

# **Current Evidence on the Effectiveness of Interventions During Heat Episodes**



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**National Collaborating Centre  
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## Introduction

This summary provides current evidence on the effectiveness of a variety of described heat interventions by highlighting the strengths and weaknesses of each. The authors argue that in the absence of a formal evaluation of effectiveness, and given the limited evaluations of interventions so far accomplished, it is difficult to present a complete review on this topic<sup>1</sup>. The authors also caution that in general there have not been evaluations of effectiveness of heat interventions because interventions such as cooling centres, while efficacious, have not been evaluated for effectiveness by monitoring the profile of those using them (specifically, whether high risk populations use them), nor has the benefit of the intervention been estimated in terms of change in quantitative morbidity and mortality figures. Also, because each heat event is rare and unique, well-documented comparisons between the interventions utilized were difficult to come by and even more difficult to assess. As a result, evidence supporting the assertions in this review is limited.

Heat events have been associated with a diverse range of adverse health effects including excess mortality from a variety of causes<sup>2,3</sup> as well as many symptoms falling under the broad umbrella of “heat-related illness”<sup>4,5</sup>. Although these effects are most marked in vulnerable populations like the elderly, socially isolated, and homeless, everyone is at risk to varying degrees<sup>6-10</sup>. The impact of heat on health was clearly evident following the Chicago heat wave in 1995, which resulted in over 700 excess deaths and more recently, the heat waves in Europe in 2003, which resulted in over 45,000 heat-related deaths<sup>3</sup>. This negative impact of heat on health continues to be a persistent concern and is expected to become even more pressing in the future, given the predicted increase in heat waves linked to climate change. Thus, mitigating this negative impact is an important task. Public health practitioners are faced with the challenge of developing and implementing effective interventions to address the immediate effects of heat, and devising longer-term strategies to reduce the impact of future heat events.

A diversity of public health interventions are implemented in response to heat events, including those aimed at the general population as well as those targeted specifically at vulnerable populations. The strengths and weaknesses of these interventions are summarized in Table 1. The adoption of interventions needs to be tailored to the local community, regardless of which interventions are used. Furthermore, it has been suggested that there is an important role for longer-term strategies like environmental modifications that are not typically addressed in the heat and health literature.

### Types of Heat Interventions\*

Table 1. *Strengths and weaknesses of public health interventions for heat episodes*

Type of Intervention	Strengths	Weaknesses
Awareness/Alerts		
Mass media messages <sup>11</sup>	Reach a large number of people, including many of the vulnerable.	These messages do not necessarily reach some vulnerable groups, such as the homeless.
Distribution of educational materials/surveys <sup>11,12</sup>	Provide specific advice for individuals to follow during heat events.	These messages do not necessarily reach nor are easily understood by many vulnerable groups.
Automated telephone notification systems	Active approach to reaching individuals at risk.	Limited to individuals who have a telephone and subscribe to this service.

Type of Intervention	Strengths	Weaknesses
Information phone lines <sup>11</sup>	Individuals can have their specific questions answered. In addition, it serves as a reporting system for individuals to notify authorities about individuals or residences that are of concern so that further investigation/remediation can occur.	Limited to individuals who have access to a telephone.
Suspension of utility service shutoffs/emergency energy funds	This is extremely beneficial in areas where the population relies heavily on air conditioning (most parts of the US).	Not as useful in areas that do not rely on air conditioning (AC).
<b>Targeted Campaigns</b>		
Street outreach to homeless	Targets one of the key vulnerable groups.	Can be expensive, so often relies on volunteers.
Outreach to vulnerable individuals through partnerships with community agencies (Red Cross and homeless shelters) <sup>13,14</sup>	Directly targets vulnerable groups and builds on existing relationships with stakeholders.	As this can be expensive, many use pre-existing networks.  Difficult for the public health unit to follow or evaluate the activities of their partner agencies to know whether messages in fact reach the vulnerable.
Promotion of "buddy systems" <sup>15,16</sup>	Similar to outreach strength where someone in the neighbourhood checks in with their buddy in the same neighbourhood.	Similar to outreach weaknesses.
<b>Cooling Interventions</b>		
Cooling centres <sup>14,17-21</sup>	AC is known to be one of the most protective factors against the effects of heat. Cooling centres provide this at no cost to the individual.  Cooling centres that use venues like senior centres can be particularly successful for groups like the elderly who may be more likely to visit a centre they are familiar with and have a relationship with, rather than a city cooling centre.	It has been suggested that people are reluctant to leave their homes for cooling shelters at night due to safety concerns or the distance needed to travel to get to the cooling centre <sup>17</sup> .  There is some evidence to suggest that cooling centres are not used by high-risk individuals, but rather by low-risk individuals <sup>8</sup> .
Fan distribution programs <sup>8,22</sup>	Can be effective if used properly.	Fans are not effective when they circulate warmer air. It is important that those using fans understand how to use them appropriately.
AC donations <sup>21</sup>	AC has been shown to be one of the greatest protective measures against the health effects of heat <sup>21</sup> .	The challenge is that air conditioners need to be offered in conjunction with funds to cover AC operation, as that is a barrier to use. Furthermore, increasing AC use adds heat load to the ambient environment, so cities increase in temperature as people use air conditioners. AC use adds to the greenhouse gas effect and decreased air quality. It is not a sustainable intervention if used alone.

Type of Intervention	Strengths	Weaknesses
Environmental Interventions		
Urban and facilities planning <sup>23</sup>	<p>A long-term strategy rather than a response to acute events. Potentially greater benefits than the short-term interventions.</p> <p>These have additional benefits such as energy savings, air quality improvement, increased attractiveness, and recreational/leisure benefits, as well as heat load reduction.</p>	Requires more elaborate and longer-term planning involving a greater number of partners.

\* adopted and modified from Bassil et al. in a systematic review contracted by the NCCEH

The current state of the evidence demonstrates minimal published research evaluating the effectiveness of these interventions for heat-related illness. This is largely due to the difficulties in evaluating public health interventions for heat episodes. There is no standard definition for a heat episode or for heat-related illness. Heat episodes are rare events with varying impacts on different populations and geographical regions. Given that no two heat episodes are the same, challenges arise in attributing changes in health outcomes to interventions rather than to differences in overall weather conditions or to particularities of study design. Furthermore, typically several interventions are implemented rather than only one, making it difficult to attribute beneficial effects to a specific intervention. Despite these challenges, some informative studies that considered either public perception of risk and practice change or health outcomes during and following heat episodes have been identified<sup>11,12,24</sup>.

As described by evaluations of population responses, most members of the public were aware when an extreme heat episode was occurring, either through their own subjective assessment or as a result of broadcast media messages. Of concern, however, was that less than half of those who were aware that it was unusually hot actually reported changing their behaviour in response to warnings<sup>12</sup>. Such lack of change is attributed to the perception that they are not part of a vulnerable group and to confusion around the meaning of the messages and what action should be taken. This included groups at greatest risk, like the elderly. There is a complete lack of evidence on socially isolated populations and the homeless given the challenges in conducting heat-health research in these communities.

In terms of effectiveness in improving health outcomes, heat-health warning systems and their related public health interventions were all associated with reduced mortality. Less certain were the causal relations between specific activities and mortality reduction, as well as which interventions protect which vulnerable groups. Intervention effects on morbidity were positive but limited to one study only<sup>25</sup>. There was evidence that some activities work well in certain communities while others are not as effective. For example, many elderly in large cities do not feel safe leaving their homes at night to visit an emergency cooling centre. However, other age groups or individuals in other neighbourhoods do not necessarily share this concern. For this reason, researchers have suggested locales need to develop interventions that are tailored to their community. To support these systems, researchers have also suggested Canada might benefit from developing a national clearinghouse with guidelines defining a heat episode and directions for setting up a local Heat-Health Warning System (HHWS), and experimenting with suggestions for potential health interventions. Such a clearinghouse could also coordinate evaluations of heat response plans nationally.

A major gap identified both in the literature and through correspondence with public health practitioners is the lack of information regarding the effectiveness of different public health interventions for heat-related illness. In order for practitioners and policy-makers to comprehensively address heat events, synthesis and critical appraisal of the available evidence on the effectiveness of these interventions needs to be done.

## Summary

This document provides a list of heat interventions and reviews the current literature on the strengths and weaknesses of each intervention to a certain extent. Major types of reported heat interventions include:

- heat alerts issued by media and special organizations,
- targeted campaigns aiming to inform the more vulnerable,
- cooling interventions to offer a place or device to cool the local environment, and
- environmental interventions that involve many partners and longer-term planning.

## Conclusions

- Most people learn about heat episodes through television media. Because each heat episode has unique circumstances, the messages and interventions delivered must be tailored to a specific community or audience in order to be effective.
- Local jurisdictions across the country would benefit from developing a heat-health response plan using a combination of the interventions introduced in this document.

## References

1. Bassil K, Cole D, Smoyer-Tomic K, Callaghan M et al. What is the evidence on applicability and effectiveness of public health interventions in reducing morbidity and mortality during heat episodes? - A review for the National Collaborating Centre for Environmental Health. [Online]. 2007 Apr 30 [cited 2008 Aug 21]. Available from: [URL:http://www.ncceh.ca/en/ncceh\\_reviews](http://www.ncceh.ca/en/ncceh_reviews)
2. Basu R, Samet JM. Relation between elevated ambient temperature and mortality: a review of the epidemiologic evidence. *Epidemiol Rev* 2002;24:190-202.
3. Robine J-M. Inserm press release. Excess mortality in summer of 2003 exceeded 70,000 deaths in Europe. [Online] 2007 Mar 22; [cited 2008 Jan 23]; Available from: [URL:http://www.inserm.fr/en/presse/CP\\_scientifiques/2007/att00004520/robine\\_cp\\_220307.pdf](http://www.inserm.fr/en/presse/CP_scientifiques/2007/att00004520/robine_cp_220307.pdf)
4. Klinenberg E. Heat wave: a social autopsy of disaster in Chicago. The University of Chicago Press; 2002.
5. Whitman S, Good G, Donoghue ER, Benbow N, Shou W, Mou S. Mortality in Chicago attributed to the July 1995 heat wave. *Am J Pub Health* 1997;87:1515-1518.
6. Ballester F, Corella D, Perez-Hoyos S, Saez M, Hervas A. Mortality as a function of temperature: a study in Valencia, Spain, 1991-1993. *Int J Epidemiol* 1997;26(3):551-561.
7. Barrow MW, Clark KA. Heat-related illness. *Am Fam Physician* 1998;58(3):749-756.
8. Kovats RS, Ebi KL. Heatwaves and public health in Europe. *Euro J Pub Health* 2006;16(6):592-599.
9. Smoyer KE, Rainham DCG, Hewko JN. Heat-stress-related mortality in five cities in Southern Ontario: 1980-1996. *Int J Biometeorol* 2000;44:190-197.
10. Staffagia M, Forastiere F, Agostini D, Biggeri A, Bisanti L, Cadum E et al. Vulnerability to heat-related mortality: a multicity, population-based, case-crossover analysis. *Epidemiology* 2006;17(3):315-323.
11. Sheridan SC. A survey of public perception and response to heat warnings across four North American cities: an evaluation of municipal effectiveness. *Int J Biometeorol* 2007 Oct;52(1):43-55.
12. Kalkstein LS, Sheridan SC. The social impacts of the heat-health watch/warning system in Phoenix, Arizona: assessing the perceived risk and response of the public. *Int J Biometeorol* 2007;52:43-55.
13. Paixao EJ, Nogueira PJ, Falcao JM. Comportamentos das familias portuguesas em epocas de calor e durante a onda de calor de Agosto de 2003. *Observatorio Nacional de Saude* 2005. (Written in Portuguese but translated and interpreted by two of our reviewers).
14. Smoyer KE. A comparative analysis of heat waves and associated mortality in St. Louis, Missouri – 1980 and 1995. *Int J Biometeorol* 1998;42:44-50.
15. Kalkstein LS, Jamason PF, Greene JS, Libby J, Robinson L. The Philadelphia hot weather-health watch/warning system: development and application, summer 1995. *Bull Am Meteor Soc* 1996;77:1519-1528.
16. Ebi KL, Teisberg TJ, Kalkstein LS, Robinson L, Weiher RF. Heat watch/warning systems save lives – estimated costs and benefits for Philadelphia 1995-98. *Am Meteorol Soc* 2004 Aug;106:7-13.
17. Smoyer KE. Environmental risk factors in heat wave mortality in St. Louis. Doctor of Philosophy [thesis]. University of Minnesota; 1997.
18. Ebi KL, Kovats RS, Menne B. An approach for assessing human health vulnerability and public health interventions to adapt to climate change. *Environ Health Perspect* 2006;114(12):1930-1934.
19. Semenza JC, Rubin CH, Falter KH, Selanrakio JD, Flanders WD et al. 1996. Heat-related deaths during the July 1995 heat wave in Chicago. *N Engl J Med* 1996;335:84-90.
20. Smoyer-Tomic KE, Kuhn R, Hudson A. Heat wave hazards: an overview of heat wave impacts in Canada. *Nat Hazards* 2003;28:463-485.
21. O'Neill MS, Zanobetti A, Schwartz J. Disparities by race in heat-related mortality in four US cities: the role of air conditioning prevalence. *J Urban Health* 2005;82(2):191-197.
22. Bernard SM and McGeehin MA. Municipal heat wave response plans. *Am J Pub Health* 2004; 94(9):1520-1522.
23. Penney J. Lessons from early adapters. Decision-makers workshop: Adapting to climate change in Toronto, 2006 Jun 26.
24. Semenza JC, Wilson DJ, Parra J, Bontempo BD, Hart M, Sailor DJ, George LA. Public perception and behaviour change in relationship to hot weather and air pollution. *Environ Res* 2008;107: 401-411.
25. INPES (Institut national de prévention et d'éducation pour la santé). Bilan de la vague de chaleur 2006 et actions nouvelles pour lutter contre une canicule. [Online] 2006; Available from: [URL: http://www.sante.gouv.fr/htm/actu/canicule\\_231006/dp\\_bilan\\_vague\\_chaleur\\_2006.pdf](http://www.sante.gouv.fr/htm/actu/canicule_231006/dp_bilan_vague_chaleur_2006.pdf)

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