

Temperature Check

**Designing Support Systems
for Older Adults in Heat Waves**

by

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ABSTRACT

The climate crisis is escalating and extreme heat events are becoming more frequent, more intense, and longer in duration. The health risks associated with extreme heat are well documented. However, ensuring the health of older adults -the fastest growing demographic in Canada - is a complex challenge that we are already facing today. Taking a design research approach, this study goes through a process of first diverging to explore the issue, and then converging on the ways in which communities can support older adults in adopting adaptive health-related behaviours in times of extreme heat. In exploration, this research connects with the voices of older adults, as well as professionals working in health, social and emergency service roles to gain a deeper understanding of the challenge at hand.

The Health Belief Model, a framework for understanding health-related behaviours, is used to push examination further, and to define a set of design principles for innovation: encourage self-sufficiency and independence, promote learning and understanding of extreme heat risks, remove barriers or incentivize benefits to taking adaptive measures, support psychological wellbeing as well as physical health, maximize existing community resources, and broaden engagement of stakeholders. These principles are used to generate five community-based interventions suitable even for smaller cities that can help to protect older adults' psychological and physical health while promoting new social practices and norms in times of extreme heat.

DEDICATION

To my parents: Thank you for all your love and support, and thank you for inspiring me to take on this project by being the best role models and champions in looking after this planet and those around you.

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The movie “The Perfect Storm” is a semi-fictionalized account of an actual 1991 event when two weather systems, a diminishing but still powerful hurricane coming from Bermuda, and a Great Lakes cold front crashed into each other in the Atlantic Ocean to produce a combined force that built destructive waves reaching 100 feet in height. Although it would be inaccurate to say that this paper describes a similar occurrence, it is true that two very significant “forces” are encountering each other today and will continue to increasingly engage with each other as time moves on. One of the forces that we speak of in this paper is climate change, but more specifically heatwaves brought on by climate change. The other force is a rapidly aging population. The first force brings with it great challenges with respect to coping with more frequent very high temperatures that last for longer periods. The second force offers a growing population of people, older adults, who are often less able to manage in stressful situations. This paper addresses this complex situation, offering insights and possible solutions as it moves forward.

Heatwaves

The fact that the climate is changing has become impossible to ignore. While July 2019 attained the hottest temperatures ever recorded, the last four years have been the warmest on record (World Meteorological Organization, 2019). 18 million more extreme heat exposure events occurred in 2017 than in 2016 (Watts N., et al., 2018).

“Heatwaves are among the most dangerous of natural hazards, but rarely receive adequate attention.”

(McGregor, G. R., 2015)

At present, Canada experiences about 20 days each summer where temperatures exceed 30C. Predictions are that number will reach more than 65 days (with local variation) by 2040. The Intergovernmental Panel on Climate Change (IPCC) expects the occurrence of heat waves will continue to increase, and without significant investment in adaptation, they will also last longer and become more intense (IPCC 2012.) Historically, the longest Ottawa heat wave has been close to 4 days, by 2051-2080 it could last for longer than 17 days (Prairie Climate Centre, 2019).

Extreme heat event, or a “heat wave,” as it’s commonly called, is an extended period of abnormally hot weather. Although there isn’t a universally accepted definition, typically a heat wave is defined by authorities as a period when the temperature hovers at or above a certain threshold for several days beyond the normal range. In Ontario, Environment Canada defines a “heat wave” as “three or more consecutive days in which the maximum temperature is greater than or equal to 32°C/90°F” (Climate Change Canada, 2019),

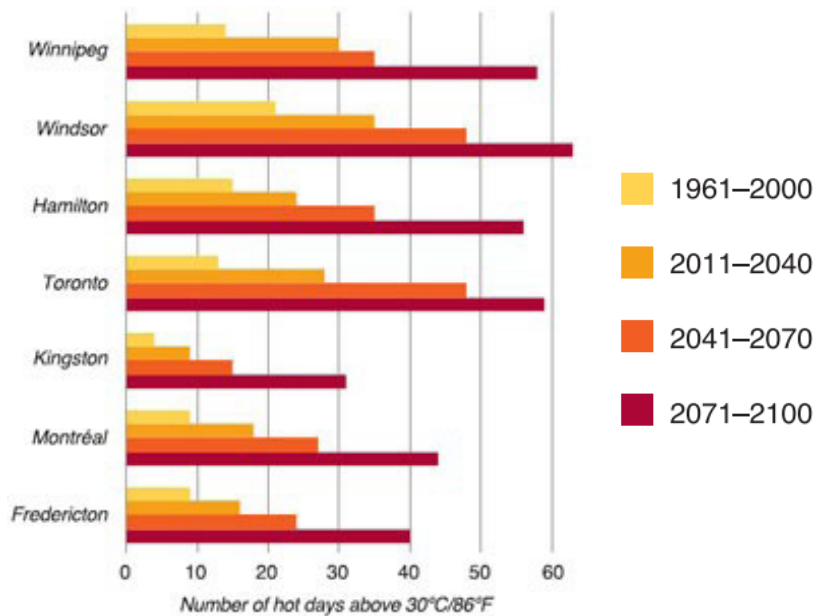


Fig. 1 Historical and projected number of hot days and warm nights for select cities in Canada. (Casati, B., Yagouti, A., In Press)

Heat and Health of Older Adults

Canada's population is currently undergoing a fundamental shift; during the next quarter century, the proportion of Canadians aged over 65 will nearly double as the baby boom generation turns 65. As a result, by 2036 nearly one out of every four Canadians will be an older adult (Statistics Canada, 2010).

Heat is sometimes termed the "silent killer" because extreme heat events cause much less infrastructure damage than other emergencies or natural disasters. Despite this, the negative impacts on health can be far greater. Unlike other natural disasters, such as floods or fires, heat waves do not elicit an immediate response to protect life, even despite their impact (Carroll, P., 2002).

Health risks associated with extreme heat are well documented. These include medical emergencies such as dehydration, heat exhaustion, heat stroke, loss of consciousness, and other health crises. Many international and Canadian studies show that when temperatures rise above certain levels that are outside the local average, daily mortality rates increase (Health Canada, 2008). Most recently, 66 people died from the heat in Montreal during the summer of 2018, when, for eight consecutive days, temperatures rose to over 40°C with the humidity (Oved, M. C., 2019).

Certain groups within society are considered to be more sensitive to heat compared with the population at large. Those considered to be more sensitive to extreme heat are infants and young children, people with chronic illnesses, and people experiencing homelessness. Older adults (65 years and older) are also one group recognized as having a heightened vulnerability to extreme heat (Caruso C., Posey V. 1985).

As well as such direct impacts on human health, extreme heat can strain existing health services as heat waves have been associated with increased hospitalizations and emergency-room visits.

While heat can be dangerous, heat-related illnesses and deaths can be largely prevented if individuals recognize the risks and undertake behaviour modification measures. Despite the fact that the severe impacts of heat waves are avoidable, evidence shows that many people may not be changing their behaviour or perceiving the risks of extreme heat (Bassil, K. Cole, D., 2010)

The potentially high-risk impact of heat waves and heightened needs of older adults means we need more than heat advisories and cooling centres. There is a need for support systems that are designed to meet the needs of older adults, and that shape health-related behaviours and attitudes towards

extreme heat in a broader sense. Understanding the experience of heat waves based on the perspective of the vulnerable and those that work closely with them is needed. While climate modelling can predict average changes in temperature with reasonable confidence, how we should respond is uncharted territory and unique in every context.

Design Thinking

As a framework for innovation, design thinking focuses on the use of empathy in problem-finding and on the use of iterative problem solving (Kumar, V. 2012). Design practice works well in the ambiguous and complex context of natural events, such as heat waves, by offering a process of thinking, which employs certain cognitive skills, tools, methods, and techniques to define problems, uncover solutions, and to make them concrete (Design Council, 2019). In order to design imaginative interventions that could improve the experience for people, their needs and motivations must first be understood.

“Much of the policy that shapes the lives of older adults, directly or indirectly has been developed without the input of older adults, and often without reference to their particular needs.”

(P. MacCourt for the B.C. Psychogeriatric Association)

Whereas in the past design practice was focused on products and services, today it is also applied to boost value in areas previously not necessarily concerned with design. In not-for-profits, health, or in the public sector, for example, design practice supports an iterative approach that can be transformative on the individual level, but also on a collective level.

PURPOSE OF THIS RESEARCH

Climate change is increasingly making its presence known, making heat waves more common and extensive at a time when older adults are becoming a greater percentage of our overall population. With heat wave strategies growing ever more necessary, especially for more vulnerable segments of our society, this project asks the question:

How might communities support older adults in adopting adaptive health-related behaviours in times of extreme heat temperatures?

More specifically, the purpose of this research project is to deeply explore individual and contextual factors that influence and shape health-related behaviours during heat waves within a small Eastern Ontario city. The aim of this project is to identify opportunities to design and offer new solutions within the community to support older adults to mitigate preventable heat-related discomfort, illness, and death.

Intended Audience

Readers who may find this research valuable include those who work in health or social services by directly or indirectly providing services for older adults. It will also be of value to those who work in city planning and public health. It may also be of value to those caring for older parents or an aging friend or neighbour.

Location of the Study

Cornwall, Ontario was the location for this study. Focusing on a particular location allowed for a more nuanced understanding of that particular context which was important to this research. The researcher was able to conduct interviews with a wide-range of important stakeholders that might not have been as accessible as in a larger city.

In addition, the majority of heat-related research in Canada has been focused on larger cities, while there is less known about the impacts of extreme heat or the support networks within smaller communities in Canada. Further details about the Cornwall context are provided on page 25.

APPROACH

To explore the research question, the design framework known as the Double Diamond design model, developed by The Design Council (2019), is used. The Double Diamond is divided into four distinct phases: Discover, Define, Develop and Deliver. These phases provide a map for tracking how the design process passes from points where thinking and possibilities are as broad as possible to situations where they are deliberately narrowed down and focused on distinct objectives (Design Council, 2019).

Discover

The beginning of the design project, the Discover Phase, is also known as the exploratory phase. The goal of this stage is to better understand the problem and the lived experiences of those impacted by the issue.

Define

The define phase channels the insights gathered from the discovery phase to help define the challenge in a more focused way. The end of this phase includes reframing or refining the research question to reflect the new narrowed focus for solution generation .

Develop

The second diamond encourages exploring a variety of answers to the clearly defined problem.

Deliver

The final quarter of the double diamond model is the delivery stage. In the scope of this study, criteria will be proposed for prototyping and iterating on the concepts with stakeholders, a next step towards delivering a final solution.

Details of how this framework is applied in this study are discussed in the upcoming Methodology section and throughout the paper.

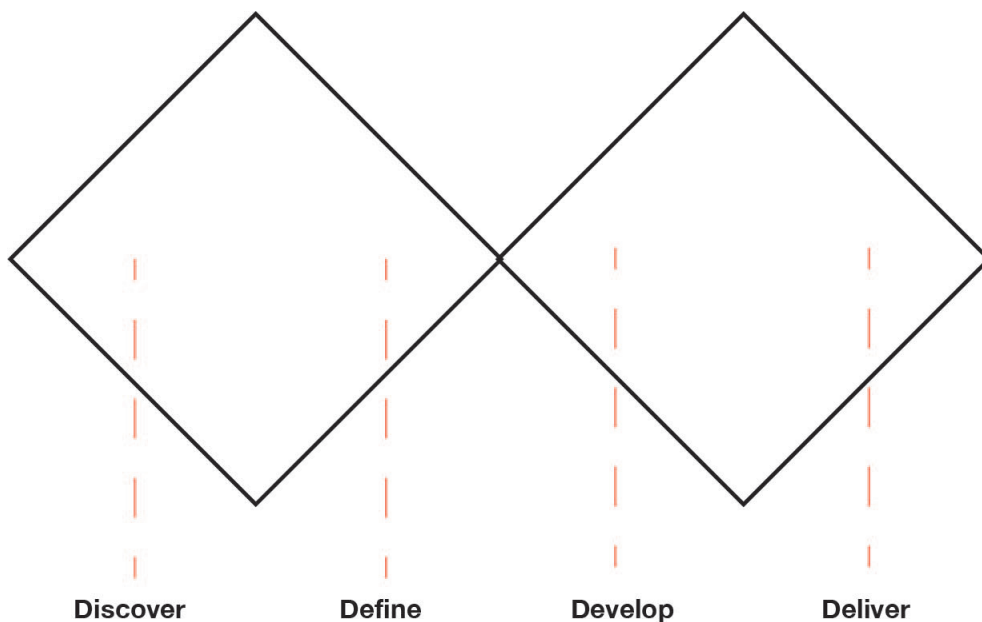


Fig. 2 Double Diamond (Design Council, 2019)

METHODOLOGY

Throughout this project, my research question is explored using a design framework developed by The Design Council UK, in 2019, known as the Double Diamond design model, which is divided into four distinct phases: Discover, Define, Develop and Deliver. This model provides a map to capture how the design process moves from exploratory, where thinking and possibilities are as broad as possible (divergent thinking), to situations where they become evaluative i.e. are deliberately limited and focused on specific objectives (convergent thinking) (Design Council, 2019).

Design Research methodology is especially appropriate “when the work is situated at the busting assumptions stages, challenging existing approaches, reframing problems or exploring entirely new problems spaces” that require fundamentally new approaches (Lahn, P., 2017). The design process can help to confront barriers, decipher assumptions, and help spark new ways of generating ideas. As a form of qualitative research, it provides an opportunity to develop a deep empathy for the older adults at the heart of the study through the process.

Design Research differs from formal academic research. It can most closely be likened to a Grounded Theory approach or an Action Research approach to research.

Grounded Theory

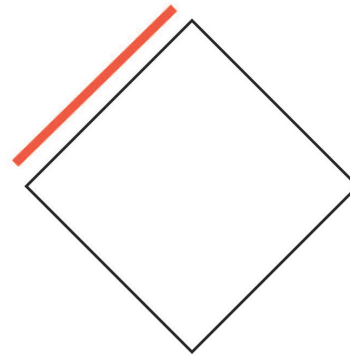
Grounded Theory is a research method that involves the discovery of emerging patterns in data (Glaser in Walsh, Holton et al 2015). Similar to Design Research, the researcher begins with an area of study and allows the theory to emerge from the data. Grounded theory is a non-linear process - it is iterative, dynamic and involves constant comparative actions. Grounded theory represents both a method of inquiry and the resulting product of the inquiry (Chun Tie, Y., et al 2019).

Action Research

Action Research is an approach in which theory and practice are explored by posing questions, collecting data, and testing hypotheses through several cycles of action (University of Lethbridge, n.d) . Similar to Design Research and Grounded Theory, it is iterative and capitalizes on earlier stages. In addition, action research is a disciplined process of inquiry conducted by and for those taking the action.

The tools and methods used in each phase of the research are described below.

The Discover Phase



The beginning of the design project, the Discover Phase, is also known as the exploratory phase, The Discover Phase is characterized by divergent thinking where the goal is to gather a wide variety of insights and inspirations, and build a rich knowledge of the problem or needs to be addressed. In order to create innovative interventions that will help older adults meet the challenges of a heat wave, it is necessary first to develop an understanding of their daily lived experiences in heat waves, such as the resources and practices they employ to manage in these times.

After conducting a comprehensive literature review of the effect of heat waves on older adults as well as the individual and community behaviour in this context, I wanted to better understand the issue from the eyes of older adults and service providers. For this, I used the qualitative Design Research method of semi-structured interview format to initiate conversations with older adult participants, as well as professionals working in health, social and emergency service roles in the Cornwall area.

Semi-structured interviews focus on particular areas, but give flexibility to the researcher to follow an idea or response in interviews in more detail. This approach also makes room for the discovery or discussion of information that is important to participants, but may not have previously been thought relevant by the researcher. Highly descriptive data on participants' personal experiences can be revealed by this method.

Older Adult Interviews

The purpose of interviews with this group of participants was to capture first hand accounts of older adults' experiences with heat waves; how they cope, and the types of strategies and resources they rely upon. Additionally, the interview focused on the inhibitors and enablers that limit older adults' ability to protect their health in a heat wave.

The participants were interviewed in their homes and were asked questions pertaining to their experiences during hot weather, both personally and of others in their social networks. Participants were encouraged to freely express their opinions, experiences as well as behaviours. In these interviews, special care was taken to build rapport and empathy for the experiences of older adults.

Interviews included asking participants to recount an experience or tell a story of a time they experienced a heat wave. Details within these stories provided the researcher with insight into the participant's subjective experience based on their perspective and helped to gain a better understanding of related emotions and issues that might otherwise be missed through using only interview questions (Allen, M., 2017). The experience or story told by a participant was then used as a guide to inquire into more detail about their experience in heat waves while touching on the topics set out in the semi-structured questions. It should be noted that these interviews took place during January, a cold winter month, so participants were drawing from what they could remember.

The broad topics explored in the qualitative interviews included:

- Experiences, everyday behaviours and responses to heat;
- Barriers to adaptation to heat;
- Perceptions of vulnerability to heat;
- Perceptions of warming weather;
- Extreme heat information and resources.

Participant Recruitment

Two service providers that were interviewed offered to assist in recruiting participants through their organizational networks. Eight of the participants came from these sources. The other participants were recruited directly by the researcher using the snowball method (Dudovskiy, n.d.), and one participant was through a personal network.

The target participants were older adults who are still living independently and not in a retirement or nursing home. Specifically, recruitment was individuals 65+ years of age.

Prior to the initiation of the study, this project received approval from the OCADU Research Ethics Board (Appendix).

Throughout the study, the confidentiality of the participants was maintained. Once participants were approached to participate, the study was fully explained to them. They were aware of their rights as a participant, that their participation was voluntary, and that they could choose to withdraw from the study at anytime. Written informed consent was obtained from all participants. Participants did not receive any compensation for participating.

Description of Participants

Twelve older adults, including two couples, participated in the interviews. The respondents were a variety of ages with different types of living and housing circumstances. All except one had some form of air conditioning. Additionally, all participants were Cornwall, Ontario residents, except two who lived in Long Sault, Ontario, a smaller town 15 minutes outside Cornwall.

The attributes of the older adult participants were as follows:

- predominantly Caucasian
- age range of 58 to 87 years
- primarily female (8 of 12)

The nature of the living arrangements of the participants varied. They included:

- apartment (4 of 12)
- house (8 of 12)
- air conditioning (11 of 12)
- residing in social housing (4 of 12)
- living alone (8 of 12)
- living with spouse (2 couples)

Self-disclosed health conditions and/or disabilities:

- Lung conditions including COPD (4)
- Person who relies on a motorized scooter (1)

Health, Social and Emergency Service Provider Interviews

The viewpoint of those who work closely with older adults, namely, professionals working in social planning, community services, public health, and emergency services is also included in this study. Topics covered with these professionals included awareness of heat-related risks, knowledge of affected groups, extreme heat adaptation planning, resources and protocol.

Interviews were conducted with the following professionals:

Occupational Therapist - Geriatric Mental Health Group, CAMH - Cornwall Community Hospital

Senior Friendly Community Coordinator/

Recreologist - City of Cornwall

Social Worker - Local Health Integration Network (LHIN)

Paramedic - Community Paramedicine Program

Administrator - Social & Housing Services

Primary Care Manager - Seaway Valley Community Health Centre

Director of Communications - Eastern Ontario Health Unit

Clinical Manager - Cornwall Community Hospital

Geriatric Emergency Management Nurse - Cornwall Community Hospital

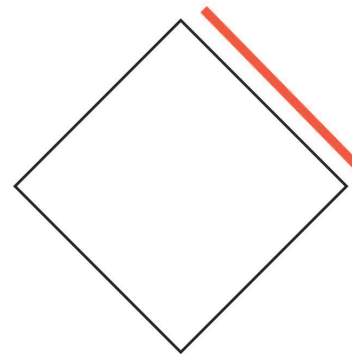
Chief Officer - Emergency Management

Property Manager - Social Housing Building

Participant Recruitment

Personal networks were used to start the recruitment process and then the snowball method (Naderifar, M., et al, 2017) was used to discover other relevant stakeholders. Professionals were directly recruited by the researcher.

The Define Phase: Narrowing In



The Define Phase channels the insights gathered from the discovery phase to help narrow in on the most important aspects of the problem and define the challenge within a specific focus area.

Data Analysis Methods

The following tools were used to develop insights from the secondary and primary information sources in order to make sense of and draw insights from the information gathered.

Thematic Analysis

Thematic analysis (TA) is the process of surfacing patterns or themes within qualitative data (Braun, V. & Clarke, V., 2006). Its purpose is to identify patterns that are of interest or particular significance in the data, that can be used to address the research or contribute insights about an issue. In addition, thematic analysis aims to look past what is said to detect or examine the deeper assumptions or ideas. Thematic analysis can be a method “which works both to reflect reality, and to unpick or unravel the surface of reality” (Braun, V. & Clarke, V., 2006).

TA can identify, code data and analyse insights in two ways:

The inductive approach is guided by what is in the data, where themes are extracted from the content of the data themselves, or in a “bottom up way” (Braun, V. & Clarke, V., 2006).

The deductive approach is where the researcher brings a series of concepts, ideas, or topics to the data in order to code and interpret it in a “top down way” (Braun, V. & Clarke, V., 2006).

In this research project, a combination of both approaches was used. First, an inductive approach was taken which allowed for the barriers and enablers to adaptive behaviour to be surfaced by the researcher. This was done through affinity mapping.

Affinity Mapping

Affinity mapping is a process of scanning each interview for key observations and insights, and then clustering these based on different themes (Martin, B., & Hanington, B., 2012). It allows for quick comparison between collected insights from all interviews. It is a physical and editable design artifact that’s invaluable for showcasing trends, themes, and areas of opportunity (Martin, B., & Hanington, B., 2012). Through this process of clustering, large amounts of data becomes visually represented. Photos of the affinity mapping can be seen in appendix 1.

Deductive Analysis

To interrogate the data set further, a health behaviour lens based on the constructs of the Health Belief Model was used to conduct deductive analysis (Braun, V. & Clarke, V., 2006). This involved

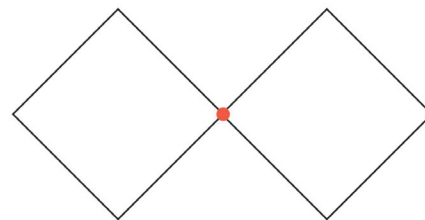
revisiting the raw data, as well as the themes around barriers and enablers to better conceptualize and highlight gaps around the complexity of individual behaviour in heat waves around the five concepts of perceived risk, perceived benefits, perceived barriers, cues to action and self-efficacy.

In this research project, which explores perceptions of risk and behaviour responses in heat waves, the Health Belief Model (HBM) is well suited as a framework to prompt further consideration of factors that can shape behaviour in extreme heat scenarios, as well as to generate solution.

In addition to being used in emergency and disaster planning, the HBM has been utilized in the past to understand the failure of people to adopt disease prevention strategies (Rosenstock, I. M., 1974); explain and predict health-related behaviors (Carpenter, C. J., 2010); develop interventions; and assess programs designed to increase health awareness (Glanz, 2008).

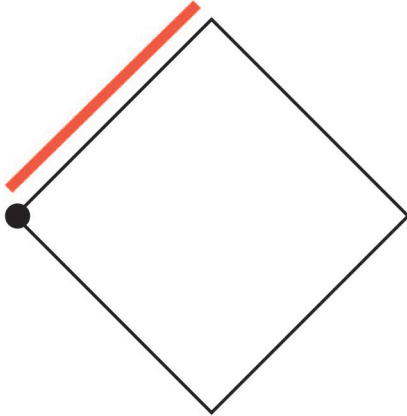
A set of insight emerged through this process of inductive and deductive thematic analysis, as well as a set of design principles. This process also helped to think in terms of actionable strategies based on the issues raised.

Establishing a Focus Area for Solution Development



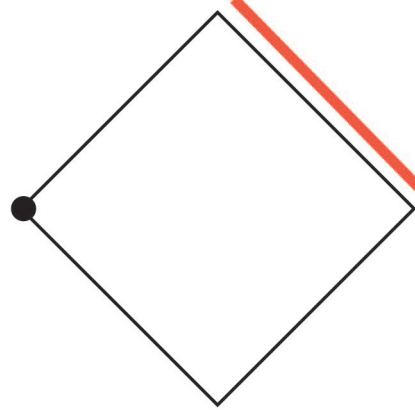
At the end of the Define Phase, the middle of the double diamond is the point where the original research question is refined or reframed to reflect the learning and insights surrounding the problem. This refined question has an intentional and narrowed focus to guide solution generation and address the most important aspects of the problem at hand.

The Develop Phase: Exploring Solutions



Within the Develop Phase begins the second stage of divergence. The process facilitates the development of ideas and concepts, but is more narrowly focused to address the key issues raised in the previous exploration phase. The Develop Phase uses a set of design principles that were surfaced in the Define Phase, and goes through a divergent process of developing concepts. In the scope of this study, the designer will be doing this independently, as opposed to with older adult participants.

The Deliver Phase: Next Steps



The final quarter of the double diamond model is the Deliver Phase. In the scope of this study, criteria will be proposed for prototyping and iterating on the concepts with a multi-group of stakeholders. This study does not deliver a final solution.

The discovery phase of this project is broken down into two main sections:

Insights from Literature Review

This section looks to the literature to better understand the problem of heat waves on older adults' health. The first chapter, "Older Adults, Heat Waves and Health" reveals how extreme heat can impact physical, social and psychological health. The second chapter discusses the factors that can affect adaptive capacity. The third chapter discusses known individual and community measures. The final section discusses adaptive behaviour and introduces a framework for health-related behaviours.

Insights from Primary Data

In the second section, we gather and discuss the findings that were uncovered through primary research with older adults, including first hand accounts of older adults' experiences with heat waves; how they manage, and the types of strategies and resources they rely upon. We also discuss the important stakeholders in the community, and share the perspective of service providers on the issue.

LITERATURE REVIEW: OLDER ADULTS, HEAT WAVES AND HEALTH

Heat is a public health risk. Not only can it cause great distress to people, if the body is unable to cool down during a period of prolonged excessive heat, the impacts can be extremely harmful. Health hazards associated with extreme heat include heat cramps, heat exhaustion, loss of consciousness and other medical emergencies. Severe and long-lasting health consequences and even death may be a consequence.

"Heatwaves can have significant direct and indirect impacts on society and it is the vulnerable individuals or sectors of society that may experience the direct impacts."
(McGregor, G.R., et al., 2007)

Further, it has been shown in many international and Canadian studies that when temperatures rise above certain levels in the long-term local average, daily mortality rates increase (Health Canada, 2008). It is primarily older age groups that experience excess deaths during prolonged exposure to high temperatures (Kenney, W. L., Craighead, D. H., & Alexander, L. M., 2014). Health Canada notes however, that heat illness is not fully reported either in Canada or internationally, therefore the number of deaths in the future could perhaps be even greater. Moreover, medical records may not reflect the entire range of people suffering effects because the presentation of heat-related symptoms can vary greatly (Health Canada, 2008).

The death toll of heat waves can be enormous. Heat is the leading weather-related reason for deaths in the United States (NOAA, 2011). One of the most well-studied heat waves within the literature is the July 1995 Chicago heat wave where an estimated 739 heat-related deaths were reported (Semenza et al., 1999). A record-breaking heat wave in the Central and Eastern parts of the US in 1988 caused the deaths of an estimated 5000 to 10,000 individuals. Deaths in the 2003 European heat wave totalled around 35,000 (Robine et al., 2008). In 2010, during a 44 day heat wave in the Russian Federation, 56,000 excess deaths occurred (World Health Organization, 2018).

Some studies suggest there could be a doubling of heat-related mortality in several Canadian cities by the 2050s (Huang C., 2011), while a more recent study projects five times more heat-related deaths

in Canada between 2031 and 2080 in comparison to numbers based on statistics from 1984 to 2015 (Guo Y. et al., 2018)

Social & Psychological Impacts

The immediate physical health impacts of extreme heat have been the focus of much research, however there are also social impacts that extend beyond the physiological health concerns.

During heat waves, those who are vulnerable have a tendency to stay indoors, and “visits by friends, neighbors, and family, the delivery of social services, such as home and community care, and the organization of social outings for older adults, frail and disabled may be reduced or canceled, further exacerbating the experience of isolation.” In light of the fact that social isolation of older adults is already a serious issue in Canada, this may exacerbate the problem. According to Employment and Social Development Canada, the number one emerging issue facing older adults in Canada is keeping older people socially connected and active (National Seniors Council, 2014).

Notably, extreme heat can also adversely affect community well-being and mental health. Psychological distress such as mood disorders, anxiety disorders and dementia have all been shown to surge when the heat rises, adding an additional stress on the more than 1.8 million people over 60 years of age who are living with a mental health problem or illness in Canada (Mental Health Commission of Canada, 2019).

Numerous studies have highlighted this hypothesis, suggesting that increases in temperature correspond with a higher incidence of crimes such as murder, riots, and assaults (Smoyer-Tomic et al., 2003). The “heat hypothesis” suggests that aggressive and violent behaviours increase in disturbingly warm temperatures (Anderson, C. A., & Anderson, K. B., 1996). Suicide rates can rise in occurrences of extreme heat too, at a rate similar to the impact of economic recessions (Burke, M. et al, 2018). Some aspects of higher cognition are harmed as well, such as reaction times and working memory (Laurent, J., et al, 2018).

Adaptive Capacity

While the health hazards of extreme heat are quite well-established, turning age 65 does not in itself make a person more vulnerable to a heat wave. There are a number of factors that can affect the adaptive capacity of older adults to any negative consequence of climate change. It is the individual physiological and social factors associated with aging that may bring greater negative impacts, rather than age itself.

Physiological & Medical Factors

Looking first at physical factors, aging can harm the mechanisms that control bodily temperature, so that even healthy older adults cannot cope with heat stress as quickly as younger people. The ability to physiologically maintain body core temperature during heat stress becomes compromised with age. On hot days, older adults are less able to produce sweat to cool the body as efficiently as younger people for example. Blood circulation may be less efficient as well (Kenny, G. P., et al, 2010).

As mentioned, because older adults are also more likely to have chronic medical conditions such as cardiovascular or respiratory illness, they may have a greater sensitivity to health complications from warmer summers, heat waves, and air pollution. They also have a greater likelihood of consuming prescription medications that compromise temperature regulation in the body. A further issue, particularly during hot weather, is that dehydration in the older adults is common, partly because of diminished thirst sensation with age (Kenny, G. P., et al, 2010).

Human and Social Capital

In addition to various physiological differences from younger populations, social factors also impact the adaptive capacity of older adults to certain climate stressors (Zimmerman et al. 2007). A key risk factor during extreme heat events is social isolation (Health Canada, 2011). Living in isolated circumstances, common amongst older people, may cause them to miss emergency messages, or they may underestimate the severity or urgency of heat alarms). In comparison, districts with larger populations of older adults are likely to have lower death rates, possibly because of the benefits of a

shared social support network (Browning et al. 2006). Currently, the number of persons living alone in Canada has more than doubled over the last 35 years, from 1.7 million in 1981 to 4.0 million in 2016 (Statistics Canada, 2019). While living alone does not necessarily mean a person will be isolated, it does increase the chances of isolation.

Economic Status

Inadequate finances may also determine the adaptive capacity of older adults in an extreme heat event if there is an inability to undertake preventative measures for that reason i.e. a primary contributor to their vulnerability is poverty (Cutter et al., 2003). Older adults may simply lack the financial capacity to prepare for or respond to climate-related risks (Browning et al., 2006). This might entail a lack of air conditioning or the reluctance to use it because of operating costs, for example, or by living in substandard housing (Drechsler et al., 2005). Older adults living in disadvantaged communities or those on fixed incomes simply have fewer resources available to support adaptation (Cutter et al., 2003).

Educational level

Along with poverty, higher mortality from heat waves correlates with a lack of a high school education (Cutter et al., 2003). Not completing high school signifies lower income, but also lower literacy rates. Lower literacy rates may predict the success of risk communications. In addition, education is known to determine health behavior in general and to influence individual health outcomes (Cutler and Lleras-Muney, 2006). With more education, it is assumed that the experience of heat stress is impacted by knowledge of appropriate responses, as well as through a healthier lifestyle (Schulz, A., & Northridge, M. E., 2004).

Individual and Community Heat Wave Measures

While responding to the unique local conditions of vulnerability, the risk and impacts, adaptations to extreme heat events can be focused at the levels of individual, community, and region.

First, we explore aspects of adaptation at the individual level. Although heat can be dangerous,

the literature indicates that most deaths from extreme heat are actually preventable. It is generally agreed that prevention of heat related illness is the best strategy. If individuals recognise the risks, adaptive modifications in health behavior can significantly reduce the risk of illness or mortality associated with heat (Richard et al., 2011).

Adaptive Behaviour of Individuals in Heat Waves

Health behaviors, sometimes called health-related behaviors, are actions taken by individuals that affect health or mortality. These actions may be intentional or unintentional, and can promote or detract from the health of the person. Actions such as smoking, substance use, diet, physical activity, sleep, healthcare seeking behaviours can be classified as health behaviors. Health behaviors are frequently discussed as individual-level behaviors, but they can also be measured and summarized for individuals, groups, or populations. Health behaviors vary over lifespan, cohorts, settings, and over time (Short, S. E., & Mollborn, S., 2015).

There are a number of adaptive behaviors an individual can undertake that could mitigate or exacerbate heat exposure and poor health outcomes as a result. Much has been written and passed on as “common sense” about what can be done to manage during heat waves. Many individuals have found ways to combat excessive heat, often learning from others, family members or friends, or simply discovering them on their own.

The preventive measures to be implemented on a personal level might include avoiding exposure to the sun on hot days, dressing appropriately, and drinking water regularly. These behaviors may also include at-home strategies for staying cool (e.g., air conditioner use, drinking fluids) or activities outside the home (e.g., going to a shaded park or cooling centre).

Health Canada offers standardized recommendations for individuals to take during extreme heat situations. These can be summed up by:

- Preparing for the heat
- Paying close attention to how you feel
- Staying hydrated
- Staying cool

Some studies report that no more than half of people typically change their behaviors in response to advisory warnings (Kalkstein, A. J., & Sheridan, S. C., 2007). Evidence also indicates that vulnerable groups may not be acknowledging necessary heat information, and that awareness of extreme heat warnings is not always coupled with an understanding of heat-health risk factors. In particular, studies show that some of the most vulnerable populations, including the older adults, low-income, and those experiencing homelessness, are frequently not perceiving themselves at risk or altering their usual routines during extreme heat events (Howe, P. D., et al, 2019). Even while recognizing that others in their age group may be at increased risk, older people tend not to consider themselves vulnerable to heat generally, which puts them at greater risk since lack of awareness is an impediment to adaption (Howe, P. D., et al, 2019).

It is predicted that global warming will worsen extreme heat hazards in areas that already experience extreme heat, but the risks will also spread to regions with little previous experience of health-threatening heat (Howe, P. D., et al, 2019).

Those in some northern areas may become increasingly at risk for negative health impacts as climate changes exacerbate extreme heat events beyond prior experience. (Howe, P. D., et al., 2019). Since Canada has a cold climate, heat waves are not perceived as a serious threat. Risk perceptions will likely lag the changing risk environment, since they are strongly influenced by a mixture of cognitive and intuitive factors, including personal experience (Smoyer-Tomic et al. 2003). Thus high-vulnerability groups, such as older adults, may overlook their

own risk factors or rely on previous experiences in warmer climates (Sampson et al., 2013).

In this research project, which aims to understand how communities can best promote positive adaptive behaviours in heat waves, the Health Belief Model (HBM) provides a fitting framework to help conceptualize the various factors and the interplay between them that can shape behaviour in extreme heat scenarios. The HBM was established from a socio-cognitive perspective. It was originally developed in the 1950s by social psychologists to explain the failure of some individuals to use preventative health behaviors. It is also one of the mostly widely used models. Perception of risk is one of six main concepts within the framework. The Health Belief Model hypothesizes that individuals are most likely to engage in a particular health-related behavior to the degree that they:

- Perceive that they too, could be prone to the problem or contract the illness (perceived susceptibility);
- Realize that the problem has severe consequences or will disrupt their daily functioning (perceived severity);
- Recognize that the intervention or preventative action will decrease symptoms (perceived benefits);
- Discern few obstructions to taking action (perceived barriers);
- Are prompted by a cue to action;
- Possess a sense of self efficacy, the conviction that one can successfully carry out the behaviour to produce the desired result

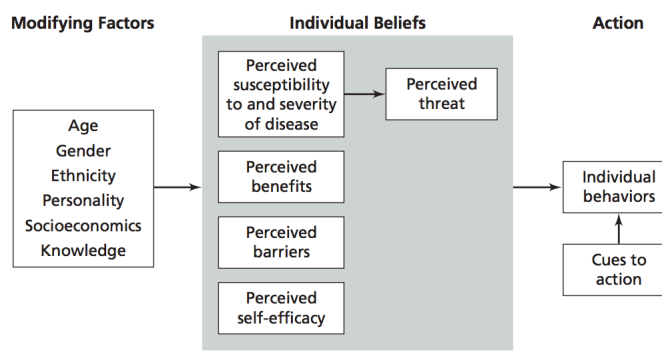


Fig. 3 Health Belief Model (Miri, M. R., et al., 2018)

All of these factors are intertwined. Even if an individual perceives the risk, if there are too many barriers, they may not take action (Bouchard et al., 2007) state “of all the constructs, perceived barriers are the most significant in determining behaviour change”. Similarly, if there is not enough benefit to taking action, they may fail to do so.

The “cues to action” construct of the HBM refers to the idea that an individual’s willingness to take action is triggered by cues such as bodily signs, environmental events, or media announcements (Champion & Skinner, 2008). Cues to action in a heat wave can be external, such as a heat wave warning on a tv, or internal, such feeling too warm or thirsty.

One further HBM concept is self-efficacy. This construct is defined by Bandura (1997) as “the conviction that one can successfully execute the behaviour to produce the outcomes”. Self-efficacy is distinct from perceived benefits in that it directs attention more towards a person’s resolve to take action.

It also acknowledges that there can be other modifying variables such as individual characteristics, age, education, group pressures, or previous experience with a disease that can affect health-related behaviors indirectly by affecting perceived seriousness, susceptibility, benefits, and barriers.

While there are limitations to this model, especially in that it puts much of the burden of responsibility on the individual, it is important to consider the various aspects that may be shaping behaviour during a heat wave. Likewise, it is also important to consider these elements in terms of the research question of this paper, which looks at how communities can support older adults to promote adaptive behaviours.

Community Measures

While individual preventative measures are important for older adults during an extreme heat event, community measures are equally so, and play an important role in supporting the steps individuals can take. Following the August 2003 heat wave in western Europe, where at least 30,000 people died (Robine et al., 2008), it was found that the lack of intervention plans for heatwaves, as well as limited

coordination between social services and health organizations, were implicated in the loss of life, and were possibly major contributing factors (Watts N., et al., 2018). Although a range of efforts are being taken at the community level to protect health in Canada, there is concern not enough is being done (Health Canada, 2012).

During a heat wave, preventative possibilities at the community level vary from offering various cool spaces such as air-conditioned shelters, to free transit to cooling centres, and an extension of the hours of public pools.

City-provided preventative options are not always fitting for older adults, however. For instance in 2017, the City of Toronto, Ontario identified 500 “cool spaces” in the city. A breakdown of the list indicates that 321 of the 500 spaces were swimming pools, wading pools or splash pads. These types of offerings often have a number of accessibility challenges for older adults.

Some Canadian cities, primarily larger ones, have developed a Heat Alert and Response System (HARS) which is a coordinated effort among public health organizations, municipal, emergency and weather forecasting services, and media outlets and includes relevant non-governmental organizations. This may involve an alert protocol, a response plan, communication plan, evaluation plan and specified community mobilization and engagement.

In the development of the City of Sherbrooke, Quebec’s emergency plan, each of the city’s parks was inspected by staff to note if they were equipped with washrooms, water fountains, showers, tables, benches, shaded areas, pools or splash pads, beaches, and air-conditioned areas. The use of these cool spaces is promoted by the city as part of its heat response during extremely hot days.

The city of Hamilton, Ontario developed targeted messaging for landlords, after determining that property owners and managers are in an ideal position to inform their residents about extreme heat risks and carry out measures to cultivate heat-resiliency. Each May, landlords in Hamilton receive posters with information about staying cool.

National Extreme Heat Event Advisories

During heat waves, the Environment and Climate Change Canada (ECCC) circulates heat alerts to public health units. An extreme heat event advisory is an alert that allows time for individuals, services and communities to organize themselves in response to the heat wave. Heat advisories are announced by ECCC 18 to 24 hours in advance of an extreme heat event. A heat warning is circulated when two successive days of weather that meets or exceeds the criteria set (daytime highs and nighttime lows) is predicted.

“Communicating heat-health risks to the elderly and other vulnerable individuals represents one of the most challenging tasks that the city had to undertake when implementing its alert protocol”

(Emergency Measures Manager for the City of Gatineau, Quebec, 2016)

In 2016, a new heat advisory system was implemented by ECCC in Ontario. Prior to 2015, there had been no uniform approach among Ontario public health units for activating heat warnings. There are three regions under the new classification, with standards based on health evidence and climatology particular to each region.

As noted earlier, according to scientists, a key risk to health from high temperatures is any discrepancy from normal temperatures (Anderson, B., & Bell, M., 2009). People who are regularly exposed to hot environments and have had an opportunity to acclimatize to them can be more resilient to heat than those living in areas with cooler climates. Therefore, in Ontario, heat advisories are issued under distinct circumstances that reflect the differing temperature sensitivities between regions.

Summary

Extreme heat is an imminent issue. There are huge health consequences, from physiological impacts to a growing recognition of social and psychological impacts. Older adults are a particularly vulnerable group that should be increasingly considered due to the fact that the population of those over 65 will double within the next 20 years.

Adaptive capacity of this demographic is not just affected by age, but also by a number of physiological and medical factors that come with aging, such as economic status, social capital, and education level. In addition, it has been found that the lack of intervention plans for heatwaves, as well as limited coordination between social services and health organizations have possibly been major contributing factors to the loss of life in past heat waves.

Studies show that older adults frequently do not perceive themselves to be at risk and are often not motivated to alter their usual routines during extreme heat events. Some studies report that no more than half the population typically change their behaviours in response to advisory warnings. The Health Belief Model is a particularly useful framework that has been used in studies to better understand health-related behaviours in heat waves.

Given the current literature and anticipated challenges in this area, this project focuses specifically on exploring opportunities outside of traditional formal advisory models (such as community support) to better enable older adults in adopting adaptive behaviours.

CORNWALL CONTEXT

Understanding the context of where a heat waves takes place is important when designing for users. Each city or place has unique characteristics including geography, climate, demographics, and resources.

Here, we describe what was learned about Cornwall as part of the discovery phase.

All statistics are from the 2016 Census, unless indicated (Statistics Canada, 2016).

Geographic Location

Cornwall is Ontario's easternmost city, located on the Saint Lawrence River in the Quebec City-Windsor Corridor along Ontario Highway 401, and is the urban centre for several surrounding communities.

Climate Characteristics

Similar to most of southern Ontario, Cornwall has a humid continental climate with cold, snowy winters and warm, humid summers. Precipitation is significant year-round although the winter months are generally drier than the summer months.

Population

Cornwall's population is 59,699. Those 65 years and over equal 13,395.

Currently 22.4% of the population is 65 years and over, compared to the province at 16.7% .

It is expected that by 2025 this will increase to 40%.

Poverty

Cornwall is situated in the 20% most deprived areas in Ontario. 14.5% are living below the low income cut-off.

Education

47% of the population has a post-secondary education.

Health

Cornwall area is noted to have the highest rate of Chronic Obstructive Pulmonary Disease (COPD) within the Champlain Local Health Integrated Network (Cornwall Community Hospital, 2018).

Chronic obstructive pulmonary disease (COPD) is a type of obstructive lung disease characterized by long-term poor airflow, including chronic bronchitis, emphysema and asthma that cause difficulty breathing. COPD is a progressive disease, meaning it typically worsens over time (Canadian Lung Association, 2005)

Heat Wave Warning System in Cornwall

The literature review speaks to the importance of coordinated community responses to heat waves. In conducting primary research in Cornwall, I was unsuccessful in gaining a meeting with representatives of the city of Cornwall and thus from a municipal perspective, unable to determine if a "master" heat plan was in place. None of the 10 service provider leaders or stakeholders I interviewed were aware of a comprehensive or coordinated heat alert response plan in existence in Cornwall.

In heat waves, the local public health unit conveys the warning issued by Environment Canada and Climate Change to local media. It was highlighted that local media in Cornwall has decreased drastically over the last several years, and there wasn't a guarantee that these warnings would be conveyed.

A scan of local newspaper articles suggested cooling centres had been available in the Cornwall area during heat waves, but it was unclear whether or not this was the case when speaking to service providers.

Summary

Some of the variables that the literature review highlighted can affect adaptive capacity are evident when we look at the Cornwall context. These include, a lack of community response to heat waves, an aging population, high rate of poverty and low education, as well as a high rate of COPD.

ECOSYSTEM MAP OF KNOWN STAKEHOLDERS

Human-centered design starts with the people we are designing for, but it also requires looking at all the diverse stakeholders within a system—not just the end users. As the aim of this research is to better understand how communities can support older adults in heat waves, it was important to understand who currently directly and indirectly touches the lives of older adults in times of extreme heat, as well as those who may be well placed to offer help.

The following is a visualization of the known stakeholders in heat wave scenarios. This map shows the stakeholders who are situated closest to older adults and may have direct contact (core ring). The second ring shows those that may be implicated during heat waves. The third and fourth ring demonstrates the stakeholders who play an important role, but do not directly interact with older adults.

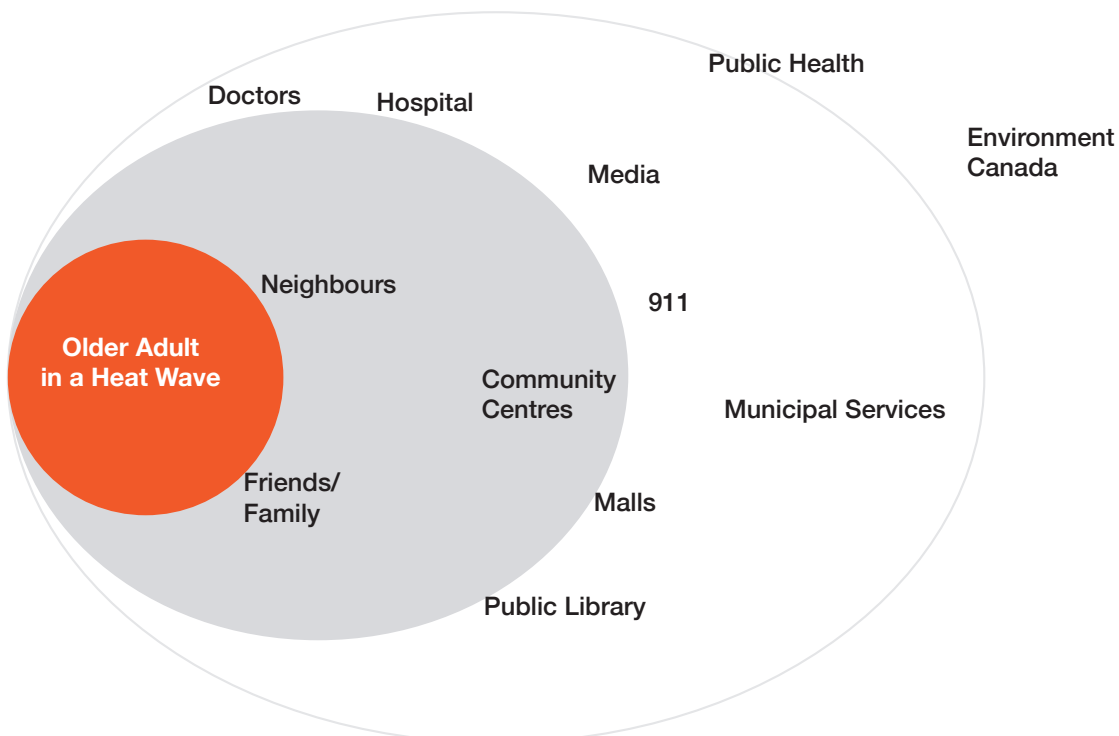


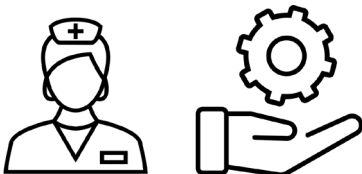
Fig. 4 Ecosystem Map of Known Stakeholders

Over the following pages, we will hear the perspectives and voices of many of these stakeholders who reside in Cornwall and were interviewed as part of the primary research. These icons will help to identify these stakeholders as we go through the findings and solutions. The icons will also help to highlight potential new stakeholders.



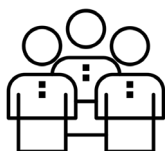
Older Adult Community Member

Those roughly 65+ years of age.



Health and Social Service Providers

Those who work in clinics, hospitals and community health centres, and are on the frontline in the identification, prevention and treatment of physical and psychological illness.



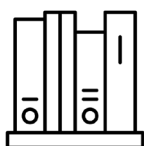
City Residents

Neighbours, friends and family members who are well placed to offer support.



Government departments

Ministry of the environment such as Environment Canada and Climate Change, and public health.



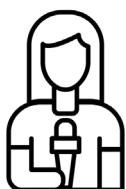
Community Centres & Public Libraries

Spaces that are open to the general public during heatwaves.



Malls

Spaces that are open to the public for shopping.



Media Outlets

News stations that deliver warning information to the public via traditional and social media including TV, radio, newspapers, Twitter and Facebook, among others.



Emergency Management Services

Municipal emergency management services that aid in response coordination such as 911.

FINDINGS: HEALTH & SOCIAL SERVICE PROVIDER PERSPECTIVE



This section discusses the primary research conducted in the Cornwall community with older adults and service

providers through interviews. Here, patterns, behaviours and the details of people's actions and words are used to uncover rich findings and interventions for the community.

Everyone interviewed, with the exception of one professional, felt that extreme heat was a relevant and important issue in regards to their clients.

“When I heard that you were doing this project, I just thought it was really appropriate and very, very topical. I mean, given the effects of climate change, and the, you know, the very hot summer we just had, and my own personal experience with several clients who, you know, they're the problems that that I was helping them with, I think, a direct result of a heatwave”

Despite acknowledging that heat waves were impacting or could impact the older adult populations they were serving, most service providers disclosed that they hadn't discussed the topic within their organizations. A number of service providers acknowledged the need for an actual plan or protocol within their organization, and within the greater community. In some instances, it appeared to be the case that without a service of some form being in place, some older adults could be in great distress or at risk of serious harm, during a heat wave. The professionals made it quite clear that there are benefits to providing services to older adults during heat waves. There is a general sense that something needs to be done, but it is not evident that organizations are jumping on this concern.

“You are starting a conversation with me and a conversation that I want to carry forward to others.”

Some professionals, those working more frontline roles, described how they are already seeing their clients affected by the heat, while others talked more about it being something to think about for the future. There was a concern by service providers that some older adults may not perceive the full risk of heat waves, and that this could be because of a number of reasons, including physiological issues (decreased detection of heat) and psychological issues (decreased cognition). This was reflected in wearing too many clothes on very hot days, not drinking enough water; doing what they always do when it's hot (only turning on a fan), which may not be enough in extreme heat.

“Last summer, they did for sure. Because on average, I mean, there's days that you know, I will see maybe four people or something, but last summer, we had our we It was quite a bit and, you know, and some of the people we would have seen the day before, and then they are coming back and a lot of times like well it's air conditioned here, right.”

Overall, service providers described seeing a number of co-morbidities in Cornwall, especially COPD, and a decline in the general health of people at younger ages that results in them presenting much older, which makes the issue of heat waves challenging and serious. They described that at times even air conditioning isn't enough for those with lung and breathing issues because of the humidity. They also described that some older adults may have early undetected Alzheimers which may result in apathy to taking action. In addition, heat illness was described as a slippery slope by those providers who work closely with older adults. It can easily go from dehydration to delirium and confusion, resulting in an inability to respond appropriately.

The Challenge of Knowing How to Respond

Some service providers expressed not knowing how to plan for environmental-type events. There was an unquestionable sensemaking of the issue in the interviews - of not being sure where to start addressing heat waves for their clients and for their organization. Of note was the challenge in determining at which point the weather conditions become sufficiently hazardous to human health in a given population to warrant intervention.

"I think traditionally we don't prepare for something that we don't understand." We don't know. Then it hits you in the head and it's too late. I'm wondering if people don't think it will happen in their generation. They think it's 10 years away and it won't affect them, but it probably is already."

Several professionals drew from past experiences, in particular they recalled the 1998 ice storm, which decommissioned the city for several weeks, but in which the community rallied together in various ways to offer help to those who didn't have electricity or heat. There was a feeling of pride in how they made it through as a community, helping each other out. Many remarked, though, that heat is not as immediately felt or visible as the cold and snow, which creates an additional challenge in knowing how and when to respond.

"When there is a flood, we evacuate and we support people - we're not doing that in a heat wave - do we need to?"

One service provider described how the community had helped refugees who had settled in the Cornwall area as an example of how the Cornwall community comes together to look after the well-being of those who need it.

The Challenge of Providing More Care

Service providers were cognizant of the fact that various factors were at play in assisting older adults during heat waves. There was a general recognition that their own organizations were stretched to provide the services they were mandated to provide. Taking on any new services, regardless of the need,

was not something that was easily accomplished. There was a tension between recognizing the need to offer more, and the limitations of their own services to do so.

Stretched Services

Service providers noted that developing and taking on new service deliveries to older adults during heat waves would increase their workloads. Service providers noted in several instances that they were encountering increasing numbers of individuals on their caseloads who were very ill, some of whom were on the young end of older adults. Lung problems were noted in a number of instances. It was evident from what the service providers were saying that increased heat waves could make the cases they see even more acute and complex.

Prioritization & Mandates

"...if the numbers go up, there might have to be, you know, further treatment options or training that's involved."

Service providers spoke of the need to be aware of mandates and expectations. Some service providers noted that there could be a need to reconsider how things are done in the future within their organizations and across services.

It was also noted that organizations periodically need to reflect on what they are doing and what is important to do, which we hear in this quote by one of the professional interviewed:

"There is an environmental type, you know, climate emergency, and it could be very similar, whether it's heat, or cold, we need a place that people can go, and we need to let the people know, we need to be able to get the people there. And who and how, and who's responsible for that."

A number of service providers spoke to the need to change their approach and to begin the process of a community response. It was noted by some service providers that when new services are offered to clients this sometimes results in existing services are reduced or dropped altogether.

FINDINGS: OLDER ADULT PERSPECTIVE



The following is a sample of responses that provide a snapshot into what a heat wave feels like for older adults. Here, participants were asked to recount, in as much detail as they could, a heat wave experience they could remember. It was winter, so this was the approach taken to get people to think about how they were affected when it's very hot.

While much has been written from an academic standpoint about the impacts of heat waves, a primary goal of this study was to centre the research around those we are designing for and to keep their needs and perspectives at the centre of the process. These words and excerpts also allow us to understand more deeply how heat waves are currently experienced, and we can begin to imagine what heat waves may be like for those in the future if they become 17 days long, more frequent and more intense, as predicted.

The “Experience” of Extreme Heat

The older adults who were interviewed spoke about how oppressive heat waves could be, especially as the heat lingered on, as heard here:

“I’m fine for the first four or five days. But if it goes on for great lengths of time, I just kind of die for a little while. But I’m quite comfortable in the first few days of that. I don’t have a problem. It’s just when it goes on for any length of time. It’s the humidity that I find that’s, that’s more intolerant, more intolerable than the heat. I can tolerate heat. But if it becomes really humid, that’s when I feel very uncomfortable.”

The heat affected their mood, making them cranky, and irritated.

“Very hot, drinking a lot of water. Tried to do wash but couldn’t because it was too hot, mood level, very cranky, very irritated. I didn’t do errands, grocery shopping because I was too irritated. Wait for a cooler day or go first thing in the morning.”

The heat itself made them cranky, as did having to limit what they could do, such as grocery shopping.

Sense of Confinement

As just noted, several older adults spoke with a sense of frustration that the heat waves were confining them to their homes, denying them the possibility of being outside.

“You’re always stuck inside. Always inside, you know. And it gets awful because it’s, you know, look outside. There’s no snow. You want to be out there, but you can’t be.”

It also limited the activities they could engage in with family and loved ones, or their routines within the home, such as baking, were curtailed.

Financial Burden

Many older adults have limited financial resources available to them. We see in the quote below that this particular older adult was highly cognizant of the various costs that were associated with having air conditioning.

“I have to pay \$200 a season for the electricity. I have an air conditioner and they charge \$50 to put it in. You’re not allowed to put in yourself. Then it broke. So I had to get another air conditioner. And they took the old one. You can’t touch it yourself. They put the new one in and I paid another \$35 so it was a costly year last year and I didn’t use the dam thing that much because it was broken most of the time.

So I had a bad time. But anyways, I got through it. The man didn’t come to take it out until the first snowfall.”

Impact on Physical Health

One major theme stood out with the older adults who were interviewed as part of this research it was the impact that heat waves had on their health, most notably their breathing, we see this in several comments made by different participants here:

“I couldn’t step outside to breathe. It was humid almost every day. I couldn’t go outside at all. It was wicked. Humidity was extremely high. I have to stay inside totally around the air conditioning.”

Just can't breathe. Period. I just can't breathe. All you're breathing is heat. Then I feel like I'm hyperventilating. I sat out twice that's how hot it was."

"I've got emphysema of the lungs very bad, very very bad. I get pneumonia a lot and when the heat wave comes I practically can't get my breath. I have an awful time getting my breath and I have an air conditioner in my in the window in the bedroom. it helps but you know with the heat I don't go out of the house at all with the heat. I can't even go on the galley (balcony) because I can't get my breath, bothers me terrible."

Range of Experiences

While there were issues that were common across the older adults, we also see that within the group there was a range of experience during heat waves. While there were most definitely older adults who remained indoors during heat waves, we see in the quotes below the determination and creativity of some individuals to be outside, a place from which they clearly derived considerable pleasure.

"When I first moved in (to this house), there were too many bugs so I had a gazebo built. But definitely the bugs are an issue because of more heat. Yeah, I think that's probably why - more humidity and more heat, the bugs love it."

"I often sit out there in the shade and I have like, if it's really hot, I'll take a fan out. And I'll have the fan just blowing on me. But I'm outside, I love to be outside."

While most described the heat as being on pleasant, the above words show us that this is not the case for everyone over the age of 65.

Summary

As the above "voices" reflect, extreme heat situations for the older adults that participated in interviews brought discomfort, confinement, and adjustments that weren't necessarily desired. It was evident that heat, combined with humidity not only created discomfort for some of the participants, but also brought on health issues, most notably with breathing.

04

The Define Phase

In this phase of the design process, we begin to converge into a narrower focus. This section describes insights generated from the exploration of the literature and the primary research.

As proposed in the methodology section, thematic analysis was used to surface themes and insights. This process involved an inductive approach using affinity mapping, and an deductive approach, by applying the Health Belief Model to hone in on

behaviour at an individual level. Through this interrogation of the literature and interview data, specific insights emerged.

Based on these insights, several design principles were developed to help guide creation of interventions in the Develop Phase. The design principles will be described within this section.

INSIGHT

1. Widening the Net

Leveraging more stakeholders within the community.

While service providers play an important role in aiding older adults during extreme heat situations, effective help can also be offered and delivered by a number of other sources. There is an opportunity to leverage more of the informal resources within the community and broaden the number of stakeholders who provide support during times of extreme heat. The known stakeholders were highlighted in the section above, but there is potential to include the private sector, other community organizations and resources, churches, service clubs, neighbourhood organizations, schools - the list of possibilities is extensive. Churches often have areas for the public. Many churches have groups within the church who provide helpful public service, extending the outreach of the church. Such groups could spring into action during heat waves. Service clubs, by their very definition, aim

to offer something to the community. These service clubs, working on their own or in concert with other service clubs, could offer a range of services, including volunteer drives for those most needy during heat waves. It is important to remember that where a community can help those in need it also helps itself in building cohesiveness and community pride.

Design Principle

Broaden engagement of informal and formal stakeholders within the community.

Interventions should attempt to engage a wide range of stakeholders and community members. Even those who fall outside typical service providers responsibilities can play an important role.

Ecosystem Map of Potential Stakeholders

Revisiting the stakeholder map, we can see through visualization how an ecosystem of stakeholders could be widened within community to promote adaptive behaviour. Many of these stakeholders fall within the “complementary” ring as there is potential for them to have direct contact with older adults.

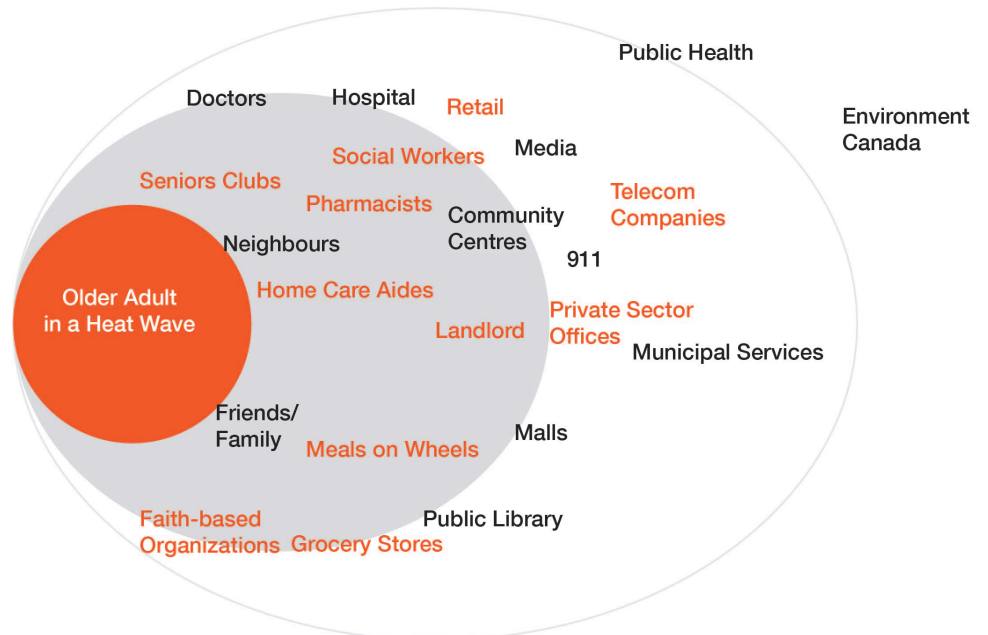


Fig. 5 Ecosystem Map of Potential Stakeholders

INSIGHT

2. The Feeling of Heat

Recognizing individual tolerances.

As the above voices reflect, it was evident that heat, combined with humidity, not only created discomfort for some of the participants, but also brought on health issues, most notably with breathing. Consistent with the literature, we can also see that the sensation and impacts of heat are highly individual, with various factors and tolerances for heat impacting each person differently. Most of the interviewees in this study spoke of negative impacts, but one participant described enjoying the heat, another was relatively indifferent.

The insight here is that the temperature on the thermometer, or the extreme heat warning provided Environment Canada and Climate Change is not and should not be the only cue to action. The thermostat on the wall provides a fixed reading, but our bodies tell a different story.

It is important for individuals and those around them, including service providers to pay attention to these feelings. What may start with minor discomfort, but can quickly escalate to a dangerous situation. The feelings described by older adults shouldn't be overlooked and can provide important information on how and when the community should respond. While actual temperatures certainly provide a good guide in heat waves, "experienced" temperature should not be ignored.

Design Principle

"Experienced" heat should be recognized as valuable information.

Interventions should attempt to recognize the feeling of heat as perceived by an older adult in order to encourage paying attention to the cues of the body and as a method of listening and learning from the needs of older adults.

INSIGHT

3. The First Line Of Defence Is Making Do

“I’m a very self sufficient person, I don’t depend on others too heavily”

A number of older adults have some strategies to make themselves more comfortable in a heat wave and a level of confidence that they can carry out these actions without external assistance.

The primary measures employed in extreme heat was staying in their homes and relying heavily on their air conditioners. All but one participant had air conditioning in their homes. Only two of the 12 participants mentioned leaving their home to get relief from the heat.

The group of older adults who were interviewed were still reasonably independent, something they greatly valued, not wanting to impose on others for assistance. Within their existing routines and practices, older adult participants’ self-efficacy appeared to currently be sufficient.

“Even in this place, see, the air conditioning doesn’t come around from the bedroom, you know. I really should have another one in here but that would be too costly, you know. But anyway, I’m making out.”

While air conditioners may provide a reprieve, several participants noted the expenses associated with running an air conditioner and that some older adults cannot afford air conditioners or the electricity to operate them. One participant spoke at length about the cost and delays of getting an air conditioner installed, adding that repair costs were incurred when the air conditioner failed and had to be replaced. As noted below, the air conditioners that some participants had in place did not fully meet the cooling requirements, but an additional air conditioner was seen to be too expensive.

Design Principle

Self-sufficiency & independence should be recognized.

Any offer that would be developed or proposed should respect the fact that older adults value their independence and self-sufficiency. Some assistance may be needed, but small bits of help, provided in a timely manner is sometimes all that may be required and can go a long way. The aim should be to help older adults to achieve their goals. Planning must include options that support a person in their home during a heat wave, given that not all older adults will leave their home, nor would they necessarily feel better off out of their home.

INSIGHT

4. Mind the Gap

The psychological and emotional toll is often overlooked in heat wave protocol.

The majority of those who were interviewed spontaneously raised the emotional toll caused by heat waves. It was evident with this group that while they valued their homes, their lives extended beyond the walls of their home. Staying in their home, close to their air conditioners, created a sense of being confined or trapped. Participants noted that even within their homes their routines were disrupted, citing being unable to clean their homes because of the discomfort from the heat. Some participants spoke of being denied the pleasure of simply going out into their yard because the heat was too intense. Some noted that forays out into the broader community were also put on hold - shopping, doing errands were suspended. Other interviewees raised the issue of being cut off from other people, making them feel isolated. They also identified the discomfort associated with the lack of change in their lives during heat waves - every day seemed the same, and there was little in which to look forward to.

“Depression because it’s another day inside, can’t go out for fresh air...Very frustrating. Not another day. You don’t want to be left alone and you’re cranky and you’re tired.”

Many raised the mental health issues that emerged during heat . Anxiety, frustration, irritation, anger, and depression were some of the mental states that participants noted experiencing during heat wave periods.

It is clear from what they said that the lives of older adults are affected extensively by the isolation they experience during heat waves - they become more isolated as a result of staying in more, they do less, they are less connected to a larger outside world. They may be either feeling less healthy or worried about their health. They can’t do the things they normally enjoy. Their lives are put on hold.

Lack of support network

In some instances the older adults had no family or friends that could easily assist them. In other cases, the older adults were reluctant to call upon family or friends, perceiving these people to be too busy in their own lives to be called upon for assistance.

“I don’t think we put enough emphasis on the fact that many of us are alone and if we were in a crisis may not have access to help immediately.”

Reducing the physiological health risks is almost exclusively always the focus in measures offered by cities. While heat illness is a serious issue and should be addressed, many older adults are also impacted also impacted psychologically. This is a gap in current heat wave protocol. This gap was also apparent in the conversations with health and social service providers. There was no doubt that the older adults might be suffering, but conversations generally centered around the physical impacts of heat.

Design Principle

There is a need to support psychological wellbeing during heat waves.

Interventions should include components that allow for older adults to address or voice their concerns, stress, as well as reduce the isolation and loneliness they may feel.

INSIGHT

5. No Place Like Home

Barriers may outweigh the benefits of going to places outside the home.

The older adults interviewed appeared to be aware that some community options where it was cooler existed for them. Examples of that were going to a mall or the library. However, it warrants noting that the those who were interviewed did not readily offer this information and some added probing was required to get the participants to think beyond what measures they could take outside of their own homes.

Two important discoveries emerged with respect to the community “cooling” options available to older adults. First off, as noted above, those interviewed did not spontaneously identify these options when interviewed about how they coped with heatwaves. In fact, some gentle but persistent probing was required before the participants would list what they understood was available in the community.

Secondly, and equally important, was the fact that participants often noted problems or what we might perceive as “barriers” to utilizing these community options. The following identifies some of the barriers they spoke of:

A sense of being unwelcome or out of place

“They (other seniors) need a place to rest, they need a place to get out of the heat. Most of the places to go, you have to shop. There’s no place to go where you can just sit there and read a book or talk.” (Older Adult Participant)

Several participants spoke of feeling uncomfortable in community places where businesses were operating. For some, it came down to feeling the need or expectation on them to buy something from a store in the mall. One participant spoke of an unpleasant encounter with a clerk in a store.

Transportation Issues

For a number of older adults, the public transit system is their mode of travel. It is noteworthy that some spoke of the physical discomfort they would experience in using public transit during a heat wave. It was noted by one interviewee that the bus stops are often in an area where there is no shade. This would mean that they would have to wait in full exposure to the sun as they awaited the bus. Clearly, this was not something that encouraged them to travel.

Health issues or lack of confidence in their own health

A number of participants shared information about their poor health. In many instances, breathing problems were noted to be the primary concern. For many of them, the extreme heat exacerbated the problem. In general, the participants either felt more unwell out in the heat or were concerned that the heat was too much for their bodies to cope well.

Financial Constraints

Money was an issue for a number of the interviewees. They spoke of the cost of air conditioning in their homes, but they also spoke of the costs associated with travel outside the home. Getting somewhere meant money had to be spent.

A full list of barriers are provided in the appendix.

Design Principle

Options outside the home need to be made easy and/or incentivized.

Interventions should attempt to reduce barriers, or increase aspects that would be considered of benefit to older adults. It must be of value and attempts should be made to reduce the effort so that it does not outweigh the benefits.

INSIGHT

6. Very Few Cues

Alerts systems are lacking.

Both within the group of older adults interviewed, and within the professional stakeholder group there was little evidence that any well developed systems are in place that lead to specific measures being taken during heat waves. There is no indication that older adults are alerted in any concerted manner that a heat wave period is approaching or underway. Given that older adults are typically advised to remain in their homes, and in fact do so, an alert system would be helpful for them to help get provisions into the home in advance.

Various parties also spoke about the decrease in the quantity and quality of local news, with much of the newspaper now featuring information that pertains to matters outside the area.

Information obtained from stakeholders reveals that there is no detailed protocol within organizations when a heat wave occurs. Not all organizations are advised about heat waves and there are no indications that a coordinated dispersal of pertinent information takes place. There is no evidence to indicate that any intentional information regarding heat waves makes it to older adults.

Design Principle

There is a need for more channels and formats to alert individuals and stakeholders of the risks.

Interventions should aim to share information widely, be timely, and be connected between stakeholders. It is important that information does not get derailed or used ineffectively as it moves forward.

INSIGHT

7. The Learning Curve

Understanding the changing climate and environmental events.

Similar to the service providers who were interviewed, some older adult participants discussed that many people don't know what appropriate measures are in heat waves and rely only on what they know, or using "common sense". They may also not even be perceiving the risk or that they are vulnerable to the heat.

"I think it's a learning curve. They need to be taught this. There should be senior classes on what to do in a heat wave. A lot of seniors don't know these things. There should be information centres for seniors to learn these things. Should be taught in the seniors buildings. Disabled homes, on 4th and pitt - walk in clinic - group things"

Of some significance is the fact that some older adults seemed uncertain as to whether the heat wave or their aging or ailing body was responsible for their discomfort. Aging or ailing bodies came up in many conversations about heat waves. There was a sense that the uncomfortable aspects of heat they felt were a result of, or made worse by, their own body. They seem to lay the blame on themselves, as opposed to external factors. Many seemed resigned or had accepted this fact. Many expressed a lack of confidence in their bodies when exposed to extreme heat.

"Well I don't know whether it's the summers are getting hotter. I think it's my lungs that it bothers me. Before it didn't bother me. I mean I thought it was too damn hot, but now it's getting my breath, that's why it's, I don't think it's in the heat, it's me."

This particular point is important as it raises the question as to whether older adults would be inclined to act during periods of extreme heat. If an older adult perceives the discomfort to be associated with their aging and failing body rather than the external heat wave, could this does this make them less inclined to take action.

Design Principle

Promote learning.

Interventions should aim to create and support practices that promote learning. It is important to recognize that there may be many unanswered questions as there are answers on this issue, if not more.

SUMMARY OF INSIGHTS

Older adults are already impacted psychologically and physically by heat waves. This is not an issue of the future, but a current day issue. It will likely only get worse. Many older adults have some strategies to cope, but as we saw, the first line of defence is to make do with they are currently have at their fingertips and within their usual practices. This may not always be enough.

Currently, the barriers to taking additional steps may outweigh the benefits of going outside the home to a cooler place, or seeking additional support. If we want to encourage older adults to take additional precautions and avoid serious health implications, there may be a need to decrease the barriers and increase the benefits of doing so. In addition, there is a general lack of external cues provided in the community that alert older adults to taking action. Current heat wave warnings may not be reaching many people.

Finally, there is a need for ongoing learning in terms of understanding what a changing climate and more extreme weather means for the health of older adults. There is a need for greater understanding in terms of what is needed in order to support adaptive health-related behaviours on the part of individuals, service providers, and the community at large.

Despite being concerned about the wellbeing of their clients in heat waves, service providers are already stretched and it will be difficult to offer more on top of their current workload and responsibilities. Recognizing this challenge, there is an opportunity to engage additional stakeholders in the community as active partners in supporting older adults, and also in the learning process.

Ensuring the health of older adults, both physically and psychologically during times of extreme heat is a complex challenge we face today. The discovery section offered the voices of older adults and service providers who described the details of this issue.

The insights from the define phase also highlighted that the fact that addressing this challenge requires new opportunities to learn; creativity; consideration of the barriers older adults face, as well as collaboration and support from a wide range of stakeholders.

As outlined in the methodology section, Design Research can be most likened to Grounded Theory or Action Research - it is iterative and dynamic, with each stage informing the next. Design Research is well-suited to explore new problem spaces in that it allows the theory to emerge from the data. To reflect this new understanding of the problem, the research question was refined to focus more narrowly on the specific challenge at hand:

How might we design small-scale community interventions that work together to support older adults' physical and psychological well-being in times of extreme heat?

While this question may not appear to be substantially different from the question set out at the beginning of this study, it challenges us to explore the ways in which community interventions can encourage health-related behaviours through the generation of new social norms and practices in extreme heat scenarios.

Social practices refer to “everyday practices and the way these are typically and habitually performed in society” (Holtz, 2014). Examples of such practices include going to work, cooking, and showering.

Or, as described by one of the service providers interviewed in this project “... *It will be just drilled*

into people's heads that they will they will know just the way we know to put our seat belt or that we know to put a baby in a car seat, that it becomes second nature (to protect yourself in a heat wave)”

The five interventions that follow were designed with the goal of highlighting how individual health-related behaviours can be supported by the community. Together, the interventions also aim to create a system that promotes new norms and social practices in extreme heat.

These ideas go beyond just avoiding heat-related deaths. They have a social purpose which is to activate the fibres and resources within the community that are essential to older adults physical and psychological well-being as our climate becomes more extreme.

Design Principles

A set of design principles, which are a simple set of rules, were also developed to guide the design of interventions. They are used to ensure a solution will support the specific needs of older adults in order to promote adaptive behaviours.

The following design principles emerged from the primary research with older adults and are statements to guide idea generation for new interventions.

1. Broaden engagement of informal and formal stakeholders within the community.
2. “Experienced” heat should be recognized as valuable information.
3. Self-sufficiency & independence should be recognized.
4. There is a need to support psychological wellbeing during heat waves.
5. Barriers should be reduced, or options outside the home need to be made easy and/or incentivized.
6. There is a need for more channels and formats to alert individuals and stakeholders of the risks
7. Promote learning and understanding of extreme heat risks.

In this phase of the design process, we begin to broaden out again to explore a variety of solutions to the refined research question and problem. In this section, five interventions are described.

The interventions are intended to be practical solutions, but are also meant to be provoke system stakeholders to envision new possibilities in supporting adaptive behaviour in heat waves.

The following items are included with each intervention:

Description of the Innovation

A brief overview of the prototype concept.

Design Principles Incorporated

Identifying which guiding principles were accounted for within the solution.

Constructs of the Health Belief Model

Identifying which constructs the solution considers and addresses (perceived risk, benefits, barriers, self-efficacy, and cues to action).

Financial Considerations

Associated costs to develop, run, that may be needed or that could be generated as income.

User Considerations (older adults or other stakeholders)

Considers how users will be engaged and the delivery experience.

Infrastructure and Process Considerations

Identifies potential risks or benefits in implementing the solutions.

Learning & Growth

Considers how knowledge and learning can be ongoing and any feedback mechanisms.

Stakeholders

The key stakeholders involved in the delivery or execution of the intervention.

SOLUTION

1. A Cool Place to Be: Micro-cooling Centres



What if cooling centres were available across town instead of one central location?

Citizens, retailers, and private businesses could make small areas of their homes, lobbies, or spaces available as a welcoming place to cool down during the heat. This would allow for more options, some of them even perhaps familiar and already frequented by older adults. By inviting people in, the goal is to reduce the feeling that they need to purchase something or are loitering. In addition, by decentralizing and providing more locations, this would bring cooling centres closer to older adults, reducing travel distance and associated costs. We learned from the findings that older adults identified a number of barriers that most likely eliminate or greatly reduce the possibility that they will utilize cooling centres that are some distance away. The participants reported health issues or health worries. They noted financial constraints. They voiced that they either don't have or are reluctant to call upon family or friends for help.

When we think of cooling centres, we tend to think big - city pools and aquatic facilities, malls, arenas, libraries. Within neighbourhoods there are any number of much smaller scale places where participants can also achieve cool comfort - places like stores, offices, homes. We need to see the plight of some older adults as situations that have a variety of solutions and as a challenge where many players can all potentially offer something.

There has got to be places where we can go and view our point. Somewhere to pass the time, play board games or cards. Respite from the heat." (Older Adult Participant)

Another possible gain that can be achieved by having micro cooling spots closer to where older adults reside is neighbourhood pride. Where neighbourhoods can work cooperatively and achieve access to meet the needs of the people who reside in the area the likelihood that the neighbourhoods can become more cohesive and proud increases. This may encourage the neighbourhoods to take on other meaningful projects - community gardens, clean-up efforts, etc. Over time, it may encourage individuals to explore different places around their neighborhood.

Additional elements

- Churches, seniors clubs, and community centres could also be involved
- Offer specialized programming sponsored by Rogers/Cogeco (show a film, do an activity)
- Special programming offered during this time
- Water freely available at these sites
- Generators available these locations in case of power outage
- Window signage identifying it as a designated cool location

Design Principles

- Encourages self-sufficiency & independence
- Removes barriers or incentivizes benefits to taking adaptive measures
- Supports psychological wellbeing as well as physical health
- Maximizes existing community resources

Barriers targeted

- Reduces distance to travel
- Low cost or free for older adults
- Reduces isolation

Health Belief Model Constructs

- Develops culture of risk perception: Opportunity to promote extreme heat risks throughout the community, not just to older adults
- Addresses barriers of travel distances
- Potential to increase benefits by allowing older adults to spend time in places they enjoy within their neighbourhoods, and where they could interact with others
- Promotes self-efficacy

Norms Challenged

Cooling centre operates in one central location and older adults must go there. Here, we bring the cooling centres closer to older adults in more familiar places on a smaller scale.

Financial Considerations

May be a small cost to those who open their doors if they need to do anything extra to make it work

Could provide a tax incentive to those who participate in providing a micro-cooling station

Could reduce costs to the city while increasing resources

User Considerations (older adults or other stakeholders)

- Motivating people to open up their space to strangers / neighbours could be a challenge
- Providing comfortable seating or entertainment in order to encourage use
- Would be important to understand minimum requirements based on older adults needs

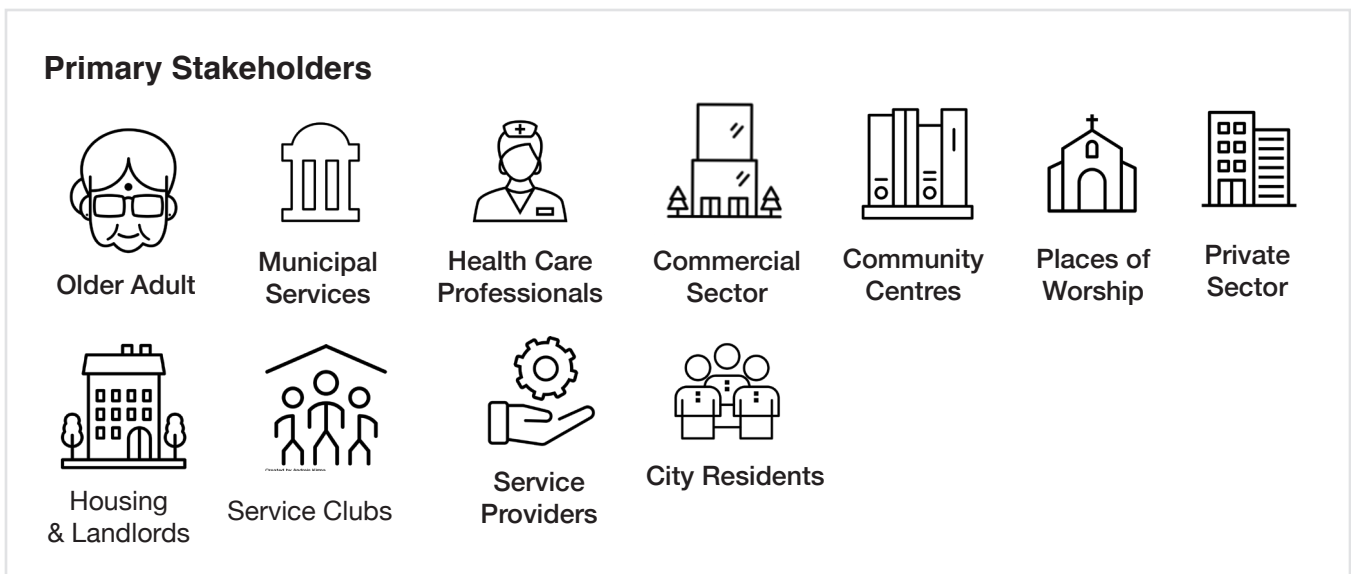
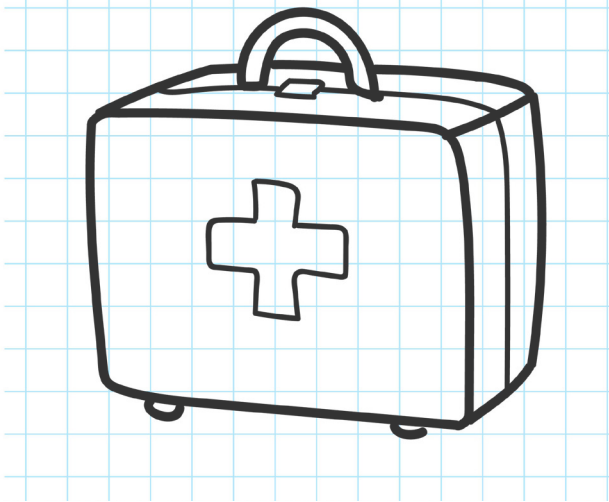


Fig. 6 Stakeholders involved in solution #1.

SOLUTION

2. Ice Box: Heat Wave Safety Kit



What if some cooling centre safety and comfort elements could come to the home rather than people going to the cooling centre?

We learned in the research that older adults who had air conditioners in their home overwhelmingly attempted to cope with heat waves by remaining in their homes. In fact, we learned that professionals often encouraged them to do so. That being the case, it is important that efforts be made to make older adults who choose to stay home as safe and comfortable as possible.

A generic heat wave awareness kit that could be given out by pharmacists, doctors, landlords early in the season to promote awareness and educate on heat wave strategies. The kit could include:

- Information on what to do such as a tip sheet on staying cool and who to call during a heat wave if you need assistance
- A list of places in the neighbourhood that would welcome you to come and cool off
- A list of local media sources to watch for more information during a heat wave
- Indoor thermometer that indicates risk levels
- Water bottle
- Bus ticket

Individualized safety and comfort kit could also be created for those who have higher needs and would help them in the acquisition of the items necessary for the kit (i.e. a fan)

Additional Elements

- Promote the kit as a gift idea (similar to boxed subscription).
- Unboxing videos to spread awareness of issues among friends and family who might look into the idea of getting these as gifts for older people in their lives.

Design Principles

- Encourages self-sufficiency & independence.
- Promotes learning and understanding of heat waves
- Supports psychological wellbeing as well as physical health.

Health Belief Model Facets

- Addresses perception of risk
- Provides cues to action
- Supports Self-efficacy

Norms challenged

- Education and tools going into the home instead of a person having to go somewhere to learn more.

Considerations

- Costs to develop the kit
- Promotion / dissemination strategies

Financial Considerations

- Cost to develop and package the kit.
- Could be sponsored, donated, or be offered as purchased gift.

User Considerations (older adults/other stakeholders)

- Appropriate language
- Would need to find ways to avoid any associated stigma of being given the box

Infrastructure and Process Considerations

Would require resources to develop and distribute

Learning & Growth

An engagement aspect that asks for feedback from users to learn more about their needs and how they used the kit.

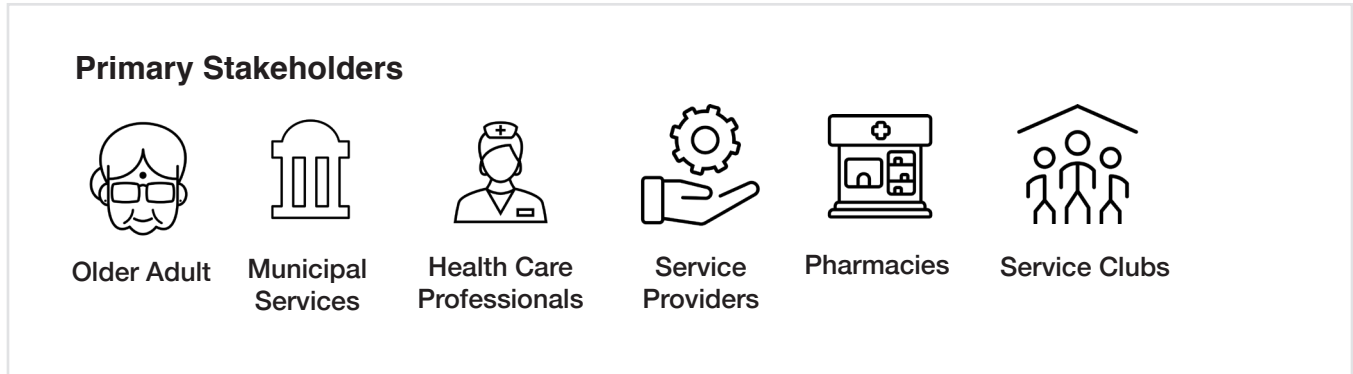


Fig. 7 Stakeholders involved in solution #2.

SOLUTION

3. What's Hot, What's Not: Mapping the Terrain



What if we identified hot and cool spots around the city?

Most people can likely relate to having experienced being uncertain of where to go and how to get there when you need something, and how stressful that can be. Sometimes there is the luxury of having the time to sort it all out, but other times, the decision is made that it's just not worth the hassle to figure it out and plans were abandoned.

We saw in the findings that older adults identified barriers to accessing comfort during heat waves. If we are to make cooling centres or options outside the home viable for older adults, it should be a prerequisite that they know where such centres are, and how to get there should not be a challenge, or, better stated, a barrier.

Encouraging hyper-local citizen reporting of hot and cool spots in the city is directed at establishing a map, so that individuals know where they can go to get cool, or avoid the heat. Similar to a 311 service, it allows people to report both hot and cool spots.

Hot Spot Reporting

A number of participants mentioned particularly hot areas of the city. These are areas that felt too hot, because they are places they move through, or desire to sit, but it's just too hot. Typically, these were areas where there wasn't any tree canopy or trees have been removed.

This map could be a place to identify these hot spots so that the city can gain an understanding of where additional steps to cool the area might be the most desired, according to the population who needs it most.

Cool Spot Reporting

Incorporating the idea of "micro-cooling centres" this map could be a place to capture where the cool spots are. This map could also be used to identify and track the spots that feel cool according to local citizens.

Design Principles

- Encourages self-sufficiency & independence.
- Promotes learning and understanding of heat waves
- Supports psychological wellbeing as well as physical health
- Maximizes existing community resources

Health Belief Model Facets

- Addresses perception of risk
- Provides cues to action
- Supports Self-efficacy

Financial Considerations

- Associated costs to develop or maintain.

User Considerations (older adults or other stakeholders)

- Technological barriers - not all older adults are comfortable using technology
- How to encourage citizens to report hot and cool areas
- Could be called in, emailed or use a hashtag.

Infrastructure and Process Considerations

- Costs to develop the map software. Additionally, information could be collected through a hashtag or through an email.
- The city could be a leader or spearhead this and use for other reporting.
- Promotion / dissemination strategies

Learning & Growth

Could be able to see how the hot and cool spots are changing over time and what this means for the area and for older adults.

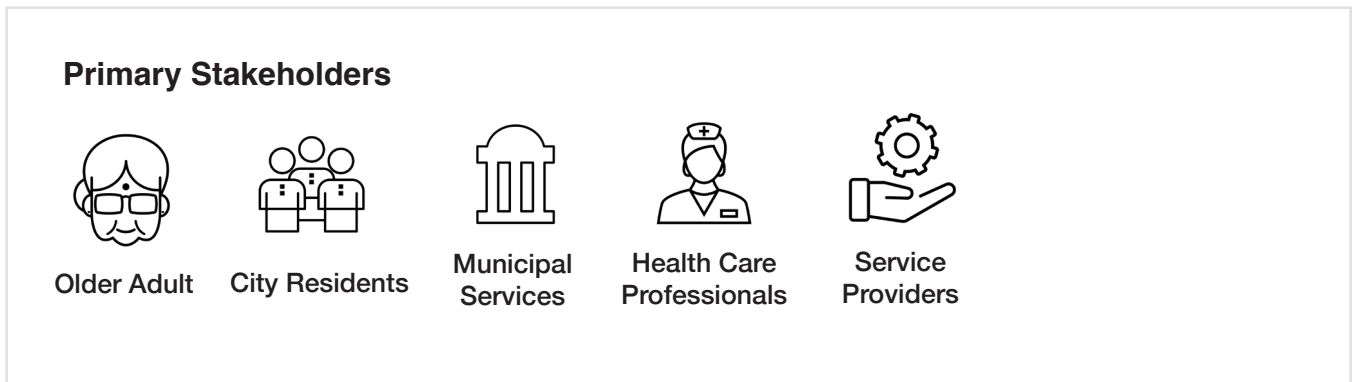
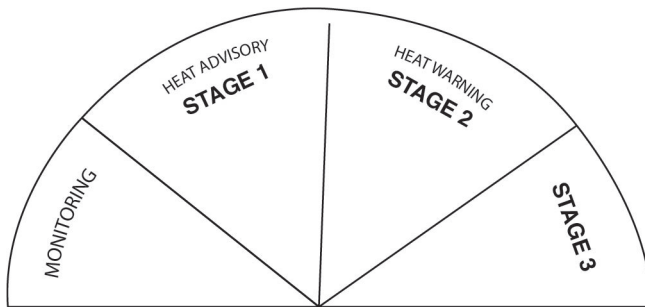


Fig. 8 Stakeholders involved in solution #3.

SOLUTION

4. City Thermometer



What if we had more ways to alert citizens?

To communicate graduated heat-health risks to the public through alert systems, some communities (e.g. Hamilton and Windsor, Ontario, and Fredericton, New Brunswick) are using heat meters, which raise awareness that risks to health increase with temperature. The “city thermometer” builds on the metered approach, but also includes steps for individuals at each level.

These types of signs have been used effectively to avoid wildfires in certain dry seasons in rural areas and in provincial and national parks. Using this concept, “city thermometers” could inform the public about the status of heat waves and what to be thinking about at that point in time.

Generally speaking, it serves as an alert system and the idea would be to work with telecom companies, weather network and others, so everyone in the city / specific location gets it.

Design Principles

- Encourages self-sufficiency & independence.
- Promotes learning and understanding of heat waves
- Provides a cue to action.

Health Belief Model Facets

- Addresses perception of risk
- Low number of Barriers
- Cues to action
- Self-efficacy

Financial Considerations

- Associated costs to develop and run.

User Considerations (seniors or other stakeholders)

- Would need to have it available in strategic locations where older adults would see it.
- Would want to make it a ritual for people to check it (just like we might check the weather every morning)
- Would allow those working in health fields to be better prepared or to notify their clients

Infrastructure and Process Considerations

- Would need to promote it to get over the challenge that exists now in terms of older people not getting the word.
- It would be important for the thermometer to use Environment Canada data and information in order to ensure consistency in information being distributed
- Promotion / dissemination strategies would be required

Primary Stakeholders



Older Adult



Media



Municipal Services



Health Care Professionals

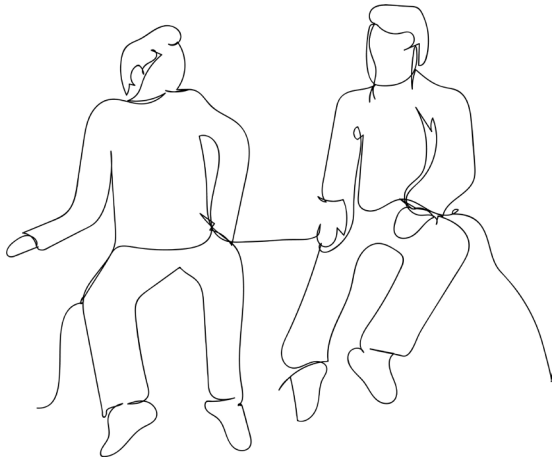


Service Providers

Fig. 9 Stakeholders involved in solution #4.

SOLUTION

5. Weather Buddy



One of the realities for many older adults is that they live alone. Some older adults remain active and engage in activities, while others are less engaged and may be reluctant to do things on their own. During heat waves, “Weather Buddies” could keep tabs on each other and make sure that needs are being met, or partake in activities together.

A senior for senior buddy system could do such things as provide updates on the weather: each buddy being responsible to make sure his or her buddy is up to date and informed of extreme weather and risks. The goal here is to not feel alone in the experience; to have someone who is aware of your situation, and whom you can ask questions or call for help as you need to. Many of the older adults interviewed showed interest in helping other adults. This intervention leverages the interest in helping others and provides individuals with an important role in heat waves.

Alternatively, it could function similarly to a neighbourhood “Block Parent” model where block parents could be assigned a manageable number of older adults to reach out to before and during heat

waves to see if the older adults were ready for a heat wave and were doing okay during it.

Design Principles

- Encourages self-sufficiency & independence
- Promotes learning and understanding of heat waves
- Supports psychological wellbeing as well as physical health
- Maximizes existing community resources

Health Belief Model Facets

- Addresses perception of risk
- Cues to action
- Promotes Self-efficacy
- Potential to offer a benefit (more social interaction)

Financial

Would require resources to be the “matchmaker”

User (seniors or other stakeholders)

- Would need strategies to make “good” matches”
- Would need to offer a set of guidelines for buddy system
- Safety - ensuring sharing of contact information doesn't infringe on someone's privacy

Infrastructure and Process Considerations

- Community-building opportunity
- Would it be client-to-client or between organizations?
- Resources to coordinating the matches
- Ensuring follow through and ongoing participation

Learning & Growth

Would be important to embed a feedback mechanism to assess overall helpfulness of buddy system.

Primary Stakeholders



Older Adult



City Residents



Health Care Professionals



Service Providers

Fig.10 Stakeholders involved in solution #5.

The final quarter of the double diamond model is the Deliver Stage, which involves testing out different solutions at a small-scale; rejecting those that will not work, and improving the ones that will (Design Council, 2019).

Given the threat of heat waves on older adults health, it is important that older adults are involved in the next stages of prototyping and testing the concepts. As was outlined earlier in this study, delivering on a final solution is not within the scope of this project. This section offers criteria for prototyping the conceptual solutions with the community and older adults. End-users should be at the centre of this process so that they can help to inform design decisions going forward in ways that ensure solutions are desirable and beneficial.

Prototyping

Prototyping is about bringing ideas from concept to life and exploring their real-world impact before finally executing them.

A prototype is a simple experimental version of the proposed solution used to test or validate ideas, design assumptions and other aspects of its conceptualisation quickly and cheaply.

Prototypes enable refinements or changes in direction before substantial investments are made. Through the processes of prototyping, followed by testing, any assumptions and biases that may have been overlooked become more visible, while further insights about users can sometimes be discovered. Moreover, through this process more can be discovered about how well the solutions incorporate the design principles outlined in the define stage, and if opportunities might arise to enhance some aspects. Thus, the solutions can be improved, or new ones generated.

1. *Does it recognize the feeling of heat?*
2. *Does it encourage self-sufficiency & independence?*
3. *Does it promote learning and understanding of extreme heat risks?*
4. *Does it remove barriers or incentivizes benefits to taking adaptive measures?*
5. *Does it support psychological wellbeing as well as physical health?*
6. *Does it maximize existing community resources?*
7. *Does it broaden engagement and include informal stakeholders?*

How to Prototype

Prototypes can take many forms, but they are tangible forms of early concepts and ideas that expose concepts to real world interaction. They are designed intentionally for learning more about how a concept performs in a real world setting, rather proving the concept is correct..They can take the shape of rough paper prototypes, hand drawn illustrations to represent digital interfaces, or even be role-playing a service offering. Prototypes do not need to be complete products or services. In fact it's often better that they be rough so that those engaging with it, feel they can still be changed or improved.

Criteria for Prototyping

- It should be quick and possible to make instant changes/test new iterations;
- It should be inexpensive;
- It should be temporary. Any aspect can be reversed or thrown-away if it does not meet requirements or goals;
- It should be a format that is accessible to end-users and service providers, not just professional designers; and,
- It should enable those involved to gain an overall view of the product or offering as opposed to the finer details

Examples of Prototypes

Below are some examples of community prototyping that can be used for inspiration.

Prototyping a Better Bus Stop

Over the course of only one day, a bus stop in Dallas is re-imagined by residents and designers as a hub and gathering point where people can sit, play and interact, and be protected from the nearby street (Better Block, 2019).

Prototyping a Safer Street

Toronto resident, Dave Meslin, and his neighbours used chalk and leaves to show how a poorly designed and dangerous intersection could be fixed (CBC News, 2017).

Developing a System of Support

The five interventions presented in the previous section were designed with the goal of highlighting how individual health-related behaviours can be supported by the community. Together, there is an opportunity for the interventions to create a system of offerings that work to promote new norms and social practices in extreme heat.

Many of the interventions could work in tandem with each other, as each one has specific strengths and focus areas. Together, these would create a variety of options across the city, allowing older adults and other groups to access offerings that fit with their unique needs.

One way to think about the community could approach this is by thinking about a road map of immediate, short, and longer term goals. The following provides a snapshot of a road map:

Short Term

Micro cooling centres: These could be opened and promoted by any organization at any time. A more formal program would be advised so that word could spread and get recognition, but it could begin informally at any point in time.

Weather buddy: A Weather Buddy program could be formally launched, but organizations and other informal stakeholders could start connecting older adults at any point in time

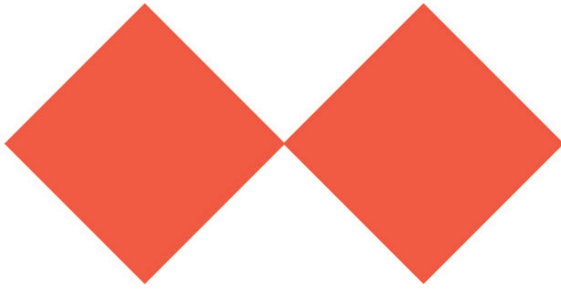
Mid Term (1-3 years)

Mapping Hot and Cool Spots: This would also require some planning and monitoring but there are many tools that can quickly generate a map.

City Thermometer: Planning would be required in order to determine criteria and a process for City Thermometer alerts and information distribution.

Heat Wave Safety Kit: These would require planning and distributing to create but also to distribute every year.

THE DESIGN JOURNEY



This major research project took us on a journey aimed at creating a suite of potential solutions to promote and support adaptive behaviours of older adults in heat waves. Together, the interventions aim to create a system that promotes new norms and social practices in extreme heat.

The insights and interventions derived from the research were made possible by employing a human-centred design approach to better understand older adults' health-related behaviours.

In the **Discovery Phase**, this major research project began by looking to the literature to better understand the impact of heat waves on older adults' health. This section revealed how extreme heat can impact physical, social and psychological health; it highlights the factors that can affect adaptive capacity, and provides an overview of the known community measures currently in place. Here, we also demonstrate that the Health Belief Model can be a useful framework to help understand the complexity and interplay of factors influencing health-related behaviours during heat waves.

The second section of the discovery phase discusses the primary research from interviews with older adults and service providers in the Cornwall community.

Through this project we saw consistency with the literature in that older adults are both physically and psychologically impacted by heat waves. Excerpts from older adults stories' offer details on how the heat can feel and brings a voice to the physical and psychological impacts that are often discussed in the literature.

Here, we also learn that stakeholders in the Cornwall community are concerned about the well being

of older adults in heat waves, but there is so far no concerted action to support them. The challenge and difficulty of dealing with extreme heat highlights a need for ongoing education in the wider community concerning the inherent risk to its older adults.

The second major section of the paper, the **Define Phase**, captures the insights from the Discovery Phase. Insights included uncovering a gap in current measures to address the isolation from staying indoors and inability to participate in normal routines standing out as a concern. A number of barriers that can limit behaviour were also brought forth, and we saw how these manifest within the local context. We also highlight a need to better support older adults independence, while also promoting learning within the community about environmental events such as heat waves.

Based on these insights, a list of seven design principles were surfaced to guide the design of future community solutions. These principles are used in the next phase, but can also help stakeholders when designing other interventions.

The learnings in previous phases led to a refined research question which reflects a new focus on generating a suite of small-scale community interventions that support both physical and psychological well-being in times of extreme heat. The aim of these is to encourage new social norms and practices.

The **Develop Phase** presents five distinct interventions as inspiration for stakeholders in the Cornwall community. These interventions were developed using these insights and inspiration from the older adults interviewed, and were guided by the design principles. These interventions are intended to be practical solutions, but are also meant to provoke stakeholders to envision new possibilities in supporting adaptive behaviour during extreme heat. Each of the interventions are accompanied with additional criteria, including behavioural constructs from the Health belief model, that can be used for evaluation of the strengths and weaknesses of each proposed solution.

The final phase of **Deliver** provides suggestions to continue iterating and testing through the use of prototyping, a step older adults and other stakeholders can do together.

Limitations of this Study

One of the limitations of this study is that it was not conducted during the warm summer months or during extreme heat. As a result, some of the insights from primary research are based on the recollection of stakeholders.

In addition, due to a time limitation, the interventions proposed have not been validated by older adults which is a core aspect of human-centered design. The perspectives of several stakeholder groups who are implicated in the interventions are also missing (private sector, neighbours, media, city/municipal services, service clubs, pharmacies, other organizations). Steps to test and prototype the interventions with older adults and other stakeholders were offered in the Deliver Phase of the study.

Considerations for the Future

Given the scope of this project, there are a few areas of note that deserve further attention. As discussed above, an important next step is to test and continue to receive feedback from older adults on these solutions. In addition, the following research area requires further attention:

Diversity of needs in older adults

It is important to understand the diversity of needs that may vary from older adult to older adult. One section of this group that should be given additional attention is those who are homebound. This study included one participant who was homebound, but more attention should be dedicated to addressing the additional barriers faced by this group.

Family members

An additional important group to involve in future research is family members. Often times family members become caregivers to aging parents. Understanding how they are perceiving the risk of extreme heat in relation to their parents, and how to support their work in caring for family members during heat waves is also important.

Temperature Check

This project involved uncovering some of the complexity of health behaviours in heat waves by engaging older adults and stakeholders from the health, community, emergency sectors in the process. The research revealed many ways adaptive behaviour can be shaped and promoted in times of extreme heat. This project asserts that through a variety of small interventions, the community can help to protect older adults' psychological and physical health in times of extreme heat.

In a future where heat waves may be 17+ days long, ensuring the health of all citizens is only possible when everyone contributes to the wellbeing of its entire population. It has become evident through this research that various stakeholders in the community must take ownership and work together to facilitate suitable interventions. It is important that older adults remain engaged and at the centre of the process. A community that supports older adults can be realized through creative, resourceful, and human-centered solutions that foster new social norms and practices in extreme heat scenarios.

BIBLIOGRAPHY

- Abrahamson, V., Wolf, J., Lorenzoni, I., et al. (2008). Perceptions of heatwave risks to health: interview-based study of older people in London and Norwich, UK. *Journal of Public Health, 31*(1), 119–126.
- Allen, M. (Ed.). (2017). Narrative Interviewing. In *The SAGE Encyclopedia of Communication Research Methods*, Vol. 3 (pp. 1073-1075). Los Angeles: SAGE Publications.
- Anderson, C. A., & Anderson, K. B. (1996). Violent crime rate studies in philosophical context: A destructive testing approach to heat and southern culture of violence effects. *Journal of Personality and Social Psychology, 70*, 740–756.
- Anderson, B. G., & Bell, M. L. (2009). Weather-related mortality: how heat, cold, and heat waves affect mortality in the United States. *Epidemiology (Cambridge, Mass.)*, 20(2), 205–213.
- Artur, L., et al (2012). Everyday realities of climate change adaptation in Mozambique. *Global Environmental Change, 22*(2), 529–536.
- Bassil, K., Cole, D. (2010). Effectiveness of public health interventions in reducing morbidity and mortality during heat episodes: a structured review. *Int J Environ Res Public Health.*;7(3), 991–1001.
- Better Block. (2019). Build a Better Bus Stop. Retrieved from <https://www.betterblock.org/post/fd19-build-a-better-bus-stop>.
- Braun, V., Clarke, V. (2006). Using thematic analysis in psychology, *Qualitative Research in Psychology, 3*:2, 77-101.
- Browning, C. R., Wallace, D., Feinberg, S. L., & Cagney, K. A. (2006). Neighborhood Social Processes, Physical Conditions, and Disaster-Related Mortality: The Case of the 1995 Chicago Heat Wave. *American Sociological Review, 71*(4), 661–678.
- Burke, M., González, F., Baylis, P., Heft-Neal, S., Baysan, C., Basu, S., & Hsiang, S. (2018). Higher temperatures increase suicide rates in the United States and Mexico. *Nature Climate Change, 8*(8), 723–729.
- Calasanti, T. (2015). Combating Ageism: How Successful Is Successful Aging? *The Gerontologist, 56*(6), 1093–1101.
- Canadian Lung Association. (2005). *Chronic Obstructive Pulmonary Disease (COPD): A National Report Card*. Ottawa: Canadian Lung Association. Available at <http://www.lung.ca>
- Carroll, P. (2002). CE Test: The Heat Is On: Protecting Your Patients From Nature’s Silent Killer. *Home Healthcare Nurse: The Journal for the Home Care and Hospice Professional, 20*(6), 386.
- Caruso C., Posey V. (1985). Heat waves threaten the old. *Geriatr. Nur. (Lond.)* ;6:209–212.
- Casati, B., Yagouti, A. (In Press). Analysis of Extreme Temperature in 9 Canadian Communities Using the Canadian Regional Climate Model Projections for Public Health Planning. *Int. J. Biometeorol.*
- CBC News. Using just chalk and leaves, Toronto residents re-imagine ‘poorly designed,’ ‘dangerous’ intersection | CBC News. (2017, December 1). Retrieved from <https://www.cbc.ca/news/canada/toronto/dave-meslin-sidewalk-toronto-chalk-leaves-1.4427663>.
- Cornwall Community Hospital. (2018). *Quality Improvement Plan Narrative for Health Care Organizations in Ontario*. Cornwall, ON.
- Climate Change Canada. (2019, April 12). Government of Canada. Retrieved from <https://www.canada.ca/en/environment-climate-change/services/types-weather-forecasts-use/public/criteria-alerts.html>.
- Design Council (2019). *The Double Diamond: 15 years on*. Retrieved from <https://www.designcouncil.org.uk/news-opinion/double-diamond-15-years>.

- Drechsler, D., et al. (2005). Public Health-Related Impacts of Climate Change in California. California Climate Change Center.
- Kenny, G. P., Yardley, J., Brown, C., Sigal, R. J., & Jay, O. (2010). Heat stress in older individuals and patients with common chronic diseases. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne*, 182(10), 1053–1060.
- Gamble, J. L., et al. (2013). "Climate Change and Older Americans: State of the Science." *Environmental Health Perspectives* 121(1), 15.
- Glanz, K., Rimer, B. K., & Viswanath, K. (2008). Health behavior and health education: theory, research, and practice. San Francisco, CA: Jossey-Bass.
- Guilbault, S. (2016). *Cities Adapt to Extreme Heat: Celebrating Local Leadership*. Institute for Catastrophic Loss Reduction.
- Guo Y, Gasparri A, Li S, et al. (2018). Quantifying excess deaths related to heatwaves under climate change scenarios: A multicountry time series modelling study. *PLoS Med.* 15(7):e1002629. Published 2018 Jul 31.
- Health Canada. (2012). Heat Alert and Response Systems to Protect Health: Best Practices Guidebook. Retrieved from http://www.hc-sc.gc.ca/ewh-semt/alt_formats/pdf/pubs/climat/response-intervention/response-intervention-eng.pdf
- Holtz, G. (2014). Generating Social Practices. *Journal of Artificial Societies and Social Simulation*, 17(1), 17.
- Howe, P. D., Marlon, J. R., Wang, X., & Leisewitz, A. (2019). Public perceptions of the health risks of extreme heat across US states, counties, and neighborhoods. *Proceedings of the National Academy of Sciences*, 116(14), 6743–6748.
- Hulme, M. (2008). The conquering of climate: discourses of fear and their dissolution. *The Geographical Journal*, 174(1), 5–16.
- IPCC (2012), Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, Cambridge University Press, New York.
- Kalkstein, A. J., & Sheridan, S. C. (2007). The social impacts of the heat–health watch/warning system in Phoenix, Arizona: assessing the perceived risk and response of the public. *International Journal of Biometeorology*, 52(1), 43–55.
- Kenney, W. L., Craighead, D. H., & Alexander, L. M. (2014). Heat waves, aging, and human cardiovascular health. *Medicine and science in sports and exercise*, 46(10), 1891–1899.
- Kumar, V. (2012). *101 Design Methods: A Structured Approach for Driving Innovation in Your Organization*. Hoboken, NJ: Wiley.
- Lahn, P. (2017). Peer Review and Rigour in User Research: High Level Outline of Issues, Consideration and Protocols. Ottawa, ON: Innovation Lab, Employment and Social Development Canada.
- Laurent, J. G. C., et al. (2018). Reduced cognitive function during a heat wave among residents of non-air-conditioned buildings: An observational study of young adults in the summer of 2016. *PLOS Medicine*, 15(7).
- Lubik, A. (2017). *Developing a Municipal Heat Response Plan: A Guide for Medium-sized Municipalities*. BC Centre for Disease Control.
- MacCourt, P. (2008). Promoting Seniors' Well-Being: A Seniors' Mental Health Policy Lens Toolkit, Victoria, British Columbia: British Columbia Psychogeriatric Association
- Martin, B., & Hanington, B. (2012). Affinity Diagramming. In *Universal Methods of Design*. Beverly, MA: Rockport Publishers.
- McGregor, G.R., et al. 2007: Using Science to Create A Better Place: The Social Impacts of Heat Waves. United Kingdom Environment Agency Report.

- McGregor, G. R. (2015). *Heatwaves and Health: Guidance on Warning-System Development*. Geneva: World Meteorological Organization.
- Mental Health Commission of Canada. (2019). Seniors. Retrieved from <https://www.mentalhealth-commission.ca/English/what-we-do/seniors>.
- Miri, M. R., Moodi, M., Sharif-Zadeh, G.-R., Moghadam, H. M., Miri, M., & Norozi, E. (2018). Health belief model components and linkages. (Version 1). PLOS ONE.
- Naderifar, M., Goli, H. & Ghaljaei, F. (2017). Snowball Sampling: A Purposeful Method of Sampling in Qualitative Research. *Strides in Development of Medical Education*, 14(3).
- National Oceanic and Atmospheric Association (NOAA) Natural hazard statistics: weather fatalities [online] National Oceanic and Atmospheric Association; Washington D.C. (2011). Available at < <http://www.weather.gov/om/hazstats.shtml>
- National Seniors Council. (2014). *Report on the Social Isolation of Seniors. Report on the Social Isolation of Seniors*. Ottawa .
- Nitschke, M., Hansen, A., Bi, P., Pisaniello, D., Newbury, J., Kitson, A., ... Grande, E. D. (2013). Risk Factors, Health Effects and Behaviour in Older People during Extreme Heat: A Survey in South Australia. *International Journal of Environmental Research and Public Health*, 10(12), 6721–6733.
- Nobert, S., & Pelling, M. (2018). The Social Life of Heatwave in London. *Framing Community Disaster Resilience*, 221–236.
- Oved, M. C. (2019, May 23). Life and Death Under the Dome. Retrieved from <https://projects.thestar.com/climate-change-canada/quebec/>.
- Prairie Climate Centre. (2019). Heat Waves and Health: A special report on climate change in Canada . Heat Waves and Health: A special report on climate change in Canada . Retrieved from <https://climateatlas.ca/heat-health-report.pdf>
- Rhoades, J., Gruber, J. & Horton, B. (2019). Promoting the Resilience of Older Adults Through Participatory Climate Change Adaptation Planning. *Journal of Homeland Security and Emergency Management*, 16(3).
- Richard, L., Kosatsky, T., & Renouf, A. (2010). Correlates of hot day air-conditioning use among middle-aged and older adults with chronic heart and lung diseases: the role of health beliefs and cues to action. *Health Education Research*, 26(1), 77–88.
- Robeson, S. M. (2004). Trends in time-varying percentiles of daily minimum and maximum temperature over North America. *Geophysical Research Letters*, 31(4).
- Schulz, A., & Northridge, M. E. (2004). Social Determinants of Health: Implications for Environmental Health Promotion. *Health Education & Behavior*, 31(4), 455–471.
- Short, S. E., & Mollborn, S. (2015). Social Determinants and Health Behaviors: Conceptual Frames and Empirical Advances. *Current opinion in psychology*, 5, 78–84.
- Science Daily. (2018). Extreme heat and reduced cognitive performance in adults in non-air-conditioned buildings. (2018, July 11). Retrieved from <https://www.sciencedaily.com/releases/2018/07/180711182748.htm>.
- Statistics Canada. (2017). *Census in Brief, A portrait of the population aged 85 and older in 2016 in Canada*, Catalogue no. 98-200-X2016004. Retrieved from <https://www12.statcan.gc.ca/census-recensement/2016/as-sa/98-200-x/2016004/98-200-x2016004-eng.cfm>.
- Statistics Canada. (2019). *Insights on Canadian Society: Living alone in Canada*, Catalogue no. 75-006-X. Retrieved from <https://www150.statcan.gc.ca/n1/pub/75-006-x/2019001/article/00003-eng.pdf>
- Turcotte, Martin. (2013). “Family caregivers: What consequences?” *Insights on Canadian Society*. September. Statistics Canada Catalogue no. 75-006-X.
- University of Lethbridge (n.d.) An Introduction to Action Research. (n.d.). Retrieved from <https://www.uleth.ca/education/research/research-centers/action-research/introduction>.

Wachinger, G., Renn, O., Begg, C., & Kuhlicke, C. (2012). The Risk Perception Paradox-Implications for Governance and Communication of Natural Hazards. *Risk Analysis*, 33(6), 1049–1065.

Watts N., Amann M., et al. (2018). The 2018 Report of the Lancet Countdown on health and climate change: Shaping the Health of Nations for Centuries to Come. *Lancet*.

World Health Organization. (2018). *Information and public health advice: heat and health*. Retrieved from <https://www.who.int/globalchange/publications/heat-and-health/en/>.

World Meteorological Organization. (2019). July matched, and maybe broke, the record for the hottest month since analysis began. Retrieved from <https://public.wmo.int/en/media/news/july-matched-and-maybe-broke-record-hottest-month-analysis-began>.

Zimmerman, R., et al. (2007). "Vulnerability of the Elderly During Natural Hazard Events." In Proceedings of the Hazards and Disasters Researchers Meeting, pp. 38–40. Boulder, Colo., July 11–12.

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Appendix B: Health Canada Heat Wave Recommendations

Prepare for the heat

- Tune in regularly to local weather forecasts and alerts so you know when to take extra care.
- Arrange for regular visits by family members, neighbours or friends during very hot days in case you need help.
- Find ways to keep cool before the hot weather starts. If you have an air conditioner, make sure it works properly. If you have ceiling fans or other fans they can help as long as the humidity isn't high.
- Find an air-conditioned spot close by where you can cool off for a few hours on very hot days. This will help you cope with the heat.
- Have cool drinks in your vehicle and keep your gas tank topped up.

Pay close attention to how you - and those around you - feel

- Watch for symptoms of heat illness, which include: dizziness or fainting, nausea or vomiting, headache, rapid breathing and heartbeat, extreme thirst (dry mouth or sticky saliva), decreased urination with unusually dark yellow urine, changes of behaviour in children (like sleepiness or temper tantrums)

Stay hydrated

- Drink plenty of cool liquids (especially water) before you feel thirsty to decrease your risk of dehydration (not having enough fluids in your body). Thirst is not a good indicator of dehydration.
- Remind yourself to drink water by leaving a glass by the sink.
- Flavouring water with natural fruit juice may make it more appealing.
- Eat more fruits and vegetables as they have a high water content.
- If you eat less, you may need to drink more water.
- Drink water before, during and after physical activity.

Stay cool

- Dress for the weather (loose-fitting, light-coloured clothing, breathable fabric)
- Take a break from the heat
- Keep your home cool
- Avoid exposure to extreme heat when outdoor
- Never leave people or pets inside a parked vehicle or in direct sunlight.
- Reschedule or plan outdoor activities during cooler parts of the day.
- Avoid sun exposure. Find or bring shade when possible.

(Health Canada, 2019)

Appendix C: Barriers as described by Service Providers

| Lack of Understanding of Risk | Mentality/Beliefs | Lack of support | Timeliness of Information on Extreme Heat | Lack of Continuity/Consistency of Care |
|---|--|--|---|--|
| Wearing too many clothes. | Denial of physiological factors that come with age and increase vulnerability. | No family in the same city to call | Many people don't get newspapers anymore | Shortened summer hours. |
| Seniors don't drink enough water generally speaking | Scared of being placed in a home if they show vulnerability/ask for help | Tight-knit communities like small social housing complexes are disappearing. | Not everyone has social media - so don't get heat warnings immediately | |
| Doing what they always do (ex. Turn a fan on) but it might not be enough | Distrust of neighbours/others or afraid of being scammed. | Don't want to burden children or others by asking for help. | Quality of local news is decreasing - No newsroom at the radio station anymore/ | |
| Difficulty projecting what the heat may be like, so not prepared, negligent | Fearful of going somewhere they aren't familiar or outside of a routine. | Younger families/generations are very busy | Watch Ottawa news where there are different weather patterns than Cornwall. I | |
| Risk of heat gets worse as time passes (after 24 hrs) | Old school thinking - don't believe in air conditioning - we always survived without it! | Children in denial that parents may need help | | |
| Worried about getting too cold, but not too hot. Loving the heat | Home is your castle. | Lack of opportunities to connect with others | | |
| General resistance on being educated on the issue | Pride that you can manage things yourself | Senior social clubs disappearing (i.e. Rotary Club) | | |
| | | Few or no friends to call | | |
| | | Don't know neighbours in apartment buildings | | |

Fig.12 A list of barriers as described by service providers.

