health authorities asking them to verify the existence of focused programs targeted at populations of concern and assess the effectiveness of these programs	• Local health authorities		
	17. Perceived quality of partnerships with Health Canada, the Public Health Agency of Canada and other regional and global partners for managing emerging vector-borne diseases?	• Perceptions on partnerships can be identified through expert focus groups	• Local health authorities • Ministry/Ministries responsible for healthcare and public health • Health Canada • Public Health Agency of Canada		
	18. Proportion of key disaster risk reduction strategies that incorporate climate-related health risks?	• Expert review of disaster risk reduction strategies	• Local health authorities • Ministry/Ministries responsible for healthcare and public health • Ministry/Ministries responsible for disaster risk reduction • Disaster risk reduction and climate change and health researchers		

RELEVANT LEVEL OF GOVERNANCE	EXAMPLE INDICATORS[15]	EXAMPLE METRICS	EXAMPLE RELEVANT STAKEHOLDERS/DATA AND KNOWLEDGE OWNERS	POTENTIAL DATA SOURCES	RESULTS
	19. Is there access to diagnosis and treatment for climate-related health conditions throughout the assessment area?	• How far must the most remote resident of your region travel in order to access diagnosis/ treatment for climate-sensitive conditions (e.g. Lyme disease, West-Nile Virus, gastro-intestinal illness, climate-sensitive mental health conditions such as post-traumatic stress following an extreme weather event, etc.)	• Local health authorities • Ministry/Ministries responsible for healthcare • Indigenous organizations • Non-governmental organizations that work with members of populations of concern (e.g. groups that help transport rural patients to health facilities)		
	20. Do health authorities/ facilities have adequate healthcare surge capacity following extreme weather events (e.g. storms, extreme heat, floods, wildfires, etc.)?	• Proportion of health authorities/facilities with mental health surge capacity	• Local health authorities • Ministry/Ministries responsible for healthcare • Health facility administrators		
	21. Do health authorities/ facilities have adequate mental healthcare surge capacity following extreme weather events (e.g. storms, extreme heat, floods, droughts, wildfires, etc.)?	• Proportion of health authorities/facilities with mental health surge capacity	• Local health authorities • Ministry/Ministries responsible for healthcare • Health facility administrators		

Step 4b: Sources for identifying adaptation options template

Use this template to identify sources of information to help identify potential modifications to policies and programs to reduce current and future health risks from climate change. A range of information sources can be used to identify and collect relevant information (e.g. interviews, literature reviews, workshops, consultations with other health authorities, etc.).

TABLE 13. Template for Step 4b: Sources for identifying adaptation options

HEALTH HAZARD EXAMPLES[17]	GUIDING QUESTIONS	KEY EXPERTS, LITERATURE, DATA COLLECTION OPPORTUNITIES
Extreme temperature (heat, cold) events	1. Who is aware of or has implemented (possible) adaptations (e.g. scientists, researchers, government health agencies, non-governmental organizations, staff within your organization, or other public health agencies)? a. Have other health jurisdictions implemented adaptations that your agency can learn from? b. Could your agency learn from work being done in other provinces/ territories or internationally? 2. What peer-reviewed or grey literature can you draw on to identify possible adaptations? 3. What are some ways this information can be collected from partners and stakeholders (e.g. workshop, webinar, teleconference and facilitated discussions)? 4. Which stakeholders work directly with populations of concern within your study area?	
Other extreme weather events (e.g. storms, floods, drought)		
Air quality (aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)		
Food and water security (including access to traditional foods)		
Food- and water-borne illnesses		
Vector-borne diseases (Lyme disease, West Nile Virus)		
Stratospheric ozone depletion and heat intensity (health impacts may include: cases of sunburns, skin cancers, cataracts and eye damage, etc.)		
Climate risks to the health system		

[17] Draw on results from the 'Project Future Health Risks' template in Step 3 to select climate change-related health hazards which are most relevant to your community.

Step 4c: Options inventory template

Use this template to develop a list of adaptation options. Refer to the information collected in Step 4b (and documented in the 'Sources for identifying adaptation options' template) to develop the inventory of potential adaptation options. Include potential adaptations to address risks from specific climate health hazards and also to reduce climate-related risks to the health system (e.g. climate and health financing, leadership, technology development, health professional training, health facility preparedness etc.). Also, include in the template a proposed timeframe for the implementation of the adaptation option and any key stakeholders that may need to be engaged when prioritizing potential options. It is important to consider how these adaptation options may impact health equity and health system resilience.

TABLE 14. Template for Step 4c: Options inventory

HEALTH HAZARD EXAMPLES	POTENTIAL ADAPTATION OPTIONS	TIMEFRAME FOR IMPLEMENTATION	STAKEHOLDERS TO ENGAGE
Extreme temperature (heat, cold) events			
Other extreme weather events (e.g. storms, floods, drought)			
Air quality (aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)			
Food and water security (including access to traditional foods)			
Food- and water-borne illnesses			
Vector-borne diseases (Lyme disease, West Nile Virus)			
Climate risks to the health system			
Stratospheric ozone depletion and heat intensity (health impacts may include: cases of sunburns, skin cancers, cataracts and eye damage, etc.)			

Step 4d: Prioritize options and develop resource needs template

Use this template to prioritize the adaptation options. This prioritization should reflect the perspectives of community members (particularly populations of concern) and should be based on feedback from community stakeholders, partners (e.g. Indigenous Peoples) and experts (e.g. health researchers).

TABLE 15. Template for Step 4d: Prioritize options and develop resource needs

HEALTH HAZARD EXAMPLES	ADAPTATION OPTION	PRIORITISATION CRITERIA EXAMPLES	OUTCOME OF PRIORITISATION PROCESS (E.G. SCORE/RANKING)
Extreme temperature (heat, cold) events	A.	1. Feasibility	
	B.	2. Effectiveness in reducing health risks, particularly for populations of concern	
Other extreme weather events (e.g. storms, floods, drought)	A.		
	B.		
Stratospheric ozone depletion (health impacts may include: cases of sunburns, skin cancers, cataracts and eye damage, etc.)	A.	3. Effectiveness in reaching populations of concern and reducing health inequities	
	B.		
Air quality (aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)	A.	4. Effectiveness in enhancing health system resilience	
	B.		
Food and water security (including access to traditional foods)	A.	5. Positive/Negative consequences	
	B.	6. Adequate financial resources	
Food- and water-borne illnesses	A.	7. Social acceptability	
	B.		
Vector-borne diseases (Lyme disease, West Nile Virus)	A.	8. Co-benefits	
	B.		
Climate risks to the health system	A.		
	B.		

Step 4e: Possible constraints template

Use this template to list possible constraints or barriers that need to be overcome when implementing the prioritized adaptation options identified in Step 4d. Include possible ways to overcome barriers in the last column.

TABLE 16. Template for Step 4e: Possible constraints

HEALTH HAZARD EXAMPLES	PRIORITIZED ADAPTATION OPTIONS	GUIDING QUESTIONS	POSSIBLE CONSTRAINTS OR BARRIERS	POSSIBLE WAYS TO OVERCOME BARRIERS
Extreme temperature (heat, cold) events	A.	1. What are the possible constraints or barriers that need to be overcome when implementing the prioritized adaptation options? 2. Are populations of concern addressed? If so, how? 3. Is health system resilience addressed? If so, how? 4. What are possible limits, which cannot be overcome? 5. What are the technological, human and financial resources required for implementation? 6. What is the expected time-frame for implementation? 7. What are other possible implementation requirements? 8. Can other sectors be involved in helping overcome adaptation barriers? 9. Are there opportunities to engage other sectors to discuss adaptation constraints and to identify non-health sector opportunities to advance adaptations and promote health?		
	B.			
Other extreme weather events (e.g. storms, floods, drought)	A.			
	B.			
Stratospheric ozone depletion (health impacts may include: cases of sunburns, skin cancers, cataracts and eye damage, etc.)	A.			
	B.			
Air quality (aeroallergens, air pollution from ground-level ozone, particulate matter and/ or wildfire smoke)	A.			
	B.			
Food and water security (including access to traditional foods)	A.			
	B.			
Food- and water-borne illnesses	A.			
	B.			
Vector-borne diseases (Lyme disease, West Nile Virus)	A.			
	B.			
Stratospheric ozone depletion (health impacts may include: cases of sunburns, skin cancers, cataracts and eye damage, etc.)	A.			
	B.			
Climate risks to the health system	A.			
	B.			

STEP 5: ESTABLISH AN ITERATIVE PROCESS FOR MANAGING AND MONITORING HEALTH RISKS

STEP 5: OVERVIEW

Develop an iterative process for managing and monitoring health risks from climate change. This involves:

- Identifying a lead agency to coordinate monitoring and reporting
- Recommending when the climate change and health vulnerability and adaptation assessment should be repeated to identify new risks
- Being aware of changes in the geographic range of health outcomes
- Consulting with partners and stakeholders to help identify and/or inform any possible adjustments to health risk monitoring practices or adaptation projects/programs
- Monitoring how changes in the assessed area (both related to climate and not) may impact the feasibility or utility of climate change adaptation options

STEP 5A: DEVELOP A MONITORING PLAN

Develop a plan for monitoring the burden of health outcomes and the effectiveness of implemented adaptation options. This plan should be inclusive of the health outcomes of the general population as well as those that may be specific to populations of concern (e.g. food insecurity among Indigenous communities driven by loss of access to traditional food sources). This highlights the value of collecting both sex-disaggregated data and data specific to populations of concern. When completed, insert the monitoring plan in the adaptation plan (Step 4e). Morbidity and mortality should decrease with effective adaptation; however, the health burden could increase if climate-related and other factors create new or exacerbate existing risks not addressed by the adaptation measures. The monitoring plan should include:

- What will be monitored
- Frequency of monitoring
- Methods of data analysis and collection (e.g. sex-disaggregated data and data on populations of concern)
- Milestones for evaluation
- Recommended adaptation modifications
- Communication protocol to ensure appropriate and timely adjustments to the adaptation options
- Refer to the 'Monitoring plan' template to collect relevant information.

STEP 5B: DEVELOP INDICATORS FOR MONITORING

An agreed set of minimum indicators and a means of verifying the efficacy and appropriateness of the indicators are needed for measuring the degree of success of health adaptation activities. Work with stakeholders, including those that represent community members and populations of concern, partners and experts to select appropriate indicators.

Select indicators to quantify health burdens over time and include qualitative metrics of the adaptation processes. Categorize indicators into themes if helpful, for example, by health hazard or by key characteristics of vulnerability. Step 1a and Step 2d provide examples of indicators that can be used for monitoring adaptation effectiveness.

Refer to the 'Monitoring indicators' template to compile these indicators. When indicators for monitoring are decided upon, include them in the monitoring plan. If possible, try to utilize existing health indicators and data sources to help reduce the burden and costs of monitoring.

STEP 5C: IDENTIFY AND SHARE LESSONS LEARNED AND BEST PRACTICES

Document lessons learned from implementing adaptations and monitoring adaptation success. Share information with partners and stakeholders to support health authorities as they conduct vulnerability and adaptation assessments and to build adaptive capacity in your jurisdiction.

ASSESSMENT TEMPLATES

The following templates are available to help complete Step 5 of the Vulnerability and Adaptation Assessment:

5a) Monitoring plan

5b) Monitoring indicators

Step 5a: Monitoring plan template

Use this template to develop the monitoring plan. Insert the completed monitoring plan into the adaptation plan (Step 4e). This plan should be inclusive of the health outcomes of the general population as well as those that may be specific to populations of concern (e.g. food insecurity among Indigenous communities driven by loss of access to traditional food sources)

The monitoring plan should include:

- What will be monitored
- Frequency of monitoring
- Methods of data analysis and collection (e.g. sex-disaggregated data and data on populations of concern)
- Milestones for evaluation
- Recommended adaptation modifications
- Communication protocol to ensure appropriate and timely adjustments to the adaptation options

TABLE 17. Template for Step 5a: Monitoring plan

HEALTH HAZARD EXAMPLES	INDICATOR TO BE MONITORED*	FREQUENCY OF MONITORING	METHODS OF DATA ANALYSIS AND COLLECTION	RECOMMENDED ADAPTATION MODIFICATIONS	COMMUNICATIONS ACTIVITIES	FOLLOW-UP ACTION TAKEN
Extreme temperature (heat, cold) events						
Other extreme weather events (e.g. storms, floods, drought)						
Air quality (aeroallergens, air pollution from ground-level ozone, particulate matter and/or wildfire smoke)						
Food and water security (including access to traditional foods)						
Food- and water-borne illnesses						
Vector-borne diseases (Lyme disease, West Nile Virus)						
Stratospheric ozone depletion (health impacts may include: cases of sunburns, skin cancers, cataracts and eye damage, etc.)						

* Use the 'Monitoring Indicators' template (Step 5b) for ideas on what could be monitored.

Step 5b: Monitoring indicators template

Work with stakeholders, including those that represent community members and populations of concern, partners and experts to select appropriate indicators. Select indicators to quantify health burdens over time and include qualitative metrics of the adaptation processes.

This template provides examples of indicators that can be used to monitor adaptation success. Select from this list, or identify new indicators and include them in the monitoring plan. For some indicators, in some locations, it may be difficult to identify data sources. Working with stakeholders, partners, experts, and any nearby health authorities that may have already completed a vulnerability and adaptation assessment may help overcome this challenge.

TABLE 18. Template for Step 5b: Monitoring indicators

HEALTH HAZARDS	VULNERABILITY CATEGORY	EXAMPLES OF VULNERABILITY INDICATORS	DATA SOURCE	METHOD(S) OF VERIFYING EFFICACY AND APPROPRIATENESS OF INDICATORS
Extreme temperature (heat, cold) events	Exposure	• Maximum and minimum temperatures, heat index • Increase in heat alerts/warnings • Projected hot days and warm nights • Projected cold days • Projected air temperature seasonal changes and extremes • Proportion of the population living in an urban heat island		
	Sensitivity	• Socially and economically disadvantaged populations (including the under-housed) • Number of people with conditions (both physical and mental) that inhibit temperature regulation (e.g. schizophrenia) • Number of pregnant and nursing women • Number of elderly people • Number of children • Number of people who work outdoors • Number of people who practice activities that increase their sensitivity to health hazards (e.g. fasting) • Number of people who drink alcohol, use illicit substances or take medication that may be impacted by extreme temperatures • Heat-related morbidity and mortality • Cold-related morbidity and mortality		

HEALTH HAZARDS	VULNERABILITY CATEGORY	EXAMPLES OF VULNERABILITY INDICATORS	DATA SOURCE	METHOD(S) OF VERIFYING EFFICACY AND APPROPRIATENESS OF INDICATORS
	Adaptive capacity	• Health and social services • Proportion of the population without air conditioning • Access to cooling centers • Number of heat wave early warning systems • Number of municipal heat island mitigation plans		
Other extreme weather events (e.g. storms, floods, drought)	Exposure	• Historical precipitation intensity, duration and frequency patterns • Projected precipitation intensity, duration and frequency patterns • Historical frequency, severity, distribution, and duration of wildfires, flooding, droughts and other extremes • Projected frequency, severity, distribution, and duration of wildfires, flooding, droughts and other extremes • Proportion of the population living on or near flood plains		
	Sensitivity	• Socially and economically disadvantaged populations • Number of people with mobility limitations • Number of people who have pre-existing physical and mental health problems or illnesses • People/families/households that are under and/or uninsured • Number of elderly people • Number of pregnant women • Number of children • Number of people who drink alcohol, use illicit substances or take medication • Morbidity and mortality from extreme weather events (e.g. injuries, infections, mental health outcomes)		

HEALTH HAZARDS	VULNERABILITY CATEGORY	EXAMPLES OF VULNERABILITY INDICATORS	DATA SOURCE	METHOD(S) OF VERIFYING EFFICACY AND APPROPRIATENESS OF INDICATORS
	Adaptive capacity	• Availability and accessibility of health and social services (including culturally relevant services) • Emergency management programs • Mental health programs focused on reducing mental health outcomes from floods, droughts and other extremes (e.g. mental health first aid)		
Air quality (aero-allergens, air pollution from ozone, particulate matter and/or wildfire smoke)	Exposure	• Stagnation air mass events • Projected ground-level ozone and particulate matter estimates due to climate change • Pollen counts, ragweed presence • Number and duration of smog advisories • Ground-level ozone and particulate matter concentrations and exceedance		
	Sensitivity	• Socially and economically disadvantaged populations • Number of elderly people • Number of children • Number of people with chronic diseases and who smoke tobacco • Cardiovascular or respiratory health outcomes from aeroallergens or poor air quality (ground-level ozone, particulate matter) • Number of persons working outdoors • Daily all-cause mortality (trends associated with air pollution) • Daily non-accidental mortality (trends associated with air pollution)		

HEALTH HAZARDS	VULNERABILITY CATEGORY	EXAMPLES OF VULNERABILITY INDICATORS	DATA SOURCE	METHOD(S) OF VERIFYING EFFICACY AND APPROPRIATENESS OF INDICATORS
	Adaptive capacity	• Health and social services • Health promotion activities on air pollution prevention and protection from air pollutants, aeroallergens or wildfire smoke • Air quality regulations • Proportion of people who use public transportation/active transportation • Air quality monitoring capabilities		
Food and water security (including access to traditional foods)	Exposure	• Availability of nutritious food • Availability of culturally appropriate food • Access to grocery stores that stock fresh foods (including fruits and vegetables) • Distance that must be travelled to access fresh foods • Number of people who rely on small water systems and private wells		
	Sensitivity	• Socially and economically disadvantaged populations • Percentage of household income spent on food • Indigenous populations relying on traditional foods and/or gathered water • Percentage of households that rely primarily on food/grocery retailers that do not stock fresh foods (e.g. convenience stores, quick service restaurants)		
	Adaptive capacity	• Health and social services available and accessible • Number of meal programs and food banks • Local community ability to grow or harvest nutritious and culturally appropriate food		

HEALTH HAZARDS	VULNERABILITY CATEGORY	EXAMPLES OF VULNERABILITY INDICATORS	DATA SOURCE	METHOD(S) OF VERIFYING EFFICACY AND APPROPRIATENESS OF INDICATORS
Food- and water-borne illnesses	Exposure	• Number of people on small water systems • Number of people using natural outdoor recreational facilities (e.g. beaches) • Number of people on flood plains • Harmful algal blooms • Number of outdoor events (e.g. farmers markets) during warm weather)		
	Sensitivity	• Socially and economically disadvantaged populations • Indigenous populations relying on traditional foods • People with suppressed or developing immune systems • Food-borne diseases or outbreaks • Water-related diseases and infections (drinking and recreational water)		
	Adaptive capacity	• Health and social services • Food safety regulations for food processing activities and food premises • Drinking and recreational water quality guidelines and regulations • Water quality advisories and programs • Surveillance of water- and food-borne diseases • Health promotion activities on food safety and drinking water safety		

HEALTH HAZARDS	VULNERABILITY CATEGORY	EXAMPLES OF VULNERABILITY INDICATORS	DATA SOURCE	METHOD(S) OF VERIFYING EFFICACY AND APPROPRIATENESS OF INDICATORS
Vector-borne diseases (Lyme disease, West Nile Virus)	Exposure	• West Nile Virus incidence • Lyme disease incidence • Other vector-borne disease incidence • West Nile disease incidence in humans • *Lyme borreliolis* incidence in humans • Number of positive test results in reservoirs/sentinels/vectors		
	Sensitivity	• Number of elderly people • Number of children • People with suppressed or developing immune systems • Number of persons spending greater time outdoors for recreation • Number of persons working outdoors • Number of persons travelling to other parts of the world where other vector-borne diseases may be endemic		
	Adaptive capacity	• Health and social services • Vector-borne diseases programs (e.g. surveillance and monitoring, larviciding, adulticiding, public awareness campaigns)		
Stratospheric ozone depletion (health impacts may include: cases of sunburns, skin cancers, cataracts and eye damage, etc.)	Exposure	• Increase or decrease in stratospheric ozone due to climate change • Extension of warm season due to climate change		
	Sensitivity	• Number of children • Number of persons working outdoors • Number of persons with skin conditions that increase sun damage risks		
	Adaptive capacity	• Health and social services • Health promotion activities on sun safety/sun damage prevention/ cancer prevention • Urban greening/shade policies		

STEP 6: EXAMINE THE POTENTIAL HEALTH CO-BENEFITS AND CO-HARMS OF ADAPTATION AND GREENHOUSE GAS MITIGATION OPTIONS IMPLEMENTED IN OTHER SECTORS

STEP 6: OVERVIEW

Climate change adaptation and mitigation options implemented in other sectors can affect public health. Policies and measures in a range of sectors (e.g. energy, water, housing, urban planning, transportation, agriculture, food systems) that are well-designed that give explicit consideration to impacts on human health can result in very large, immediate and long-term health co-benefits and cost savings to the health system. Collaborative efforts to address vulnerabilities to a changing climate can promote resilience in health and other sectors simultaneously. Importantly, if decision makers do not consider health linkages when developing and implementing adaptation and GHG mitigation measures negative health outcomes among the population may result, thereby eroding climate-resilience.

STEP 6A: REVIEW ADAPTATION AND MITIGATION OPTIONS PROPOSED OR IMPLEMENTED IN OTHER SECTORS

Identify proposed and/or implemented adaptation and mitigation strategies in other sectors that may affect health as well as possible adjustments that could promote health by:

- Engaging with other sectors
- Engaging with local or regional climate change programs
- Arranging for an expert evaluation of the human health implications of policies and programs proposed or implemented in other sectors

Health effects from adaptation and mitigation efforts in other sectors are generally unintended and can range from non-existent to highly significant. For example, green roofing has multiple environmental benefits, such as cooling and storm water management, that are likely to have only beneficial or neutral health effects. Changes to industrial processes to reduce carbon dioxide emissions have the potential for human exposures to potentially hazardous materials depending on the technology, the chemicals or other agents involved, and how they are implemented. Refer to the 'Health Implications of Adaptation and Mitigation Options' template to document relevant information.

STEP 6B: IDENTIFY ACTIONS TO MAXIMIZE SYNERGIES AMONG ADAPTATION AND MITIGATION OPTIONS

Greenhouse gas mitigation is a primary prevention health measure that is required and advocated for by public health officials to reduce climate change and associated health risks.

There are many examples of actions that aim to mitigate GHG emissions while at the same time increasing resilience to future climate-related health risks, such as planting trees, buying local food, conserving resources (e.g. water, energy, etc.) and installing green roofs. Refer to the 'Maximizing Synergies Among Adaptation and Mitigation Options' template to document relevant information.

ASSESSMENT TEMPLATES

The following templates are available to help complete Step 6 of the Vulnerability and Adaptation Assessment:

6a) Health implications of adaptation and mitigation options

6b) Maximizing synergies among adaptation and mitigation options

Step 6a: Health implications of adaptation and mitigation options template

Use this template to document proposed and/or implemented adaptation and mitigation strategies in other sectors that may affect health along with recommendations to minimize risks and maximize potential health gains. For example, planting trees, buying local food and installing green roofs might both mitigate greenhouse gas emissions and increase resilience to future climate-related health risks. This template may serve as a means of identifying areas where inter-sectoral partnerships could be formed or where public health officials should develop dialogues in order to convey health concerns and work towards solutions (these may be recorded in the 6b template). It is important to evaluate the identified proposed and/or implemented strategies in the context of health equity and health systems resilience. This includes considering how the impacts of the identified strategies may differ between population groups. When evaluating non-health sector adaptation and mitigation options consider the following:

- Does the adaptation/mitigation option negatively impact or further exacerbate the vulnerability of any group to a health hazard (e.g. a GHG emissions mitigation technology implemented in a manufacturing facility that reduces air quality)?
- Does the adaptation/mitigation option promote health for all groups, particularly populations of concern? If not, can it be modified to promote health for all groups (e.g. an active transport infrastructure project that may serve high-income areas could be extended or modified to be more inclusive)?

TABLE 19. Template for Step 6a: Health implications of adaptation and mitigation options

EXAMPLES OF SECTORS	ADAPTATION AND MITIGATION STRATEGIES THAT CAN AFFECT HEALTH	TIMEFRAME FOR STRATEGY IMPLEMENTATION	HEALTH IMPLICATIONS (SYNERGIES/IMPACTS), IF ANY	RECOMMENDATIONS TO REDUCE RISKS/MAXIMIZE HEALTH BENEFITS
Planning (e.g. Urban)				
Emergency management				
Water and waste-water/ public works				
Conservation and environmental management				
Transportation				
Natural resources				
Parks and recreation				
Infrastructure (e.g. roads, sewers, sidewalks)				
Energy and communications services (e.g. electrical grid capacity, surface and sub-surface electrical wires, telephone and cell phone networks, and information networks)				
Social services				
Tourism/arts/ entertainment				
Waste management				
Housing				
Educational facilities				

Step 6b: Maximizing synergies among adaptation and mitigation options template

Use this template to document actions that aim to mitigate greenhouse gas emissions and also increase resilience to future climate-related health risks. Examples include planting trees, buying local food, and installing green roofs. When identifying synergies, ask the question what is the likelihood/certainty that the program, policy or initiative decreases greenhouse gas emissions as well as reduces current and future health risks from a changing climate? Recommend options that are of high probability and/or certainty for achieving positive outcomes for your jurisdiction.

TABLE 20. Template for Step 6b: Maximizing synergies among adaptation and mitigation options

EXAMPLES OF SECTORS	RECOMMENDATIONS FOR OPTIONS TO MAXIMIZE ADAPTATION AND MITIGATION SYNERGIES
Planning (e.g. Urban)	
Emergency management	
Water and waste-water/ public works	
Energy and communications services	
Conservation and environmental management	
Transportation	
Natural resources	

EXAMPLES OF SECTORS	RECOMMENDATIONS FOR OPTIONS TO MAXIMIZE ADAPTATION AND MITIGATION SYNERGIES
Parks and recreation	
Infrastructure (e.g. roads, sewers, sidewalks)	
Social services	
Tourism/arts/entertainment	
Waste management	
Housing	
Educational facilities	

GLOSSARY OF KEY TERMS

Adaptation: "is the process societies go through in order to prepare for and cope with an uncertain future. Adapting to climate change entails taking measures to reduce the negative effects of climate change—or to take advantage of the positive effects."[i]

Adaptive capacity: "is the ability of a system to adjust to climate change, to moderate potential damages, to take advantage of opportunities, or to cope with the consequences."[ii]

Climate-resilient health systems: "have the ability to anticipate, respond to, cope with, recover from and adapt to climate-related shocks and stresses, so as to bring sustained improvements in population health, despite an unstable climate."[iii]

Health equity: "Within the health system, equity means reducing systemic barriers in access to high quality health care for all by addressing the specific health needs of people along the social gradient, including the most health-disadvantaged populations. Equity planning acknowledges that health services must be provided and organized in ways that contribute to reducing overall health disparities."[iv]

Health system: "(i) all the activities whose primary purpose is to promote, restore and/or maintain health; (ii) the people, institutions and resources, arranged together in accordance with established policies, to improve the health of the population they serve, while responding to people's legitimate expectations and protecting them against the cost of ill-health through a variety of activities whose primary intent is to improve health."[v]

Impact: "an impact is a change in, for example, a health outcome. Impact is used instead of effect to better characterize the often complex interrelationships between changes in weather variables (including extreme weather and climate events) other factors that are important for determining the magnitude and pattern of a health outcome, and the health outcome. For example, changing weather patterns mean that the ticks that can carry Lyme disease are increasing their geographic range in southern Ontario. This change in range along with outdoor activities putting people into contact with ticks, increased forestation in some urban areas, and other factors can affect the distribution and incidence of the disease. Impacts can refer not just to effects on lives, but also on ecosystems, economic status, social and cultural assets, and infrastructure, as well as to effects on geophysical systems, including floods and droughts. The term impact is generally used to describe effects that have occurred."[vi]

Mitigation: "in climate change science, mitigation means human interventions to reduce the sources of greenhouse gasses or enhance their sinks. This differs from standard usage in health, disaster risk management, and other fields, where it means actions to reduce the severity or seriousness of an outcome."[vii]

Populations of concern: those at increased risk to health impacts of climate change. These groups often have common characteristics to those at increased risk of general ill-health, such as those with low-income, members of minority communities, Indigenous Peoples, those with pre-existing conditions, those with disabilities, those with compromised immune-systems, the very young and the very old. However, in the context of climate change, in some cases those typically not considered at risk may be to specific impacts (e.g. otherwise healthy individuals engaged in outdoor recreation during an extreme heat event).[viii]

Resilience: "describes the capacity of a system to respond or cope with a hazardous event or disturbance in ways that maintain its essential function."[ix]

Risk: "describes the possible consequences of future changes in climate and the other factors relevant for a health outcome. Risk is generally described as the probability of occurrence of an adverse event multiplied by the consequences of that event if it occurs. For example, extreme heat events are increasing in frequency, intensity, and duration, increasing the risk of heat stress in vulnerable populations."[x]

Sensitivity: "is the degree to which a community or system is affected (positively or negatively) by climate variability or change."[xi]

Vulnerability: "the core of the many definitions of vulnerability is that it is the propensity or predisposition to be adversely affected. Vulnerability can arise because of individual susceptibility, geographic location, socioeconomic factors, and a wide range of other factors that determine an individual or community's susceptibility to harm and ability to cope with an event. For example, certain individuals can be vulnerable to extreme heat events because of where they live (parts of cities may warm more than others), characteristics of their dwelling (such as whether there is cross ventilation) that influence inside."[xii]

ENDNOTES

[i] Ebi et al. 2016. "Ontario Climate Change and Health Vulnerability and Adaptation Assessment Guidelines." www.health.gov.on.ca/en/common/ministry/publications/reports/climate_change_toolkit/climate_change_health_va_guidelines.pdf

[ii] WHO. 2015. "Operational framework for building climate resilient health systems." http://apps.who.int/iris/bitstream/10665/189951/1/9789241565073_eng.pdf?ua=1

[iii] WHO. 2015. "Operational framework for building climate resilient health systems." http://apps.who.int/iris/bitstream/10665/189951/1/9789241565073_eng.pdf?ua=1

[iv] Ontario Ministry of Health and Long-term Care. 2012. "Health Equity Impact Assessment Workbook." www.health.gov.on.ca/en/pro/programs/heia/docs/workbook.pdf

[v] World Health Organization. 2015. "Health Systems Strengthening Glossary." https://cdn.who.int/media/docs/default-source/documents/health-systems-strengthening-glossary.pdf

[vi] Ebi et al. 2016. "Ontario Climate Change and Health Vulnerability and Adaptation Assessment Guidelines." www.health.gov.on.ca/en/common/ministry/publications/reports/climate_change_toolkit/climate_change_health_va_guidelines.pdf

[vii] Ebi et al. 2016. "Ontario Climate Change and Health Vulnerability and Adaptation Assessment Guidelines." www.health.gov.on.ca/en/common/ministry/publications/reports/climate_change_toolkit/climate_change_health_va_guidelines.pdf

[viii] Ebi et al. 2016. "Ontario Climate Change and Health Vulnerability and Adaptation Assessment Guidelines." www.health.gov.on.ca/en/common/ministry/publications/reports/climate_change_toolkit/climate_change_health_va_guidelines.pdf

[ix] Ebi et al. 2016. "Ontario Climate Change and Health Vulnerability and Adaptation Assessment Guidelines." www.health.gov.on.ca/en/common/ministry/publications/reports/climate_change_toolkit/climate_change_health_va_guidelines.pdf

[x] Ebi et al. 2016. "Ontario Climate Change and Health Vulnerability and Adaptation Assessment Guidelines." www.health.gov.on.ca/en/common/ministry/publications/reports/climate_change_toolkit/climate_change_health_va_guidelines.pdf

[xi] Ebi et al. 2016. "Ontario Climate Change and Health Vulnerability and Adaptation Assessment Guidelines." www.health.gov.on.ca/en/common/ministry/publications/reports/climate_change_toolkit/climate_change_health_va_guidelines.pdf

[xii] Ebi et al. 2016. "Ontario Climate Change and Health Vulnerability and Adaptation Assessment Guidelines." www.health.gov.on.ca/en/common/ministry/publications/reports/climate_change_toolkit/climate_change_health_va_guidelines.pdf