



Health Santé
Canada Canada

HEAT RESILIENCY PROGRAM

EVALUATION

Final Report

Approved by

Executive Committee

Finance, Evaluation and Accountability (EC-FEA)

Health Canada

March 24, 2011

Canada 

TABLE OF CONTENTS

- **Management Action Plan for the Heat Resiliency Program — Evaluation — Final Report**
- **Heat Resiliency Program — Evaluation — Final Report**

Heat Resiliency Program – Evaluation Management Action Plan

#	Recommendation	Response	Planned Actions	Responsible Manager	Time Frame
1	Consider developing a strategy to ensure the capacity outside Health Canada exists to implement Program deliverables. This may include expanding the scope of Health Canada's involvement in delivering and disseminating outputs. For example, Health Canada could work with public health institutions and associations to incorporate heat health information in training curricula and professional development opportunities for health professionals.	Accepted	<p>By 2011, Health Canada will have produced Guidelines for Healthcare Workers for extreme heat events and a Best Practices Guide for developing Heat Alert and Response Systems.</p> <ol style="list-style-type: none"> 1) To support the dissemination and uptake of these products, Health Canada will launch its dissemination and outreach strategy that includes engaging health professional associations and public health and emergency management officials across Canada. 2) Health Canada will develop, in collaboration with health professional associations, training curriculum and continuing education programs with respect to the health impacts of extreme heat. 3) Health Canada will work, in collaboration with health professional associations, to accredit its extreme heat training curriculum and continuing education programs for health professionals. 	<p>Manager, Climate Change and Health Office (CCHO), Water Air Climate Change Bureau (WACCB), Safe Environment Directorate (SED), Health Environments and Consumer Safety Branch (HECSB), Health Canada (HC)</p>	<p>1) May 2011</p> <p>2) April 2012</p> <p>3) April 2013</p>
2	Review and validate the Program's design, especially the intermediate and long-term outcomes. Once the design has been validated, ensure that baseline and trend data are collected for performance measurement. This data should be collected at various times throughout the year, and over time, to establish trends and determine what impacts the Heat Resiliency Program may have.	Accepted	<p>Health Canada agrees that understanding the capacity of individuals and communities in Canada to take preventive action against extreme heat is essential to providing targeted, high quality products.</p> <ol style="list-style-type: none"> 1) As part of the development of the <i>2011-2016 Heat Resiliency Strategic Plan</i>, Health Canada will review the <i>2007-2011 Heat Resiliency Management Framework</i>, including the logic model, to strengthen how the program short-term outcomes are linked and related to the longer-term outcomes. 2) As part of the development of the <i>2011-2016 Heat Resiliency Implementation Plan</i>, Health Canada will review the <i>2007-2011 Heat Resiliency Performance Measurement Plan</i> to ensure consistency of performance indicators and validate data collection methods. 3) Health Canada will collect baseline data starting in 2011 and collect data at regular intervals over the next five (5) years to determine trends and impacts of the program. 	<p>Manager, CCHO, WACCB, SED, HECS, HC</p>	<p>1) April 2011</p> <p>2) April 2011</p> <p>3) April 2011 (Establish a baseline in April 2011 and review annually)</p>

#	Recommendation	Response	Planned Actions	Responsible Manager	Time Frame
3	Review pilot Heat Alert and Response Systems in time to feed into the next cycle of evaluation for the Heat Resiliency Program. These reviews should include an assessment of the approach, best practices, lessons learned, and costs borne by communities in designing, implementing and maintaining the systems.	Accepted	Health Canada agrees that a formal assessment of the pilot Heat Alert and Response Systems (HARS) will provide important information to other communities about the costs of developing and maintaining a HARS. Health Canada intends to include a review of the pilot HARS as part of the 2011-2016 Heat Resiliency implementation plan to determine the success of the program, lessons-learned and best practices.	Manager, CCHO, WACCB, SED, HECS, HC	April, 2015 (Assessment completion)
4	Explore the option of providing national guidance on complementary approaches to reducing Canadians' vulnerability to extreme heat events, including modifications to the built environment.	Accepted	<p>By 2011, Health Canada will have produced a Best Practices for developing and implementing a Heat Alert and Response System. This Best Practices Report will provide guidance on a national scale regarding reducing the vulnerability to extreme heat, including mitigating the impacts of urban heat islands.</p> <ol style="list-style-type: none"> 1) To support the dissemination of this product, Health Canada will launch a dissemination and outreach strategy that will engage key partners and stakeholders (e.g. Medical Officers of Health, Emergency Management Officials, Public Health Units, Healthcare Workers) at a national scale. 2) As part of the 2011-2016 Heat Resiliency Program, Health Canada will continue to conduct research with existing partners to complement and enhance existing knowledge on reducing community and regional level vulnerability to extreme heat. 	Manager, CCHO, WACCB, SED, HECS, HC	<p>1) May 2011</p> <p>2) April 2011</p>



Health Santé
Canada Canada

HEAT RESILIENCY PROGRAM

EVALUATION

Final Report

January 2011

Canada 

Prepared by
Prairie Research Associates (PRA) Inc. for Health Canada

TABLE OF CONTENTS

Executive Summary	iii
1.0 Introduction.....	1
1.1 Report purpose and outline	1
2.0 Profile of the Heat Resiliency Program	1
3.0 Methodology	6
3.1 Evaluation objectives and scope	6
3.2 Data collection	6
3.3 Analysis and triangulation of findings.....	9
3.4 Limitations	9
4.0 Findings.....	11
4.1 Relevance.....	11
4.2 Performance	19
5.0 Conclusions and recommendations.....	32
5.1 Conclusions.....	32
5.2 Recommendations.....	34
Appendix A — References	35
Appendix B — Evaluation Matrix	40
Appendix C — Examples of Heat Alert and Response Systems.....	44

ACRONYMS USED IN THE REPORT

CAA	Clean Air Agenda
CCHO	Climate Change and Health Office
HARS	Heat Alert and Response Systems
HPIT	Health Professional Intervention and Training
IPCC	Intergovernmental Panel on Climate Change
MOA	Memorandum of Agreement
NGO	Non-Governmental Organization
OECD	Organization for Economic Co-operation and Development
PHAC	Public Health Agency of Canada
PRA	Prairie Research Associates Inc.
PWGSC	Public Works and Government Services Canada
RMAF	Results-based Management and Accountability Framework
WACCB	Water, Air and Climate Change Bureau
WHO	World Health Organization

EXECUTIVE SUMMARY

Forming part of the Government of Canada's Clean Air Agenda (CAA) Adaptation Theme, the Heat Resiliency Program is a four-year (2007 to 2011), \$7.9 million, research and development program. The objective of the Heat Resiliency Program is to reduce the vulnerability of communities and Canadians from extreme heat events in a changing climate. Specifically, the Program is intended to reduce the health risks from extreme heat events by improving their adaptive capacity, as well as to improve the ability of health professionals to assist populations that are vulnerable to heat-related illnesses.

The Heat Resiliency Program comprises two integrated components: heat alert and response system (HARS) and health professional intervention and training (HPIT).

- HARS involves designing and implementing operational heat alert and response systems in four pilot communities, and developing a guidebook for planning and managing community-based heat alert and response systems.
- HPIT develops clinical guidelines for preventing, diagnosing, and treating heat-related illnesses.

In essence, these two components prepare information products to educate a range of stakeholders on the threats associated with extreme heat events and the range of responses to such events. At the conclusion of funding in 2011, the Program plans to share the results with a range of stakeholders including Program partners; municipal, regional, and provincial public health and emergency response units; health professionals; non-governmental organizations; the media; and the general public. However, the Program does not have the continued resources to implement the policies and programs indicated by the research and information being produced.

Evaluation objective and methodology

This evaluation was undertaken to meet the Treasury Board of Canada's requirement to evaluate the Heat Resiliency Program and to support a review of findings of the Clean Air Agenda's Adaptation Theme at the thematic level, which is being led by Environment Canada. Health Canada engaged Prairie Research Associates (PRA) Inc. to evaluate the activities undertaken in Program G2 of the Clean Air Agenda's Adaptation Theme, also known as the Heat Resiliency Program. The objectives of the evaluation were to assess the Program's relevance and performance including effectiveness, efficiency and economy.

The evaluation was conducted in the second year of the Program, with data collection occurring between March and August 2010. The evaluation comprised two phases:

- Phase 1 developed a performance review and analysis report based on a document review and key informant interviews with the Program's management and senior staff members. Health Canada provided Environment Canada with the Performance Review and Analysis Report (Phase 1) for inclusion in the horizontal evaluation review report of the Adaptation Theme of the CAA.
- Phase 2 involved a literature review and 22 key informant interviews with staff, all four pilot site coordinators and some members of the Heat Resiliency Program's two Advisory Committees and heat-health subject matter experts.

Findings – relevance

There is a continued need to increase Canadians' resiliency to extreme heat events. Average temperatures in Canada are rising and extreme heat events are expected to occur with greater frequency and severity. Extreme heat events can have significant mortality and morbidity impacts. Heat alert and response systems have the potential to reduce the morbidity and mortality related impacts of extreme heat events. However, few Canadian communities have implemented them and Canadians, in general, do not perceive themselves as vulnerable to extreme heat events. There is a need to increase health professionals' knowledge of extreme heat events and their potential health impacts as research findings suggest that few health service providers consider climate change risks in their planning processes. There is also a need to encourage health professionals to better prepare Canadians to protect themselves during extreme heat events.

Although the administration and delivery of healthcare services is the responsibility of provincial governments, the federal government plays a key role in providing health services to certain at-risk population groups, administering the *Canada Health Act*, and conducting health research on public health and health protection programs. Therefore, the federal government is in a position to provide leadership, support, and advice related to extreme heat events. In addition, Health Canada is specifically responsible for helping Canadians maintain and improve their health and therefore is well positioned to fulfill a leadership and information development role.

Announced in Budget 2006, the \$1.9 billion dollar Clean Air Agenda (CAA) represents the Government of Canada's continued commitment to address climate change. \$85.9 million of the CAA funding was allocated to address climate change adaptation. The Heat Resiliency Program forms part of the CAA Adaptation Theme. The Heat Resiliency Program aligns well with Health Canada's strategic outcome of reduced health and environmental risk from products and substances, and safer living and working environments. The Program also benefits from the existing infrastructure within the Climate Change and Health Office, which has a mandate to advance the understanding of the health impacts of climate change, raise awareness of the effects of climate change on human health, promote adaptation to climate change and provide advice on best practices for adapting to climate change.

Findings – performance

Program design and implementation

The Program's activities involve conducting primary research; implementing HARS pilot projects; developing heat-health information; developing partnership networks and strengthening existing relationships with partners and stakeholders; and disseminating information. These activities are informing the development of a core set of outputs including operational pilot projects; a HARS best practices guidebook for communities; supporting information and tools (e.g., health messaging, factsheets); and clinical guidelines for health care workers.

While the program theory from activities to outputs to immediate outcomes is clear, it weakens in the transition from immediate to intermediate outcomes. The Program's intended intermediate outcomes relate to increased capacity to adapt to extreme heat events associated with a changing climate. By disseminating its deliverables, the Program will achieve its immediate outcomes of increased availability of, and access to, extreme heat-related information and tools. However, achievement of the intermediate outcomes requires communities, health professionals, and the general public to access the available information about extreme heat events and, in response to this information, implement behaviour changes. The Program has not yet articulated a strategy to ensure its capacity exists to respond to the information being generated, that the information will be used, and that behaviour change occurs.

The Program has developed a performance measurement strategy. Indicators for the immediate outcomes included in the strategy are activity and output-oriented. At the time of writing this report, the Program had not substantially collected the baseline information needed to assess its performance.

The Program has largely been implemented as planned, although activities and outputs had to be completed under reduced timelines and budgets. Delays in approvals reduced the Program duration by one year and the Program lost the associated funding for that year (\$550,000). Subsequently, a department-wide strategic review further reduced the budget by approximately \$460,000. Internal staffing processes impeded implementation, as it took two years to reach a full staff complement. Further, the Program experienced some start-up challenges with the pilot studies.

Effectiveness

Given that the Program is not launching its dissemination strategy until early 2011, its immediate outcomes have yet to be realized. For this reason, it is also premature to assess the Program's achievement of longer-term outcomes.

Efficiency and Economy

The program appears to be efficient; in spite of reduced timelines and budget, the Program is on track to produce and disseminate its intended outputs by 2011. According to staff, aside from the cancellation of the planned public opinion research, no other aspects of the Program were eliminated. However, it has been difficult for the Program to fully utilize its available resources, the available data collection period has been reduced, and there may be incomplete use of research findings in the Program's planned outputs. There are no obvious alternative approaches

to producing the Program's intended outputs for lower cost. However, the evaluation did identify alternative or potentially complementary approaches to achieving the Program's longer-term outcomes. These include modifications to the built environment and social marketing.

In terms of economy, the Program is at too early a stage of implementation to make an assessment.

RECOMMENDATIONS

If Health Canada plans to pursue continuation of the Heat Resiliency Program beyond 2011, it should consider findings from this evaluation. In particular, this evaluation recommends that Health Canada should:

1. Consider developing a strategy to ensure the capacity outside Health Canada exists to implement Program deliverables. This may include expanding the scope of Health Canada's involvement in delivering and disseminating outputs. For example, Health Canada could work with public health institutions and associations to incorporate heat health information in training curricula and professional development opportunities for health professionals.
2. Review and validate the Program's design, especially the intermediate and long-term outcomes. Once the design has been validated, ensure that baseline and trend data are collected for performance measurement. This data should be collected at various times throughout the year, and over time, to establish trends and determine what impacts the Heat Resiliency Program may have.
3. Review pilot HARS in time to feed into the next cycle of evaluation for the Heat Resiliency Program. These reviews should include an assessment of the approach, best practices, lessons learned, and costs borne by communities in designing, implementing and maintaining the systems.
4. Explore the option of providing national guidance on complementary approaches to reducing Canadians' vulnerability to extreme heat events, including modifications to the built environment.

1.0 INTRODUCTION

Health Canada engaged PRA Inc. to evaluate the activities undertaken in Program G2 of the Clean Air Agenda's (CAA) Adaptation Theme, also known as the Heat Resiliency Program. This evaluation was undertaken to meet the Treasury Board of Canada's requirement for program-level evaluations of each CAA Adaptation Theme program and to support a review of findings of the CAA's Adaptation Theme at the thematic level, led by Environment Canada. The objectives of the evaluation were to assess the Program's relevance and performance including effectiveness, efficiency and economy.

1.1 Report purpose and outline

This document presents the findings and recommendations of the evaluation of the Heat Resiliency Program. The report is divided into the following sections:

- Section 2.0 – Profile of the Heat Resiliency Program
- Section 3.0 – Methodology
- Section 4.0 – Findings
- Section 5.0 – Conclusions and recommendations

2.0 Profile of the Heat Resiliency Program

Forming part of the Government of Canada's CAA Adaptation Theme, the Heat Resiliency Program is a four-year (2007 to 2011), \$7.9 million, research and development program. The Heat Resiliency Program falls within the Adaptation Theme, which seeks to increase the resiliency and capacity of Canadians to reduce their vulnerability to the impacts of climate change.

The objective of the Heat Resiliency Program is to reduce the vulnerability of communities and Canadians due to extreme heat events in a changing climate. Specifically, the Program is intended to reduce the health risks from extreme heat events by improving their adaptive capacity as well as to improve health professionals'¹ ability to assist populations that are vulnerable to heat-related illnesses.

¹ The terms of reference for the HPIT Advisory Committee, defines the term "health professional" as "those whose job it is to provide (at least, elements of) direct care for the health-related well-being of members of the public, and particularly in the context of the extreme heat events (EHEs) that are associated with climate change." For example, this may include physicians; naturopaths/osteopaths; nurse practitioners; nurses; pharmacists; physiotherapists; thermoregulatory researchers; and personal care/support workers.

A Strategic Plan for Heat Resilient Communities, which was based on a document and literature review as well as a planning session held in July 2007, provided guidance and direction for the Health Canada's Heat Resiliency Program (D J Fairbairn Environmental Consulting, 2007, p. 2). The Strategic Plan was prepared in response to the initiation of the CAA Adaptation Theme, which identified addressing the need for heat resilient communities as a priority. It identified four key directions:

- **Preventing exposure**, involves developing a strong understanding of the impact of heat events and developing tools and mechanisms to mitigate those impacts
- **Preventing and managing illness**, involves increasing service and health care providers' understanding of the clinical aspects of, and individual responses to, heat and developing a set of guidelines for responding to and addressing those effects
- **Warning systems and response**, involves developing and implementing pilot studies to test heat health warning systems and identifying a set of best practices for communities wanting to implement a heat alert and response system
- **Tracking and surveillance**, involves collecting the data, information, and knowledge needed to manage heat-health impacts

The Heat Resiliency Program is organized into two integrated components: heat alert and response systems (HARS) and health professional intervention and training (HPIT).

- The HARS² component involves supporting the design and implementation of operational heat alert and response systems in four pilot communities³ - Winnipeg (MB), the Assiniboine Health Region (MB), Windsor (ON), and Fredericton (NB) - and developing a guidebook for planning and managing community-based heat alert and response systems.
- The HPIT component develops clinical guidelines for preventing, diagnosing, and treating heat-related illness.

² A heat alert and response system is designed to protect individuals, particularly those most vulnerable, from health effects of extreme heat. It is primarily a community-based driven process that draws upon local resources to minimize heat-related morbidity and mortality. A HARS has several interrelating components and its design will vary between systems. However, each HARS will have two main parts: an early-warning preparedness notification and alert protocol and a response measures and public health intervention program.

³ A number of factors were involved in the selection process of the four pilot communities. First, a short-list of communities was established based on having four pilots of varying population size [1 larger urban center (+500,000), 2 small-medium size urban regions (75,000-500,000) and 1 rural area (<75,000)]; communities lacking an existing HARS; and communities that reflect Canada's geographic, climatic, political/ institutional, socio-economic, and cultural climate. This list was further shortened by engaging communities to determine if there was a local acknowledgement of heat being an issue. A local champion was identified to lead each pilot. An advisory committee of local and regional partners was established for each pilot, and these were supported by Health Canada through provision of technical expertise. The advisory committees were intentionally varied in size and types of partners to reflect the different priorities and needs of each pilot community. The committees were chaired by the local champion with support from the relevant Medical Officer of Health.

In essence, these two components prepare information products to educate a range of stakeholders on the threats associated with extreme heat events and the range of responses to such events.

The Program prepared a Project Implementation Plan to guide its conduct. The Project Implementation Plan divides the Program into six themes:

- **Heat Management Framework**, which involves developing a strategic plan, project management plan, HARS Advisory Committee, and HPIT Advisory Committee.
- **Pilot HARS Project**, which involves Health Canada funding four communities to design and implement pilot HARS. The pilot project also includes identifying sound practices for triggers and response measures through the evaluation and assessment of existing HARS in Toronto, Montreal and Hamilton, and defining/assessing urban and rural heat risk.
- **Health Messaging**, which involves synthesizing an existing literature review on public response to warning systems, reviewing existing warning systems, assessing health messaging practices, and developing consensus on health messaging best practices.
- **Heat Health Science**, which involves thermoregulatory research, tracking and surveillance of heat mortality and morbidity, and beginning to research the health care costs associated with heat mortality and morbidity.
- **Clinical Competencies**, which involves assessing existing clinical guidelines on heat and developing national guidelines based on thermoregulatory research as well as examining the need for revisions to codes and regulations affecting workers subject to exposure to extreme heat.
- **Dissemination and Outreach**, which involves preparing a communications strategy for advising public health officials and other key partners and stakeholders of the Heat Resiliency Program's key information products: *Extreme Heat Events Guidelines: Technical Guide for Health Care Workers; Heat Alert and Response Systems to Protect Health: Best Practices Guidebook and Communicating the Health Risks of Extreme Heat Events: Toolkit for Public Health and Emergency Management Officials.*

The Program plans to share the results with a range of stakeholders including Program partners; municipal, regional, and provincial public health and emergency response units; health professionals; non-governmental organizations; the media; and the general public.

A logic model for the Heat Resiliency Program appears below. As shown in the logic model, planned activities include:

- developing a project implementation plan as well as creating HARS and HPIT Advisory Committees

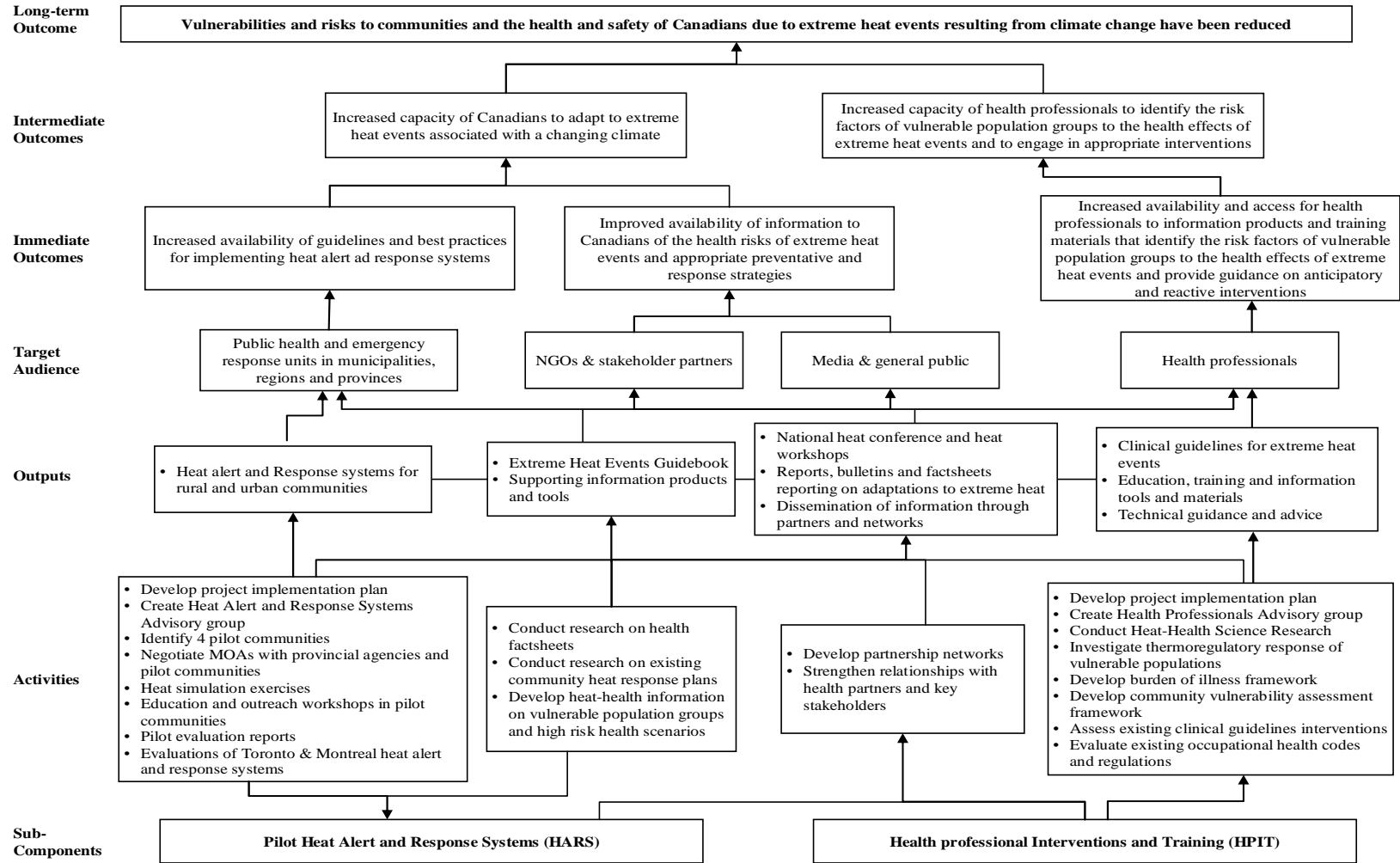
- conducting primary research on existing HARS, vulnerable populations, heat-health science, and thermoregulatory responses
- identifying HARS pilot communities and negotiating Memorandum of Agreements
- conducting heat simulation exercises
- evaluating existing HARS in Toronto and Montreal
- assessing existing clinical guidelines on interventions
- evaluating existing occupational health codes and regulations
- developing and strengthening partnerships and networks

By developing a HARS guidebook, HARS pilot projects, and guidelines for health care workers, the Program intends to increase the availability of guidelines and best practices for implementing HARS by:

- improving the availability of information to Canadians about the health risks of extreme heat events and appropriate preventative and response strategies, and
- increasing the availability of, and health professionals' access to, information products and training materials that identify the risk factors of vulnerable population groups to the health effects of extreme heat events and provide guidance on anticipatory and reactive interventions.

The Heat Resiliency Program seeks to increase the capacity of governments, non-governmental organizations, the media and public to respond to extreme heat events through the provision of information on the threats associated with these events and then to identify effective responses. The Program does not include resources to implement policies and programs that may be indicated by the research and information being produced.

CAA Logic Model – Heat Resiliency Program



3.0 METHODOLOGY

This section outlines the evaluation methodology. It describes the data collection tasks, analysis processes, and limitations of the methodology.

3.1 Evaluation objectives and scope

The evaluation focused on assessing whether the Program was on track to achieve its expected results by reporting on its preliminary results since its inception. It was conducted in the second year of the Program, with data collection substantially occurring between March and August 2010.

The evaluation comprised two phases:

- Phase 1 developed a performance review and analysis report based on a document review and key informant interviews with four of the Program's senior managers and staff members. In May 2010, Health Canada provided Environment Canada with the performance review and analysis report for inclusion in the Evaluation of the Adaptation Theme of the CAA, led by Environment Canada.
- Phase 2 involved a literature review and 22 key informant interviews with program staff, pilot site coordinators, Advisory Committee members, and subject matter experts.

This report integrates the findings from both phases of the evaluation.

3.2 Data collection

The evaluation drew on three lines of evidence: document review; literature review; and key informant interviews with program management and staff, pilot site coordinators, advisory committee members, and subject matter experts.

3.2.1 Document review

A review of documents supported the development of a profile of the Heat Resiliency Program and provided evidence needed to inform the response to the evaluation questions. Health Canada provided the documents required for the review, such as Treasury Board submissions, the Heat Resiliency Project Implementation Plan and other relevant working documents. Over 200 documents were reviewed.

3.2.2 Literature review

The literature review focussed on the relevance of the HARS component of the Heat Resiliency Program. It provided an overview of past extreme heat events; gathered evidence on the health impacts of extreme heat events; described Canadians’ awareness of and preparedness to respond to extreme heat events; and discussed methods of improving resilience to extreme heat as well as compliance with extreme weather warnings, advisories, and messaging.

The literature review involved a search of national, regional, and municipal government websites in Canada, the US, select Organization for Economic Co-operation and Development (OECD) countries, the World Health Organization (WHO) and numerous think tanks and research institutes. It also involved keyword and Boolean searches (searches within subject areas) of the academic literature (articles in peer-reviewed journals) and technical literature (reports produced by research institutes). The literature review employed the search terms in Table 1 below.

Table 1
Selected search terms for the Heat Resiliency Program literature review

Category A	Category B	Category C
“extreme heat”	adaptation	“clinical guidelines”
“extreme heat event”	alert	disadvantaged
“extreme weather”	awareness	elderly
“heat advisory”	behaviour	“health care worker”
“heat alert”	“climate change”	“health professional”
“heat awareness”	“early warning”	“health care practitioner”
“heat event”	“emergency preparedness”	low-income
“heat stress”	emergency	public
“heat wave”	“health impact”	vulnerable
malaria	perception	
“public health”	planning	
smog OR “air quality”	(preparation OR preparedness)	
(ultraviolet OR UV) radiation	resilience	
UV index	response	
West Nile virus	“risk communication”	
floods OR flooding	vulnerability	
	system	
	“information needs”	

The keyword searches were also used to identify key journals in the field, which were searched for additional relevant materials. Abstracts of key articles and reports were reviewed to determine their relevance. Further, the bibliographies of relevant articles were reviewed to identify additional pertinent materials.

The literature review also included a brief media monitoring exercise, which involved a review of print-based and digital media relating to past extreme heat events, to assess the Canadian public's awareness and perception of extreme heat events and their impact on human health. Articles printed within three months of the following five heat events were included in the media monitoring exercise: the city of Chicago and the US Midwest (July 1995); Europe (June–August 2003); North America (July–August, 2006); Vancouver (July–August 2009); and the North America (July 2010).

Once collected, articles were organized according to the literature review framework developed in collaboration with Health Canada, as well as to key themes identified in the literature. A total of 244 articles were referenced in the literature review.

3.3.3 Key informant interviews

Health Canada provided a list of potential key informants and PRA completed interviews with 26, representing the following groups:

- program management (n=4)
- program staff (n=9)
- pilot site coordinators (n=3)
- advisory committee members (n=5)
- subject matter experts (n=5)

Health Canada emailed key informants an introductory letter describing the objectives of the evaluation and explaining that PRA may contact them to schedule an interview. Interviews were conducted over the phone, in the key informant's preferred official language. Prior to the interview, key informants received a copy of the interview guide so they could provide informed responses. PRA prepared five interview guides—one for each of the key informant groups interviewed. Phase 1 interviews were conducted in March 2010 and Phase 2 interviews were conducted between July and August 2010.

3.3 Analysis and triangulation of findings

A matrix of questions, indicators, and data sources, included in Appendix B, guided the development of the data collection tools and analysis of findings. The data collection tools were designed to gather evidence relating to the indicators included in the evaluation matrix. For example, documents and literature were scanned for information related to, and key informants were asked questions related to, the indicators for each question.

As shown in Table 2, multiple lines of evidence were used to inform the response to each evaluation question. The data gathered from each line of evidence was compared and contrasted. In cases where information aligned, the various lines of evidence were considered to support conclusive findings. Where lines of evidence do not align, findings are less conclusive.

3.4 Limitations

Limitations associated with data collection are:

- Due to the timing of the evaluation, many of the information sources reviewed for the document review were working documents that are under revision. Thus, the information reported in the evaluation will become outdated as program documentation and deliverables are modified. Much of the material required for the document review was provided in April and May 2010.
- The media monitoring exercise relied on media sources that are not peer-reviewed and therefore may be inaccurate or biased.⁴ Some of the articles included in the exercise were editorials, which may not be representative of the general public opinion of an issue. Further, media coverage of extreme heat events may reflect topics perceived as having greater public appeal, rather than public health priorities (Glantz, 2004).
- Most key informants did not have detailed knowledge about and/or involvement in all aspects of the Program and therefore could only respond to a subset of the evaluation questions. Further, some key informants such as subject matter experts often had no direct involvement with the operation of the Program.

⁴ Media monitoring also has particular advantages as an approach to studying extreme heat events and media sources can be an important source of data for health research. Some of these strengths are described in Soskolne, Klaver-Kibria, Clarke, and Berry (2005).

Table 2
Heat Resiliency Program — Immediate and intermediate outcomes

Evaluation question	Lines of evidence						
	Doc. rev.	Lit. rev.	Interviews with...				
			Mgrs.	Staff	Pilots	Adv. Cmte.	Experts
Relevance — Do activities under the Heat Resiliency Program align with and contribute to federal government clean air priorities and the key environmental and health needs of Canadians?							
1. Is there a continued need for the Heat Resiliency Program?	✓	✓	✓	✓	✓	✓	✓
2. Is the Heat Resiliency Program aligned with federal government priorities?	✓		✓				
3. Is there a unique and necessary role for Health Canada in the Heat Resiliency Program?	✓		✓		✓	✓	
Performance — Has the Heat Resiliency Program met its intended outcomes? Are the most appropriate, efficient, and economic means being used to achieve outcomes?							
4. Does the Heat Resiliency Program have clearly defined activities, outputs, and outcomes? Does it have a valid theoretical basis that links these together?	✓	✓	✓			✓	✓
5. Has the Heat Resiliency Program organized its activities, at least cost, consistent with the required outputs and their timing?	✓		✓	✓			
6. Have each of the Heat Resiliency Program activities been implemented, or are they on track to being implemented as planned?	✓		✓	✓	✓	✓	
7. Are appropriate performance data being collected, captured, and safeguarded? If so, is this information being used to inform senior management and decision-makers?	✓		✓	✓	✓	✓	
8. Are Heat Resiliency Program activities resulting in the production of the required outputs, at least cost?	✓		✓	✓		✓	
9. To what extent have immediate outcomes been achieved as a result of the Heat Resiliency Program?	✓		✓	✓	✓	✓	
10. Have there been any unintended (positive or negative) outcomes observed at this time?	✓		✓	✓	✓	✓	
11. Is the Heat Resiliency Program designed to achieve its expected immediate outcomes at least cost? If not, what changes are recommended?			✓	✓			✓
12. Is there any evidence to suggest that alternative methods for producing the outputs and/or realizing the outcomes would be more effective for lower cost?		✓	✓	✓		✓	✓

4.0 FINDINGS

The evaluation findings rest on the three lines of evidence: document review, literature review, and key informant interviews. This section presents the evaluation findings by evaluation issue (relevance and performance) and by the related evaluation questions.

4.1 Relevance

Evaluation Issue Relevance

There is a continued need to increase Canadians' resiliency to extreme heat events. Extreme heat events cause morbidity and mortality, and they are expected to increase in frequency and severity. Few Canadian communities have implemented HARS and Canadians, in general, do not perceive themselves as vulnerable to extreme heat events. Findings suggest that few health service providers consider climate change risks in their planning processes. Further, there appears to be a need to encourage health professionals to better prepare Canadians to protect themselves during extreme heat events.

The Heat Resiliency Program forms part of the Clean Air Agenda Adaptation Theme, which represents the Government of Canada's continued commitment to address climate change, including adaptation.

Health Canada is well positioned to fulfill a leadership and information development role. Moreover, the Heat Resiliency Program aligns with Health Canada's strategic outcome for reduced health and environmental risk from products and substances, and safer living and working environments. The Program benefits from the existing infrastructure within the Climate Change and Health Office, which has a mandate to advance the understanding of the health impacts of climate change, raise awareness of the effects of climate change on human health, promote adaptation to climate change and provide advice on best practices for adapting to climate change.

4.1.1 Continued need

This section responds to the evaluation question: *Is there a continued need for the Heat Resiliency Program?*

Extreme heat trends in Canada

One of the factors driving the need to increase Canadians' resiliency to extreme heat events is that, as a consequence of global climate change, extreme heat events will continue to occur with greater frequency and severity than in the past (Keim, 2008; Luber & McGeehin, 2008; O'Neill & Ebi, 2009; IPCC, 2007; WHO, 2010). Some examples of recent extreme heat events in Canada are:

- On July 23, 2006, during a North American heat wave, the temperature in Winnipeg reached 35.3°C, breaking the previous record of 34.4°C, set in 1903 (Rollason, 2006).
- In early summer 2009, Vancouver experienced temperatures that are more common in the middle of summer. In late July, some parts of British Columbia recorded temperatures over 40°C (teBrake, 2009). Media reports released a year later suggested that heat waves in July and August contributed to more than 200 deaths across the province (Fayerman, 2010; Lee, 2010).
- In the summer of 2010, the city of Fredericton experienced humidex values of 40 (McLaughlin, 2010).

It is estimated that, by 2050, hot summer days (exceeding 30°C) in southern Canadian cities will be four times as frequent as they were in 2005 (Hengeveld, Whitewood, & Fergusson, 2005, p. 44). Cities believed to be most at risk of experiencing increases in the frequency of extreme heat events are Winnipeg, Toronto, London, and Fredericton.

Extreme heat events cause mortality and morbidity

Another factor contributing to the need to increase Canadians' resiliency to extreme heat events is that these events can have significant mortality and morbidity impacts. In its *Fourth Assessment Report of Climate Change Impacts, Adaptation, and Vulnerability*, the Intergovernmental Panel on Climate Change (IPCC) concluded with "medium confidence" that climate change *has* contributed to increased heat-related mortality (IPCC, 2007, p. 393). In fact, over the past 15 years, extreme heat events throughout the world have resulted in hundreds or thousands of deaths. For example:

- In mid-July 1995, an extreme heat event in the American Midwest resulted in more than 700 deaths in Chicago (Changnon, Kunkel, & Reinke, 1996, pp. 1499–1500).
- In the summer of 2003, a heat wave in Europe is believed to have caused some 70,000 deaths, including 40,000 in France and Spain. Many of those who died were elderly (Robine et al., 2008).
- In January and February 2009, two extreme heat events in southeastern Australia resulted in 374 deaths in Melbourne (Australian Associated Press Pty Limited, 2009).
- In July and August 2009, two extreme heat events in British Columbia resulted in over 200 deaths (Kosatsky, 2010).

Moreover, the estimates presented above may underestimate the mortality associated with these events (Luber & Sanchez, 2006).

Heat events can also have direct and indirect effects on morbidity. Direct morbidity effects of extreme heat may include heat cramps, heat syncope (e.g., heat-induced giddiness), heat exhaustion, heat stroke, and death (Luber & McGeekin, 2008, p. 429). Indirect effects may include increased risk of death from cardiovascular disease, cerebrovascular accidents and vascular lesions, respiratory diseases, and increased susceptibility to infectious diseases (Smoyer-Tomic, Kuhn, & Hudson, 2003, p. 468).

Certain segments of the population may be more vulnerable to extreme heat events due to their physical health, mental capacity, mobility, duration of exposure to heat, or socio-economic status. Examples of vulnerable populations include:

- young children (Bernardo, Crane, & Veenema, 2006; HC, 2008; McLaren, 2005; and Null, 2010)
- elderly individuals (Flynn, McGreevy, & Mulkerrin, 2005; Luber & McGeehin, 2008; and HC, 2008)
- individuals with pre-existing medical conditions (Schwartz, 2005; Stafoggia et al., 2006, in Kovats & Hajat, 2008; Naughton et al., 2002; City of Ottawa, 2010; and Flynn et al., 2005)
- obese individuals (Koppe, Kovats, Jendritzky, & Menne, 2004; and PHAC, 2009)
- lower-income individuals (HC, 2008; Naughton et al., 2002; Institut de la statistique du Québec (ISQ), 2009; Sheridan, 2007; Bassil, 2008; and Sheridan and Kalkstein, 2004)
- Aboriginal people (HC, 2008)
- workers in hot environments (Jay & Kenny, 2010).

Other factors and trends at the community or societal level may also amplify the impacts of extreme heat events on Canadians:

- **Demand for health resources.** Heat-related illnesses can significantly increase the demand for scarce health care resources, such as the services provided by paramedics, nurses, and physicians. For example Knowlton et al. (2009) found that during the 2006 California heat wave (July 15–August 1, 2006), emergency department visits related to heat illness increased more than six-fold and hospitalizations increased more than ten-fold (p. 64). Other studies found that, during extreme heat events, 911/emergency/ambulance calls increased (Dolney and Sheridan, 2006; Bassil, 2008; and Nease, 2010).
- **Urban heat islands.** The urban heat island effect, which is a phenomenon whereby urban areas tend to be warmer than the surrounding region, increases the urban populations' vulnerability to extreme heat events (Kovats & Hajat, 2008; City of Hamilton, 2006; and Frumkin, 2002). According to Statistics Canada (2010), 80% of the Canadian population live in urban areas. Moreover, urban sprawl, which refers to the gradual expansion of cities into surrounding areas, increases the radius of the urban heat island and increases the severity of the effect (Frumkin, 2002, pp. 206–207).

- **State of Canadian infrastructure.** Much of Canada’s infrastructure is nearing the end of its useful life and is vulnerable to the effects of a changing climate as heat stress can affect its performance and integrity (HC, 2008, pp. 384–385). The decaying state and limited capacity of Canada’s infrastructure could increase Canadians’ vulnerability to extreme heat events through blackouts (Daubs, 2010) or road closures resulting from heat-related buckling, which could prevent people from reaching cooling centres or hospitals (Palecki, Changnon, & Kunkel, 2001, in HC, 2008, p. 77). Subject matter experts also cautioned that increased use of air conditioning during extreme heat events may increase the risk of power outages and reduce air quality in areas drawing on coal electricity, both of which may compound health impacts.

Few Canadian communities have implemented HARS

One factor supporting the continued need for the HARS component of the Heat Resiliency Program is that, although HARS have the *potential* to reduce the health impacts of extreme heat events (Fouillet, 2008; Alberini, Mastrangelo, & Pitcher, 2008; Tan et al., 2007; Naughton et al., 2002; Palecki et al., 2001; and Whitman et al., 1997, CCHO, 2009), few Canadian communities have implemented a response. For example:

- A 2007 Health Canada study of heat management activities in Canadian communities found that many of the active HARS were concentrated in Ontario and Quebec, which collectively have 62% of the Canadian population (Statistics Canada, 2010). It also reported that many communities throughout the country—that have experienced and will continue to experience extreme heat exposure—have yet to undertake heat management activities. Moreover, the study noted that few of the small urban communities and none of the rural communities included in the study had engaged in heat management activities (Health Canada, 2007, p. 35).
- A brief web search of several large urban communities in British Columbia, Alberta, Saskatchewan, and Atlantic Canada undertaken as part of this evaluation concluded that heat management activities remain uncommon outside of Ontario and Quebec.⁵ One important exception is the recent unveiling of a HARS for the city of Vancouver (Lee, 2010), which was developed in response to the extreme heat event in July 2009 (Vancouver Extreme Hot Weather Committee, 2010).
- The key features of existing HARS, which are operating in Toronto, Ontario; Kingston, Ontario; Montreal, Quebec; and Vancouver, British Columbia, are summarized in Appendix C.⁶

⁵ It should be noted that the online search was necessarily confined to information available to the public.

⁶ The HARS operating in Chicago, Illinois, and England are also summarized in Appendix C.

Canadians do not perceive they are vulnerable to, and are not prepared to respond to, extreme weather events

Canadians do not perceive themselves as vulnerable to extreme heat events and may rely on governments and emergency service providers to respond on their behalf. For example:

- An Environics Research Group (2008) study found that 36% of Canadians believe climate change will result in more frequent heat waves. The study noted that more than two-thirds of Canadians do not believe they would have difficulty protecting themselves or their families in the event of a heat wave (Environics Research Group, 2008, in Berry et al., 2009, p. 10, 16, & 18). It also determined that Canadians viewed heat waves as a relatively minor health issue compared to other health risks (e.g., obesity, heart disease, air pollution, food pesticides).
- Research studies concluded that many seniors do not believe they are vulnerable to extreme heat events or are unaware of their vulnerability (Sheridan, 2007; Abrahamson et al., 2008). Nonetheless, one study found that elderly residents with chronic cardiac and pulmonary disease acknowledged their vulnerability to heat and were likely to take measures to protect themselves (Kosatsky et al., 2009).

Health service providers do not appear to be well informed about or prepared to respond to extreme heat events

Part of the Heat Resiliency Program's efforts are focussed on providing heat-health information to health service providers. Climate change has been identified as the biggest global health risk of the 21st century (WHO, 2008; Costello, 2009). However, research findings suggest that few health service providers consider climate change risks (of which extreme heat is one) in their planning processes and health professionals do not appear to be adequately preparing Canadians to protect themselves during extreme weather events (including heat). Below are the findings from various sources:

- A Health Canada commissioned study on the "degree to which public health decision-makers, practitioners, and organizations are considering climate change risks in their policies and planning" found that while Canadian public health officials are generally aware of health impacts related to climate change, only half said climate change was a recognized public health issue in their jurisdiction. Of these, most reported it was not a high priority (HC, 2006, p. 8).
- Ferrier (2002), in an assessment of emergency planning in Canadian hospitals, found important gaps that may compromise their ability to protect public health during extreme weather events, such as shortcomings in emergency communications strategies and plans for acquiring surge capacity to deal with public health emergencies.

- Berry et al. (2009) conducted a review of health authority websites and found that about half provided information on extreme heat, with half of these located in Ontario (p. 39). Moreover, a study by Health Canada (2010) found that while some form of health messaging is provided in most health units in British Columbia, Ontario, and Quebec, such resources are nearly absent in Manitoba and Saskatchewan, which are two of the provinces expected to experience the greatest increases in annual temperature change over time. It also found substantial inconsistencies in the health messages provided.
- Subject matter experts believe emergency management systems (emergency physicians, ambulance care, air ambulance, emergency care in acute settings) are well equipped to diagnose and treat heat-related illness. They also reported that diagnosing, managing, and treating heat-related illness is part of Royal College's (Ontario) examination process. However, according to the same interviewees, opportunities exist for physicians to better prepare vulnerable patients for possible heat events.

Based on these findings, it appears that there is a need in the health service community for extreme heat event information.

4.1.2 Alignment with federal priorities

This section responds to the evaluation question: *Is the Heat Resiliency Program aligned with federal government priorities?*

The Heat Resiliency Program is well-aligned with federal government priorities. As part of the Clean Air Agenda, announced in Budget 2006, the program represents the Government of Canada's continued commitment to address climate change. The Adaptation Theme of the CAA seeks to increase the resiliency and capacity of Canadians to reduce their vulnerability to the impacts of climate change. The Heat Resiliency Program forms part of the Climate and Infectious Disease Alert and Response Systems portion of the Adaptation Theme.

4.1.3 Role for Health Canada

This section responds to the evaluation question: *Is there a unique and necessary role for Health Canada in the Heat Resiliency Program?*

There is a role for Health Canada in the Heat Resiliency Program

The *Canada Health Act* requires Health Canada to take all actions required to protect Canadians when there is sufficient risk; therefore, there is a role for the Department to increase Canadians' resiliency to extreme heat events. However, should an extreme heat event occur, it is the responsibility of provinces to deliver health services. Therefore, it can be concluded that the federal government's role is to provide leadership and support, as a public good to the provinces.

Given that Health Canada is “responsible for helping the people of Canada maintain and improve their health”, it is well positioned to fulfill a leadership and information development role (HC, 2009). Moreover, the Heat Resiliency Program aligns with Health Canada’s strategic outcome of “reduced health and environmental risk from products and substances, and safer living and working environments” (HC, 2009).

The Heat Resiliency Program is part of the Healthy Environments and Consumer Safety Branch’s Safe Environments Directorate, which promotes healthy living, working and recreational environments by identifying and assessing health risks to Canadians posed by environmental factors. The Program is situated within one of the bureaus responsible for Safe Environments Directorate, the Water, Air and Climate Change Bureau (WACCB), the mandate of which includes protecting and promoting the health of Canadians from risks associated with climate change.

The Climate Change and Health Office (CCHO), which forms part of the Water, Air and Climate Change Bureau, aims to advance the understanding of the health impacts of climate change, raise awareness of the effects of climate change on human health, promote adaptation to climate change and provide advice on best practices for adapting to climate change. The Heat Resiliency Program fits well within this existing infrastructure.

Program managers reported that the Heat Resiliency Program is an ideal project for Health Canada, since it enables the Department to demonstrate leadership and it is developing information that provinces do not have the time or resources to pursue on their own. Health Canada is able to provide a national direction and consistent messaging on issues related to extreme heat. Moreover, program staff said the medical community and Canadians find Health Canada is a credible and unbiased source of information.

Other stakeholders also have a role to play in HARS

Although there is a unique and necessary role for Health Canada in the Heat Resiliency Program, other stakeholders, including other levels of government, non-governmental organizations, and individuals, also have an important role to play. Table 3 below describes various stakeholders’ roles and responsibilities regarding health adaptation to extreme heat events.

Table 3
Roles and responsibilities for health adaptation in Canada related to extreme heat

Jurisdiction	Health issue	Role
Federal government <i>Provides “public good”-type services that fit well with a national government</i>	Heat-specific	<ul style="list-style-type: none"> • Prepare meteorological and severe weather forecasts • Conduct scientific monitoring (e.g. climatology, temperature-mortality research) and provide technical advice for development of heat advisories • Undertake forecasting used for heat alerts (e.g., humidex advisories) • Issue extreme temperature/humidex warnings/alerts
	General/cross-cutting	<ul style="list-style-type: none"> • Enhance the resiliency of Canada’s health care system • Provide national leadership for health issues and collaborate with international partners to protect the health of Canadians; facilitate development and implementation of federal/provincial initiatives; maintain existing collaborative arrangements; and enhance coordination, optimal knowledge transfer, and flow of scientific and policy information between levels of government • Conduct research into health risks and trends, publish health indicators, and provide scientific technical expertise to provinces, municipalities, and health professionals • Engage in health promotion activities that reduce health risks from climate change and extreme weather events • Undertake or support continued training and education of health professionals
Provincial and territorial governments <i>Fits well as they are responsible for delivering health services</i>	Heat-specific	<ul style="list-style-type: none"> • Issue heat-health based warnings/alerts • Provide emergency measures services • Provide home, community, and residential care for seniors vulnerable to heat-related risks
	General/cross-cutting	<ul style="list-style-type: none"> • Facilitate local/municipal strategies to improve health and well-being • Develop strategies and policies to focus on priority health areas • Deliver health care services • Engage in health promotion activities that reduce health risks from climate change and extreme weather events • Undertake or support continued training and education of health professionals
Municipal governments <i>Act as a subset of provincial governments</i>	Heat-specific	<ul style="list-style-type: none"> • Assess community vulnerability to extreme heat • Issue heat-health based warnings/alerts • Provide local response measures and public health interventions
	General/cross-cutting	<ul style="list-style-type: none"> • Engage in health promotion activities that reduce health risks from climate change and extreme weather events • Undertake or support continued training and education of health professionals
NGOs <i>Fill service gaps and help educate specific populations (e.g., seniors)</i>	General/cross-cutting	<ul style="list-style-type: none"> • Implement emergency management programs that provide information and emergency social services • Support disaster relief and mitigation by increasing public awareness, provide education and training, facilitate access to health care delivery and personal support, conduct research and data collection to support policy planning and development • Help people with special needs access health services
Individuals	General/cross-cutting	<ul style="list-style-type: none"> • Take preventative measures to reduce health risks from climate change and extreme weather events • Stay informed of risks to health and measures to protect health

Source: HC (2008, pp. 420–423), adapted from Philpot (2006)

The Heat Resiliency Program complements other heat alert and response-related work

Some staff noted the Heat Resiliency Program complements the emergency preparedness activities of Canadian communities. More specifically, they commented the Program complements the heat alert and response work completed in other urban centres such as Toronto and Montreal. For example, one of the Heat Resiliency Program’s planned activities is to work with the Cities of Toronto and Montreal to evaluate their respective HARS to integrate best

practices and lessons learned into guidance materials for other communities. Further, staff reported that another component of the Heat Resiliency Program involves engaging provinces and other stakeholders in the development of heat alert and response plans for their communities.

4.2 Performance

Evaluation Issue Performance

The Heat Resiliency Program has clearly defined activities, outputs and outcomes. However, the theoretical basis linking these activities, outputs and immediate outcomes to the longer-term outcomes is weaker. Achievement of the longer-term outcomes is dependent on other groups, including communities and health service providers. The Program has not yet articulated a strategy to ensure the capacity exists outside of Health Canada to deliver the Program outputs.

In spite of reduced timelines and budgets, the Program has largely been implemented as planned and is on track to produce its intended outputs by 2011. Implementation was impeded by internal staffing processes and start-up challenges with the pilot studies.

The Program's immediate outcomes will not be realized until post 2011. No unintended outcomes have been identified at this stage of implementation. Although the Program is collecting activity and output-related information, it has not collected the baseline information that will be required to measure achievement of intermediate and long-term outcomes.

It appears that the Heat Resiliency Program has been implemented efficiently. However, due to the status of program implementation, it is premature to determine economy. In terms of producing stated program outputs at lower cost, the evaluation did not identify any alternative approaches. However, alternative, or potentially complementary approaches to achieving program outcomes were identified (such as modifications to the built environment and social marketing).

4.2.1 Program theory and logic

This section responds to the evaluation question: *Does the Heat Resiliency Program have clearly defined activities, outputs, and outcomes? Does it have a valid theoretical basis that links these together?*

The Heat Resiliency Program has well-defined activities, outputs, and outcomes

As part of the Heat Resiliency Program implementation strategy, a program logic model (see Section 2.0) was developed that clearly defines its activities, outputs, and outcomes. The logic model focuses on two program components—HARS and HPIT. According to the logic model,

the HARS component involves conducting and assessing the HARS pilots; undertaking extreme heat table-top exercises; conducting heat education and outreach workshops; evaluating two existing HARS (Toronto & Montreal); conducting supportive heat research; and developing heat-health information. The HPIT component involves conducting heat-health research; developing a burden of illness framework; assessing clinical guidelines interventions and existing occupational health codes and regulations. Both Program components involve developing partnership networks and strengthening relationships with partners and stakeholders. Staff explained that the research activities of both Program components are integrated and complementary.

As mentioned in Section 2.0, the Program activities are informing the development of a core set of outputs including operational pilot projects; a HARS best practices guidebook for communities; supporting information and tools (e.g., health messaging, factsheets); clinical guidelines for health care workers; and information dissemination. By producing these outputs and sharing information, the Program will achieve its immediate (or direct) outcomes, which are:

- increased availability of guidelines and best practices for implementing HARS
- improved availability of information to Canadians about the risks of extreme heat events and appropriate preventative and response strategies
- increased availability and access for health professionals to information products and training materials that identify the risk factors of vulnerable population groups to the effects of extreme heat events
- increased availability and access for health professionals to information products and training materials that provide guidance on anticipatory and reactive interventions

While the program theory from activities to immediate outcomes is clear, it weakens in the transition from immediate to intermediate outcomes. The Program's intended intermediate outcomes are increased capacity to adapt to extreme heat events associated with a changing climate and increased capacity of health professionals to identify the risk factors of vulnerable populations to the health effects of extreme heat events and provide guidance on anticipatory and reactive interventions. Achievement of these intermediate outcomes requires communities, health professionals, and the general public to access the available information about extreme heat events and, in response to this information, implement behaviour changes. However, the Program has not articulated a strategy to ensure the capacity to respond to the information generated exists and that behaviour change occurs. This assumes that stakeholders have the motivation, skills, and resources required to implement a behaviour change.

Moreover, to achieve its final intended outcome—reduced vulnerabilities and risks to communities and the health and safety of Canadians due to extreme heat events resulting from climate change—the Program relies on communities to develop and implement appropriate intervention strategies, such as a HARS. It also relies on communities and health professionals to educate Canadians on how to protect themselves and assumes that this will result in behaviour change. Achievement of this final outcome requires communities and health service providers to devote resources to developing a response strategy and/or education campaign. These community-based costs are over and above those associated with the Program and are unknown.

There is a risk that even though information exists it will not be used and will not result in behaviour change.

The program theory for HARS rests on a number of assumptions; the effectiveness of HARS in Canada would benefit from further study

The theory underlying the HARS component of the Program assumes that heat alert and response systems will increase resiliency to extreme heat events. Structurally, this theory is valid, given that a HARS can be described as fitting within a standard model for disaster/emergency management systems consisting of four pillars of action: mitigation/prevention, preparedness, response and recovery (Auld, 2008, p. 119; HC, 2008, p. 80; Keim, 2008).

Specifically, HARS addresses the preparedness and response pillars of the model, which increases individuals' and communities' *resilience* to, or capacity to cope with and recover from, disasters. Moreover, HARS can be said to use a combination of risk reduction and crisis management measures. Preparedness involves *risk reduction measures* implemented prior to an incident such as issuing heat warnings and providing Canadians with information on how to protect themselves from the heat. Response involves *crisis management measures* applied during or after the incident has occurred such as opening cooling centres and distributing water bottles to the homeless.

HARS program theory also assumes that early warning systems reduce morbidity and mortality. For extreme weather events, early warning systems are mechanisms designed “to alert the population and relevant authorities that meteorological conditions are such that adverse health events could result” (Ebi, 2005, p. 51). The basic components of an early warning system include techniques for identifying and forecasting events correlated with mortality or morbidity; protocols for assessing the event's likely health outcomes; a response plan describing what to do if the event occurs; and ongoing system evaluation (Ebi and Schmier, 2005, p. 117).

Staff reported that experiences in other countries have demonstrated that HARS can reduce the number of deaths and illnesses associated with extreme heat events. Nonetheless, Health Canada's 2008 *Canadian Assessment of Vulnerabilities and Adaptive Capacity* identifies the need to develop a better understanding of effectiveness of current adaptations and conduct additional research to fill existing knowledge gaps about the impact of heat on human health.

Few evaluations of heat alert and response systems have been completed. Evaluating and comparing systems can be a challenge for various reasons, for example, the same HARS implemented in two different locations may not be equally effective (Mersereau, 2007, pp. 15–16; Smoyer-Tomic, 2009). In addition, subject matter experts noted that because many HARS employ differing triggers, it is difficult to compare and contrast their effectiveness. Further, in many cases, several public health interventions included in a response plan are operated simultaneously, making it difficult to assess the individual contribution of each intervention (Bassil & Cole, 2010, p. 998). Ebi and Schmier (2005) reported that, in the context of extreme heat, “little is known about the (relative) effectiveness of specific interventions in reducing [...]

morbidity and mortality,” adding that “research is needed to better understand where resources should be directed to achieve the most effective results” (p. 119).

Hajat et al. (2010) concur, noting that few evaluations of the cost-effectiveness of HARS have been carried out to date (p. 1142). Nonetheless, numerous studies suggest that early warning systems, often in combination with other factors (such as increased public awareness of risks of heat, improved housing, wider availability of air conditioners, and the establishment of extreme weather operational plans) are associated with lower mortality during extreme heat events (Fouillet, 2008; Alberini, Mastrangelo, & Pitcher, 2008; Tan et al., 2007; Naughton et al., 2002; Palecki et al., 2001; and Whitman et al., 1997).

Studies of extreme heat warnings and HARS suggest these interventions can, to varying degrees, lead to behaviour changes (Sheridan, 2007; Mills and Herrick, 2010, Stieb, Paola, and Neuman, 1996; Semenza et al., 2008; Burningham et al., 2008). However, some subject matter experts interviewed in the course of the evaluation expressed doubt that HARS are an effective tool for increasing Canadians’ resiliency to extreme heat events. They stressed the importance of taking into account the circumstances of vulnerable populations when developing HARS. For example, a senior with a chronic lung problem could not benefit from a swimming pool that has extended its operating hours; vulnerable populations may not be located close to cooling centres; and HARS may be challenged to reach difficult-to-contact populations (e.g., the homeless and those who do not listen to the radio or watch TV).

Advisory committee members highlighted the need for an impact analysis of existing HARS and noted that through the Heat Resiliency Program, this process is under way in Toronto and Montreal.

4.2.2 Performance measurement

This section responds to the evaluation question: *Are appropriate performance data being collected, captured, and safeguarded? If so, is this information being used to inform senior management/decision-makers?*

The implementation plan for the Program includes a performance measurement plan, which has been circulated to all staff. Examples of indicators included in the performance measurement plan are the number of outreach activities conducted; the number of factsheet and information products available; the number of new guidelines and best practices on preventative heat response strategies; and the number of hits on Health Canada’s website. Given that the Program’s immediate outcomes focus on the increased availability of information, these indicators are appropriate; however, they are highly output-focused and do not gather information on impacts, benefits, or changes.

The Program has been collecting the following performance information and compiles it once per year:

- The Program has been tracking information on outreach activities. As Table 4 (Section 4.2.3) mentions, the Program has participated in meetings, webinars, workshops, and conferences
- Information on new guidelines and best practices will be included in two of the Program's outputs; namely, the *Adapting to Extreme Heat Events: Guidelines for Assessing Health Vulnerability and Extreme Heat Events Guidelines: Technical Guide for Health Care Workers*. In support of these outputs, the pilot projects are preparing debriefing reports that will include recommendations for responding to future extreme heat events
- Information on the number of hits on Health Canada's website was not available.

The performance measurement plan also identifies increased awareness and increased knowledge and understanding as indicators, but does not specify measures. Although the Program intended to conduct surveys to gather baseline awareness data, it could not obtain timely approval for public opinion research and has not collected the information. The Program will need to collect baseline information and conduct follow-up surveys if it is to measure the achievement of outcomes.

Given that the HARS and HPIT components of the Program are integrated, they are not reported on separately. According to staff, the performance reporting process includes:

- Keeping the Branch Associate Deputy Minister and Directorate Director General aware of major Heat Resiliency Project deliverables through the Associate Deputy Minister 3 month outlook, which all branch programs inform. The outlook describes and provides a schedule of ongoing program activities
- Reporting to senior management through the annual Report on Plans and Priorities and Departmental Performance Reports
- Attending weekly informal, information-sharing WACCB management meetings (note: formal minutes for these meetings are not prepared)
- Weekly management meetings between the WACCB Director and the CCHO Manager
- Annual meetings with the WACCB Director
- Weekly 'Heat' meetings, where staff provide updates on projects and discuss various items related to the Program. The CCHO Manager regularly attends these meetings
- Progress reports to the CAA Secretariat.

4.2.3 Implementation

This section responds to the evaluation question: *Have each of the Heat Resiliency Program activities been implemented, or are they on track to being implemented as planned?*

The Program is on track to produce its intended outputs by 2011. Staff reported that the Program's core outputs are in the process of being developed and finalized. The Program's deliverables are expected to be completed and disseminated in early 2011. Staff explained that as a consequence of the reduced Program period and budget, it has been difficult to fully utilize available resources; the data collection period has been reduced; and there may be incomplete use of research findings in the Program's planned outputs. However, according to staff, aside from the cancellation of the planned public opinion research, no other aspects of the Program were eliminated.

Within the six themes of the Heat Resiliency Program (as described in Section 2.0 Profile of the Heat Resiliency Program), the Program has implemented the activities described in Table 4 below.

Table 4
Activities implemented

Theme	Activities implemented
Heat Management Framework	<ul style="list-style-type: none"> ▶ Developed a strategic plan ▶ Developed a Project Management Plan, including logic model and performance measurement framework ▶ Established HARS and HPIT Advisory Committees
Pilot HARS Project	<ul style="list-style-type: none"> ▶ Negotiated Memorandum of Agreement for the implementation of HARS in Winnipeg, the Assiniboine Health Region, Windsor, and Fredericton ▶ Pilot projects: <ul style="list-style-type: none"> - The pilot communities provided Health Canada with inception reports, which provided an overview of the region where the pilot is being conducted, detailed existing natural hazard/weather response systems, proposed a structure for a local community-based HARS management committee, and outlined a work plan for the project. - The pilot communities provided Health Canada with baseline capacity/vulnerability assessment reports. This included "table-top" exercises that discuss the processes to respond to an extreme heat event, ensure responses are well-coordinated, and identify and resolve any gaps in existing plans and response capabilities. - The pilot communities provided Health Canada with end-of-season reports for 2009 and 2010. These reports provided an overview of the community's vulnerabilities, described the community-based HARS management committee, provided an overview of the HARS being piloted and activities that have taken place, described the extreme heat events that occurred, and identified lessons learned (as applicable). ▶ Evaluation of HARS: <ul style="list-style-type: none"> - Funded the development of an evaluation framework for the Toronto HARS. The framework was completed in January 2010. - Prepared a planning document for an evaluation of the Montreal HARS. - Identified lessons learned and best practices from the Hamilton HARS ▶ The program is undertaking research on the urban heat island effect. ▶ The pilot projects and background research are supporting the development of a document titled, <i>Heat Alert and Response Systems to Protect Health: Best Practices Guidebook</i>. <ul style="list-style-type: none"> - A draft document has been prepared. It includes information on heat events in Canada, the relationship between heat and health, an overview of HARS, a description of the process for developing a HARS and engaging stakeholders, and HARS best practices. It is scheduled for release in 2011.
Health Messaging	<ul style="list-style-type: none"> ▶ Background research supported the development of a document titled, <i>Communicating the Health Risks of Extreme Heat Events: Toolkit for Public Health and Emergency Management Officials</i>. <ul style="list-style-type: none"> - A draft document is being prepared for publication. It is scheduled for release in 2011. - An overview of the toolkit was presented at a Canadian Public Health Association Conference in June 2010. The presentation is available online at http://resources.cpha.ca/CPHA/Conf/Data/A10-740e.pdf - The report provides an overview of extreme heat and health risks, discusses communicating health risks from extreme heat, and describes how to evaluate heat-health communication campaigns. It also includes

Theme	Activities implemented
	a health communication message review tool, heat-health messages, heat-health factsheets, a template for heat advisory media releases, and public involvement strategies.
Heat Health Science	<ul style="list-style-type: none"> ▶ The Program is funding research projects on thermoregulatory responses (e.g., the effectiveness of fans and hats in extreme heat). ▶ The Program is collecting data from 39 Environmental Heat Monitoring Systems (EHMS) as well as heat-related mortality and morbidity data. It is using this information to develop heat-mortality curves.
Clinical Competencies	<ul style="list-style-type: none"> ▶ Background research is supporting the development of a document titled, <i>Extreme Heat Events Guidelines: Technical Guide for Health Care Workers</i>. A draft document has been prepared. It includes information on heat events in Canada; the relationship between heat and health; key issues for health care workers; risk factors for heat-related illnesses; drugs and heat; prevention interventions; and the recognition and diagnosis of heat illness. It is scheduled for release in 2011.
Dissemination and Outreach	<ul style="list-style-type: none"> ▶ To build relationships and share information with key stakeholders, the Program has: <ul style="list-style-type: none"> - Participated in meetings with stakeholders - Participated in three heat-related workshops: Extreme Heat and Human Health (co-sponsored with Montreal Public Health); Heat-Health Messaging Workshop (hosted by CCHO); and The Urban Heat Island Summit (hosted by Clean Air Partnership, CCHO is a sponsor) - Held four webinars to inform stakeholders of the Program and its progress - Presented information on the Program at conferences - Worked with the Weather Network to prepare heat-related vignettes (the Program provided the Weather Network with the content for the vignettes; the Weather Network is responsible for producing the vignettes) - Been developing its plans for the roll-out of the Program outputs ▶ Pilot site coordinators said they have been increasing awareness of heat risks and vulnerabilities as well as extreme heat events through media releases, articles in newsletters, newspapers, and magazines.

As mentioned in Table 4 (above), two advisory committees were created to guide the activities of the Heat Resiliency Program:

- The HARS Advisory Committee is composed of 18 members (from international, federal, provincial and municipal public health organizations, non-governmental organizations and academia) who provide advice and guidance on the implementation of the Heat Resiliency Program. Members provide advice and guidance based on international, national, provincial, and local perspectives in the areas of public health, education, health policy, vulnerable populations, emergency management, disease prevention, and communication. Members are appointed to the committee based on their expertise.

According to the terms of reference, the committee helps Health Canada prioritize issues for research; comments on approaches to research initiatives; reviews outputs and draft reports; identifies opportunities for partnership and collaboration; and assists with the development of a communication strategy for the dissemination of results to stakeholders.

The HARS Advisory Committee has held four meetings (July 2008, February 2009, November 2009, and October 2010). Discussions revolved around the scope of the Program and identification of topics for the pilot projects; identification of topics for inclusion in, and the format of, the best practices guidebook; and processes for sharing program results.

- The HPIT Advisory Committee is composed of 11 members (public health practitioners and educators from a variety of public health disciplines) who provide advice and guidance to CCHO on the HPIT component of the Heat Resiliency Program. CCHO's Head of Science selected the committee members, based on their expertise and with input from a broad range of sources.

According to the terms of reference, the committee helps CCHO identify gaps in the knowledge base of health professionals and science-based information; prioritizes research projects; identifies methods of communicating with practitioners and educators; identifies pre-existing authoritative sources; and reviews and comments on draft materials intended for dissemination.

The HPIT Advisory Committee held three meetings (April 2009, November 2009, and September 2010). Discussions revolved around identification of information gaps and research topics of interest; identification of best practices for health messaging; identification of topics for inclusion in the *Extreme Heat Events Guidelines: Technical Guide for Health Care Workers*; reviewing and commenting on draft sections of the guidelines; and processes for sharing program results and messages.

Various factors confounded program implementation

Staff noted that the Heat Resiliency Program, along with the other Adaptation Theme programs, was intended to be completed over four years, but delays in approvals reduced this period to three years. They reported that despite the shortened timeframe, the Program was still expected to produce all of its intended deliverables.

Staff also reported that the Program experienced some budget cuts due to the delays in launching the Adaptation Theme as well as a departmental Strategic Review that reallocated its funding.

Further, implementation was impeded because CCHO had to hire additional staff to produce the outputs associated with this program. Staff indicated that, due to staffing processes, it took two years for the Program to reach a full staff complement.

The Program also experienced start-up challenges with some pilot studies. For example, pilot site coordinators reported that a city-wide strike delayed the launch of one pilot project and it took longer than anticipated to engage some communities and stakeholders in the pilot projects. Further, the extent of extreme heat education needed in the communities was underestimated; and the process of defining heat vulnerability and designing the HARS was more involved than expected. Finally, some sites experienced delays in hiring coordinators and communications specialists.

As mentioned in Section 4.2.2, the Program was to include a public opinion research component consisting of a survey of vulnerable populations and health messaging focus groups. However, staff said that by the time approval for the research was received, it would have had to take place in the winter, which may have influenced participants' perceptions of extreme heat-related issues. Therefore, to inform the development of the health messaging component, instead of

conducting the public opinion research, the Program decided to rely on more extensive literature review and insights gained through the pilot studies.

Staff and pilot site coordinators identified a few additional challenges:

- It has been difficult to secure data on heat health. In many cases, the data is over five years old and heat illnesses are often misclassified, which may result in underreporting of the incidence and prevalence of heat-induced illness.
- One of the summers during the pilot studies was cool, which limited the extreme heat-related data that could be collected and used to assess the effectiveness of the HARS.
- The existence of many stakeholders complicates the development of consistent messaging, as each has its own priorities and wants to customize the messages.
- Having some communications materials and information on best practices from Health Canada prior to the launch of the pilot project would have helped to implement projects and would have reduced the amount of new material required. It would have been helpful if Health Canada had retained a communications contractor for the pilot projects to use rather than asking them to contract someone on their own.
- The Program's information dissemination strategy initially intended to launch its deliverables through a National Heat Forum; however, the Program is now considering holding a series of regional workshops instead as this will enable it to target information to regional needs.

Some unanticipated issues arose during implementation

Staff and pilot project coordinators reported being somewhat surprised by the level of interest stakeholders have expressed in the Program:

- Some community workshops had over 50 stakeholder groups represented
- Stakeholders have been asking for quicker release of information and communications materials.

Some pilot site coordinators also mentioned they did not anticipate that the public health function would play such a key role in decision-making; they thought emergency management would be a key decision-maker. Moreover, Staff and pilot site coordinators said the Program addresses gaps in planning for, and communications related to, extreme heat and clarifies the roles and responsibilities of various stakeholders in responding to an extreme heat event.

4.2.4 Effectiveness

This section responds to the evaluation questions:

- To what extent have immediate outcomes been achieved as a result of the Heat Resiliency Program?

- Have there been any unintended (positive or negative) outcomes observed at this time?

It is too early in program implementation to make an assessment of effectiveness.

The 2009 Policy on Evaluation indicates that ‘effectiveness’ is the extent to which a program is achieving expected outcomes (p.7).

The Program’s immediate outcomes are:

- increased availability of guidelines and best practices for implementing HARS
- improved availability of information to Canadians about the risks of extreme heat events and appropriate preventative and response strategies
- increased availability and access for health professionals to information products and training materials that identify the risk factors of vulnerable population groups to the effects of extreme heat events
- increased availability and access for health professionals to information products and training materials that provide guidance on anticipatory and reactive interventions.

The Heat Resiliency Program involves conducting primary research to inform the development of information products for communities and health professionals. However, its intended outputs will not be ready for publication and release until 2011. Therefore, due to the nature of its design, this Program has not begun to realize its intended outcomes at this time. For this reason, it is premature to assess the Program’s effectiveness.

Staff reported that because the Program’s immediate outcomes focus on increasing the availability of and access to information, these outcomes will be achieved simply by publishing and disseminating the Program’s intended outputs once they are completed. Staff reported that they are in the process of ensuring the Department has the capacity and approvals required for dissemination and outreach.

As the dissemination strategy is in the planning stages, the specific reach of the information that the Program is producing is unknown. Further, the extent to which the immediate outcomes will lead to intermediate and final outcomes is unknown.

As mentioned above, the Program has not collected baseline information about Canadians’ awareness of, and capacity to respond to the risks of extreme heat or the proportion of the population covered by HARS. Nor has the Program collected baseline data on the capacity of health professionals. In order to assess achievement of intermediate outcomes, this data will need to be collected prior to dissemination of outputs.

In terms of unintended outcomes, there was no evidence that any had been produced. Staff and pilot project coordinators noted that since the Program is still at the output production stage, it is too early to identify any unintended outcomes.

4.2.5 Efficiency and Economy

This section responds to the evaluation questions:

- Has the Heat Resiliency Program organized its activities, at least cost, consistent with the required outputs and their timing?
- Are Heat Resiliency Program activities resulting in the production of the required outputs at least cost?
- Is the Heat Resiliency Program designed to achieve its expected immediate outcomes at least cost? If not, what changes are recommended?
- Is there any evidence to suggest that alternative methods for producing the outputs and/or realizing the outcomes would be more effective or lower cost?

Based on available data, the Program appears to be efficient; it is on track to achieving its stated outputs in spite of reductions in planned time and resources

According to the 2009 Policy on Evaluation ‘efficiency’ is defined as: the extent to which resources are used such that a greater level of output is produced with the same level of input or, a lower level of input is used to produce the same level of output (p. 7).

The Heat Resiliency Program’s planned inputs included \$7.9 million in funding over four fiscal years (2007–2008 to 2010–2011) and 11 full-time equivalents (FTEs). Table 5 shows the amount of funding the Program was to receive over four fiscal years.

Table 5
Heat resiliency, approved funding

	2007–2008	2008–2009	2009–2010	2010–2011	Total
Salaries, wages, benefits	\$238,008	\$939,813	\$902,377	\$918,018	\$2,998,216
Operating and maintenance	\$286,207	\$1,408,374	\$1,149,866	\$1,732,531	\$4,576,978
*PWGSC accommodation	\$25,784	\$101,813	\$97,757	\$99,452	\$324,806
Total	\$550,000	\$2,450,000	\$2,150,000	\$2,750,000	\$7,900,000
Note: Totals may not sum due to rounding.			*Public Works and Government Services Canada.		

Although the Program was approved to receive \$7.9 million in total funding, during the 2007–2008 fiscal year, no resources were allocated to this Program, or any of the Clean Air Agenda Adaptation Theme programs. Due to delays in launching the CAA Adaptation Theme programs, the Heat Resiliency Program was unable to access its first year funding of (\$550,000). The budget was further reduced by approximately \$460,000 as result of a departmental Strategic Review process.

According to the information provided by the Program (Table 6), expenditures between 2008–2009 and 2009–2010 were \$3,802,894. This is \$1.3 million less than anticipated, mainly because the Program was not fully staffed until summer 2010. Most staff members involved in the Program reported devoting 100% of their time to it. Table 6, below, show actual Program expenditures.

Table 6
Heat resiliency, actual expenditures

	2007–2008	2008–2009	2009–2010	Total
Salaries, wages, benefits	-	\$573,822	\$801,343	\$1,375,165
Operating and maintenance	-	\$841,966	\$1,386,193	\$2,228,159
PWGSC accommodation	-	\$101,813	\$97,757	\$199,570
Total	-	\$1,517,601	\$2,285,293	\$3,802,894
This table assumes PWGSC received the full amount for accommodation. It also assumes that accommodation was not paid in 2007–2008, since the Program did not receive any funding that year.				

In addition to funding salaries, the Program spent approximately \$2.2 million on 40 contracts for research services, expert advice and review services, research equipment and editing services. Contracts for the HARS pilot projects and related research totaled \$1.07 million and contracts in support of heat health science totaled \$597,900. About \$26,000 went to contracts for general support, (including report development, writing, and review, expert advice, and expert review services) and \$23,500 was used for workshops.

Staff reported that despite the shortened funding period, budget reductions, and various delays and challenges, the Program is on track to produce its intended outputs by 2011. Staff reported that the Program’s core outputs are in the process of being developed and finalized. The Program’s deliverables will be published and disseminated in early 2011.

Staff reported that an advantage of the approach being used is that in-house resources are devoted to report writing. A few mentioned that internal staffing and contracting processes and reporting requirements are cumbersome. They believe opportunities exist to reduce administrative costs by changing these internal processes.

It is important to note that this evaluation did not have the resources to examine management processes in terms of the acquisition and deployment of inputs.

It is too early in program implementation to make an assessment of economy

According to the 2009 Policy on Evaluation, ‘economy’ is achieved when the cost of resources used approximates the minimum amount of resources needed to achieve expected outcomes (p.7). As mentioned above, the Program has not yet achieved its outcomes due to the status of implementation. Therefore, economy cannot be assessed at this time.

No alternatives methods to producing the Program’s outputs at lower cost were suggested, although complementary methods to achieving longer-term outcomes were identified

In terms of producing the Heat Resiliency Program’s planned outputs, the evaluation did not identify any alternative approaches. However, some interviewees provided suggestions related to details of program implementation. For example, some members of the advisory committees suggested the committees could have been more involved in the planning phase of the Program, and that some members would have been willing to assist Health Canada directly in conducting some of the research projects, which may have resulted in some cost-savings. Additionally, some advisory committee members suggested that it would have been more cost-effective to hold meetings via video conference rather than in person.

In terms of the realization of longer-term program outcomes, subject matter experts suggested some alternative or potentially complementary approaches. These suggestions would not result in the same deliverables and immediate outcomes; rather, they would address longer-term outcomes using alternative interventions. Some subject matter experts suggested the Program could have used social marketing and/or modifications to the built environment.

The launching of a social marketing campaign to raise Canadians’ awareness of heat risks and educate them about developing a personal heat plan was one suggestion. It is generally agreed in the literature that achieving widespread compliance with warnings requires planners to recognize and address the diverse needs of the population when developing communications products, particularly for at-risk groups (Auld, 2008, p. 123; Tierney, 2000, p. iv). It cannot be assumed that a single message or delivery method will work for everyone (Parkin, Embrey, & Hunter, 2003, pp. 61-62; Silver & Conrad, 2010).⁷ Consequently, several writers recommended that messaging should be tailored to individual groups (Berry et al., 2009, p. 71; Ebi, 2005, p. 54). However, it is also advisable to issue broad mass media messages to avoid giving the general public the impression that the messages don’t also apply to them (Bassil & Cole, 2010, p. 998).⁸ In the context of extreme heat, in addition to public services messages aimed at the general population, specific messages should be targeted to the elderly, the disabled, children, minorities, and low-income populations (Ebi & Schmier, 2005, p. 119).

Another suggestion was funded environmental modification initiatives and/or pilots to reduce communities’ vulnerability to extreme heat events. Environmental interventions aim to change aspects of the physical or built environment. Medium-term measures include increased use of heat-reflective paints, external shade areas, and insulating homes to protect against the heat (NHS, 2010; Smoyer-Tomic & Rainham, 2001, pp. 1241–1242).

⁷ As Keys (1997) said, “to assume that broad brush messages will communicate effectively with everyone who might need to be informed of flooding [...] is akin to believing that the same size of shoe fits all feet” (p. 6).

⁸ While beyond the scope of the literature review, it should be noted that it is also important to ensure effective interventions exist for vulnerable populations. A study of 18 heat-health response plans for US cities found that while many made some provisions for seniors, only one addressed the needs of the disabled, and only two addressed the needs of the homeless (Bernard & McGeehin, 2004, p. 1520).

An example of a long-term measure is urban planning. This might include changes to the design of building and settlements such as shaded dwellings for protection from the sun; light-coloured road surfaces and building materials to reflect heat; and well placed vegetative areas like green rooftops (Smoyer-Tomic and Rainham, 2001, pp. 1241–1242).

The evidence suggests that modifications to the built environment are often effective in reducing heat stress in urban environments, and may be cost-effective or even cost-saving in some instances (Kovats et al., 2004, Banting et al. (2005), Solecki et al. (2005), McPherson, Nowak, and Rowntree (1994)). While environmental interventions may be more expensive and time-consuming to implement, Smoyer-Tomic (2009) argues that, compared to behavioural modifications, they may be more successful in achieving health outcomes. One reason for this is that modifications to the built environment generally provide health benefits to the public without requiring significant changes in behaviour.

It is important to recognize that while modifications to the built environment could potentially reduce heat stress in urban areas, no references in the literature were identified that suggested these can or should act as substitutes for heat alert and response systems. In fact, environmental modification initiatives are implemented alongside heat alert and response plans in some jurisdictions. For example, the City of Toronto has an operational heat alert and response system and it has adopted a new bylaw, which requires new commercial, residential, and institutional developments of a certain size to use green rooftops. Similarly, the City of Chicago and England have heat plans that include environmental modification plans along with heat alert and response systems (NHS, 2010, p. 17).

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Relevance

Canada is experiencing warmer temperatures and increased frequency and severity of extreme heat events. Given that this trend is expected to continue, and that extreme heat events can cause mortality and morbidity, there is a need to increase Canadians' resiliency to extreme heat events resulting from climate change. Although HARS have the potential to reduce the health impacts associated with extreme heat events, few communities have implemented them. Further, Canadians, in general, do not perceive themselves as vulnerable to extreme heat events. These findings demonstrate the need for the HARS component of the Program.

It appears that some health service providers may not be considering climate change risks in their planning processes, and health professionals may not be providing Canadians with adequate information about how to protect themselves during extreme heat events. These findings suggest there is a need for the health professionals' information/interventions and training component of the Program.

The Heat Resiliency Program forms part of the Clean Air Agenda Adaptation Theme, which is the Government of Canada's primary strategy to address adaptation to the impacts of climate change. The Heat Resiliency Program aligns with Health Canada's strategic outcome for reduced health and environmental risk from products and substances, and safer living and working environments. Further, it directly supports Health Canada's Climate Change and Health Office's mandate, which is to advance the understanding of the health impacts of climate change in collaboration with researchers across Canada; raise awareness of the effects of climate change on human health; promote adaptation to climate change; and provide advice on best practices for adapting to changing climate.

Performance

The program theory supporting the linkages from activities to outputs to immediate outcomes is clear. The theory assumes that conducting primary research/pilot studies and developing networks/partnerships will inform the development of information products. In turn, sharing these outputs will achieve the immediate outcomes of increased availability of, and access to, information.

In transitioning to intermediate and final outcomes, the program theory becomes weaker. The theory assumes that the availability of information will increase capacity to respond to extreme heat events and that this will increase Canadians' resiliency to the events. However, to realize these outcomes, communities and health service providers will need to devote their own resources and efforts, and Canadians will need to change their behaviour. At this time, the Program has not defined a strategy to ensure this occurs.

To assess its performance, the Program has developed a performance measurement strategy. Indicators for the immediate outcomes included in the strategy are activity and output-oriented. Thus, they do not provide information on impacts, benefits, or changes. Further, the Program has not collected the baseline data needed to assess its performance.

Generally, the Program has been implemented as planned and appears efficient. The timeline and budget within which the work was to be completed were reduced, but these changes do not appear to have altered the Program's planned deliverables; it is on track to produce outputs. Given that the Program is not launching its dissemination strategy until early 2011; its immediate outcomes have yet to be realized. Further, for this reason, it is premature to assess the Program's effectiveness and economy.

There are no obvious alternative approaches that could produce the Program's intended outputs for lower cost. However, alternative or potentially complementary approaches to achieving the Program's longer-term outcomes were identified, including modifications to the built environment and social marketing.

5.2 Recommendations

If Health Canada plans to pursue continuation of the Heat Resiliency Program beyond 2011, it should consider findings from this evaluation. In particular, this evaluation recommends that Health Canada should:

1. Consider developing a strategy to ensure the capacity outside Health Canada exists to implement Program deliverables. This may include expanding the scope of Health Canada's involvement in delivering and disseminating outputs. For example, Health Canada could work with public health institutions and associations to incorporate heat health information in training curricula and professional development opportunities for health professionals.
2. Review and validate the Program's design, especially the intermediate and long-term outcomes. Once the design has been validated, ensure that baseline and trend data are collected for performance measurement. This data should be collected at various times throughout the year, and over time, to establish trends and determine what impacts the Heat Resiliency Program may have.
3. Review pilot Heat Alert and Response Systems in time to feed into the next cycle of evaluation for the Heat Resiliency Program. These reviews should include an assessment of the approach, best practices, lessons learned, and costs borne by communities in designing, implementing and maintaining the systems.
4. Explore the option of providing national guidance on complementary approaches to reducing Canadians' vulnerability to extreme heat events, including modifications to the built environment.

APPENDIX A

REFERENCES

- Abrahamson, V., Wolf, J., Lorenzoni, I., Fenn, B., Kovats, S., Wilkinson, P., Adger, W. N., et al. (2008). Perceptions of heatwave risks to health: interview-based study of older people in London and Norwich, UK. *Journal of Public Health, 31*(1), 119–126. doi:10.1093/pubmed/fdn102
- Alberini, A., Mastrangelo, E., & Pitcher, H. (2008). *Climate change and human health: assessing the effectiveness of adaptation to heat waves*. Retrieved from <http://www.aere.org/meetings/documents/0608Alberini.pdf>
- Auld, H. (2008). Disaster risk reduction under current and changing climate conditions. *WMO Bulletin, 57*(2), 118–125.
- Australian Associated Press Pty Limited. (2009, December 9). Australia records hottest six months. Retrieved from <http://www.watoday.com.au/breaking-news-national/australia-records-hottest-six-months-20091209-kj56.html>
- Bassil, K. L. (2008). The relationship between temperature and 911 medical dispatch data for heat-related illness in Toronto, 2002-2005: An application of syndromic surveillance. Toronto, ON: University of Toronto. Retrieved from https://tspace.library.utoronto.ca/bitstream/1807/17296/1/Bassil_Katherine_L_200811_PhD_thesis.pdf
- Bassil, K. L., & Cole, D. C. (2010). Effectiveness of public health interventions in reducing morbidity and mortality during heat episodes: a structured review. *International Journal of Environmental Research and Public Health, 7*(3), 991-1001. doi:10.3390/ijerph7030991
- Bernardo, L. M., Crane, P. A., & Veenema, T. G. (2006). Treatment and prevention of pediatric heat-related illnesses at mass gatherings and special events. *Dimensions of Critical Care Nursing: DCCN, 25*(4), 165-171.
- Berry, P., Clarke, K., Pajot, M., Hutton, D., & Verret, M. (2009). *The role of risk perception and health communication in adapting to the health impacts of climate change in Canada*. Ottawa, ON: Climate Change Impacts and Adaptation Program, Earth Sciences Sector, Natural Resources Canada. Retrieved from http://adaptation.nrcan.gc.ca/projdb/pdf/205_e.pdf
- Burningham, K., Fielding, J., & Thrush, D. (2008). 'It'll never happen to me': understanding public awareness of local flood risk. *Disasters, 32*(2), 216–238.
- CCHO (2009). *Helping Canadians Adapt to a Changing Climate: Developing Heat Resilient Individuals and Communities in Canada*.
- Changnon, S. A., Kunkel, K. E., & Reinke, B. C. (1996). Impacts and responses to the 1995 heat wave: a call to action. *Bulletin of the American Meteorological Society, 77*(7), 1497–1506. doi:10.1175/1520-0477(1996)077<1497:IARTTH>2.0.CO;2
- City of Hamilton. (2006, August). Air quality and climate change corporate strategic plan: Phase I. Retrieved from http://www.hamilton.ca/NR/rdonlyres/C43C2AB2-0F88-4076-A49A-92AD9D3429AC/0/FINAL_AQCCStratPlanPhaseI.pdf
- City of Ottawa. (2010). Medications and heat related illness. Retrieved July 25, 2010, from http://www.ottawa.ca/residents/health/environments/issues/hot/kit/medications_en.html
- City of Toronto. (2010). Green Roof ByLaw. Retrieved September 21, 2010, from <http://www.toronto.ca/greenroofs/overview.htm>

- Collins, M. L., & Kapucu, N. (2008). Early warning systems and disaster preparedness and response in local government. *Disaster Prevention and Management*, 17(5), 587–600.
- D J Fairbairn Environmental Consulting (2007). Strategic Plan for Heat Resilient Communities.
- Daubs, K. (2010, July 5). Toronto's baby blackout. *Toronto Star*. Retrieved from <http://www.thestar.com/news/gta/article/832275--toronto-s-baby-blackout>
- Dolney, T. J., & Sheridan, S. C. (2006). The relationship between extreme heat and ambulance response calls for the city of Toronto, Ontario, Canada. *Environmental research*, 101(1), 94–103.
- Ebi, K. L. (2005). Improving public health responses to extreme weather events. In W. Kirch, R. Bertollini, & B. Menne (Eds.), *Extreme Weather Events and Public Health Responses*. Berlin/Heidelberg: Springer-Verlag. Retrieved from <http://www.springerlink.com/index/10.1007/3-540-28862-7>
- Ebi, K. L., & Schmier, J. K. (2005). A stitch in time: improving public health early warning systems for extreme weather events. *Epidemiologic Reviews*, 27(1), 115.
- Ebi, K. L., Teisberg, T. J., Kalkstein, L. S., Robinson, L., & Weiher, R. F. (2004). Heat watch/warning systems save lives: Estimated costs and benefits for Philadelphia 1995–1998. *Bulletin of the American Meteorological Society*, August 2004.
- Environics Research Group. (2008). Assessing perceived health risks of climate change: Canadian public opinion—2008. Ottawa, ON: Health Canada.
- Fayerman, P. (2010, June 16). Heat waves last summer linked to 200 deaths. *Vancouver Sun*. Retrieved from <http://www.vancouver.sun.com/health/Heat+waves+last+summer+linked+deaths/159087/story.html>
- Ferrier, N. (2002). *A national assessment of emergency planning in Canada's general hospitals*. Office of Critical Infrastructure Protection and Emergency Preparedness. Retrieved from http://dsp-psd.pwgsc.gc.ca/collection_2008/ps-sp/D82-69-2002E.pdf
- Flynn, A., McGreevy, C., & Mulkerrin, E. (2005). Why do older patients die in a heatwave? *QJM*, 98(3), 227–229. doi:10.1093/qjmed/hci025
- Fouillet, A., Rey, G., Wagner, V., Laaidi, K., Empereur-Bissonnet, P., Le Tertre, A., Frayssinet, P., et al. (2008). Has the impact of heat waves on mortality changed in France since the European heat wave of summer 2003? A study of the 2006 heat wave. *International Journal of Epidemiology*, 37(2), 309–317. doi:10.1093/ije/dym253
- Frumkin, H. (2002). Urban sprawl and public health. *Public Health Reports*, 117(3), 201–217.
- Glantz, M. (2004). *Early warning systems*. Shanghai, China. Retrieved from <http://www.ccb.ucar.edu/warning/report.html>
- Government of Canada. (2010a). Speech from the throne. Retrieved from <http://www.discours.gc.ca/eng/index.asp>
- Government of Canada. (2010b). Budget 2010. Retrieved from <http://www.budget.gc.ca/2010/home-accueil-eng.html>
- Hajat, S., Sheridan, S. C., Allen, M. J., Pascal, M., Laaidi, K., Yagouti, A., Bickis, U., et al. (2010). Heat-health warning systems: a comparison of the predictive capacity of different approaches to identifying dangerously hot days. *Am J Public Health*, 100(6), 1137–1144. doi:10.2105/AJPH.2009.169748

- HC (2006). *Snapshot of adaptation and response capacity to climate change in public health*. Report prepared by the Canadian Public Health Association for Health Canada. Retrieved from http://www.cpha.ca/uploads/progs/env/ccph_final_e.pdf
- HC (2007). *Heat management in Canadian communities*. Report prepared by D. Paszkowski for Health Canada.
- HC (2008). Human health in a changing climate: a Canadian assessment of vulnerabilities and adaptive capacity.
- HC (2009). About Health Canada. Retrieved April 26, 2010, from <http://www.hc-sc.gc.ca/ahc-asc/index-eng.php>
- HC (2010). Assessing Canadian public health recommendations in relation to extreme heat events (EHEs). Report prepared by M. Verret for Health Canada.
- Hengeveld, H., Whitewood, B., & Fergusson, A. (2005). *An introduction to climate change: a Canadian perspective*. Environment Canada. Retrieved from www.msc.ec.gc.ca/education/scienceofclimate/change
- IPCC. (2007). *IPCC Fourth Assessment Report: Working Group II Report "Impacts, Adaptation and Vulnerability"*. Cambridge, UK: Cambridge University Press. Retrieved from <http://www.ipcc.ch/ipccreports/ar4-wg2.htm>
- ISQ. (2009, December 23). Proportions des ménages qui disposent de certaines composantes de l'équipement ménager, selon la tranche de revenu, Québec, 2007. Website of the Institut de la statistique du Québec. Retrieved July 25, 2010, from http://www.stat.gouv.qc.ca/donstat/societe/famls_mengs_niv_vie/patrm_equip/5equip_repar.htm
- Jay, O., & Kenny, G. P. (2010). Heat exposure in the Canadian workplace. *American Journal of Industrial Medicine*, 9999(9999), n/a. doi:10.1002/ajim.20827
- Kalkstein, L. S., Sheridan, S. C., & Kalkstein, A. J. (2009). Heat/health warning systems: development, implementation, and intervention activities. In K. L. Ebi, I. Burton, & G. R. McGregor (Eds.), *Biometeorology for Adaptation to Climate Variability and Change* (pp. 33–48). Dordrecht: Springer Netherlands.
- Keim, M. E. (2008). Building human resilience: the role of public health preparedness and response as an adaptation to climate change. *American Journal of Preventive Medicine*, 35(5), 508–516.
- Knowlton, K., Rotkin-Ellman, M., King, G., Margolis, H. G., Smith, D., Solomon, G., Trent, R., et al. (2009). The 2006 California heat wave: impacts on hospitalizations and emergency department visits. *Environmental Health Perspectives*, 117(1), 61–67. doi:10.1289/ehp.11594
- Koppe, C., Kovats, S., Jendritzky, G., & Menne, B. (2004). *Heat-waves: risks and responses* (No. 2). Health and Global Environmental Change. World Health Organization Europe. Retrieved from <http://www.euro.who.int/document/E82629.pdf>
- Kosatsky, T. (2010). Hot day deaths, summer 2009: What happened and how to prevent a recurrence. *BC Medical Journal*, 52(5), 261.
- Kosatsky, T., Dufresne, J., Richard, L., Renouf, A., Giannetti, N., Bourbeau, J., Julien, M., et al. (2009). Heat awareness and response among Montreal residents with chronic cardiac and pulmonary disease. *Canadian Journal of Public Health*, 100(3), 237–240.
- Kovats, S., & Hajat, S. (2008). Heat stress and public health: a critical review. *Annual Review of Public Health*, 29, 41–55.

- Lee, J. (2010, July 6). Vancouver unveils plan for 'extreme heat'. *The Vancouver Sun*. Retrieved from <http://www.vancouversun.com/news/Vancouver+unveils+plan+extreme+heat/3243231/story.html>
- Levy, C. J. (2010, July 29). From Fires to Fish, Heat Wave Batters Russia. *The New York Times*. Retrieved from http://www.nytimes.com/2010/07/30/world/europe/30moscow.html?_r=1&ref=russia
- Luber, G., & McGeehin, M. (2008). Climate change and extreme heat events. *American Journal of Preventative Medicine*, 35(5), 429–435.
- Luber, G. E., & Sanchez, C. A. (2006). Heat-Related Deaths: United States, 1999-2003. *Morbidity and Mortality Weekly Report*, 55(29), 796–798.
- Malilay, J. (1997). Floods. In E. K. Noji (Ed.), *The Public Health Consequences of Disasters* (pp. 287–301). New York, NY: Oxford University Press US.
- McLaren, C. (2005). Heat stress from enclosed vehicles: Moderate ambient temperatures cause significant temperature rise in enclosed vehicles. *Pediatrics*, 116(1), e109–e112. doi:10.1542/peds.2004-2368
- McLaughlin, H. (2010, July 9). Heat alert level increased. *The Daily Gleaner*, A1.
- Mersereau, V. (2007). *A scan of municipal heat/health watch warning systems and hot weather response plans*. Clean Air Partnership. Retrieved from http://www.cleanairpartnership.org/pdf/heat_report.pdf
- Mills, D., & Herrick, C. (2010). Heat alert and response systems (HARS) review: challenges and best practices. Stratus Consulting Inc.
- National Research Council. (1994). Facing the challenge: the U.S. national report to the IDNDR World Conference on Natural Disaster Reduction, Yokohama, Japan, May 23-27, 1994. Washington, DC: National Academy Press.
- Naughton, M. P., Henderson, A., Mirabelli, M. C., Kaiser, R., Wilhelm, J. L., Kieszak, S. M., Rubin, C. H., et al. (2002). Heat-related mortality during a 1999 heat wave in Chicago. *American Journal of Preventive Medicine*, 22(4), 221–227. doi:10.1016/S0749-3797(02)00421-X
- Nease, K. (2010, July 7). Ottawa's heat wave: "You just have to bear it". *The Ottawa Citizen*, A1.
- Null, J. (2010, September 13). Fact sheet - Hyperthermia deaths of children in vehicles. *Website of the Department of Geosciences, San Francisco State University*. Retrieved September 14, 2010, from <http://ggweather.com/heat/index.htm#study>
- O'Neill, M. S., & Ebi, K. L. (2009). Temperature extremes and health: impacts of climate variability and change in the United States. *Journal of Occupational and Environmental Medicine / American College of Occupational and Environmental Medicine*, 51(1), 13–25. doi:10.1097/JOM.0b013e318173e122
- Palecki, M. A., Changnon, S. A., & Kunkel, K. E. (2001). The Nature and Impacts of the July 1999 Heat Wave in the Midwestern United States: Learning from the Lessons of 1995. *Bulletin of the American Meteorological Society*, 82(7), 1353–1368. doi:10.1175/1520-0477(2001)082<1353:TNAIOT>2.3.CO;2
- PHAC. (2009). *Obesity in Canada - snapshot*. Public Health Agency of Canada. Retrieved from <http://www.phac-aspc.gc.ca/publicat/2009/oc/index-eng.php>
- Philpot, A. (2006). Scan of literature on drinking water, infectious disease control and food safety in Canada's 10 provinces. Canadian Public Health Association.

- Robine, J., Cheung, S. L. K., Le Roy, S., Van Oyen, H., Griffiths, C., Michel, J., & Herrmann, F. R. (2008). Death toll exceeded 70,000 in Europe during the summer of 2003. *Comptes Rendus Biologies*, 331(2), 171–178. doi:10.1016/j.crv.2007.12.001
- Rollason, K. (2006, July 25). Heat wave shatters records. *Winnipeg Free Press*, B2.
- Schwartz, J. (2005). Who is sensitive to extremes of temperature?: A case-only analysis. *Epidemiology (Cambridge, Mass.)*, 16(1), 67–72.
- Semenza, J. C., Wilson, D. J., Parra, J., Bontempo, B. D., Hart, M., Sailor, D. J., & George, L. A. (2008). Public perception and behavior change in relationship to hot weather and air pollution. *Environmental Research*, 107(3), 401–411. doi:10.1016/j.envres.2008.03.005
- Sheridan, S. C. (2007). A survey of public perception and response to heat warnings across four North American cities: an evaluation of municipal effectiveness. *International Journal of Biometeorology*, 52(1), 3–15. doi:10.1007/s00484-006-0052-9
- Sheridan, S. C., & Kalkstein, L. S. (2004). Progress in heat watch-warning system technology. *Bulletin of the American Meteorological Society*, 85(12), 1931–1942.
- Smoyer-Tomic, K. E. (2009, July 29). *Heat early warning systems*. Presented at the 2009 NCAR Workshop on Climate and Health. Retrieved from <http://www.isse.ucar.edu/climatehealth/2009/presentations/Tomic%20HHWS%20NCAR%202009.pdf>
- Smoyer-Tomic, K. E., Kuhn, R., & Hudson, A. (2003). Heat wave hazards: an overview of heat wave impacts in Canada. *Natural Hazards*, 28(2), 465–486.
- Solecki, W. D., Rosenzweig, C., Parshall, L., Pope, G., Clark, M., Cox, J., & Wiencke, M. (2005). Mitigation of the heat island effect in urban New Jersey. *Global Environmental Change Part B: Environmental Hazards*, 6(1), 39–49. doi:10.1016/j.hazards.2004.12.002
- Stafoggia, M., Forastiere, F., Agostini, D., Biggeri, A., Bisanti, L., Cadum, E., Caranci, N., et al. (2006). Vulnerability to heat-related mortality: a multicity, population-based, case-crossover analysis. *Epidemiology (Cambridge, Mass.)*, 17(3), 315–323. doi:10.1097/01.ede.0000208477.36665.34
- Statistics Canada. (2010). Population by year, by province and territory. Retrieved from <http://www40.statcan.ca/101/cst01/demo02a-eng.htm>
- Stieb, D. M., Paola, J., & Neuman, K. (1996). Do smog advisories work? Results of an evaluation of the Canadian Smog Advisory Program. *Canadian Journal of Public Health. Revue Canadienne De Santé Publique*, 87(3), 166–169.
- Tan, J., Zheng, Y., Song, G., Kalkstein, L. S., Kalkstein, A. J., & Tang, X. (2007). Heat wave impacts on mortality in Shanghai, 1998 and 2003. *International Journal of Biometeorology*, 51(3), 193–200. doi:10.1007/s00484-006-0058-3
- teBrake, R. (2009, July 29). Heat wave expected to last until weekend; Southern Interior hardest-hit part of province, with temperature in low 40s. *Vancouver Sun*, A4.
- Vancouver Extreme Hot Weather Committee. (2010). *Review of preparedness and response services during extreme weather*. Retrieved from <http://vancouver.ca/ctyclerk/cclerk/20100706/documents/rr1.pdf>
- Whitman, S., Good, G., Donoghue, E. R., Benbow, N., Shou, W., & Mou, S. (1997). Mortality in Chicago attributed to the July 1995 heat wave. *American Journal of Public Health*, 87(9), 1515–1518.
- WHO. (2010). Climate change and health. Retrieved from <http://www.who.int/mediacentre/factsheets/fs266/en/>

APPENDIX B

EVALUATION MATRIX

Evaluation information summary table - Issues, questions, indicators, and analysis			
Evaluation issues and questions	Indicators	Collection methods	Data sources
Relevance – Do activities under the Heat Resiliency Program align with and contribute to federal government clean air priorities and the key environmental and health needs of Canadians?			
1. Is there a continued need for the Heat Resiliency Program?	<ul style="list-style-type: none"> ▶ Assessment of the health implications of extreme heat events ▶ Evidence of the presence of any factors that may increase or diminish the health implications of extreme heat events ▶ Evidence of gaps in Canadian extreme heat event response systems ▶ Evidence of unnecessary overlap and duplication with other programs and jurisdictions (provinces, territories, and municipalities) 	Document and database review	▶ TB Submission of the CAA/ Heat Resiliency Program
		Literature review	<ul style="list-style-type: none"> ▶ Literature assessing the current state of knowledge around heat and human health ▶ Literature describing the health implications of extreme heat events and demonstrating the existence of factors that could increase or diminish the impact of extreme heat events ▶ Literature identifying existing extreme heat event response systems and their associated strengths and weaknesses ▶ Review of other national, provincial/territorial, regional, or local programs that could potentially complement or duplicate the objectives of the Heat Resiliency Program
		KI interviews	▶ Interviews with program staff and subject matter experts
2. Is the Heat Resiliency Program aligned with federal government priorities?	<ul style="list-style-type: none"> ▶ Evidence of commitments/policies to increase communities resilience to extreme heat events ▶ Alignment between the objectives of the Heat Resiliency Program and the Adaptation Theme of the CAA ▶ Alignment between the objectives of the Heat Resiliency Program and HC's mandate and priorities 	Document and database review	<ul style="list-style-type: none"> ▶ Speech from the Throne ▶ Federal budgets ▶ TB Submission for the CAA/ Heat Resiliency Program ▶ Reports on Plans and Priorities ▶ PAA ▶ Business plans ▶ RMAF
		KI interviews	▶ Interviews with program staff
3. Is there a unique and necessary role for HC in the Heat Resiliency Program?	<ul style="list-style-type: none"> ▶ Extent to which HC and Canada have the jurisdiction (constitutional) for involvement in this type of project ▶ Views on the appropriateness of HC involvement in the program ▶ Expression of need by pilot site coordinators, key stakeholders, and subject matter experts 	Document and database review	<ul style="list-style-type: none"> ▶ Authorities governing HC involvement in heat alert projects (e.g., legislation, policies) ▶ Provincial program inception documents ▶ MOUs between federal/provincial governments
		KI interviews	▶ Interviews with program staff, pilot site coordinators, key stakeholders, and subject matter experts

Evaluation information summary table - Issues, questions, indicators, and analysis

Evaluation issues and questions	Indicators	Collection methods	Data sources
Performance – Has the Heat Resiliency Program met its intended outcomes? Are the most appropriate, efficient, and economic means being used to achieve outcomes?			
4. Does the Heat Resiliency Program have clearly defined activities, outputs, and outcomes? Does it have a valid theoretical basis that links these together?	<ul style="list-style-type: none"> ▶ Documented evidence of intended outputs and expected outcomes ▶ Theory and policy development supporting the program ▶ Validity of theoretical foundation for the Heat Resiliency Program ▶ Ability of staff to discuss intended outputs and outcomes for the aspects of the program in which they are involved 	<ul style="list-style-type: none"> Document and database review Literature review KI interviews 	<ul style="list-style-type: none"> ▶ TB submission for the CAA/ Heat Resiliency Program ▶ Heat Resiliency Program Implementation Plan ▶ RMAF ▶ Evidence that heat alert response systems can increase the community resilience to extreme heat events ▶ Opinion/media reaction to past heat events ▶ Interviews with program staff
5. Has the Heat Resiliency Program organized its activities, at least cost, consistent with the required outputs and their timing?	<ul style="list-style-type: none"> ▶ Analysis of actual project operation costs in relation to the production of outputs ▶ Timelines and deliverable dates compared to plans ▶ HC staff time used in the creation of outputs ▶ Outsourcing used in the creation of outputs ▶ Views on how outputs and program activities could be produced for a lower cost 	<ul style="list-style-type: none"> Document and database review KI interviews 	<ul style="list-style-type: none"> ▶ Human resources ▶ Financial data ▶ Interviews with program staff ▶ Activity template for program staff
6. Have each of the Heat Resiliency Program activities been implemented, or are they on track to being implemented, as planned?	<ul style="list-style-type: none"> ▶ Description of Heat Resiliency Program activities ▶ Identification of factors that have encouraged or confounded project implementation ▶ Evidence of defined and executed strategies to overcome implementation challenges 	<ul style="list-style-type: none"> Document and database review KI interviews 	<ul style="list-style-type: none"> ▶ Program progress reports ▶ Departmental Performance Reports ▶ Program performance data ▶ Meeting minutes ▶ Correspondence ▶ Records of decisions ▶ Interviews with program staff and pilot site coordinators ▶ Activity template for program staff
7. Are appropriate performance data being collected, captured and safeguarded? If so, is this information being used to inform senior management/ decision-makers?	<ul style="list-style-type: none"> ▶ Performance data collection plans ▶ Reports of performance ▶ Review of database content 	<ul style="list-style-type: none"> Document and database review KI interviews 	<ul style="list-style-type: none"> ▶ Program progress reports ▶ Departmental Performance Reports ▶ Program performance data ▶ Interviews with program staff

Evaluation information summary table - Issues, questions, indicators, and analysis

Evaluation issues and questions	Indicators	Collection methods	Data sources
10. Have there been any unintended (positive or negative) outcomes observed at this time?	▶ Perceived or recorded presence/absence of unintended outcomes	Document and database review	▶ Program progress reports ▶ Program performance data ▶ Project progress reports ▶ Project performance data
		KI interviews	▶ Interviews with all groups of key informants
11. Is the Heat Resiliency Program designed to achieve its expected immediate outcomes at least cost? If not, what changes are recommended?	▶ Evidence that alternative approaches could achieve the same or better results at a lower cost	KI interviews	▶ Interviews with all groups of key informants
12. Is there any evidence to suggest that alternative methods for producing the outputs and/or realizing the outcomes would be more effective for lower cost?	▶ Existence of alternative delivery approaches ▶ Perceptions and rationale for selected approach	Literature review	▶ Design and delivery approaches used in other programs ▶ Costs of other programs (if available) ▶ Best practices identified in similar programs
		KI interviews	▶ Interviews with all groups of key informants

APPENDIX C

EXAMPLES OF HEAT ALERT AND RESPONSE SYSTEMS

Examples of heat alert and response systems in Canada and other jurisdictions: summary				
City/country	Key players	Thresholds	Main strategies*	Evaluation**
City of Toronto (ON)	Toronto Public Health (lead agency) Medical Officer of Health City of Toronto (various departments) Healthy Environments Community partners	► Synoptic/air-mass-based system Heat alert at 65% chance of excess mortality Extreme heat alert at 90% chance of excess mortality	Communicating with public, interviews Street outreach Extending park/pool hours Operating cooling centres Sending supplies to hospitals Maintaining a public hotline	Evaluated regularly by Healthy Environments
City of Kingston (ON)	KFL&A Public Health (lead agency) City of Kingston Community partners	Level 1: 36°C or humidex for two days, no smog warning Level 2: 36°C or humidex for two days, with smog warning OR 40°C for two days, no smog warning Level 3: 36°C or humidex or greater AND other factors (power outage, water failure), OR 40°C or humidex for two days with smog warning, OR 45°C or humidex for two days with or without smog	Informing the public through media releases on how to stay cool Encouraging municipalities to leave air-conditioned buildings open later Operating cooling centres for seniors Opening some public pools at no charge	Unknown
City of Montreal (QC)	Direction de santé publique de Montréal (Montreal Public Health Authority, DSP) (lead agency) Centre de sécurité civile Emergency Preparedness Centre	Heat Warning: Environment Canada forecasts a maximum temperature of 30°C or greater and a humidex value of at least 40°C Extreme Heat Warning: minimum temperature of 20°C and maximum temperature of 33°C for three days, OR nighttime temperature of at least 25°C for two nights	Informing the public Operating cooling shelters Opening public pools for longer hours Supplying bottled water Providing transportation to rest stops Establishing program for identifying vulnerable citizens	A program formed in 2003 to evaluate the levels for calling heat alerts and taking action for 2004 and 2005 (Kosatsky et al., 2005, p. 170)
City of Vancouver (BC)	Extreme Hot Weather Committee (lead agency—headed by the City of Vancouver’s Community Services Group) Vancouver Coastal Health (VCH) (responsible for issuing alerts) City of Vancouver (various departments) Community agencies	VCH announces a heat warning when hot weather conditions threaten lives or well-being of vulnerable groups. Includes factors such as above-normal temperatures, humidity and air quality, the expected duration of high temperatures, and other neighbourhood factors	Informing the public and relying on the public at large to take care of neighbours and vulnerable groups Community organizations aid vulnerable groups of citizens Phase 2 (2011) will explore other activities	The Extreme Hot Weather Committee will evaluate the initial response plan for the summer of 2010 in October and November

Examples of heat alert and response systems in Canada and other jurisdictions: summary

City/country	Key players	Thresholds	Main strategies*	Evaluation**
City of Chicago (US)	Department of Public Health (lead agency) National Weather Service Department of Human Services Department of Environment City of Chicago (various other departments) Office of Emergency Management and Communications	Heat watch (warning level): if the forecast predicts a heat index between 38°C and 40°C for three days, OR a heat index of at least 41°C for two days, OR 43°C for one day Heat warning (intervention level): if the above forecasted conditions actually occur	Informing the public Operating cooling centres (including transportation to and from) Extending hours of pools and parks	Unknown
England (UK)	Met Office United Kingdom Department of Health Health Protection Agency Strategic Health Authorities Local social services	Each region has a different threshold level (average 30°C during the day and 15°C at night) Level 1: Long-term planning, preparedness Level 2: Forecast predicts 60% chance of heat wave conditions Level 3: One region experiences heat wave conditions Level 4: Two or more regions experience heat waves for four days or greater	For each threshold level, there are different responsibilities at the national, regional, and local levels Identifying high-risk groups Informing the public Operating cooling places Hospitals and care homes providing drinking water and cooling places for patients and residents	The Health Protection Agency is responsible for evaluating the program after every hot season during the autumn and winter months
* The main strategies listed here only include the alert and response strategies, not passive strategies or modifications to the built environment. ** This refers to whether there is a system in place to evaluate the heat alert and response system.				