

Rapid Review

**Adaptation Strategies for Reducing
Extreme Heat Health Impacts: A Rapid
Review**

June 2022



INSTITUTE OF
HEALTH ECONOMICS
ALBERTA CANADA

INSTITUTE OF HEALTH ECONOMICS

The Institute of Health Economics (IHE) is an independent, not-for-profit organization with key competencies in health economics and decision analytic modelling, health technology assessment, and knowledge transfer/exchange. Our mission is to inform coordinated, innovative, evidence-guided health policy and practice.

IHE BOARD OF DIRECTORS

Chair

Mr. Robert Seidel, QC – Canada Managing Partner, DLA Piper

Government and Public Authorities

Mr. Paul Wynnyk – Deputy Minister, Alberta Health

Mr. Shawn McLeod – Deputy Minister, Alberta Jobs, Economy and Northern Development

Mr. Tim Murphy – Vice-President, Health, Alberta Innovates

Dr. Francois Belanger – Vice-President and Chief Medical Officer, Alberta Health Services

Academia

Dr. Jason Acker – Associate Vice-President (Research Integrity Support), University of Alberta

Dr. Todd Anderson – Dean of the Cumming School of Medicine, University of Calgary

Dr. Brenda Hemmelgarn – Dean, Faculty of Medicine and Dentistry, University of Alberta

Dr. Christine Hughes – Interim Dean, Faculty of Pharmacy & Pharmaceutical Sciences, University of Alberta

Dr. Braden Manns – Sware Professor in Health Economics, University of Calgary

Dr. Valentina Galvani – Chair, Department of Economics, University of Alberta

Dr. Bill Ghali – Vice-President Research, University of Calgary

IHE

Mr. Douglas Gilpin – Chair, Audit & Finance Committee, IHE

Dr. Kate Harback – Interim CEO and Executive Director, IHE

Mr. John Sproule – Board Secretary; Senior Policy Director, IHE

Ms. Kaitlin Froehlich – Treasurer; Director of Finance and Administration, IHE

Rapid Review

Adaptation Strategies for Reducing Extreme Heat Health Impacts: A Rapid Review

Prepared by:

Lindsey Warkentin, MSc, Research Associate

Carmen Moga, MD MSc, Principal Research Lead

Lisa Tjosvold, MLIS, IHE Information Specialist

Correspondence

Please direct any inquiries about this report to Ken Bond, Director, Evidence Synthesis at kbond@ihe.ca.

Funding

This report was supported by a financial contribution from Alberta Health through a Health Evidence Review grant.

The views expressed herein do not necessarily represent the official policy of Alberta Health.

Declared Competing Interest of Authors

Competing interest is considered to be financial interest or non-financial interest, either direct or indirect, that would affect the research contained in this report or create a situation in which a person's judgement could be unduly influenced by a secondary interest, such as personal advancement.

The authors of this publication claim no competing interest.

Suggested Citation

Institute of Health Economics. *Adaptation strategies for reducing extreme heat health impacts: a rapid review*. Edmonton (AB): Institute of Health Economics; 2022.

© Institute of Health Economics, 2022

This work may be copied or redistributed for non-commercial purposes, provided that attribution is given to the Institute of Health Economics. Modification is prohibited without the express written permission of the Institute of Health Economics.

Executive Summary

Background

In the summer of 2021, Alberta experienced unusually high atmospheric temperatures, with record daily high temperatures in numerous locations and near record highs experienced across much of the province. Extreme heat events pose a growing public health threat. Various adaptation strategies (that is, adjusting to actual or expected future climate in order to reduce one's vulnerability to the harmful effects of extreme heat) have been proposed, but uncertainty remains regarding their uptake and effectiveness for reducing heat-related morbidity and mortality.

Methods

The objective of the rapid review was to identify strategies to protect individuals' health during extreme heat events, to describe the effectiveness of those strategies for reducing health effects of heat, and to report the cost of these strategies. These strategies should be ones that might be feasibly implemented before and during summer 2022 (that is, within 3-4 months). The IHE information specialist conducted a targeted literature search to identify evidence on extreme-heat events and individual-focused adaptation strategies. One reviewer screened the titles and abstracts of all citations retrieved by the searches, and assessed the full text of any potentially relevant articles for inclusion. The list of strategies was developed iteratively, and the interventions were described, focusing on evidence for the vulnerable populations of interest.

Results

A total of 47 articles were included in this rapid review, which proposed and/or described one or more adaptation interventions. Eleven articles provided effectiveness evidence and 15 articles discussed facilitators and barriers to implementation and/or utilization of the strategies. In total, 51 strategies were identified, with 10 strategies having effectiveness data, and 12 strategies having information on the facilitators and barriers to implementation/utilization. The individual-focused heat adaptation strategies included

- Individual and care provider behaviour strategies;
- Care provider preparedness strategies to identify those who may be at increased risk for heat-related illnesses and ensuring supports are in place;
- Community strategies that encourage providing items or infrastructure, and assisting people with adapting their behaviours;
- Communication strategies for education and awareness, and
- Government policy strategies to develop heat response plans and provide financial resources or infrastructure.

Most strategies were implemented as part of a heat health action plan or heat health warning system. Many strategies were modified for or targeted vulnerable populations, with the majority focused on protecting the elderly or those experiencing homelessness during extreme heat events. Effectiveness outcomes typically measured mortality, and there were comparatively few studies reporting on health care utilization and cost. The effectiveness evidence exclusively reported the combined impact of concurrent strategies, and was favourable for the combined strategies/heat health actions plans, suggesting that intervening during extreme heat events reduced population-level morbidity and/or

mortality risk. Factors affecting implementation or utilization highlighted the need for awareness and motivation in both individuals and decisions makers, as well as the capability, and opportunity to adapt. The influence of population characteristics, setting or institutional factors, and the involvement of government and participating organizations on the development and implementation of successful extreme heat strategies remains poorly understood.

Conclusion

A variety of adaptation strategies for reducing the health impacts of extreme heat events have been proposed or implemented. The majority of strategies focused on reactive approaches, such as adapting individual behaviours during extreme heat, or providing cooling items or infrastructure. Strategies that focused on preparing for extreme heat centered around education and awareness, as well as identifying those who may be at increased risk for heat-related illnesses. Strategies were often implemented concurrently in heat health actions plans or as part of heat health warning systems for the general population. Overall, extreme heat adaptation options are available, but the evidence supporting their effectiveness and implementation is lacking and those wishing to adopt such strategies will need to prioritize those deemed feasible and fit-for-purpose within the local context.

Table of Contents

Background.....	1
Objective and Research Question	1
Methods.....	1
Literature Search.....	1
Study Selection.....	2
Data Extraction and Synthesis	3
Results.....	4
Literature Search.....	4
Extreme Heat Health Adaptation Strategies	5
Overall Effectiveness.....	5
Overall Implementation and Utilization Facilitators and Barriers	8
Elderly Populations	9
Those Experiencing Homelessness	11
Chronically Ill Populations.....	12
Those with Low Socioeconomic Status	13
Infants and Children	14
Pregnant Persons.....	15
Indigenous Populations.....	15
Rural Populations	15
Discussion.....	16
Conclusion.....	17
References	18
Appendix A: Heat and Health Search Strategy.....	22
Appendix B: Evidence for Extreme Heat Health Adaptation Strategies	29
Author Contributions.....	61

Tables

Table 1: Study Selection Criteria.....	2
Table 2: List of Extreme Heat Health Adaptation Strategies.....	6
Table 3: Number and Type of Effectiveness Studies for Extreme Heat Health Adaptation Strategies	8
Table 4: Extreme Heat Health Adaptation Strategies for the Elderly.....	10
Table 5: Extreme Heat Health Adaptation Strategies for those Experiencing Homelessness.....	12
Table 6: Extreme Heat and Health Adaptation Strategies for the Chronically Ill.....	13
Table 7: Extreme Heat and Health Adaptation Strategies for those with Low Socioeconomic Status	14
Table 8: Extreme Heat and Health Adaptation Strategies for Infants and Children.....	14
Table 9: Extreme Heat and Health Adaptation Strategies for Rural Populations.....	16

Figures

Figure 1: PRISMA Diagram	4
--------------------------------	---

Background

Extreme heat, which is defined as a period of excessively hot weather, can have negative impacts on health, both directly (for example, dehydration and heat stroke) or by making pre-existing conditions worse (for example, cardiovascular or respiratory conditions). In the summer of 2021 Alberta experienced unusually high atmospheric temperatures, with record daily high temperatures in numerous locations and near record highs experienced across much of the province.¹ It is expected that extreme heat events will increase in frequency, length, and severity, with the potential to increase utilization of health care services, including calls to Emergency Medical Services, emergency department visits, and physician visits/hospitalization for heat-related illnesses. Extreme heat events pose a growing public health threat, and various adaptation strategies (that is, adjusting to actual or expected future climate in order to reduce one's vulnerability to the harmful effects of extreme heat) have been proposed. Uncertainty remains regarding their uptake and effectiveness for reducing heat-related morbidity and mortality.

Objective and Research Question

The objective of this rapid review was to identify strategies to protect individuals' health in times of high temperatures, and to describe the effectiveness of those strategies for reducing health consequences of heat, and cost of the strategies. The strategies should be ones that might be feasibly implemented before and during summer 2022 (that is, within 3-4 months).

To achieve the objective, the following research questions were proposed:

- What are the adaptation strategies for reducing the health impacts of extreme heat events?
 - How, where, and by whom are these interventions provided?
 - How do these interventions compare in terms of their effectiveness?
 - Are there interventions to address the needs of specific populations or settings (for example, elderly, chronically ill, persons experiencing homelessness, those with low socioeconomic status, infants and children, pregnant persons, Indigenous populations, rural locations) or strategies to tailor or adapt broader strategies to address the specific needs of these populations or settings?

To produce a list of strategies that might be considered, the rapid review focused on identifying interventions that were individual-driven and that could leverage existing infrastructure within Alberta.

Methods

Literature Search

The IHE information specialist conducted a targeted literature search to identify evidence on extreme-heat events and individual-focused adaptation strategies (*Appendix A*). Literature was sought through a search in Medline and Google Scholar for English language articles focusing on extreme heat adaptation, published from 2012 onward (last 10 years) in Canadian or similar temperate jurisdictions (for example, Australia, Europe, United States, Japan, China), using a combination of

relevant keywords and medical subject health (MeSH) terms. Relevant grey literature was sought through advanced searches of Google and relevant websites including the National Collaborating Centre for Environmental Health (<https://nccch.ca/>), the National Institute of Environmental Health Sciences (<https://tools.niehs.nih.gov/cbbhl/index.cfm>), the European Health and Climate Observatory (<https://climate-adapt.eea.europa.eu/>) and the Global Heat Health Information Initiative (<https://gbbin.org/>).

Study Selection

One reviewer screened the titles and abstracts of all citations retrieved by the searches, and assessed the full text of any potentially relevant articles for inclusion (*Table 1*). All definitions for extreme heat events/heat waves, and heat related illness were included. Heat health alerts were not considered an intervention, nor were adjustments to the information used to develop the heat alert thresholds.

Because the focus of the review was on strategies that are implementable in summer 2022, strategies that may require large individual or collective time/investment, mitigation strategies designed to reduce climate changes/extreme temperature occurrences (for example, green roofs, reflective surfaces) and national or international frameworks and guidance on climate change/extreme heat plans (for example, the World Health Organizations’ guidance for heat-health actions plans) were excluded from the rapid review.

Table 1: Study Selection Criteria

	Description
Study Design/Type	<p><i>Included</i></p> <ul style="list-style-type: none"> • Systematic reviews, reviews of reviews, narrative reviews • Effectiveness, implementation, ecological, case studies • Evidence-based lists, governments’ grey literature <p><i>Excluded</i></p> <ul style="list-style-type: none"> • Modelling, efficacy, physiological, simulation studies
Population	<p><i>Included</i></p> <ul style="list-style-type: none"> • General population (any age) exposed to extreme heat events (as defined in the literature), and are at risk of suffering from direct or indirect heat-related illness. • Emphasis will be placed on populations of potentially vulnerable individuals (e.g., elderly, infants and toddlers, chronically ill, pregnant persons, those experiencing homelessness, those with low socioeconomic status, Indigenous populations) and those living in rural communities <p><i>Excluded</i></p> <ul style="list-style-type: none"> • Athletes or occupational groups that may be exposed to high atmospheric temperatures and are at risk to exertion or occupation heat stress

	Description
Intervention	<p><i>Included</i></p> <ul style="list-style-type: none"> • Any extreme heat health adaptation strategies (e.g., hydration, limb immersion, electric fans, cooling centres, outreach, preparedness) • Emphasis will be placed on identifying interventions that are individual-driven, that leverage existing health supports and/or general infrastructure within Alberta. <p><i>Excluded</i></p> <ul style="list-style-type: none"> • Mitigation strategies designed to reduce climate changes/extreme temperature occurrences • Heat-related illness treatments (i.e., strategies employed after the onset of heat-related illness) • Alterations/improvements to heat warning alerts (e.g., temperature thresholds, regional division, vulnerability data incorporation)
Comparator	<ul style="list-style-type: none"> • Any comparator (e.g., historical, another strategy) • No comparator
Outcomes of Interest	<p><i>Included</i></p> <ul style="list-style-type: none"> • Description of the heat health adaptation strategy <p><i>And/or</i></p> <ul style="list-style-type: none"> • Heat-related illness incidence (as defined in the literature; e.g., dehydration, heat stroke, heat exhaustion, preterm or stillbirth, exacerbation of cardiovascular, respiratory, kidney and/or mental health conditions) • Mortality • Heat-related health care utilization (e.g., emergency calls, physician visits, emergency room visits, hospitalization) • Self-reported individual behaviour change • Cost • Factors effecting implementation or utilization (facilitators and/or barriers) <p><i>Excluded</i></p> <ul style="list-style-type: none"> • Physiological measures (e.g., temperature, heat rate) • Risk factors for heat-related illness

Data Extraction and Synthesis

The list of strategies was developed iteratively, in collaboration with the Health Protection Branch. First, an initial list of interventions was developed from the identified evidence, with feedback sought from the Health Protection Branch to identify interventions that may not have been captured in the literature, as well as identifying those that are least likely to be feasible for summer 2022. Second, the interventions were described, including intervention details (for example, description, population, setting, providers), study details (for example, study type, publication date) and outcomes (for example, effectiveness and implementation/utilization considerations). Relevant data was extracted by one reviewer into pre-developed summary tables. Interventions were also described narratively, focusing on evidence for the vulnerable populations of interest. Quality assessment of the included studies was not conducted for this review.

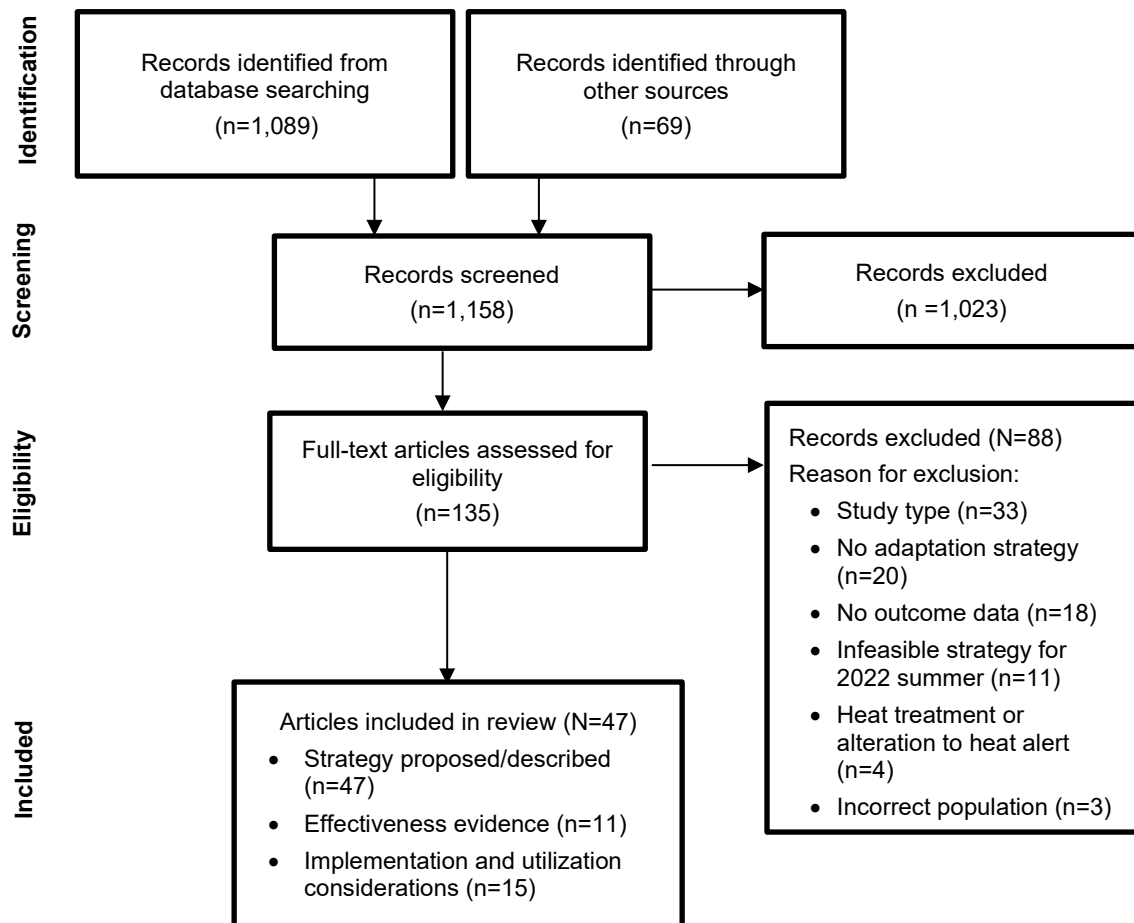
Results

Literature Search

From a total of 1083 citations (titles/abstracts) identified, 47 articles were included in this rapid review which proposed and/or described one or more an adaptation interventions²⁻⁴⁸ (*Figure 1*). Eleven articles^{2, 16, 23, 31, 34, 35, 37, 41, 46-48} provided effectiveness evidence and 15 articles^{3, 8-11, 13, 19, 22, 27, 29, 30, 39, 43, 45, 47} discussed facilitators and barriers to implementation and/or utilization of the strategies.

There was a broad range of study types, including reviews, government reports and intervention descriptions, and primary studies. The literature was also diverse in where studies were conducted, including Australia, United States, Europe, Canada, and Japan (*Appendix B*).

Figure 1: PRISMA Diagram



Extreme Heat Health Adaptation Strategies

In total, 51 strategies were identified (*Table 2* and *Appendix B*), with 10 strategies having effectiveness data, and 12 strategies having information on the facilitators and barriers to implementation/utilization. The majority of interventions were implemented concurrently, mostly as part of an overall heat health action plan and/or heat health warning system, and were often proposed for or implemented in urban areas for the general population. The majority of strategies focused on reactive approaches: adapting individual behaviours during extreme heat, or encouraging, providing items or infrastructure, and assisting people with adapting their behaviours during heat waves. Strategies that focused on preparing for extreme heat centered around education and awareness, as well as identifying those who may be at increased risk for heat-related illnesses and ensuring there are supports in-place for increased social connection/monitoring during times of increased temperatures.

Overall Effectiveness

Effectiveness outcomes typically measured heat-related mortality or excess mortality (that is, more deaths during a period of time than would be expected for that period), through comparing time periods with and without interventions in place. Surveys or interviews were also often utilized to gather self-reported perceptions of heat stress, and compared participants who utilized adaptation strategies to those who did not. There were comparatively few studies reporting on health care utilization and cost. Due to the design of the studies and outcome measures, effectiveness studies exclusively reported the combined impact of concurrent strategies, or that of overall heat health action plans (that is, multiple interventions with special considerations given to the needs and contexts of vulnerable subpopulations), therefore the impact attributable of any individual extreme heat health adaptation strategy could not be determined (*Table 3*). Overall, the effectiveness evidence was favourable for the combined strategies/heat health actions plans, suggesting that intervening during extreme heat events reduced population-level morbidity and/or mortality risk.

Table 2: List of Extreme Heat Health Adaptation Strategies

Individual and Care Provider Behaviour ^a	Care Provider Preparedness ^a	Community	Communication	Government Policy
<ul style="list-style-type: none"> • Air conditioning • Applying water to extremities (e.g., using wet towels, submerging feet) • Block sunlight (e.g., closing blinds, shade shutters) • Cold showers or shower more frequently • Cooking/eating differently (e.g., not using oven; avoiding alcohol caffeine, hot drinks; attention to salt intake) • Creating natural ventilation (e.g., opening windows) • Drinking more fluids/ maintaining hydration • Expand and maintain vegetation cover on private property • Fans • Modified work arrangements (e.g., more frequent rest periods, scheduling heavy work during cooler part of the day) • Monitoring technology (e.g., weather forecasts and individualized warning app, personal multi-senor monitor) 	<ul style="list-style-type: none"> • Checklists • Facility heat health action/response plan or protocols • Information/Education campaign specific to care providers • Maintenance of equipment • Meeting of all agencies to discuss coordination issues • Participating in community committees (e.g., health councils, school boards, recreation programs) • Patient risk pre-assessment and identification • Provide information during non-heat related visits and increased surveillance for signs/symptoms of heat related illness 	<ul style="list-style-type: none"> • Cooling bus programs • Cooling centres or shelters • Distribution of water (e.g., water bottles, install public fountains, portable water stations, public coolers) • Distribute shading/cooling items (e.g., tents, umbrellas, misting fans, super soakers, water jugs, water balloons) • Expand and maintain vegetation cover on public property/businesses • Expanded programs for vulnerable and isolated people • Extending operational hours of public pools, outdoor recreation spaces, spray parks • Outreach • Shade structures • Spray/sprinkler caps on fire hydrants • Transportation to heat-health infrastructure • Welfare check-ins 	<ul style="list-style-type: none"> • Declaring a “Heat Advisory Day” • Disseminate city maps with heat-health infrastructure (e.g., water fountains, cooling centres) • Heat Hotline • Mass notification app or website, or automated phone warning • Public information or education campaign (e.g., press releases, pamphlets, advertisements, social media) • Promotion materials (e.g., fridge magnets, thermometers) • Weather safety talks 	<ul style="list-style-type: none"> • Expand and maintain vegetation cover • Financial assistance for home or common room air conditioning, or utility assistance (e.g., subsidized electricity bills) • Fan and air conditioner distribution programs • Grants for temporary community cooling infrastructure (e.g., portable misting stations) • Heat Health Action/Response Plan • Provide incentives to increase passive cooling and reduce “waste” heat (e.g., by subsidizing tree planting or home retrofits) • Review of emergency, ambulance and other clinical response capabilities in the health sector

Individual and Care Provider Behaviour ^a	Care Provider Preparedness ^a	Community	Communication	Government Policy
<ul style="list-style-type: none"> • Reducing or rescheduling recreational activity • Resting in the shade, create your own shade (e.g., umbrella, hat) • Turning off heat-producing equipment (e.g., computer, television) • Use thinner bedding/modify sleeping arrangements • Wearable personal cooling system (e.g., cooling vest, neck ties) • Wearing less or light/breathable clothing 				

Category headings are linked to their respective evidence summary table in Appendix B.

Strategies which had effectiveness evidence identified, are shaded grey.

^a Care providers include all those who contribute to the health and well-being of others including healthcare providers, community public health providers, allied health and social services.

Table 3: Number and Type of Effectiveness Studies for Extreme Heat Health Adaptation Strategies

		Adaptation strategies									
		Patient risk pre-assessment and identification	Cooling Centre or shelter	Distribution of water	Expand programs for vulnerable/isolated people	Outreach	Welfare check-ins	Mass notification app or automated phone warning	Public information or education campaign	Promotion materials	Heat Health Action Plan
Study Type	Literature Review		1								2
	Randomized controlled trial							1	1	1	
	Community Trial			1							
	Ecological Study or Case Series					2	1				1
	Cost Analysis	1	1		1		1				

Overall Implementation and Utilization Facilitators and Barriers

Implementation and utilization considerations highlighted awareness and motivation behaviours, as well as capability and opportunities, both in individuals and decision makers/implementers, as the major factors influencing for heatwave adaptation. Mayhuber et al. (2018)²⁹ identified four assumptions that modulate the effect of heat health adaption behaviours and influence how vulnerable population are reached:

- Informing people about the danger of heat and particular risks in a way that will make them aware and adapt their behavior according to advice.
- Ensuring at-risk individuals recognize their own vulnerability and therefore will feel concerned by heat alerts and heat messaging.
- Having the benefits of visiting cooling infrastructure and other heat advice behavior commonly understood and taken seriously.
- Having care providers of vulnerable groups possess the infrastructural and human resource capacity to intensify care provision during heatwaves, and are sufficiently trained in thermoregulation and possible heat reduction measures.

However, the intervention components necessary to support these assumptions were not described in the literature. Many studies reported underutilization or delays in the implementation of extreme heat strategies because of a persisting disbelief from both individuals and decisions makers of the seriousness of heat waves on health, a lack of awareness of or the inability to access cooling

resources, or limited means to implement adaptation strategies. Evidence from reviews highlighted that there was large variability in the implementation of heat health action plans,²⁰ as well as for specific strategies (for example, cooling centres).^{17, 27}

Elderly Populations

The literature discussing vulnerable populations focused on the elderly, particularly those in congregate living facilities, as well as those living alone in the community. There was a broad range of strategies used for seniors (*Table 4*). Kemen et al. (2021)¹⁶ surveyed urban community dwelling adults over the age of 65 years old in Cologne, Germany, who reported utilizing the many individual behaviour strategies, though water-related heat adaptation strategies, such as applying water to extremities, were not frequently used. People who reported heat as more challenging (that is, had a higher heat perception) applied more coping strategies, suggesting that perceived risk was a strong predictor of whether or not an individual changed their behavior. McInnes and Ilbrahim (2013)³⁰ interviewed public sector residential care nursing or managerial staff in Victoria, Australia, and described several behaviour adaptations for the elderly including:

- Ensuring an adequate supply of fluids for residents, including thickened drinks or diabetic cordial; a drink fountain was provided in the facility foyer for residents (and visitors).
- Provided cooling “neck-ties” for all residents (and staff).
- Assisting in the relocation of residents to air-conditioned common rooms.
- Protocols for “cool change” messaging, to ensure that staff acted early in the day to close windows, pull down blinds, open awnings, and turn on air conditioning, and again when windows could be reopened later in the evening.

The need to respect residents’ responsibility and self-determination was mentioned,²² though health care providers have a particular responsibility to protect residents who are confused, disoriented, or disabled, against their own actions or lack thereof.

Care provider preparedness strategies for community-based care was reported, and facility heat health action/response plans were the most common interventions described.^{22, 30} McInnes and Ilbrahim (2013)³⁰ identified numerous response plan components, with the more frequent or novel strategies being

- a heatwave checklist meant to act as prompt and to provide a framework for planning and preparedness activities;
- staff education, including monthly meetings, topic-specific seminars and staff newsletters; and,
- routine maintenance programs for air conditioning units.

Staff awareness of the dangers of heat for older people was seen as a facilitator for heatwave preparedness. Challenges with air conditioning was a frequently discussed barrier, including capacity issues due to restricted power supply and delayed repairs due to lack of access to parts and repair personnel.³⁰

Welfare check-ins were also utilized as a community-based social connection strategy. Vulnerable seniors were identified through registration (by care providers or self-registration), and in-person or telephone follow ups were conducted to ensure registrants were prepared and/or not actively experiencing heat stress. In the case where heat related illness was suspected, or registrants could not

be contacted, the case was escalated to other organizations (for example, community services or first responders) to conduct welfare check-ins or intervene. Examples of such programs include

- The United States Postal Service’s Carrier Alert Program.⁴⁵ If a postal carrier notices that the person doesn’t pick up mail in three or four days, the post office alerts a list of nearby community-based organizations and the organization or a first responder is sent to see if the person is well.
- The Telecross Redi program.^{35, 48} A program conducted by the Australian Red Cross, that provides phone calls to registered vulnerable clients during heat alerts; in the event that an individual does not respond to a welfare call the case is escalated and first responders will conduct a home welfare check.
- Montreal’s Heat Action Plan:² The plan includes home care patients receiving daily contact by telephone or home visits, with calls registered and a compilation of questionnaires for home and risk evaluation completed.

Generally, welfare check-in strategies were facilitated by having staff and volunteers available, both early in the year to identify and assess clients, as well as to connect with clients during heatwaves.³⁹ However, the prioritization of clients of most need and ability to identify early sign of heat related illness (especially over the phone) was challenging, even with appropriate levels of staffing. Implementing and sustaining programs successfully requires strong relationships and good communication with both participants and between program partners, and building these relationships can take time.¹⁰

Community strategies targeted specifically for the elderly were also described. For example, agencies also provided additional transportation to and from the cooling centers for their senior population,³³ or mailing water and educational materials to household of those over the age of 65 years old.⁴¹

Information communicated about heat health risk and adaptation was similar to that for the general public, but modified for seniors by making it available in formats appropriate for those with poor eyesight, who are hard of hearing, or when English is not their first language.¹⁰ Distribution focused on more traditional forms of media which may be more likely to reach seniors (for example, television, radio, and newspapers) or through care providers (for example, home care visits, non-heat related doctor visits, senior centre talks).³³

Table 4: Extreme Heat Health Adaptation Strategies for the Elderly

Strategies	Implementation Considerations
<i>Individual and care provider behaviour</i>	
<ul style="list-style-type: none"> • Air conditioning • Applying water to extremities • Block sunlight • Cold showers or shower more frequently • Cooking/eating differently • Creating natural ventilation • Drink more fluids/maintaining hydration • Fans • Reducing or rescheduling recreational activities 	<ul style="list-style-type: none"> • Behaviour changes are associated with perceived risk and older adults don’t always recognize themselves as being particularly vulnerable to heat • Residents’ responsibility and self-determination, for those living in long-term or residential care

Strategies	Implementation Considerations
<ul style="list-style-type: none"> • Use thinner bedding/modify sleeping arrangements • Wear less or light/breathable clothing 	
<i>Care provider preparedness</i>	
<ul style="list-style-type: none"> • Checklists • Facility heat health action/response plan or protocols • Information and education campaign specific to care providers • Maintenance of equipment • Patient risk pre-assessment and identification • Provide information during non-heat related visits and increased surveillance for signs or symptoms of heat related illness 	<ul style="list-style-type: none"> • Staff awareness of the dangers of heat for older people • Restricted power supply for air conditioners and delayed repairs (access to parts and repair personnel) • Challenges in accurately identifying and assessing those at risk
<i>Community</i>	
<ul style="list-style-type: none"> • Cooling centres • Distribution of water • Outreach • Transportation to heat health infrastructure • Welfare check-ins 	<ul style="list-style-type: none"> • Leveraging existing services (e.g., health services, neighborhood and building associations, business communities, faith-based groups, and senior centres) • Distances to cooling centers/available transportation • Relies on strong relationships with good communication, which can take time to establish • Staff and volunteer availability
<i>Communication</i>	
<ul style="list-style-type: none"> • Public information/education campaign 	<ul style="list-style-type: none"> • Format messaging for those with poor eyesight, hard of hearing, or adapt messaging where English is not their first language • Use of multiple media outlets that are most likely to reach seniors (e.g., television, radio, newspapers)

Those Experiencing Homelessness

There were several community-led adaptation strategies which focused on supporting those experiencing homelessness during extreme heat events (*Table 5*). Cabantog (2017)⁵ provided recommendations to creating policies and programs adaptation for extreme heat events affecting homeless populations in British Columbia’s Lower Mainland, which included

- Increasing the availability of and accessibility to cooling spaces,
- Enhancing health service delivery, and
- Increasing outreach services and communication.

The Code Red program in Adelaide, Australia was designed to provide those sleeping rough a place to stay cool and hydrated.⁴⁸ The program was part of regular services to the homeless, enabling greater respite options during heatwaves. The Code Red program in Baltimore, Maryland distributed bottled water to those experiencing homelessness through the Salvation Army outreach teams.²⁷ Widerynski et al. (2017)⁴⁶ described cooling centres, including the specific location or functionality factors that may increase utilization of homeless population, including

Adaptation strategies for reducing extreme heat health impacts

- organizations learning the most ideal areas to open them to serve the largest vulnerable population;
- providing safe and reliable transportation to the centre;
- providing additional accommodations for homeless individuals such as food, clothing and referring services to shelters, mental health care and food bank; and
- partnerships that link support from communities to government programs and financial resources.

Cooling centres were established in homeless shelters, often with extended hours, as part of Southern California Edison’s Cool Center Program, because program managers noticed with past experiences, visitors often were at publicly available cooling centre facilities for another reason and then stayed due to the heat.⁴⁶ Homeless survey respondents from Adelaide, Australia have stated that it is hard to find a public cool space without being asked to leave, or have difficulty getting to a cooling centre because of lack of transportation. Instead, homeless individuals congregated in shady and green parks due to not wanting to go into a building that is unfamiliar, or where they do not feel welcome.⁴⁶

Table 5: Extreme Heat Health Adaptation Strategies for those Experiencing Homelessness

Strategies	Implementation Considerations
<i>Community</i>	
<ul style="list-style-type: none"> • Cooling centres or shelters • Distribution of water • Expanded programs for vulnerable and isolated people • Extending operational hours of public pools, outdoor recreation, spaces, spray parks • Outreach • Transportation to heat health infrastructure 	<ul style="list-style-type: none"> • Identifying most ideal areas to open centres, to provide easy access for and to serve the most vulnerable populations • Those experiencing homeless reported having trouble accessing public centres or feel reluctant because of stigma (may not go into a building where they do not feel welcome or are not familiar with) • Centres should include partnerships that link support from communities to government programs and financial resources • Safe and reliable transportation to the centre supports utilization to those who do not have access to personal transportation

Chronically Ill Populations

There were strategies targeting people with a chronic illness, particularly those with mental illness, as it is believed that individuals, family members, and professionals may be less aware that mental illnesses can create vulnerability during a heat wave (*Table 6*). Williams et al. (2022)⁴⁸ described a patient risk pre-assessment and identification intervention for mental health clients in Adelaide, Australia. Clients were assessed at the beginning of summer using a heat vulnerability assessment tool to identify those who may require closer monitoring during heatwaves. On activation of South Australia’s heat health warning system, clients who were considered vulnerable received daily welfare checks by phone or home-visits if needed. Price et al. (2013)⁴⁰ reported that the Montreal Heat Response plan had a specific communication campaign during heat waves that targeted individuals with mental illness. In addition, the plan included further preparation work with local health and social services centres, community organizations, and psychiatric hospitals to ensure that there was proper outreach to individuals with mental illness.

Boyson et al. (2014)³ conducted focus groups with frontline clinical staff and senior managers of a hospital, to discuss the implementation of England’s National Heatwave Plan, which includes identifying and increasing surveillances on vulnerable patients. Though most frontline staff were unaware of the National Heatwave Plan, many were able to identify at-risk patients and outline simple actions to undertake during periods of increased temperatures. Respondents rejected the idea that mass care should change when a heatwave occurs and emphasized instead the idea that healthcare professionals should continue to manage patients on an individual level. Clinical experience during heatwaves was seen as important for encouraging the use of heat adaptation strategies with patients.

Discussion of heat risk and adaptation strategies at non-heat-related visits was also suggested. The adaptation of behaviour is associated with perceived risk, and those who are chronically ill don’t always recognize themselves as being particularly vulnerable to heat or realize that there is an increased risk of heat-related mortality among patients who take certain medication such as psychotropic medications, diuretics, and long-term antihypertensives.³⁸

Table 6: Extreme Heat and Health Adaptation Strategies for the Chronically Ill

Strategies	Implementation Considerations
<i>Care provider preparedness</i>	
<ul style="list-style-type: none"> • Information/education campaign specific to care providers • Patient risk pre-assessment • Provide information during non-heat related visits and increased surveillance for signs or symptoms of heat related illness 	<ul style="list-style-type: none"> • Awareness of certain illnesses creating vulnerability to heat (e.g., mental illness) and tailoring messages to their care providers • Clinical experience during heatwaves • Care providers belief in altering clinical practices for heatwaves
Communication	
<ul style="list-style-type: none"> • Public information/education campaign 	<ul style="list-style-type: none"> • Awareness of certain illnesses creating vulnerability to heat (e.g., mental illness) and tailoring messages to those individuals

Those with Low Socioeconomic Status

Two government policies were suggested, to target those who have low socioeconomic status ([Table 7](#)). Providing financial assistance for utility bills, or placing a moratorium on service cancellations/charges during extreme heat events, may prevent citizens from being cautious in using their air conditioning because of the financial cost.²⁴ Jin et al. (2022)¹⁴ reported that moratoriums were used over the summer months in 25 cities across the United States, which often ended before the summer heat ended. Particularly during the COVID-19 pandemic, many families were still expected to avoid the use of air conditioning and/or allow indoor temperatures to reach unsafe levels due to concerns over future financial burdens and the unrelated accumulation of financial stress from COVID-19 economic impacts. To provide cooling infrastructure to those who qualify based on level of income or medical need, White-Newsome et al. (2014)⁴⁵ suggested fan and air conditioning distribution programs; however, concerns were raised about the lack of utilization of the air conditioners once distributed, due to perceived financial stress and the inability to pay associated utility costs.

Table 7: Extreme Heat and Health Adaptation Strategies for those with Low Socioeconomic Status

Strategies	Implementation Considerations
<i>Government policy</i>	
<ul style="list-style-type: none"> • Financial assistance for home or common room air conditioning, or utility assistance • Fan and air conditioner distribution programs 	<ul style="list-style-type: none"> • Concerns over ongoing and future utility specific and overall financial stress

Infants and Children

The strategies targeting children focused on education/awareness for care providers and increased access to child-friendly cooling infrastructure (*Table 8*). Extending operational hours of public pools, parks and playgrounds, and spray parks was seen as a family-friendly heat adaptation strategy, and suggested building shade structures in heat vulnerable areas where trees are not feasible (e.g., playgrounds).²⁴ Jin et al. (2022)¹⁴ described the addition of distributing shading and cooling items as part of Philadelphia’s Playstreets Program. This program was in response to COVID-19 pandemic-related budget cuts, which led to the closure of public pools and recreation centers for the summer of 2020. The Playstreet Program was an extension of federal free lunch program, and provided 100 streets throughout Philadelphia with free tents, patio umbrellas, misting fans, super soakers, water jugs, water balloons, and neck cooling rags.

Paterson et al. (2020)³⁸ suggested that risk communication materials be developed specifically for children and their caregivers. Local weather service employees have conducted public information talks to schools,⁴⁵ and it was suggested that community pediatricians actively participate in school wellness committees, health councils, school boards, local, regional, or national sports medicine advisory committees, or in local parks and recreation programs to help to educate youth, parents, caregivers, coaches, and administrators on how to minimize heat-related health effects for children.²¹

Table 8: Extreme Heat and Health Adaptation Strategies for Infants and Children

Strategies	Implementation Considerations
<i>Community</i>	
<ul style="list-style-type: none"> • Distribute shading and/or cooling items • Extending operational hours of public pools, outdoor recreation spaces, spray parks • Shade structures 	None reported
<i>Care-provider preparedness</i>	
<ul style="list-style-type: none"> • Information and/or education campaign specific to care providers • Participating in community committees 	None reported
<i>Communication</i>	
<ul style="list-style-type: none"> • Weather safety talks 	None reported

Pregnant Persons

Only one scoping literature review mentioned a potential adaptation strategy for pregnant persons. Paterson et al. (2020)³⁸ suggested that risk communication materials be developed specifically for pregnant persons and their unborn child. They noted that further evidence is needed regarding exposure of pregnant persons to heat stress and the implications on the parent and unborn child's health in a temperate climate.

Indigenous Populations

No studies were identified examining strategies targeting Indigenous populations specifically, but a First Nations Band was consulted in developing a rural community heat action and response plan.⁹

Rural Populations

There was limited information regarding interventions designed to address the distinct challenges rural communities may face in heat health adaptation, and few studies examining the strategies most amendable to rural locations. Most reports implied that similar strategies may be employed across urban and rural locations (*Table 9*). Rural locations may benefit from numerous natural cooling resources like trees and lakes, and extreme heat adaptation may be expected to be more community-driven as rural residents are more likely to know and trust their neighbours, provide unpaid volunteer work, and have a strong sense of belonging to their community.^{9, 33} However, rural individuals may be less able or willing to travel to a cooling infrastructure and may not participate in community activities aimed at heat health information dissemination.⁴⁶

Deegan et al. (2022)⁹ reported on the community-driven, collaborative, approach to extreme heat alert and response system planning for the small rural community of Ashcroft, British Columbia. The development of the Ashcroft heat alert and response system identified several considerations unique to rural populations:

- Communicating heat messages where there might be a lack of traditional media, such as a dedicated radio station or newspaper. Paper flyers were seen as preferable for disseminating messaging, in part to ensure that vulnerable populations such as seniors were reached. During heat events, brochures and posters were distributed through the local post office and through household mail boxes, were placed on bulletin boards at high-traffic sites. Lawn signs were placed throughout the community, and notices were posted on the village website and social media.
- Taking into account resource availability and allocation. Ashcroft had limited municipal resources to oversee the implementation of the heat action and response plan, so the plan was based on or embedded in existing physical, procedural, and communications infrastructure. The Ashcroft heat action and response committee (composed of municipal government and regional district, Emergency Management, the local school district, public health, community organizations including non-profits, first responders, a volunteer coordinator, First Nation Band members, and members of the public) was leveraged, and each committee member had a responsibility for their respective actions during an extreme heat event.

The Ashcroft heat action and response plan was simple, concise, and considerate of the community’s unique context, and endeavoured to create a supportive environment and strengthen community action.

Nayak et al. (2017)³³ reported that only 3% of cooling centres in the New York state were located in rural areas. The study authors suggested that it would be prudent to set up cooling centers in publicly accessible facilities in rural areas (for example, in conjunction with American Red Cross chapters), so that people without access to air conditioning at home can access them in their local community. Lubik and Kosatsky (2017)²⁴ recommended that rural jurisdictions have a strategy in place to assure that residents who are not on municipal systems have access to water.

Table 9: Extreme Heat and Health Adaptation Strategies for Rural Populations

Strategies	Implementation Considerations
<i>Community</i>	
<ul style="list-style-type: none"> • Cooling centre • Distribution of water 	<ul style="list-style-type: none"> • Sparse population • Natural cooling resources (e.g., lakes, trees) • Transportation options (less able or willing to travel to a cooling centre)
<i>Government policy</i>	
<ul style="list-style-type: none"> • Heat action and response plan 	<ul style="list-style-type: none"> • Community-led and informed by the intersectoral stakeholders • Utilizing existing physical, procedural and communications infrastructure

Discussion

There are many individual-focused heat adaptation strategies that may be feasible for implementation for summer 2022 in Alberta. These strategies include

- Individual and care provider behaviour strategies;
- Care provider preparedness strategies to identify those who may be at increased risk for heat-related illnesses and ensuring supports are in place;
- Community strategies that encourage providing items or infrastructure, and assisting people with adapting their behaviours;
- Communication strategies for education and awareness, and
- Government policy strategies to develop heat response plans and provide financial resources or infrastructure.

Most strategies were implemented as part of a heat health action plan or heat health warning system. Settings and populations varied, as well as data sources and reporting, reflecting the different needs and available resources for different groups. Many strategies were modified for or targeted vulnerable populations, with the majority focused on protecting the elderly or those experiencing homelessness during extreme heat events.

Effectiveness outcomes were primarily focused on the effects of concurrent strategies on mortality, with limited outcomes data for healthcare utilization and costs. Heat health action plans, which included concurrent interventions and special considerations given to the needs and contexts of vulnerable subpopulations were effective in reducing heat-related adverse health outcomes, but the

attributable impact from single strategies on these outcomes was unclear. Interventions for heat wave events are difficult to evaluate because no two heat wave events, and the populations that are affected, are exactly alike. Evaluations of adaptation strategies are also hindered by a lack of a guiding framework, on the assessment of interventions in reducing heat-related mortality and morbidity.²⁰

Facilitators of and barriers to implementation and utilization were themed around awareness, motivation, capability, and opportunity for both individuals and decisions makers. For individuals, the most frequently cited barrier was having people understand and accept the dangers of heat and their own personal risk of adverse health effects, as well as being aware of and having access to cooling infrastructure. Decision makers were also often hindered by the lack of perceived risk of heat, limited access to financial and personnel resources to enact response plans, and difficulties in reaching vulnerable populations. The influence of population characteristics, setting or institutional factors, and the involvement of government and participating organizations on the development and implementation of successful extreme heat strategies remains poorly understood.

The information collected for this review was limited in several ways. The literature search was confined to a single database, limited to publications within the last 10 years, and was devised to capture a broad selection of potential strategies. For these reasons, it is possible that some relevant articles and studies may have been missed. We also expect that relevant information is likely contained in grey literature and unpublished sources, which were not exhaustively searched. The ability to collect effectiveness evidence may also have been limited by strict selection criterion focusing on direct outcomes such as morbidity, mortality, and healthcare resource utilization. Data on indirect outcomes, such as physiological or atmospheric temperature changes, may have helped to provide a more complete picture of the potential effectiveness of the strategies. As a result, there may be more strategies that are effective than we have been able to identify, and this limitation should be considered when prioritizing implementation of the strategies, based on the effectiveness data (or lack thereof) presented in this rapid review.

Conclusion

Extreme heat events are expected to increase in frequency, length, and severity, and cause excess mortality, morbidity and healthcare utilization, specifically in vulnerable populations. A variety of adaptation strategies for reducing the health impacts of extreme heat events have been proposed or implemented. The majority of strategies focused on reactive approaches, such as adapting individual behaviours during extreme heat, or providing cooling items or infrastructure. Strategies that focused on preparing for extreme heat centered around education and awareness, as well as identifying those who may be at increased risk for heat-related illnesses and ensuring there was supports in-place. Strategies were often implemented concurrently in heat health actions plans or as part of heat health warning systems for the general population. Effectiveness studies reported that utilizing concurrent strategies or heat health action plans were effective in reducing population-level heat-related adverse outcomes, but the impact attributable to single strategies remains unclear. Factors affecting implementation or utilization highlighted the need for awareness and motivation in both individuals and decisions makers, as well as the capability, and opportunity to adapt, but the influence of population characteristics, setting or institutional factors, and the involvement of government and participating organizations on the development and implementation of successful extreme heat strategies remains poorly understood. Overall, extreme heat adaptation options are available, but the evidence supporting their effectiveness and implementation is limited. Those wishing to adopt adaptation strategies will need to determine which ones are likely most feasible and fit-for-purpose within their context.

References

1. Bartko K. Edmonton set to reach 40°C mid-week as 11 heat records broken Saturday across Alberta. *Global News*. 27 Jun 2021 [cited 30 May 2022]: Sect. Weather. Available from: <https://globalnews.ca/news/7984915/edmonton-alberta-heat-warning-records-june-27/>.
2. Benmarhnia T, Bailey Z, Kaiser D, Auger N, King N, Kaufman JS. A difference-in-differences approach to assess the effect of a heat action plan on heat-related mortality, and differences in effectiveness according to sex, age, and socioeconomic status (Montreal, Quebec). *Environ Health Perspect* 2016;124(11):1694-9.
3. Boyson C, Taylor S, Page L. The national heatwave plan - a brief evaluation of issues for frontline health staff. *PLoS Curr* 2014;6:ecurrents.dis.aa63b5ff4cdaf47f1dc6bf44921afe93.
4. Brennan M, O'Shea PM, Mulkerrin EC. Preventative strategies and interventions to improve outcomes during heatwaves. *Age Ageing* 2020;49(5):729-32.
5. Cabantog ED. *Strategies to mitigate the impacts of extreme heat events among homeless populations in BC's lower mainland: A review of evidence-based approaches and recommendations*. Vancouver (BC): Simon Fraser University; 2017 Available from: <https://nceh.ca/sites/default/files/SFU-Cabantog-2017.pdf>.
6. Calabro R, Hoffman C. The Rhode Island climate change and health program: Building knowledge and community resilience. *R I Med J* 2021;104(9):45-8.
7. Casanueva A, Burgstall A, Kotlarski S, Messeri A, Morabito M, Flouris AD, et al. Overview of existing heat-health warning systems in Europe. *Int J Environ Res Public Health* 2019;16(15):2657.
8. Christenson ML, Moran CE, Grant BS, Tomaro NC, Meiman JG. Community assessment of extreme heat preparedness in Milwaukee, Wisconsin. *WMJ* 2021;120(3):222-5.
9. Deegan HE, Green J, El Kurdi S, Allen M, Pollock SL. Development and implementation of a heat alert and response system in rural British Columbia. *Can J Public Health* 2022;113(3):446-54.
10. Eyquem J, Feltmate B. *Irreversible extreme heat: Protecting Canadians and communities from a lethal future*. Waterloo (ON): Intact Centre on Climate Adaptation 2022 [cited 2022 May 3]. Available from: https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2022/04/UoW_ICCA_2022_04-Irreversible-Extreme-Heat.pdf.
11. Hasan F, Marsia S, Patel K, Agrawal P, Razzak JA. Effective community-based interventions for the prevention and management of heat-related illnesses: A scoping review. *Int J Environ Res Public Health* 2021;18(16):8362.
12. Huang C, Barnett AG, Xu Z, Chu C, Wang X, Turner LR, et al. Managing the health effects of temperature in response to climate change: Challenges ahead. *Environ Health Perspect* 2013;121(4):415-9.
13. Jay O, Capon A, Berry P, Broderick C, de Dear R, Havenith G, et al. Reducing the health effects of hot weather and heat extremes: From personal cooling strategies to green cities. *Lancet* 2021;398(10301):709-24.

14. Jin AS, Sanders KT. Analyzing changes to U.S. Municipal heat response plans during the COVID-19 pandemic. *Environ Sci Policy* 2022;128:347-58.
15. Kafesity A, Henderson SB, Lubik A, Kancir J, Kosatsky T, Schwandt M. Social connection as a public health adaptation to extreme heat events. *Can J Public Health* 2020;111(6):876-9.
16. Kemen J, Schaffer-Gemein S, Grunewald J, Kistemann T. Heat perception and coping strategies: A structured interview-based study of elderly people in Cologne, Germany. *Int J Environ Res Public Health* 2021;18(14):7495.
17. Kim K, Jung J, Schollaert C, Spector JT. A comparative assessment of cooling center preparedness across twenty-five U.S. cities. *Int J Environ Res Public Health* 2021;18(9):4801.
18. Kingma BRM, Steenhoff H, Toftum J, Daanen HAM, Folkerts MA, Gerrett N, et al. ClimApp—integrating personal factors with weather forecasts for individualised warning and guidance on thermal stress. *Int J Environ Res Public Health* 2021;18:11317.
19. Kondo K, Mabon L, Bi Y, Chen Y, Hayabuchi Y. Balancing conflicting mitigation and adaptation behaviours of urban residents under climate change and the urban heat island effect. *Sustain Cities Soc* 2021;65:102585.
20. Kotharkar R, Ghosh A. Progress in extreme heat management and warning systems: A systematic review of heat-health action plans (1995-2020). *Sustain Cities Soc* 2022;76:103487.
21. Kravchenko J, Abernethy AP, Fawzy M, Lyster HK. Minimization of heatwave morbidity and mortality. *Am J Prev Med* 2013;44(3):274-82.
22. Kunst AE, Britstra R. Implementation evaluation of the Dutch national heat plan among long-term care institutions in Amsterdam: A cross-sectional study. *BMC Health Serv Res* 2013;13:135.
23. Liotta G, Inzerilli MC, Palombi L, Madaro O, Orlando S, Scarcella P, et al. Social interventions to prevent heat-related mortality in the older adult in Rome, Italy: A quasi-experimental study. *Int J Environ Res Public Health* 2018;15(4):715.
24. Lubik A, Kostatsky T. *Developing a municipal heat response plan: A guide for medium-sized municipalities*. Vancouver (BC): British Columbia Center for Disease Control 2017 [cited 2022 May 4]. Available from: <http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Health-Environment/Developing%20a%20municipal%20heat%20response%20plan.pdf>.
25. Lundgren-Kownacki K, Gao C, Kuklane K, Wierzbicka A. Heat stress in indoor environments of Scandinavian urban areas: A literature review. *Int J Environ Res Public Health* 2019;16(4):560.
26. Lundgren-Kownacki K, Hornyanszky ED, Chu TA, Olsson JA, Becker P. Challenges of using air conditioning in an increasingly hot climate. *Int J Biometeorol* 2018;62(3):401-12.
27. Martin JL. Responding to the effects of extreme heat: Baltimore City's Code Red Program. *Health Secur* 2016;14(2):71-7.
28. Martinez GS, Linares C, Ayuso A, Kendrovski V, Boeckmann M, Diaz J. Heat-health action plans in Europe: Challenges ahead and how to tackle them. *Environ Res* 2019;176:108548.

29. Mayrhuber EA-S, Duckers MLA, Wallner P, Arnberger A, Alex B, Wiesbock L, et al. Vulnerability to heatwaves and implications for public health interventions - a scoping review. *Environ Res* 2018;166:42-54.
30. McInnes JA, Ibrahim JE. Preparation of residential aged care services for extreme hot weather in Victoria, Australia. *Aust Health Rev* 2013;37(4):442-8.
31. Mehriiz K, Gosselin P, Tardif I, Lemieux M-A. The effect of an automated phone warning and health advisory system on adaptation to high heat episodes and health services use in vulnerable groups-evidence from a randomized controlled study. *Int J Environ Res Public Health* 2018;15(8):1581.
32. Mücke H-G, Litvinovitch JM. Heat extremes, public health impacts, and adaptation policy in Germany. *Int J Environ Res Public Health* 2020;17(21):7862.
33. Nayak SG, Lin S, Sheridan SC, Lu Y, Graber N, Primeau M, et al. Surveying local health departments and county emergency management offices on cooling centers as a heat adaptation resource in New York State. *J Community Health* 2017;42(1):43-50.
34. Nitschke M, Krackowizer A, Hansen AL, Bi P, Tucker GR. Heat health messages: A randomized controlled trial of a preventative messages tool in the older population of South Australia. *Int J Environ Res Public Health* 2017;14(9):992.
35. Nitschke M, Tucker G, Hansen A, Williams S, Zhang Y, Bi P. Evaluation of a heat warning system in Adelaide, South Australia, using case-series analysis. *BMJ open* 2016;6(7):e012125.
36. Okwuofu-Thomas B, Beggs PJ, MacKenzie RJ. A comparison of heat wave response plans from an aged care facility perspective. *J Environ Health* 2017;79(8):28-37.
37. Orlando S, Mosconi C, De Santo C, Emberti Gialloreti L, Inzerilli MC, Madaro O, et al. The effectiveness of intervening on social isolation to reduce mortality during heat waves in aged population: A retrospective ecological study. *Int J Environ Res Public Health* 2021;18(21):11587.
38. Paterson SK, Godsmark CN. Heat-health vulnerability in temperate climates: Lessons and response options from Ireland. *Glob Health* 2020;16(1):29.
39. Price K, Benmarhnia T, Gaudet J, Kaiser D, Sadoine ML, Perron S, et al. The Montreal heat response plan: Evaluation of its implementation towards healthcare professionals and vulnerable populations. *Can J Public Health* 2018;109(1):108-16.
40. Price K, Perron S, King N. Implementation of the Montreal heat response plan during the 2010 heat wave. *Can J Public Health* 2013;104(2):e96-100.
41. Takahashi N, Nakao R, Ueda K, Ono M, Kondo M, Honda Y, et al. Community trial on heat related-illness prevention behaviors and knowledge for the elderly. *Int J Environ Res Public Health* 2015;12(3):3188-214.
42. United Kingdom Health Security Agency, National Health Services (NHS) England. *Heatwave plan for England - protecting health and reducing harm from severe heat and heatwaves*. London: Government UK; 2022 [cited 2022-05-04]. Report No.: GOV-12083. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1071250/Heatwave_Plan_for_England_2022_-_260422.pdf.

43. van Loenhout JAF, Rodriguez-Llanes JM, Guha-Sapir D. Stakeholders' perception on national heatwave plans and their local implementation in Belgium and The Netherlands. *Int J Environ Res Public Health* 2016;13(11):1120.
44. White-Newsome JL, Ekwurzel B, Baer-Schultz M, Ebi KL, O'Neill MS, Anderson GB. Survey of county-level heat preparedness and response to the 2011 summer heat in 30 U.S. States. *Environ Health Perspect* 2014;122(6):573-9.
45. White-Newsome JL, McCormick S, Sampson N, Buxton MA, O'Neill MS, Gronlund CJ, et al. Strategies to reduce the harmful effects of extreme heat events: A four-city study. *Int J Environ Res Public Health* 2014;11(2):1960-88.
46. Widerynski S, Schramm PJ, Conlon KC, Noe RS, Grossman E, Hawkins M, et al. *Use of cooling centers to prevent heat-related illness : Summary of evidence and strategies for implementation*. Atlanta (GA): Centers for Disease Control and Prevention - National Center for Environmental Health 2017 [cited 2022 Apr 29]. Available from: <https://www.cdc.gov/climateandhealth/docs/UseOfCoolingCenters.pdf>.
47. Williams L, Erens B, Ettelt S, Hajat S, Manacorda T, Mays N. *Evaluation of the heatwave plan for England*. London, UK: Policy Innovation and Evaluation Research Unit; 2019 [cited 2022 May 12]. Report No.: 2019-24. Available from: <https://piru.ac.uk/assets/files/Evaluation%20of%20the%20Heatwave%20Plan%20for%20England%20-%20Final%20Report.pdf>.
48. Williams S, Nitschke M, Wondmagegn BY, Tong M, Xiang J, Hansen A, et al. Evaluating cost benefits from a heat health warning system in Adelaide, South Australia. *Aust N Z J Public Health* 2022;46(2):149-54.

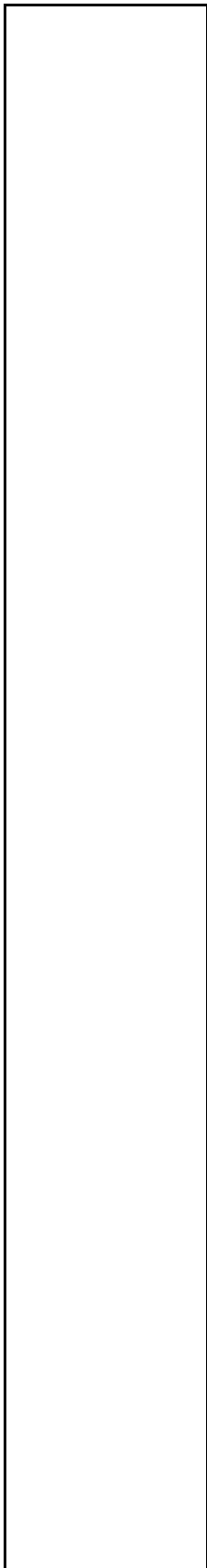
Appendix A: Heat and Health Search Strategy

Box A.1: Extreme Heat Adaptation Strategies Scoping Search - Search Strings

Database	Edition or Date Searched	Search Terms
Ovid MEDLINE(R) ALL 1946 to April 13, 2022	2022-04-14 Results: 1089	<ol style="list-style-type: none"> 1. ((rural or urban) adj (heat or temperature*)).ti,kf. 2. ((rural or urban) adj (heat or temperature*)).ab. /freq=2 3. (Heat adj (wave* or health or day*)).ti,kf. 4. (Heat adj (wave* or health or day*)).ab. /freq=2 5. (Hot adj (day* or night* or weather)).ti,kf. 6. (Hot adj (day* or night* or weather)).ab. /freq=2 7. Heatwave*.ti,kf. 8. heatwave*.ab. /freq=2 9. or/1-8 10. exp Hot Temperature/ 11. ((Extreme or high or rising) adj (heat or temperature*)).ti,kf. 12. ((Extreme or high or rising) adj (heat or temperature*)).ab. /freq=2 13. exp heat stress disorders/ or (dehydration or heat-health or heat exhaustion or heat stroke).ti,kf. 14. or/10-13 15. exp climate change/ 16. (weather or climat* or meteorolog* or global warming).mp. 17. (weather or climat* or meteorolog* or global warming or environment*).in,nw. 18. or/15-17 19. 9 or (14 and 18) [EXTREME HEAT TERMS] 20. public policy/ or environmental policy/ or health policy/ 21. (policy or policies).ti,kf. 22. exp Health Planning/ or exp Adaptation, Physiological/ or public health practice/ or environmental monitoring/ 23. ((adapt* or prepar* or (action adj2 plan*) or manage* or mitigat* or resilien* or "preventive measures" or prevent* or solution* or intervention* or evaluation* or strateg*) not (Occupation or work)).ti,kf. 24. ((adapt* or (action adj2 plan*) or mitigat* or "preventive measures" or prevent* or solution* or intervention* or evaluation*) not (occupation or work)).ab. /freq=2 25. hydrat*.mp. or exp Fluid Therapy/ 26. exp Immersion/ and exp Extremities/ 27. ((limb or limbs or hand or hands or foot or feet) adj2 immers*).ti,kf. 28. ((limb or limbs or hand or hands or foot or feet) adj2 immers*).ab. /freq=2 29. (cool* adj2 (centr* or center*)).ti,ab,kf. 30. air conditioning/ or ventilation/

31. (air adj2 (condition* or cool*)).ti,kf.
32. (fan or fans or fanning).ti,kf.
33. (outreach or ((heat or system) adj2 warn*)).mp.
34. exp city planning/ or urban plan*.ti,ab,kf.
35. disaster planning/ or relief work/ or environmental policy/
36. or/20-35 [ADAPTATION STRATEGIES]
37. 19 and 36
38. exp Geriatrics/ or exp Aged/ or Health Services for the Aged/ or Senior Centers/ or (elders or elderly or geriatric* or "gerontolog* old age" or (seniors not "high school") or (older adj3 (adult*or person* or people or man or men or woman or women)) or centenarian* or nonagenarian* or octogenarian* or septuagenarian* or sexagenarian* or dottering or decrepit or tottering or overaged or "oldest old" or supercentenarian*).mp.
39. Vulnerable Populations/ or abortion applicants/ or child, abandoned/ or disabled persons/ or disabled children/ or persons with mental disabilities/ or mentally ill persons/ or drug users/ or enslaved persons/ or homeless persons/ or homeless youth/ or prisoners/ or refugees/ or sex workers/ or "sexual and gender minorities"/ or intersex persons/ or transgender persons/ or terminally ill/ or "transients and migrants"/ or working poor/ or ((vulnerable or migrant or transient* or marginal* or "at risk" or impoverished) adj2 (population* or people or person* or individual* or child* or youth* or population* or worker* or men or women or man or woman)).ti,ab. or (street adj2 (people or person* or individual* or youth* or population* or child* or men or women or man or woman)).ti,ab. or (underhoused or "lack of housing" or ((substandard or insufficien* or unstabl* or under or instabil*) adj3 hous*) or squatter* or homeless* or vagrant* or indigent or "hard to house" or refugee* or asylee* or "mental* ill*" or "mental disorder*" or PTSD or "post traumatic stress" or "brain injur*" or "brain damag*" or disabled or pwud or "drug user*" or "drug dependen*" or addict* or alcoholi* or "sex worker*" or "released prisoner*" or "formerly incarcerated" or "pregnant teen*" or "pregnant youth*" or runaway* or "run away*" or (traffik* adj3 (youth* or women or woman or child* or person* or people*)) or "low income" or "low socioeconomic" or "low SES" or "poorest poor" or "battered women" or "intimate partner violen*" or "domestic violen*" or (abuse* adj3 elder*).ti,ab.
40. rural population/ or suburban population/ or urban population/
41. rural health/ or suburban health/ or urban health/
42. rural health services/ or suburban health services/ or urban health services/
43. "Catchment Area (Health)"/
44. (rural* or urban or semi-rural or semi-urban or city or non-urban or farm* or agricultur* or town* or village* or metropolitan or non-metropolitan or suburb* or remote or region or residence or jurisdiction or geographic or geography or location or residence or catchment).ti,ab,kf.
45. (community adj (dwelling or resid* or based)).ti,ab,kf.
46. (care adj network).ti,ab,kf.
47. exp Child/ or "Congenital, Hereditary, and Neonatal Diseases and Abnormalities"/ or exp infant/ or adolescent/ or exp pediatrics/ or child, abandoned/ or exp child, exceptional/ or child, orphaned/ or child, unwanted/ or minors/ or (pediatric* or paediatric* or child* or newborn* or

	<p>congenital* or infan* or baby or babies or neonat* or pre-term or preterm* or premature birth* or NICU or preschool* or pre-school* or kindergarten* or kindergarden* or elementary school* or nursery school* or (day care* not adult*) or schoolchild* or toddler* or boy or boys or girl* or middle school* or pubescen* or juvenile* or teen* or youth* or high school* or adolesc* or pre-pubesc* or prepubesc*).mp. or (child* or adolesc* or pediat* or paediat*).jn.</p> <p>48. exp Pregnancy Complications, Infectious/ or exp Pregnancy/ or exp Pregnant Women/ or exp Labor, Obstetric/ or exp Delivery, Obstetric/ or exp Obstetric Labor, Premature/ or exp Obstetric Labor Complications/ or Prenatal Care/ or (obstetric* or prenatal* or pregnan* or gestat* or perinatal or antenatal or parturi* or childbirth or (labo?r adj3 delivery)).mp.</p> <p>49. Transsexualism/ or exp Ethnic Groups/ or bisexuality/ or exp homosexuality/ or exp disabled persons/ or transgendered persons/ or exp refugees/ or exp Cultural Diversity/ or exp Socioeconomic Factors/</p> <p>50. (Metis or Indigenous* or Aboriginal* or Amerindian* or Autochtone* or First Nations or First Nation* or Inuit or Innu or Inuk or Inuvialuit or tribal or diversity or underprivileged or underrepresented or disadvantaged or minority or minorities or transient* or migrant* or immigrant* or blind or visual* impair* or hearing impair* or deaf or amputat* or paraplegic* or quadraplegic* or wheelchair* or transsexual* or homosexual* or bisexual* or two spirit* or gender-questioning or HIV positive or elders or elderly or oldest old or senior citizen* or shut-in or house-bound or neglected).mp.</p> <p>51. (battered adj3 (spouse* or wife* or partner)).mp.</p> <p>52. (disable* or transgender* or ethnic* or poverty or impoverished or working poor or unemploy* or under-employed or transportation deficit* or low soci* status or low income* or low-SES or hard-to-house or homeless* or under-housed).mp.</p> <p>53. (street adj3 (worker* or people or child or children or youth)).mp.</p> <p>54. (prostitute* or inner city or downtown core or city core or skid row or rural or remote or alcoholic* or mental* ill*).mp.</p> <p>55. ((drug or substance*) adj3 (abuse* or use* or illegal or illicit or addict*)).mp.</p> <p>56. or/38-55 [POPULATION TERMS]</p> <p>57. exp Canada/</p> <p>58. (canada or canadian\$ or alberta or british columbia or columbie britannique or saskatchewan or manitoba or ontario or quebec or new brunswick or nouveau brunswick or nova scotia or nouvelle ecosse or prince edward island or ile du prince edward or PEI or newfoundland or terre neuve or labrador or nun?v?t or nun?v?t or nwt or territoires du nord ouest or northwest territories or yukon).ti,ab,jw,kw.</p> <p>59. (Toronto* or Vancouver* or Montreal* or Edmonton* or Calgary* or Winnipeg* or Ottawa* or Halifax* or Regina* or Saskatoon* or whitehorse or yellowknife or inuvik).ti,ab,jw,kw.</p> <p>60. (alberta* or (edmonton* not England) or calgary or calgarian* or medicine hat or lethbridge or athabasca or barrhead or beaverlodge or Drayton Valley or Drumheller or Buffalo Lake or Kikino or Kinuso or Okotoks or Onoway or Paddle Prairie or peerless Lake or Pincher Creek or Piyami or Ponoka or Wabasca or Wetaskiwin or Zama or Fort Chippewayan or (Banff not (scor* or grade or grades or criteria or grading or scheme or schema or type* or classification or type or Scotland)) or (Jasper not (jumper or Penfield)) or Waterton or Canmore or Cadotte Lake or Woodland Cree or Fort Macleod or Shaganappi or ((spruce grove or settler or strathmore or sundre or sylvan lake or airdrie or beaumont or</p>
--	--



Calling Lake or Camrose or Coronation or (Devon not England) or Didsbury or East Prairie or Eckville or Edson or Elk Point or elnora or evansburg or fairview or Fishing Lake or Gibbons or Gift Lake or Glendon or Grande Cache or grande Prairie or Grimshaw or Hanna or Hinton or Hobbema or Innisfail or Kitscoty or Lac la Biche or Leduc or Manyberries or Mill Woods or Morinville or Myrnam or Nanton or (Olds not "year olds") or Rainbow Lake or Raymond or Red Earth Creek or Rimbey or Rocky Mountain House or Sedgewick or Strathmore or Sundre or Taber or Thorhild or Thorsby or Three Hills or Tofield or Trout Lake or Valleyview or Vauxhall or Vegreville or Vermillion or Viking or Viina or Vulcan or Wainwright or Jasper Place or Westlock or Whitecourt or Winfield or Worsley) and canada*).mp. or Alberta/

61. or/57-60 [CANADA ALBERTA]

62. exp united states/ or chile/ or Costa Rica/ or Colombia/ or israel/ or turkey/ or exp japan/ or exp Republic of Korea/ or austria/ or belgium/ or exp baltic states/ or estonia/ or latvia/ or lithuania/ or czech republic/ or hungary/ or poland/ or slovakia/ or slovenia/ or exp france/ or exp germany/ or united kingdom/ or exp england/ or northern ireland/ or exp scotland/ or wales/ or greece/ or exp ireland/ or exp italy/ or luxembourg/ or netherlands/ or portugal/ or exp "scandinavian and nordic countries"/ or exp denmark/ or finland/ or iceland/ or norway/ or sweden/ or spain/ or switzerland/ or exp australia/ or exp new zealand/ or (Australia or Austria or Belgium or Canada or Chile or Colombia or "Costa Rica" or "Czech Republic" or Denmark or Estonia or Finland or France or Germany or Greece or Hungary or Iceland or Israel or Italy or Japan or "Republic of Korea" or "South Korea" or Latvia or Lithuania or Luxembourg or Mexico or Netherlands or New Zealand or Norway or Poland or Portugal or "Slovak Republic" or Slovenia or Spain or Sweden or Switzerland or Turkey or "United Kingdom" or England or Ireland or Scotland or Wales or "United States").mp.

63. 37 and (56 or 61 or 62)

64. Developing Countries.sh,kf.

65. (Africa or Asia or West Indies or South America or Central America).hw,kf,ti,ab,cp.

66. (Caribbean or Latin* America*).hw,kf,ti,cp.

67. (Afghanistan or Albania or Algeria or Angola or Antigua or Barbuda or Argentina or Armenia or Armenian or Aruba or Azerbaijan or Bahrain or Bangladesh or Barbados or Benin or Byelarus or Byelorussian or Belarus or Belorussian or Belorussia or Belize or Bhutan or Bolivia or Bosnia or Herzegovina or Hercegovina or Botswana or Brasil or Brazil or Bulgaria or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cambodia or Cairo or Khmer Republic or Kampuchea or Cameroon or Cameroons or Cameron or Camerons or Cape Verde or Central African Republic or Chad or Chile or China or Colombia or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Costa Rica or Cote d'Ivoire or Ivory Coast or Croatia or Cuba or Cyprus or Czechoslovakia or Czech Republic or Slovakia or Slovak Republic or Djibouti or French Somaliland or Dominica or Dominican Republic or East Timor or East Timur or Timor Leste or Ecuador or United Arab Republic or Egypt or El Salvador or Eritrea or Estonia or Ethiopia or Fiji or Gabon or Gabonese Republic or Gambia or Gaza or Georgia Republic or Georgian Republic or Ghana or Gold Coast or Greece or Grenada or Guatemala or Guinea or Guam or Guiana or Guyana or Haiti or Honduras or Hungary or India or Maldives or Indonesia or Iran or Iraq or Isle of Man or Jamaica or Jordan or Kazakhstan or Kazakh or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or Kyrgyz Republic or Kirghiz or Kirgizstan or Lao PDR or Laos or Latvia or Lebanon or Lesotho or Basutoland or Liberia or Libya or Lithuania or Macedonia or Madagascar or Malagasy

		<p>Republic or Malaysia or Malaya or Malay or Sabah or Sarawak or Malawi or Nyasaland or Mali or Malta or Marshall Islands or Mauritania or Mauritius or Agalega Islands or Mexico or Micronesia or Middle East or Moldova or Moldavia or Moldovan or Mongolia or Montenegro or Morocco or Ifni or Mozambique or Myanmar or Myanma or Burma or Namibia or Nepal or Netherlands Antilles or New Caledonia or Nicaragua or Niger or Nigeria or Northern Mariana Islands or Oman or Muscat or Pakistan or Palau or Palestine or Panama or Paraguay or Peru or Philippines or Philipines or Phillipines or Phillippines or Poland or Portugal or Puerto Rico or Romania or Rumania or Roumania or Russia or Russian or Rwanda or Ruanda or Saint Kitts or St Kitts or Nevis or Saint Lucia or St Lucia or Saint Vincent or St Vincent or Grenadines or Samoa or Samoan Islands or Navigator Island or Navigator Islands or Sao Tome or Saudi Arabia or Senegal or Serbia or Montenegro or Seychelles or Sierra Leone or Slovenia or Sri Lanka or Ceylon or Solomon Islands or Somalia or South Africa or Sudan or Suriname or Surinam or Swaziland or Syria or Tajikistan or Tadzhhikistan or Tadjikistan or Tadzhhik or Tanzania or Thailand or Togo or Togolese Republic or Tonga or Trinidad or Tobago or Tunisia or Turkey or Turkmenistan or Turkmen or Uganda or Ukraine or Uruguay or USSR or Soviet Union or Union of Soviet Socialist Republics or Uzbekistan or Uzbek or Vanuatu or New Hebrides or Venezuela or Vietnam or Viet Nam or West Bank or Yemen or Yugoslavia or Zambia or Zimbabwe or Rhodesia).hw,kf,ti,ab,cp.</p> <p>68. ((developing or less* developed or under developed or underdeveloped or low* income or underserved or under served or deprived or poor*) adj (countr* or nation? or population? or world)).ti,ab.</p> <p>69. (middle income adj (countr* or nation? or population? or world)).ti.</p> <p>70. (low* adj (gdp or gnp or gross domestic or gross national)).ti,ab.</p> <p>71. (low adj3 middle adj3 countr*).ti.</p> <p>72. (lmic or lmics or third world or lami countr*).ti,ab.</p> <p>73. transitional countr*.ti,ab.</p> <p>74. or/64-73 [LMIC FILTER]</p> <p>75. microbiology.jw.</p> <p>76. animals/ not (animals/ and humans/)</p> <p>77. (in vitro or in vivo).ti.</p> <p>78. 63 not (74 or 75 or 76 or 77)</p> <p>79. limit 78 to (english language and yr="2012 -Current")</p> <p>80. limit 79 to (comment or editorial or letter)</p> <p>81. 79 not 80</p>
<p>Google Scholar https://scholar.google.com/</p>	<p>2022-04-29</p> <p>Results: 12</p> <p>Retrieved: 9</p>	<p>allintitle: +"extreme heat" OR heatwave OR heatwaves +implementation OR plan OR strategy OR strategies OR interventions OR program OR programs evaluation OR evaluate OR effectiveness OR outcomes</p> <p>Limited to 2012-2022</p> <p>+"extreme heat" OR heatwave OR heatwaves OR "extreme temperatures" +implementation OR implement OR plan OR strategy OR strategies OR intervention OR interventions OR program OR programs evaluation OR evaluate OR effectiveness OR outcomes OR study OR studies</p>

		Limited to 2012-2022
Grey literature		
Global Adaptation Mapping Initiative https://globaladaptation.github.io/index.html	2022-03-25 Retrieved: 3	Browsed publications
National Collaborating Centre for Environmental health https://ncceh.ca/	2022-03-25	Browsed Extreme Heat page – 0 results https://ncceh.ca/environmental-health-in-canada/health-agency-projects/extreme-heat
Qwant https://www.qwant.com/	2022-03-25 Retrieved: 7	extreme heat systematic review – retrieved 4 extreme heat mitigation OR adaptation systematic review – retrieved 3
Google Advanced Search https://www.google.ca/	2022-04-29 Retrieved: 20	Google extreme heat mitigation OR adaptation OR management health systematic review – 96 results (retrieved – 9) allintitle: +"extreme heat" OR heatwave OR heatwaves OR "extreme temperatures" +implementation OR implement OR plan OR strategy OR strategies OR intervention OR interventions OR program OR programs evaluation OR evaluate OR effectiveness OR outcomes OR study OR studies – 15 Results (retrieved – 7) allintext: +"extreme heat" OR heatwave OR heatwaves OR "extreme temperatures" +implementation OR implement OR plan OR strategy OR strategies OR intervention OR interventions OR program OR programs evaluation OR evaluate OR effectiveness OR outcomes – browsed 1 st 100 results (retrieved – 4)

<p>Intergovernmental Panel on Climate Change (IPCC) https://www.ipcc.ch/</p>	<p>2022-05-02</p>	<p>Browsed publications – 0 results</p>
<p>Climate Change and Human Health Literature Portal https://tools.niehs.nih.gov/cchhl/index.cfm</p>	<p>2022-05-04 Retrieved: 20</p>	<p>Evaluation – 34 results Evaluate – 64 results Implement – 15 results Implementing – 19 results Implementation – 35 results Effective – 65 results Outcomes – 98 results</p> <p>Filters for all searches: Assessment/Book/Report Research Article United States Europe Non-U.S. North America Heat Drought Health Impact Review Article Australasia Year Published 2021 2020 2019 2018 2017 2016 2015 2014 2013 2012 Health Sector Influence Vulnerable Population Sociodemographic Vulnerability Research Gap Policy Mitigation</p>
<p>Global Heat Health Information Network https://ghhin.org/</p>	<p>2022-05-04 Retrieved: 5</p>	<p>Browsed Tools Products and Services page</p> <p>Searched: Evaluation, evaluate (retrieved – 3) Implementation (retrieved – 0) Health outcomes: (retrieved – 1) Uptake – 0 results Effectiveness (retrieved – 1)</p>
<p>European Observatory https://climate-adapt.eea.europa.eu/observatory/evidence/health-effects/heat-and-health/heat-and-health</p>	<p>2022-05-04 Retrieved: 4</p>	<p>Browsed site</p>

Appendix B: Evidence for Extreme Heat Health Adaptation Strategies

Table B.1: Summary of Evidence for Individual and Care Provider Extreme Heat Health Behaviour Strategies

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
Air conditioning ^{2, 10, 13, 15, 16, 19, 20, 22, 24-26, 29, 33, 42}	<ul style="list-style-type: none"> Mechanically controlling the humidity, ventilation, and temperature in a building, in order to maintain a cool indoor environment. AC units may be installed or utilized within private dwellings, or patients/those living in a congregate living facility may utilize an air-conditioned common area. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public Vulnerable populations <i>Implementers</i> <ul style="list-style-type: none"> Individuals Care providers 	Kemen 2021 ¹⁶ Survey study Cologne, Germany	<ul style="list-style-type: none"> The sum of all coping-strategies is positively correlated with perception of heat strain (Spearman's $\rho = 0.396$), and more adaptation strategies are associated with more heat strain (individual strategies not analyzed) 	Not reported
			Christenson 2021 ⁸ Survey study Milwaukee, Wisconsin, United States	Not reported	<i>Barriers</i> <ul style="list-style-type: none"> Cost (e.g., installation, energy bills, repairs) Noise Discomfort with use Safety concern with window unit overnight
			Kondo 2021 ¹⁹ Survey study Fukuoka, Japan	Not reported	<i>Facilitator</i> <ul style="list-style-type: none"> Educate the public about an efficient/appropriate use of AC and how to use AC while saving energy
Applying water to extremities ^{13, 16, 25}	<ul style="list-style-type: none"> Using wet towels, spraying, or submerging arms, feet, neck and/or head in cool water to reduce to the body's heat load through evaporative heat loss. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public 	Kemen 2021 ¹⁶ Survey study Cologne, Germany	<ul style="list-style-type: none"> The sum of all coping-strategies is positively correlated with perception of heat strain (Spearman's $\rho = 0.396$), and more adaptation strategies are 	Not reported

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
		<ul style="list-style-type: none"> Vulnerable populations <i>Implementers</i> <ul style="list-style-type: none"> Individuals Care providers 		associated with more heat strain (individual strategies not analyzed)	
Block sunlight ^{10, 15, 16, 19, 22, 25, 42}	<ul style="list-style-type: none"> Preventing increased indoor temperatures through latent solar heat, by closing blinds, shades, or shutters during the day. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public Vulnerable populations <i>Implementers</i> <ul style="list-style-type: none"> Individuals Care providers 	Kemen 2021 ¹⁶ Survey study Cologne, Germany	<ul style="list-style-type: none"> The sum of all coping-strategies is positively correlated with perception of heat strain (Spearman's $\rho = 0.396$), and more adaptation strategies are associated with more heat strain (individual strategies not analyzed) 	Not reported
Cold showers or shower more frequently ^{9, 12, 16, 25}	<ul style="list-style-type: none"> Wetting the body, to reduce the body's heat load through evaporative heat loss. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public Vulnerable populations <i>Implementers</i> <ul style="list-style-type: none"> Individuals Care providers 	Kemen 2021 ¹⁶ Survey study Cologne, Germany	<ul style="list-style-type: none"> The sum of all coping-strategies is positively correlated with perception of heat strain (Spearman's $\rho = 0.396$), and more adaptation strategies are associated with more heat strain (individual strategies not analyzed) 	Not reported
Cooking and eating differently ^{16, 19, 25, 33, 42}	<ul style="list-style-type: none"> Avoiding increased indoor temperatures through the use of cooking appliance (e.g., not using oven). Avoiding food and beverages that can dehydrate (e.g., alcohol, caffeine, high in salt). 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General Public Vulnerable populations <i>Implementers</i>	Kemen 2021 ¹⁶ Survey study Cologne, Germany	<ul style="list-style-type: none"> The sum of all coping-strategies is positively correlated with perception of heat strain (Spearman's $\rho = 0.396$), and more adaptation strategies are associated with more 	Not reported

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
		<ul style="list-style-type: none"> Individuals Care providers 		heat strain (individual strategies not analyzed)	
Creating natural ventilation ^{7, 10, 16, 19, 20, 22, 25, 26, 33, 42}	<ul style="list-style-type: none"> Opening windows, during cooler parts of the day (i.e., nighttime) to circulate and introduce cooler air indoors. Natural-draft ventilation (allowing cooler air to enter at the base/north side, and letting hotter air exit through an opening at the top of the building) and cross-ventilation (opening doors or windows on opposite walls) configurations are suggested. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public <i>Implementers</i> <ul style="list-style-type: none"> Individuals Care providers 	Kemen 2021 ¹⁶ Survey study Cologne, Germany	<ul style="list-style-type: none"> The sum of all coping-strategies is positively correlated with perception of heat strain (Spearman's $\rho = 0.396$), and more adaptation strategies are associated with more heat strain (individual strategies not analyzed) 	Not reported
			Mayrhuber 2018 ²⁹ Scoping review United States, Canada, Europe, Australia, Japan, China, Hong Kong, and South Africa.	Not reported	<i>Barriers</i> <ul style="list-style-type: none"> Safety/security concerns with leaving windows open at night
Drinking more fluids and/or maintaining hydration ^{4, 7, 9, 12, 13, 15, 16, 19, 22, 25, 26, 33, 42}	<ul style="list-style-type: none"> Drinking fluids regularly, to prevent dehydration. Water is the preferred fluid, with soft-drinks, alcohol and caffeinated beverages being avoided because of their diuretic properties. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public Vulnerable populations <i>Implementers</i> <ul style="list-style-type: none"> Individuals 	Kemen 2021 ¹⁶ Survey study Cologne, Germany	<ul style="list-style-type: none"> The sum of all coping-strategies is positively correlated with perception of heat strain (Spearman's $\rho = 0.396$), and more adaptation strategies are associated with more heat strain (individual strategies not analyzed) 	Not reported

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
Expand and maintain vegetation cover on private property ¹⁰	<ul style="list-style-type: none"> Reducing artificial surfaces in size (which absorb re-emit heat) through the addition of vegetation in gardens/yards, alleyways, driveways and balconies. 	<i>Setting</i> <ul style="list-style-type: none"> Urban <i>Population</i> <ul style="list-style-type: none"> General public <i>Implementers</i> <ul style="list-style-type: none"> Individuals 	None identified		
Fans ^{10, 13, 15, 16, 19, 25, 29, 33}	<ul style="list-style-type: none"> Using electrical ceiling, floor or desk fans to improve ventilation in indoor spaces and support convection/evaporative heat loss from the skin In non-humid conditions applying water to extremities or wetting clothes in conjunction with fan use, to support evaporative heat loss. Guidelines recommend against using fans in heat that exceeds 35°C or when high humidity is present in conjunction with a heat wave. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public Vulnerable populations <i>Implementers</i> <ul style="list-style-type: none"> Individuals Care providers 	Kemen 2021 ¹⁶ Survey study Cologne, Germany	<ul style="list-style-type: none"> The sum of all coping-strategies is positively correlated with perception of heat strain (Spearman's $\rho = 0.396$), and more adaptation strategies are associated with more heat strain (individual strategies not analyzed) 	Not reported
Modified work arrangements ^{7, 10}	<ul style="list-style-type: none"> Arranging with employers to work at cooler times of the day. Taking more frequent work breaks for workers in hot, non-air-conditioned environments. Scheduling heavy work during cooler part of the day. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public Vulnerable populations <i>Implementers</i> <ul style="list-style-type: none"> Individuals 	None identified		

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
Monitoring technology ^{13, 18}	<ul style="list-style-type: none"> Monitoring the health of individuals outside of healthcare facilities using apps or personal monitors. Alerting the individual or a care provider when parameters indicate an elevated risk for heat-related illness. <p><i>Example: ClimApp¹⁸</i></p> <ul style="list-style-type: none"> An app (available for Android, iOS) which combines the current and 24-hour weather forecasting with individual information to offer personalized guidance related to heat exposure Advice can be for individuals or groups and the user can customize the model input according to their personal situation (e.g., activity level, clothing, body characteristics, heat acclimatization, indoor or outdoor situation, and geographical location) 	<p><i>Setting</i></p> <ul style="list-style-type: none"> Urban or rural <p><i>Population</i></p> <ul style="list-style-type: none"> General public Vulnerable populations <p><i>Implementers</i></p> <ul style="list-style-type: none"> Individuals Care providers 	None identified		
Reducing or rescheduling recreational activity ^{9, 13, 15, 16, 20, 22, 25, 33}	<ul style="list-style-type: none"> Reducing, eliminating or rescheduling strenuous activities for early morning or late evening, when temperatures are cooler, to reduce the risk of heat stress through excursion. 	<p><i>Setting</i></p> <ul style="list-style-type: none"> Urban or rural <p><i>Population</i></p> <ul style="list-style-type: none"> General public Vulnerable populations <p><i>Implementers</i></p> <ul style="list-style-type: none"> Individuals 	Kemen 2021 ¹⁶ Survey study Cologne, Germany	<ul style="list-style-type: none"> The sum of all coping-strategies is positively correlated with perception of heat strain (Spearman's $\rho = 0.396$), and more adaptation strategies are associated with more heat strain (individual strategies not analyzed) 	Not reported

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
		<ul style="list-style-type: none"> Care providers 			
Resting in the shade and/or creating one's own shade ^{9, 22, 26}	<ul style="list-style-type: none"> Resting away from direct sunlight (e.g., under an awning, umbrella, or tree's shadow), or wearing a hat to reduce the risk of one's body temperature rising. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public Vulnerable populations <i>Implementers</i> <ul style="list-style-type: none"> Individuals Care providers 	None identified		
Turning off heat-producing equipment ^{3, 10, 22}	<ul style="list-style-type: none"> Avoiding increasing the indoor temperatures by turning off heat-producing equipment (e.g., TVs, computers). 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public Vulnerable populations <i>Implementers</i> <ul style="list-style-type: none"> Individuals Care providers 	None identified		
Use thinner bedding and/or modify sleeping arrangements ^{7, 10, 16, 25}	<ul style="list-style-type: none"> In homes with different rooms and floors, arranging sleeping areas differently, so that people can benefit from cooler areas of the house (e.g., basements, lower floors, and rooms that receive less sunlight). Using thinner bedding may reduce the risk of over-heating. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public Vulnerable populations <i>Implementers</i> <ul style="list-style-type: none"> Individuals Care providers 	None identified		

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
Wearable personal cooling system ^{25, 30}	<ul style="list-style-type: none"> Wearing neck ties, cooling vests or other clothing, which may use water, ice packs, personal ventilation (e.g., ventilated clothing with integrated electric fans), or and phase change materials. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public Vulnerable populations <i>Implementers</i> <ul style="list-style-type: none"> Individuals Care providers 	None identified		
Wearing less, light, and/or breathable clothing ^{7, 9, 12, 13, 15, 16, 19, 22, 25, 33}	<ul style="list-style-type: none"> Wearing fewer garments, that are light coloured and are breathable or do not retain heat (e.g., cotton, linen, silk) to improve air circulating over one's skin, as well as allowing sweat/moisture to evaporate. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public Vulnerable populations <i>Implementers</i> <ul style="list-style-type: none"> Individuals Care providers 	Jay 2021 ¹³ Literature review	Not reported	<i>Barriers</i> <ul style="list-style-type: none"> Can compromise skin protection from ultraviolet radiation

AC: air conditioning; ρ : rank correlation coefficient; TV: television

Table B.2: Summary of Evidence for Care Provider Extreme Heat Health Preparedness Strategies

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
Checklists ³⁰	<ul style="list-style-type: none"> An extreme heat checklist is developed to highlight issues and provide a systematic approach to hot weather preparation. <p><i>Example: Heatwave checklist for residential aged care(Victoria, Australia)³⁰</i></p> <ul style="list-style-type: none"> Checklist designed to assist residential aged care providers to prepare for summer and periods of extreme heat. It is meant to act as prompt and to provide a framework for planning and preparedness activities It is used by multiple personnel to review and prepare their respective work areas. 	<p><i>Setting</i></p> <ul style="list-style-type: none"> Urban or rural <p><i>Population</i></p> <ul style="list-style-type: none"> Healthcare providers and patients (healthcare facilities) Seniors (nursing homes) <p><i>Implementers</i></p> <ul style="list-style-type: none"> Public health authority Care providers 	None identified		
Facility heat health action-response plan or protocols ^{20, 21, 30, 36}	<ul style="list-style-type: none"> Healthcare facilities or community services develop plans or protocols which help prepare for and guide their services through extreme heat events. Healthcare facilities or community services may also adapt local or national heat health plans to their individual context. Planned interventions and protocols may include: installation of thermometers in patient bays and recording of 	<p><i>Setting</i></p> <ul style="list-style-type: none"> Urban or rural <p><i>Population</i></p> <ul style="list-style-type: none"> Patients Vulnerable populations Seniors (nursing homes) <p><i>Implementers</i></p> <ul style="list-style-type: none"> Public health authority Care providers 	Boyson 2014 ³ Survey study England	Not reported	<p><i>Facilitators</i></p> <ul style="list-style-type: none"> Clinical experience and knowledge about heat and health Capacity to identify vulnerability and increase surveillance Family involvement <p><i>Barriers</i></p> <ul style="list-style-type: none"> Lack of awareness; do not perceive as a priority Limited or unsuitable resources and facilities (e.g., lack of ice machines,

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
	temperatures frequently; identifying vulnerable individuals; creation of cool areas for high-risk patients; obtain and maintains supplies (e.g., ice machine, water fountains, fans); turning off unnecessary lights and electrical equipment; maximizing green areas on and around the facility site.				fans; poor design of building) <ul style="list-style-type: none"> • Conflicting actions with other guidelines • Lack of, or poor channeling of communications to frontline staff
			McInnes 2013 ³⁰ Survey study Victoria, Australia	Not reported	<i>Facilitators</i> <ul style="list-style-type: none"> • Awareness; education of staff on plan/protocols (e.g., audits of staff knowledge, compulsory information sessions, staff meetings and easy access to materials [hard copy and electronic] <i>Barriers</i> <ul style="list-style-type: none"> • Staff absences • Lack of time
			Kunst 2013 ²² Survey study Amsterdam, The Netherlands	Not reported	<i>Barriers</i> <ul style="list-style-type: none"> • Poor dissemination of heat plans within institutions • Shortage of expertise among personnel • Residents' lack of awareness of risks vs. need to respect residents' responsibility and self- determination • High cost to install cooling measures (e.g., AC) in older buildings
Information and/or education	<ul style="list-style-type: none"> • Training sessions and reminders to personnel of 	<i>Population</i>	None identified		

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
campaign specific to care providers ^{4, 7, 20, 30, 38}	preventive measures to put in place and signs of heat-related illness.	<ul style="list-style-type: none"> Care providers and patients (healthcare facilities) Children (schools) Seniors (nursing homes) <i>Implementers</i> <ul style="list-style-type: none"> Public health authority Care providers 			
Maintenance of equipment ³⁰	<ul style="list-style-type: none"> An early preparation activity for healthcare facilities to ensure cooling resources are available, including repair and maintenance of AC units. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> Patients Care providers <i>General public</i> <i>Implementers</i> <ul style="list-style-type: none"> Public health authority 	None identified		
Meeting of all agencies to discuss coordination issues ³⁵	<ul style="list-style-type: none"> An early preparation activity for decision makers and care providers to review heat health action plans and discuss responsibilities, and coordination of resources. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> Care providers <i>General public</i> <i>Implementers</i> <ul style="list-style-type: none"> Public health authority Government Healthcare providers 	None identified		

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
		<ul style="list-style-type: none"> • Not-for-profit groups • Combination of partners and agencies 			
Participating in community committees ²¹	<ul style="list-style-type: none"> • Care providers can participate in community committees, (e.g., health councils; school boards; recreation programs) to provide expertise on how minimize heat-related health effects during program activities and spread awareness on extreme heat adaptation. 	<i>Setting</i> <ul style="list-style-type: none"> • Urban or rural <i>Population</i> <ul style="list-style-type: none"> • General population • Children (schools) <i>Implementers</i> <ul style="list-style-type: none"> • Care providers 	None identified		
Patient risk pre-assessment and identification ^{3, 18, 22, 24, 48}	<ul style="list-style-type: none"> • Patients/clients are pre-assessed using a heat vulnerability assessment tool, to identify those who may require close monitoring during heatwaves. • Assessments may include the effects of current medications, condition or behavioral factors, and/or limited resources/support. • Those identified as high risk for heat-related illness may receive education, or be enrolled in a welfare-check in program. <p><i>Example: Health Heatwave intervention for mental health clients (Adelaide, Australia)⁴⁸</i></p> <ul style="list-style-type: none"> • Mental health clients were assessed at the beginning of 	<i>Setting</i> <ul style="list-style-type: none"> • Urban or rural <i>Population</i> <ul style="list-style-type: none"> • Chronically ill <i>Implementers</i> <ul style="list-style-type: none"> • Healthcare providers 	Williams 2022 ⁴⁸ Cost Analysis Adelaide, Australia	<ul style="list-style-type: none"> • For mental health clients, total costs were estimated as \$222,365 AUS, (pre-season risk assessment: \$145,895 AUS; client education and follow up \$35,506 AUS) • Potential costs averted through combined HHWS-attributable reductions in hospital admissions and ambulance callouts: benefit-to-cost ratio of 2.0–3.3 (but contribution of the intervention was not evaluated) • There was no apparent decrease in mental health hospitalizations 	Not reported

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
	summer, to identify those who may require closer monitoring during heatwaves; on activation of the HHWS, these clients receive daily welfare checks by phone or home-visits if needed.			following introduction of the HHWS	
Provide information during non-heat related visits and increased surveillance for signs or symptoms of heat related illness ^{2, 38}	<ul style="list-style-type: none"> • Bringing awareness to extreme heat related risk and adaptation during routine health appointments. • During times of extreme heat, intensified surveillance of signs or symptoms of heat-related illness may be prudent in those who are unable to notice and respond accordingly. 	<i>Setting</i> <ul style="list-style-type: none"> • Urban or rural <i>Population</i> <ul style="list-style-type: none"> • Chronically ill • Seniors <i>Implementers</i> <ul style="list-style-type: none"> • Care providers 	None identified		

AC: air conditioning; HHWS: heat health warning system

Table B.3: Summary of Evidence for Community Extreme Heat Health Adaptation Strategies

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
Cooling bus program ¹⁴	<ul style="list-style-type: none"> Leveraging public transportation system's air-conditioned buses as cooling centers that can strategically be placed in locations that needed cooling access. 	<i>Setting</i> <ul style="list-style-type: none"> Urban <i>Population</i> <ul style="list-style-type: none"> General Public <i>Implementers</i> <ul style="list-style-type: none"> Municipal government Community organization 	None identified		
Cooling centres or shelters ^{8, 9, 11-14, 17, 20, 21, 24, 27, 33, 38, 45, 46}	<ul style="list-style-type: none"> An air-conditioned building designated to provide respite and safety during extreme heat. Often a government-owned building (e.g., library, museum, school, recreation center), an existing community or religious centre, or a private business (e.g., shopping mall, or movie theatre), with trained staff which can recognize signs of heat-illness. Extreme-heat education materials, water, food/snacks and entertainment is sometimes provided. Disseminating information regarding the centres was most often through public radio, social media, and newspapers, with targeted reach-out to vulnerable populations. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public Seniors Homeless <i>Implementers</i> <ul style="list-style-type: none"> Public health authority Municipal government Non-profit groups Combination of agencies and/or partners 	Widerynski 2017 ⁴⁶ Report	<ul style="list-style-type: none"> Spending time (even a few hours) in a cool environment reduces the risk of mortality (approximately 66% reduction) 	<i>Facilitator</i> <ul style="list-style-type: none"> Transportation (e.g., free bus service) <i>Barriers</i> <ul style="list-style-type: none"> Lack of awareness Stigma/perception of need (e.g., do not feel they are vulnerable to heat) Don't want house unoccupied (e.g., crime in area, pets)
			White-Newsome 2014 ⁴⁵ Qualitative study Detroit, Michigan, New York City, New York, Philadelphia, Pennsylvania and Phoenix,	Not reported	<i>Barriers</i> <ul style="list-style-type: none"> Stigma (e.g., misconception that centres are only for seniors or homeless) Hygiene, health and safety Access, lack of transportation Difficulty evacuating one's home

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
	<ul style="list-style-type: none"> There may be designated centres for persons experiencing homelessness, which may provide other services such as food, clothing, referring services, and mental health care. <p><i>Example: Code Red program (Adelaide, Australia)⁴⁸</i></p> <ul style="list-style-type: none"> Provide those sleeping rough a place to stay cool and hydrated. This was provided in addition to regular services to those experiencing homelessness. <p><i>Example: Code Red program (Baltimore Maryland, United States)</i></p> <ul style="list-style-type: none"> The program is in effect from May 15 to September 15 each summer, with cooling centers opened to the public (including in Community Action Centers and city-run senior centers) on days when a heat declaration was issued by the health commissioner; This runs in conjunction with bottled water distribution to the homeless, and energy assistance to those who apply and qualify (i.e., help with the cost of heating and cooling bills). 		Arizona, United States		
			Nayak 2017 ³³ Survey study New York State, United States	Not reported	<p><i>Facilitators</i></p> <ul style="list-style-type: none"> Food and activities provided Use of multiple media outlets to notify the community (e.g., television, radio, newspapers to reach seniors) Large distribution of cooling centres (i.e., across metropolitan areas, suburban, and rural) <p><i>Barriers</i></p> <ul style="list-style-type: none"> Limited resources (e.g., facilities, funds, staff) Making aware vulnerable populations
			Williams 2022 ⁴⁸ Cost analysis Adelaide, Australia	<ul style="list-style-type: none"> For Code Red program, total cooling center costs were \$48,000 AUS Potential costs averted through combined HHWS-attributable reductions in hospital admissions and ambulance callouts: benefit-to-cost ratio of 2.0–3.3 (but contribution of the individual intervention was not evaluated) 	Not reported

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
			Christenson 2021 ⁸ Survey study Milwaukee, Wisconsin, United States	Not reported	<p><i>Facilitators</i></p> <ul style="list-style-type: none"> • Messaging about intended audience <p><i>Barriers</i></p> <ul style="list-style-type: none"> • Lack of awareness • Negative perception • Long distance from home • Limited hours of operation • Worried about personal safety • Cannot bring pets • Building not accessible for disabilities
			Martin 2016 ²⁷ Program description Baltimore, Maryland, United States	Not reported	<p><i>Facilitators</i></p> <ul style="list-style-type: none"> • Leverages existing assets and programs in the city <p><i>Barriers</i></p> <ul style="list-style-type: none"> • Variation in cooling centre implementation and operation • Lack of channels of communication with vulnerable population • Message fatigue during long periods of extreme heat • Deterred by getting comfortable at the centre, only to become uncomfortable again at home

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
Distribution of water ^{4, 11, 14, 20, 24, 27, 38, 41}	<ul style="list-style-type: none"> • Distribution of water bottles, installation of public fountains, providing portable water stations, or public coolers, to provide hydration options for individuals. • Along with water distribution to the general population, educational materials regarding heat health risk and individual behaviour adaptations may be included. • Water distribution to vulnerable populations, may coincide with outreach efforts or as part of home visits. • For patients/those living in a congregate living facility, access to fluids may be enhanced (e.g., water stations, distributing cups of water), in conjunction with reminders to stay hydrated. <p><i>Example: Heat health warning plus bottled water delivery (Nagasaki, Japan)⁴¹</i></p> <ul style="list-style-type: none"> • In addition to heat health warnings, two 500 mL bottles of water with short messages about heat-related illness prevention behaviors were delivered by couriers to each household once a week for 5 weeks. 	<p><i>Setting</i></p> <ul style="list-style-type: none"> • Urban or rural <p><i>Population</i></p> <ul style="list-style-type: none"> • General public • Homeless • Homecare clients (seniors, chronically ill) <p><i>Implementers</i></p> <ul style="list-style-type: none"> • Government • Non-profit groups • Care providers • Volunteers • First responders 	Takahashi 2015 ⁴¹ Community trial Nagasaki, Japan	<ul style="list-style-type: none"> • In conjunction with a heat health warnings and public information materials, water bottle distribution improved nighttime AC use, water intake, cooling body behaviours, and reduced activity in the heat. • There was no improvement of the knowledge scores with water bottle distribution. 	Not reported

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
Distribute shading and/or cooling items ¹⁴	<ul style="list-style-type: none"> Distribution of shading or cooling items (e.g., free tents, patio umbrellas, misting fans, super soakers, water jugs, water balloons and/or neck cooling rags) to encourage individual heat adaptation behaviours. <p><i>Example: Playstreets program (Philadelphia, Pennsylvania)</i>¹⁴</p> <ul style="list-style-type: none"> As an extension of a pop-up play program with free lunches, the program provided participants with shading and cooling items during program participation. 	<p><i>Setting</i></p> <ul style="list-style-type: none"> Urban or rural <p><i>Population</i></p> <ul style="list-style-type: none"> General public Children <p><i>Implementers</i></p> <ul style="list-style-type: none"> Municipal government Non-profit groups 	None identified		
Expand and maintain vegetation cover on public property or businesses ^{4, 10, 13, 19-21, 24, 42}	<ul style="list-style-type: none"> Reducing artificial surfaces, (which absorb re-emit heat) through increasing vegetation in parking areas, alleyways, streets, and other public (e.g., school yards), or commercial infrastructure. 	<p><i>Setting</i></p> <ul style="list-style-type: none"> Urban <p><i>Population</i></p> <ul style="list-style-type: none"> General public <p><i>Implementers</i></p> <ul style="list-style-type: none"> Community groups Businesses 	Eyquem 2022 ¹⁰ Report Canada	Not reported	<p><i>Barriers</i></p> <ul style="list-style-type: none"> High land costs Competition for space
Expanded programs for vulnerable and isolated people ^{26, 48}	<ul style="list-style-type: none"> Existing programs (e.g., senior centres, homeless shelters and outreach) may expand services (e.g., hours, personnel, services) to increase support for those vulnerable populations during extreme heat events. <p><i>Example: Code Red program (Adelaide, Australia)</i>⁴⁸</p>	<p><i>Setting</i></p> <ul style="list-style-type: none"> Urban or rural <p><i>Population</i></p> <ul style="list-style-type: none"> General public Seniors Homeless <p><i>Implementers</i></p>	Williams 2022 ⁴⁸ Cost analysis Adelaide, Australia	<ul style="list-style-type: none"> For Code Red program, total cooling center costs were \$48,000 AUS Potential costs averted through combined HHWS-attributable reductions in hospital admissions and ambulance callouts: benefit-to-cost ratio of 2.0–3.3 (but contribution 	Not reported

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
	<ul style="list-style-type: none"> Provide those sleeping rough a place to stay cool and hydrated in addition to regular services to those experiencing homelessness. 	<ul style="list-style-type: none"> Public health authority Municipal government Non-profit groups Combination of agencies and/or partners 		of the individual intervention was not evaluated)	
Extending operational hours of public pools, outdoor recreation, spaces, spray parks ^{2, 9, 24, 33, 38}	<ul style="list-style-type: none"> Extending operational hours of public pools, outdoor recreational spaces, and spray parks, to increase access to cooling infrastructure. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public Children Homeless <i>Implementers</i> <ul style="list-style-type: none"> Municipal government Businesses 	None identified		
Outreach ^{4, 5, 10, 21, 23, 24, 27, 29, 37, 45}	<ul style="list-style-type: none"> Engaging with the public about the risks of extreme heat, and preventive measures that can reduce these risks. Programs may also look at the sites (e.g., low-income communities, seniors' residences) for indicators of elevated risk and provided education and assistance as needed. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General public Seniors (community dwelling, isolated) <i>Implementers</i> <ul style="list-style-type: none"> Homeless 	Orlando 2021 ³⁷ Ecological Study Rome, Italy	<ul style="list-style-type: none"> The Long Live Elderly program reduced excessive mortality^a: 2% intervention vs. 3.81% controls; rate ratio 0.70, 95% CI (0.54 to 0.92); adjusted IRR: 0.44, 95% CI (0.3 to 0.60). 	Not reported

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
	<ul style="list-style-type: none"> For homeless populations, outreach teams may patrol the streets, looking for vulnerable people and providing information, water/sports drinks, and basic necessities (e.g., hygiene kits, socks) <p><i>Example: Gatekeeping program (Detroit, Michigan)⁴⁵</i></p> <ul style="list-style-type: none"> Utility service providers go out into the field to look at sites and provide assistance to vulnerable customers (e.g., senior citizens); if someone is in danger, it was reported back to the appropriate group (e.g., Aging agency)⁴⁵ <p><i>Example: Long Live the Elderly Program (Rome, Italy)^{23, 37}</i></p> <ul style="list-style-type: none"> All those over 75 receive a letter and then a phone call to obtain their consent to be part of the program; refusal for participation is low (2%). Periodically assessing social and health needs, health promotion campaigns, and assistance in handling bureaucratic matters, or seeking formal or informal care; this is often provided by volunteers living or working near participants. 	<ul style="list-style-type: none"> Government Non-profit groups Volunteers Utility providers First responders 	<p>Liotta 2018²³</p> <p>Case control study</p> <p>Rome, Italy</p>	<ul style="list-style-type: none"> Cumulative mortality^b rates for Long Live Elderly program participants 25% (SD 1.4) vs. non-participants 29% (SD 6.7) 	<p>Not reported</p>
Shade structures ^{13, 25, 30}	<ul style="list-style-type: none"> Artificial canopies are strategically located over outdoor areas (e.g., transit stops, play areas, and picnic 	<p><i>Setting</i></p> <ul style="list-style-type: none"> Urban <p><i>Population</i></p>	<p>Jay 2021¹³</p> <p>Literature review</p>	<p>Not reported</p>	<p><i>Barriers</i></p> <ul style="list-style-type: none"> High cost of canopy materials.

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
	<p>areas) and buildings, minimize radiative heat load.</p> <ul style="list-style-type: none"> Building shade can be strategically used to provide shading for pedestrians and high-use urban areas (e.g., plazas and transit stops). 	<ul style="list-style-type: none"> General public Children Homeless <p><i>Implementers</i></p> <ul style="list-style-type: none"> Municipal government 			<ul style="list-style-type: none"> Coverage dependent on size, height, and orientation of shading. Shading implementation should assess use (e.g., time of day and demographics) to ensure shade is optimally cast at the hottest times of day.
Spray or sprinkler caps on fire hydrants ⁴⁵	<ul style="list-style-type: none"> Misting or sprinkler heads are attached to fire hydrants, which control how much water is used for cooling sprays (rather than having people opening fire hydrants). 	<p><i>Setting</i></p> <ul style="list-style-type: none"> Urban <p><i>Population</i></p> <ul style="list-style-type: none"> General public <p><i>Implementers</i></p> <ul style="list-style-type: none"> Municipal government 	None identified		
Transportation to heat health infrastructure ^{21, 24, 33, 38}	<ul style="list-style-type: none"> Shuttles or public transportation are utilized to better provide access to heat health infrastructure (e.g., cooling centres, public pools). Allocation and routes are designed to target those who are at high-risk for heat related illness, or are unlikely to have personal transportation options (e.g., lower income areas). 	<p><i>Setting</i></p> <ul style="list-style-type: none"> Urban or rural <p><i>Population</i></p> <ul style="list-style-type: none"> General public Vulnerable populations <p><i>Implementers</i></p> <ul style="list-style-type: none"> Municipal government 	None identified		
Welfare check-ins ^{4, 7, 9, 10, 20, 24, 27, 32, 35, 38, 39, 48}	<ul style="list-style-type: none"> Leveraging emergency services to assist vulnerable populations during heat events or community-led 	<p><i>Setting</i></p> <ul style="list-style-type: none"> Urban or rural <p><i>Population</i></p> <ul style="list-style-type: none"> Seniors (community) 	Eyquem 2022 ¹⁰ Report Canada	Not reported	<p><i>Barriers</i></p> <ul style="list-style-type: none"> Community relationships take time to build Co-operation required between many parties

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
	<p>initiatives that strengthen social networks.</p> <ul style="list-style-type: none"> Including door-to-door visits or automated calls; for individuals that do not respond to a welfare call/check, the case is escalated and first responders, EMS or other organizations will conduct a home welfare check. Individuals may self-register or are registered by family members, doctors, or support workers. For those who receive routine home visits, the intensity of follow up may increase. <p><i>Example: Telecross Redi program (Adelaide, Australia)^{35, 48}</i></p> <ul style="list-style-type: none"> A telephone support program conducted by the Red Cross that provides phone calls to registered vulnerable clients during heat alerts, principally the community dwelling elderly population. In the event that an individual does not respond to a welfare call the case is escalated and first responders will conduct a home welfare check. <p><i>Example: United States Postal Service's Carrier Alert Program (New York City, New York)⁴⁵</i></p> <ul style="list-style-type: none"> If the postal carrier notices that the person doesn't pick 	<p>dwelling, isolated, homecare clients)</p> <p><i>Implementers</i></p> <ul style="list-style-type: none"> Public health authority Municipal government Non-profit groups Community or volunteer groups First responders Utility providers Postal service Certain occupation groups (e.g., doormen, maintenance workers) 	Williams 2022 ⁴⁸ Cost analysis Adelaide, Australia	<ul style="list-style-type: none"> For the Telecross Redi program, total costs were \$89,621 AUS (calls to registered clients: \$67,621 AUS) Potential costs averted through combined HHWS-attributable reductions in hospital admissions and ambulance callouts: benefit-to-cost ratio of 2.0–3.3 (but contribution of the individual intervention was not evaluated). 	<ul style="list-style-type: none"> Availability of staff or volunteers <p>Not reported</p>
			Price 2013 ³⁹ Mixed methods Study Montreal, Quebec, Canada	Not reported	<p><i>Facilitators</i></p> <ul style="list-style-type: none"> Volunteers available to identify/assess clients early in the year <p><i>Barriers</i></p> <ul style="list-style-type: none"> Prioritization of clients Identifying early signs of heat-related illness
			Nitschke 2016 ³⁵ Ecological study	<ul style="list-style-type: none"> In conjunction with a HHWS, IRR for total ambulance calls and emergency presentations were lower during the 	Not reported

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
	up mail in three or four days, the post office alerts a list of nearby community-based organizations, which sends a volunteer (or first responders) go to check to see if the person is well.		Adelaide, Australia	2014 heatwaves compared with the 2009 heatwaves (2014:2009, 0.9 95% CI [0.83 to 0.99], and 0.95, 95% CI [0.88 to 1.01], respectively) • Excess mortality ^a was not reduced.	

^a Excess(ive) mortality: more deaths during a period of time than would be expected for that period

^b Cumulative mortality: proportion of individuals alive at the start of a period that die over that period

AC: air conditioning; CI: confidence interval; HHWS: heat health warning system; IRR: incidence risk ratio; SD: standard deviation;

Table B.4: Summary of Evidence for Communication Extreme Heat Health Adaptation Strategies

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
Declaring a “Heat Advisory Day” ⁴⁵	<ul style="list-style-type: none"> Press packets and public information statements, to promote heat awareness and provide heat safety tips. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General population <i>Implementers</i> <ul style="list-style-type: none"> Municipal, provincial, federal government Local weather service 	None identified		
Disseminate maps with heat-health infrastructure ^{9, 38}	<ul style="list-style-type: none"> Pamphlets or searchable web-based maps, which identify available heat-health infrastructure and information (e.g., water fountains, outdoor pools, recreational areas, spray parks, cooling centres) Distributing maps as part of a public information campaign or with outreach to vulnerable populations 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General Public Vulnerable populations Indigenous populations <i>Implementers</i> <ul style="list-style-type: none"> Public health authority Municipal government Community agencies Schools Volunteers 	Deegan 2022 ⁹ Project description Ashcroft, British Columbia, Canada	Not reported	<i>Facilitators</i> <ul style="list-style-type: none"> Integration with heat alert and response system Use of multiple forms of media, including traditional media (e.g., radio station, newspaper) <i>Barriers</i> <ul style="list-style-type: none"> Lack of resources (e.g., employees) to develop and distribute
Heat Hotline ^{4, 11, 38}	<ul style="list-style-type: none"> A hotline available during extreme heat events, which 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural 	None identified		

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
	<p>can provide general heat risk and safety information</p> <ul style="list-style-type: none"> Sometimes municipal or business hotlines (e.g., 311) are repurposed as heat helplines in heat emergencies, with extended hours. A public health nurse may be on staff to talk to individuals, to determine whether or not to seek medical attention 	<p><i>Population</i></p> <ul style="list-style-type: none"> General public <p><i>Implementers</i></p> <ul style="list-style-type: none"> Municipal government Public health authority <p>Healthcare providers</p>			
<p>Mass Notification app/website, or automated phone warning^{31, 45}</p>	<ul style="list-style-type: none"> Alerts are issued, to notify anyone of extreme heat events and provide recommendations individual behaviours to adopt during high temperatures. People interested in receiving notifications can register, and subscribers can opt-in to the types of notifications they'd like to receive (emergency alerts may be automatic to all). Messages can be received in a variety of ways including phone message, email, text or social media. May be used for the entire population, or within a subset of a population (i.e., vulnerable). <p><i>Example Notify NYC (New York City, New York)⁴⁵</i></p> <ul style="list-style-type: none"> Citizens can register to be notified of any type of emergency or disaster in the city 	<p><i>Setting</i></p> <ul style="list-style-type: none"> Urban or rural <p><i>Population</i></p> <ul style="list-style-type: none"> General Public Vulnerable populations <p><i>Implementers</i></p> <ul style="list-style-type: none"> Public health authority Municipal government 	<p>Mehiriz 2018³¹ RCT Montreal, Quebec, Canada</p>	<ul style="list-style-type: none"> Téléphone Santé call receivers were more likely to adopt preventative behaviours (drinking water, taking cool shower, staying indoors) Reduced heat related symptoms (OR 1.18, [SE 0.38]) Women Téléphone Santé call receivers had reduced use of healthcare resources (5.7% vs 11.3% control) 	<p>Not reported</p>

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
	<p><i>Example: Téléphone Santé (Montreal, Quebec)</i>³¹</p> <ul style="list-style-type: none"> • A programmed warning message was sent to registered heat-vulnerable people to warn them of heat episodes and provide recommendations; the threshold for contacting participants was lower than general heat warnings (given the risk of heat-related illness and need ability to test the system). 				
Public information and/or education campaign ^{4, 6, 7, 9, 11, 21, 27, 29, 35, 38, 45}	<ul style="list-style-type: none"> • Providing information about the risks of extreme heat, and preventive measures that can reduce these risks • Messaging often focuses on individual behaviours people 	<p><i>Setting</i></p> <ul style="list-style-type: none"> • Urban or rural <p><i>Population</i></p> <ul style="list-style-type: none"> • General Public 	Eyquem 2022 ¹⁰ Report Canada	<ul style="list-style-type: none"> • Increased awareness • Information does not necessarily lead to action 	Not reported

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
	<p>can do to protect themselves during a heat wave, and less often about reducing risk ahead of time.</p> <ul style="list-style-type: none"> • May includes press releases, radio, TV, brochures/flyers, websites, billboards/posters, social media, email, or door-to-door campaigns • Educational materials are often provided in several languages, and distribution is coordinated with community groups (e.g., faith-based organizations), with particular efforts to ensuring it reaches vulnerable populations. 	<ul style="list-style-type: none"> • Vulnerable populations <p><i>Implementers</i></p> <ul style="list-style-type: none"> • Public health authority • Government 	<p>White-Newsome 2014⁴⁵</p> <p>Qualitative study</p> <p>Detroit, Michigan, New York City, New York, Philadelphia, Pennsylvania and Phoenix, Arizona, United States</p>	Not reported	<p><i>Facilitator</i></p> <ul style="list-style-type: none"> • Adapting communication to meet the needs of the public (i.e., illiterate, hearing impaired, blind, non-English speaker) <p><i>Barriers</i></p> <ul style="list-style-type: none"> • Ability to share information with those who lack internet access • Extreme heat messages often perceived as not as serious as other emergencies (e.g., natural disaster). • Public desensitization with multiple risk warnings or messages
			<p>Nitschke 2017³⁴</p> <p>RCT</p> <p>Adelaide, Australia</p>	<ul style="list-style-type: none"> • A “Beat the heat” magnet, along with educational material, increased the use of cooling systems (AC) and the use of a wet cloth to cool the skin. • Self-reported heat stress experienced was reduced 63% (RR 0.37; 95% CI [0.22 to 0.63]) 	Not reported

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
Promotion materials ^{11, 34}	<ul style="list-style-type: none"> Items, such as magnets or critical temperature-marked thermometers are distributed to households to promote awareness to extreme heat Information is provided in conjunction, outlining the risks of extreme heat, and preventive measures that can reduce these risks 	<p><i>Setting</i></p> <ul style="list-style-type: none"> Urban or rural <p><i>Population</i></p> <ul style="list-style-type: none"> General Public Vulnerable populations <p><i>Implementers</i></p> <ul style="list-style-type: none"> Public health authority Government 	Nitschke 2017 ³⁴ RCT Adelaide, Australia	<ul style="list-style-type: none"> A “Beat the heat” magnet, along with educational material, increased the use of cooling systems and the use of a wet cloth to cool the skin. Self-reported heat stress experienced was reduced 63% (RR 0.37; 95% CI [0.22 to 0.63]) 	Not reported
Weather safety talks ⁴⁵	<ul style="list-style-type: none"> Community discussions (e.g., local weather service talks with community organizations or in schools) or more formal trainings (e.g., CERT programs) to help organizations/citizens prepare and respond to extreme heat events. These talks often happen before an extreme heat event takes place, thus promoting heat awareness. 	<p><i>Setting</i></p> <ul style="list-style-type: none"> Urban or rural <p><i>Population</i></p> <ul style="list-style-type: none"> General public Civic organizations Children (schools) Care providers <p><i>Implementers</i></p> <ul style="list-style-type: none"> Local weather service Trained volunteers 	None identified		

AC: air conditioning; CERT: community emergency response team; CI: confidence interval; OR: odds ratio; RCT: randomized controlled trial; RR: relative risk; SE: standard error; TV: television.

Table B.5: Summary of Evidence for Government Policy Extreme Heat Health Adaptation Strategies

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
Expand and maintain vegetation cover ¹⁰	<ul style="list-style-type: none"> Planting trees, or expanding public green spaces to reduce the urban-heat-island effect. Municipalities may also make inventories of the natural assets and actively managing them alongside their built infrastructure, as part of regular municipal asset management. 	<i>Setting</i> <ul style="list-style-type: none"> Urban <i>Population</i> <ul style="list-style-type: none"> General public <i>Implementers</i> <ul style="list-style-type: none"> Municipal government 	None identified		
Financial assistance for home or common room air conditioning or utility assistance ^{14, 27, 38}	<ul style="list-style-type: none"> Utility assistance (e.g., subsidized electricity bills) and moratorium on utility disconnections throughout the summer, to ensure AC will be used within private households and make cooling resources more affordable and accessible. 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> Low SES populations Vulnerable populations <i>Implementers</i> <ul style="list-style-type: none"> Municipal, provincial, and/or federal government Utility companies 	None identified		
Fan and air conditioner distribution programs ⁴⁵	<ul style="list-style-type: none"> Installing AC or fans, for vulnerable people who qualify (e.g., based on income status and/or a prescribed medical need). 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> Low SES populations Seniors Chronically ill <i>Implementers</i>	White-Newsome 2014 ⁴⁵ Qualitative study Detroit, Michigan, New York City, New York, Philadelphia, Pennsylvania	Not reported	<i>Barriers</i> <ul style="list-style-type: none"> Being able to afford the associated energy bills Homes must be in suitable condition

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
		<ul style="list-style-type: none"> Municipal, provincial, and/or federal government 	and Phoenix, Arizona, United States		
Grants for temporary community cooling infrastructure ⁶	<ul style="list-style-type: none"> Funding is available for communities to set up cooling infrastructure (e.g., portable misting stations). 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General population <i>Implementers</i> <ul style="list-style-type: none"> Municipal, provincial, and/or federal government 	None identified		
Heat Health Action or Response Plan ^{9-11, 28, 32, 35, 40, 43, 44, 47}	<ul style="list-style-type: none"> Plans which help prepare for and guide communities through extreme heat events. Frameworks for developing the heat health action plans are available (e.g., WHO heat health action plans guidance, Government of Canada Heat Alert and Response Systems to Protect Health: Best Practices Guidebook) Plans include: information on heat-related health effects, risk groups and aggravating factors, weather surveillance and thresholds for action (HHWS), communication 	<i>Setting</i> <ul style="list-style-type: none"> Urban or rural <i>Population</i> <ul style="list-style-type: none"> General population Vulnerable populations <i>Implementers</i> <ul style="list-style-type: none"> Public health authority Municipal, provincial, and/or federal government Social services 	Hasan 2021 ¹¹ Scoping review United States, Australia, Western Europe, Canada, Japan, India, and China	<ul style="list-style-type: none"> Reduction of mortality (relative risk, daily deaths) and morbidity 	<i>Facilitators</i> <ul style="list-style-type: none"> Locally led plans Collaboration Local workforce and infrastructure Multilateral transparent communications Use of digital technology, mobile-cellular subscriptions <i>Barriers</i> <ul style="list-style-type: none"> Variable vulnerability Financial constraints

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
	<p>plans, individual and community interventions, and outlines responsibilities and coordination between stakeholders.</p> <ul style="list-style-type: none"> • Real-time surveillance of health-care demand may also be included to guide action (e.g., Health-link calls, EMS transports and community deaths) • Responses most often included were: providing outreach/education, collaborating with other organization to support vulnerable populations, and opening cooling centres • Plans often consider and provide specific guidance for vulnerable populations. • These plans often have a unified command centre, which brings together representatives of all major involved organizations, to help coordinate an effective response while also carrying out individual jurisdictional responsibilities 		<p>Williams 2019⁴⁷ Report England</p>	<ul style="list-style-type: none"> • There was very little change in the temperature-health relationship since the UK plan has been in operation • Provision of hot weather-related publicity/advice was not associated with the likelihood of people experiencing hot weather-related health problem; participants who said they had changed their behaviour as a result of hearing the advice were significantly more likely to report hot weather-related health symptoms. 	<p><i>Facilitator</i></p> <ul style="list-style-type: none"> • Good communication between stakeholders, managers and frontline staff • Annual updates • Plan made available to stakeholders earlier in the year <p><i>Barriers</i></p> <ul style="list-style-type: none"> • Low priority, given competing severe weather and other local emergency events • Responsibility “passed around” • Lack of awareness; positive views about hot weather; “wait and see” approach before enacting plan • Historical focus on “warning and informing” rather than public health planning or intervention • Difficulties identifying and reaching vulnerable populations • Message oversaturation and/or fatigue

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
			Benmarhnia 2016 ² Before and after study Montreal, Quebec, Canada	<ul style="list-style-type: none"> • Mortality was reduced during hot days by 2.52 deaths/day, 95% CI (-0.34 to 5.38) • Elderly vs. non-elderly: reduced differences in mortality during hot days by 2.44 deaths/ day, 95% CI (0.27 to 4.59) • Low SES vs. high SES neighborhoods: reduced differences in mortality by 2.48 deaths/day, 95% CI (0.69 to 4.27) 	Not reported
			White-Newsome 2014 ⁴⁵ Qualitative study Detroit, Michigan, New York City, New York, Philadelphia, Pennsylvania and Phoenix, Arizona, United States	<ul style="list-style-type: none"> • Not reported 	<i>Facilitator</i> <ul style="list-style-type: none"> • Political will • Resources and funding (access and coordination)

Strategy	Intervention Characteristics		Intervention Outcomes		
	Description	Setting Population Implementers	Studies	Effectiveness	Implementation and Utilization Considerations
			Van Loenhout, 2016 ⁴³ Qualitative Study Brussels, Belgium and Amsterdam, The Netherlands	Not reported	<i>Facilitator</i> <ul style="list-style-type: none"> • Emphasis on a variety of vulnerable groups • Clarity in roles and responsibilities • Best practices and lessons learned are shared
Provide incentives to increase passive cooling and reduce “waste” heat ¹⁰	<ul style="list-style-type: none"> • Subsidies and/or rebates for improving energy efficiency in homes or buildings • Improvements may include: subsidizing tree planting, home retrofits (EnerGuide), green or cool roofs • Programs often do not mention that eligible retrofits help control indoor-temperatures during extreme heat events 	<i>Setting</i> <ul style="list-style-type: none"> • Urban or rural <i>Population</i> <ul style="list-style-type: none"> • General population <i>Implementers</i> <ul style="list-style-type: none"> • Municipal, provincial, and/or federal government • Utility companies 	Eyquem 2022 ¹⁰ Report Canada	<ul style="list-style-type: none"> • Effectiveness depends on how many people choose to participate 	Not reported
Review of emergency, ambulance and other clinical response capabilities in the health sector ³⁵	<ul style="list-style-type: none"> • Continuous review of emergency, ambulance and other clinical response capabilities in the health sector to ensure adequate healthcare resources are available in the event of high needs during extreme heat events. 	<i>Setting</i> <ul style="list-style-type: none"> • Urban or rural <i>Population</i> <ul style="list-style-type: none"> • General population <i>Implementers</i> <ul style="list-style-type: none"> • Public health authority 	None identified		

AC: air conditioning; CI: confidence interval, EMS: emergency medical services; HHWS: heat health warning system; SES: socioeconomic status; WHO: world health organization.

Author Contributions

Lindsey Warkentin contributed to study conception and design, and conducted the study selection, data extraction, and interpretation. Lindsey wrote the draft and revised the report.

Carmen Moga assisted with the data extraction.

Lisa Tjosvold conducted the literature and data searches.



Institute of Health Economics
1200 – 10405 Jasper Avenue
Edmonton AB Canada T5J 3N4
Tel. 780.448.4881 Fax. 780.448.0018
info@ihe.ca

www.ihe.ca

ISBN 978-1-989429-11-2 (online)