Excessive Heat Events Guidebook

EPA 430-B-06-005 | June 2006

United States Environmental Protection Agency
Office of Atmospheric Programs (6207J)
1200 Pennsylvania Avenue NW, Washington, DC 20460

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Table of Contents

Acknowledgments

The primary agencies that partnered to support this guidebook's development are the U.S. Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), the National Oceanic and Atmospheric Administration's (NOAA's) National Weather Service (NWS), and the U.S. Department of Homeland Security (DHS).

This guidebook reflects the commitment of individuals who contributed their time and expertise to guide its development while evaluating a wide range of information. The key contacts at each of the partnering agencies were instrumental in the guidebook's development. Alan Perrin and Jason Samenow of EPA served as the guidebook's day-to-day project managers from its conceptualization through production. Jannie Ferrell and Mark Tew of NOAA's NWS, George Luber and Mike McGeehin of CDC, and Carl Adrianopoli of DHS similarly served as the principal guidebook contacts at their respective agencies, facilitating access to the respective staff and resources of those agencies. David Mills of Stratus Consulting managed the guidebook's technical development as the primary EPA consultant. He was greatly assisted in this work by Dr. Laurence Kalkstein of Applied Climatologists Inc. and the University of Delaware Center for Climatic Research. Dr. Kalkstein helped pioneer, and continues to lead, the development of integrated meteorological and human health models for forecasting excessive heat event (EHE) conditions. He also contributed a wealth of background information in the form of published articles about and insight into forecasting EHEs, quantifying their health impacts, and coordinating the development of EHE watch/warning systems.

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- Nancy Day and Marco Vittiglio, *Toronto Public Health*
- Timothy Burroughs, Nikolaas Dietsch, Anne Grambsch, and Kathy Sykes, *EPA*
- Tony Haffer, Melinda Hinojosa, and Paul Trotter, *NOAA/NWS*
- Jerry Libby (retired) and Lawrence Robinson, *City of Philadelphia Department of Public Health*
- Christopher Payne, *Cincinnati Health Commissioner's Office*
- Liz Robinson, *Energy Coordinating Agency of Philadelphia*.

The TWG's guidance and perspective make this guidebook such a potentially useful resource. The members' enthusiasm and commitment of time to the guidebook's development are deeply appreciated by the partnering agencies and those involved with the guidebook's technical development.

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Pamela Blixt, *City of Minneapolis Emergency Preparedness Coordinator*; Robert Davis and Chip Knappenberger, *New Hope Environmental Services*; Kristie Ebi, *Exponent Inc.*; Pat Finnegan, *Metropolitan Chicago Healthcare Council*; Robert French and Warren Leek, *Maricopa County*; Stephen Keach, *Perrin Quarles Associates*; Sari Kovats, *London School of Hygiene and Tropical Medicine*; Marc Rosenthal, *Yale University*; Jonathan Skindlov, *Salt River Project Water Resource Operations*; Steven Wallace, *University of California, Los Angeles Center for Health Policy Research*; and Scott Wright, *University of Utah*.

List of Acronyms and Abbreviations

CDC	Centers for Disease Control and Prevention
CSA	Canadian Standards Approved
DHS	U.S. Department of Homeland Security
EHE	excessive heat event
EMS	emergency medical service
EPA	U.S. Environmental Protection Agency
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
PCA	Philadelphia Corporation for Aging
SMSA	standard metropolitan statistical area
SSC	spatial synoptic classification
TWG	Technical Working Group
UL	Underwriter Laboratories

Summary

Introduction

Excessive heat events (EHEs) are and will continue to be a fact of life in the United States. These events are a public health threat because they often increase the number of daily deaths (mortality) and other nonfatal adverse health outcomes (morbidity) in affected populations. Distinct groups within the population, generally those who are older, very young, or poor, or have physical challenges or mental impairments, are at elevated risk for experiencing EHE-attributable health problems. However, because EHEs can be accurately forecasted and a number of low cost but effective responses are well understood, future health impacts of EHEs could be reduced. This guidebook provides critical information that local public health officials and others need to begin assessing their EHE vulnerability and developing and implementing EHE notification and response programs.

Health impacts of EHEs

EHE conditions are defined by summertime weather that is substantially hotter and/or more humid than average for a location at that time of year. EHE conditions can increase the incidence of mortality and morbidity in affected populations. Recent examples of EHE health impacts include:

- More than 15,000 deaths in France alone (all of western Europe was affected) attributed to EHE conditions in August 2003
- More than 700 deaths attributed to EHE conditions in Cook County, Illinois, in July 1995
- Roughly 120 deaths attributed to EHE conditions in Philadelphia, Pennsylvania, in July 1993.

Concern over the potential future health impacts of EHEs follows research conclusions that EHEs may become more frequent, more severe, or both in the United States.

Responding to EHE conditions

The potential for reducing future health impacts of EHEs in the United States is significant for several reasons.

First, meteorologists can accurately forecast EHE development and the severity of the associated conditions with several days of lead time. This provides an opportunity to activate established EHE notification and response plans or to implement short-term emergency response actions absent an existing plan.

Second, specific high-risk groups typically experience a disproportionate number of health impacts from EHE conditions. The populations that have physical, social, and economic factors and the specific actions that make them at high risk include:

- Older persons (age > 65)
- Infants (age < 1)
- The homeless
- The poor
- People who are socially isolated

- People with mobility restrictions or mental impairments
- People taking certain medications (e.g., for high blood pressure, depression, insomnia)
- People engaged in vigorous outdoor exercise or work or those under the influence of drugs or alcohol.

Identifying these high-risk groups in given locations allows public health officials to develop and implement targeted EHE notification and response actions that focus surveillance and relief efforts on those at greatest risk.

Third, broad consensus exists on the types of actions that will provide relief to those at risk during EHEs and help minimize associated health impacts. These actions include:

- Establishing and facilitating access to air-conditioned public shelters
- Ensuring real-time public access to information on the risks of the EHE conditions and appropriate responses through broadcast media, web sites, toll-free phone lines, and other means
- Establishing systems to alert public health officials about high-risk individuals or those in distress during an EHE (e.g., phone hotlines, high-risk lists)
- Directly assessing and, if needed, intervening on behalf of those at greatest risk (e.g., the homeless, older people, those with known medical conditions).

Experience in several North American cities has demonstrated that comprehensive and effective EHE notification and response programs can be developed and implemented at relatively low cost. These programs generally use available resources instead of creating EHE-specific institutions. This approach recognizes that short-term resource reallocations for EHEs are justified by the severity of their public health risks, the limited duration and frequency of the events, and the cost-effectiveness of the reallocations.

Guidebook goals and next steps

This guidebook provides interested public health officials with enough background information on EHE risks and impacts to roughly assess potential local health risks from EHEs. In addition, it provides a menu of notification and response actions to consider when developing or enhancing a local EHE program.

The 2005 U.S. hurricane season was a stark reminder that inadequate public and private preparation and response to well-forecasted and well-understood extreme meteorological phenomena can have severe public health consequences.

The remaining public health challenge for EHEs is to develop and implement meaningful EHE notification and response programs that increase public awareness and lessen future adverse health impacts.

1 Overview

EHEs can increase the number of deaths (mortality) and nonfatal outcomes (morbidity) in vulnerable populations, including older people, the very young, the homeless, and people with cognitive and physical impairments *(NOAA, 1995; American Medical Association Council on Scientific Affairs, 1997; Semenza et al., 1999)*. Climate research suggests that future health risks of EHEs could increase with an increase in EHE frequency and severity *(Meehl and Tebaldi, 2004)*. At the same time, demographic patterns including increasing urbanization will increase the size and percentage of the vulnerable U.S. population. To develop appropriate EHE responses, local officials need to understand the risks that these events pose to their populations and their response options. The intent of this guidebook is to address both needs.

1.1 Why Care about EHEs?

Studies estimate that the combined EHE-attributable summertime mortality for several vulnerable U.S. metropolitan areas is well above 1,000 deaths per year *(Kalkstein, 1997; Davis et al., 2003a)*. Although similar research to quantify EHE-attributable mortality in rural areas has not been completed, recent research *(Sheridan and Dolney, 2003)* found evidence of such an impact.

Despite the history of adverse health impacts, there is consensus that most of these outcomes are preventable *(CDC, 2004a)*. Lessening future adverse health outcomes from EHEs will require improving the awareness of public health officials and the general public about the health risks of EHEs while continuing to develop and implement effective EHE notification and response programs.

1.2 Guidebook Goals

This guidebook has two basic goals: first, to provide local health and public safety officials with the information they need to develop EHE criteria and evaluate the potential health impacts of EHEs, and second, to offer a menu of EHE notification and response actions to be considered.

To meet these goals, this guidebook is organized as follows.

Chapter 2 provides information on EHE-attributable health impacts and sources of risk that affect the vulnerability of individuals and communities to EHEs. Specific information provided in the chapter includes:

- A general EHE definition
- Guidance on criteria for EHE forecasting and identifying EHE conditions
- Estimates of the number and rate of EHE-attributable summertime deaths for select U.S. metropolitan areas
- A review of the meteorological, demographic, behavioral, and regional characteristics that increase health risks from EHEs.

Chapter 3 gives the menu of notification and response options that local officials can use as a starting point when considering whether to develop or enhance an EHE program. This menu consists of the following information:

- The components of current EHE notification and response programs
- Case studies of specific EHE response programs to understand their development and lessons learned
- A review of the efficacy of EHE response programs.

Chapter 4 provides recommendations that should be considered when developing an EHE notification and response program. Specifically, this chapter contains:

- Guidance on specific actions to consider when planning to develop or enhance an EHE program
- Recommendations for coordinating EHE programs with other public health programs (e.g., ozone alert programs).

In addition, the guidebook includes a series of appendices with information that officials may want to incorporate in other materials or make available independent of the guidebook. This information includes:

- A partial list of resources for additional information on EHE-attributable health risks and impacts and details on EHE programs *(***Appendix A***)*
- Guidance on the personal use of portable electric fans during EHEs *(***Appendix B***)*
- A summary of specific actions people and communities can take in response to forecast EHE conditions to reduce the risk of experiencing heat-attributable health problems *(***Appendix C***)*.

1.3 Guidebook Development

Other documents have summarized the health risks of EHEs, described the factors that increase an individual's health risk during these conditions, and recommended elements for EHE notification and response programs *(e.g., Basu and Samet, 2002; Bernard and McGeehin, 2004; CDC, 2004a,c; FEMA, 2005b; U.S. EPA, 2005)*.

This guidebook, however, is unique because it was developed as a collaborative effort among several of the principal federal agencies responsible for addressing EHEs: the Centers for Disease Control and Prevention (CDC), the National Oceanic and Atmospheric Administration's (NOAA's) National Weather Service (NWS), the U.S. Department of Homeland Security (DHS), and the U.S. Environmental Protection Agency (EPA) along with three other institutions with extensive experience developing and operating recognized EHE programs in the United States and abroad: the Philadelphia Health Department, Toronto Public Health, and the University of Delaware Center for Climatic Research.

Summarizing the collective insight and experience of the individuals from these organizations was facilitated through the participation of their staff in a Technical Working Group (TWG). The TWG helped shape the guidebook's content through regular group discussions and review of draft versions of the guidebook.

2 EHE Health Impacts and Risk Sources

This chapter first defines an EHE and reviews possible criteria for identifying EHE conditions, followed by a discussion of the range of EHE-attributable medical conditions, adverse health outcomes, and mortality estimates for several U.S. metropolitan areas. It also reviews the characteristics that can affect an individual's health risk and the incidence of adverse health outcomes in a population.

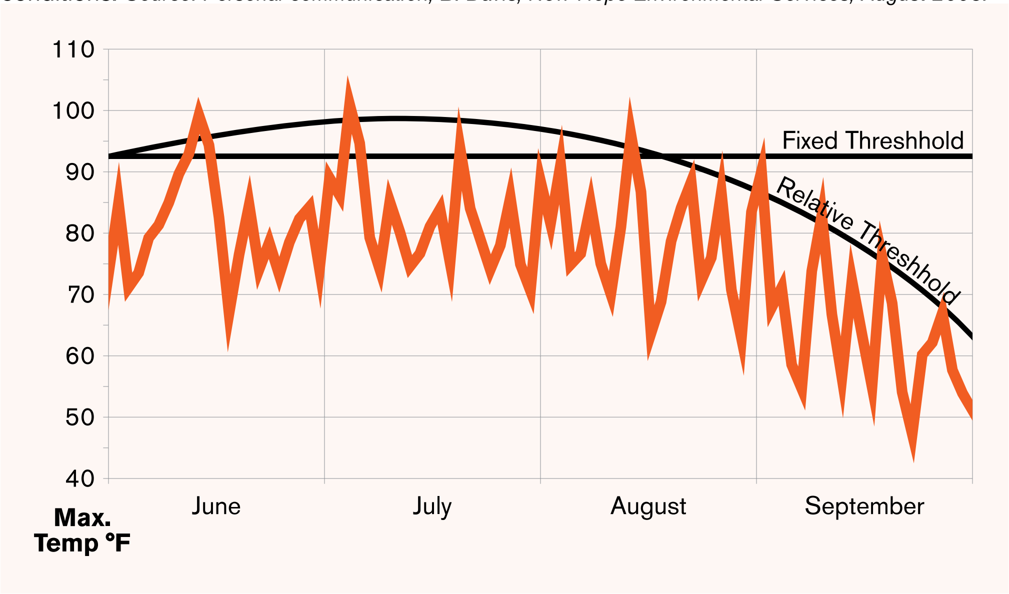
2.1 Defining an EHE

EHE conditions are defined by summertime weather that is substantially hotter and/or more humid than average for a location at that time of year. Because how hot it feels depends on the interaction of multiple meteorological variables (e.g., temperature, humidity, cloud cover), EHE criteria typically shift by location and time of year. In other words, Boston, Philadelphia, Miami, Dallas, Chicago, San Diego, and Seattle are likely to have different EHE criteria at any point in the summer to reflect different local standards for unusually hot summertime weather. In addition, these criteria are likely to change for each city over the summer. As a result, reliable fixed absolute criteria, e.g., a summer day with a maximum temperature of at least 90°F, are unlikely to be specified.

There are different ways to identify EHE conditions. Some locations evaluate current and forecast weather to identify EHE conditions with site-specific, weather-based mortality algorithms. Other locations identify and forecast EHE conditions based on statistical comparisons to historical meteorological baselines. For example, the criterion for EHE conditions could be an actual or forecast daily high temperature that is equal to or exceeds the 95TH percentile value from a historical distribution for a defined time period (e.g., the summer or a month-long window centered on the date).

Figure 2.1 presents a hypothetical example that shows the difference in defining EHE conditions when using a seasonally adjusted relative temperature versus a fixed temperature criterion.

Figure 2.1. An example illustrating the difference between a seasonally adjusted relative temperature threshold and a fixed absolute temperature threshold for defining EHE conditions. *Source: Personal communication, B. Davis, New Hope Environmental Services, August 2005.*

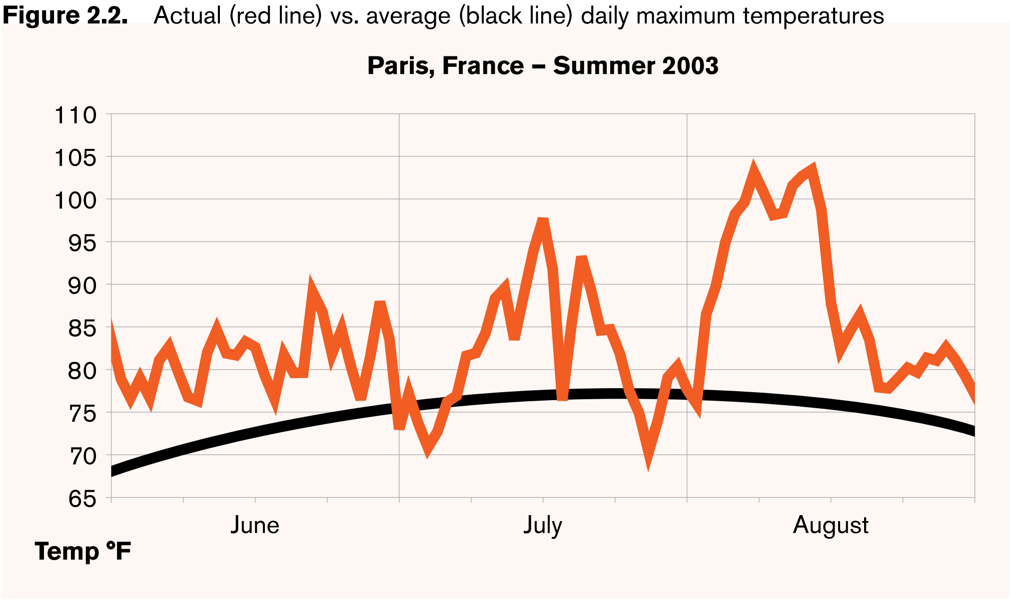


Chapter 2

Representations of actual EHEs can help illustrate these conditions. During the summer of 2003, Western Europe experienced EHE conditions of unprecedented severity. *Figure 2.2* presents the June through August 2003 daily maximum temperature readings in Paris with the corresponding average daily maximum temperature from the historical record.

Although the June and July temperatures in *Figure 2.2* may not seem exceptional, the extent to which they generally exceeded the long-term average shows why Paris experienced EHE conditions. The period from August 3 to August 17, however, is notable for its absolute temperatures and its tremendous deviation from typical conditions. Reflecting the significant health risks of EHE conditions, France experienced roughly 15,000 heat-related deaths during this period *(Koppe et al., 2004)*.

Figure 2.2. Actual (red line) vs. average (black line) daily maximum temperatures



2.2 Health Risks Attributable to EHE Conditions

Maintaining a consistent internal body temperature, generally 98.6°F, is essential to normal physical functioning *(American Medical Association Council on Scientific Affairs, 1997)*. EHE conditions stress the body's ability to maintain this ideal internal temperature. If individuals fail or are unable to take steps to remain cool and begin to experience increasing internal temperatures, they increase their risk of experiencing a range of potential adverse health outcomes.

Table 2.1 lists some of the medical conditions directly attributable to excessive heat exposure, along with recommended responses.

EHE conditions can result in increases in the number of cases of other health problems as well. For example, EHEs can increase the number of patients experiencing circulatory system conditions. These additional problems come from the added strain on the heart, increasing circulation to regulate internal temperatures, or to overcome the effects of dehydration, which thickens the blood, making it harder for the heart to pump.

Table 2.1. Medical conditions directly attributable to excessive heat exposure

Medical Condition	Symptoms	Responses
Heat cramps	Painful muscle cramps and spasms, usually in muscles of legs and abdomen. Heavy sweating.	Apply firm pressure on cramping muscles or gently massage to relieve spasm. Give sips of water; if nausea occurs, discontinue water intake. Consult with a clinician or physician if individual has fluid restrictions (e.g., dialysis patients).
Heat exhaustion	Heavy sweating, weakness, cool skin, pale, and clammy. Weak pulse. Normal temperature possible. Possible muscle cramps, dizziness, fainting, nausea, and vomiting.	Move individual out of sun, lay him or her down, and loosen clothing. Apply cool, wet cloths. Fan or move individual to air-conditioned room. Give sips of water; if nausea occurs, discontinue water intake. If vomiting continues, seek immediate medical attention. Consult with a clinician or physician if individual has fluid restrictions (e.g., dialysis patients).
Heat stroke (sunstroke)	Altered mental state. Possible throbbing headache, confusion, nausea, and dizziness. High body temperature (106°F or higher). Rapid and strong pulse. Possible unconsciousness. Skin may be hot and dry, or patient may be sweating. Sweating likely especially if patient was previously involved in vigorous activity.	Heat stroke is a severe medical emergency. Summon emergency medical assistance or get the individual to a hospital immediately. Delay can be fatal. Move individual to a cooler, preferably air-conditioned, environment. Reduce body temperature with a water mister and fan or sponging. Use air conditioners. Use fans if heat index temperatures are below the high 90s. Use extreme caution. Remove clothing. If temperature rises again, repeat process. Do not give fluids.

Sources: CDC, 2004a; Kunihiro and Foster, 2004; NWS, 2004.

2.3 Quantifying the Health Impacts of EHEs

Quantifying the health impacts of EHEs is complicated by the differences in quantification methods and a lack of accurate data.

The most conservative quantification method counts only outcomes on EHE days where the attribution information (e.g., primary diagnosis, cause of death) lists excessive weather-related heat exposure or a condition unequivocally associated with excessive heat exposure, such as heat stroke. This approach underestimates the health impacts of EHEs because not all the heat-related cases will include an attribution that recognizes this impact. More inclusive methods quantify EHE health impacts based on increases in outcomes during EHE periods compared to long-term averages. But such approaches can be absolute and attribute all observed increases in outcomes to EHEs, overestimating the heat-related mortality. Alternatively, the approach can be partial and attribute only a portion of the observed increase in outcomes to EHEs based on professional judgment or the results of additional analyses such as regression.

2.3.1 EHEs and U.S. mortality

There are a number of methods for estimating the public health threat and impact of EHEs. Since these methods can have a significant impact on the resulting estimate, it is important to recognize their differences when reviewing information describing the public health burden of EHEs.

The most conservative estimate of EHE mortality counts only cases in which exposure to excessive heat is reported on a death certificate as a primary or contributing factor. Using this approach, it was estimated that extreme heat from weather conditions is, on average, responsible annually for 182 deaths in the United States *(CDC, 2002)*.

The conservative nature of this estimate due to the narrow criteria is recognized in the study itself *(CDC, 2002)*. The accuracy of this estimate would improve with widespread adoption of revised criteria for attributing a death to excessive heat exposure. Typically, medical examiners list heat exposure as a primary or contributing cause of death only if the core body temperature exceeds 105°F. In the revised criteria, a death also can be classified as heat-related if the person is "found in an enclosed environment with a high ambient temperature without adequate cooling devices and the individual had been known to be alive at the onset of the heat wave" *(Donoghue et al., 1997)*. Importantly, the National Association of Medical Examiners supports using these broader criteria, and medical examiners in several large cities (e.g., Philadelphia) have adopted them.

Alternative EHE mortality estimates come from analyses of daily urban summertime mortality patterns in the United States *(Kalkstein and Greene, 1997; Davis et al., 2003a)*. These studies first defined EHE conditions and then calculated the number of EHE-attributable deaths based on differences in daily deaths on EHE days compared to longer-term averages. Although differences in the time series, definitions of urban populations, and other analytical methods prevent an exact comparison of results from Kalkstein and Greene *(1997)* and Davis et al. *(2003a)*, their findings correspond closely [for details of the studies' methods and the comparison of results see accompanying background technical report *(Mills, 2005)*]. *Table 2.2* presents the estimates of heat-attributable excess deaths and mortality rates from these studies.

The results in *Table 2.2* are notable for several reasons. First, despite differences in methods and the locations evaluated, the studies' results fall in a narrow range of roughly 1,700-1,800 total heat-attributable deaths per summer. These estimates are roughly an order of magnitude greater than the comprehensive national annual average of 182 deaths with a listed cause of death of "excessive heat due to weather conditions" *(CDC, 2002)*. This difference highlights the importance of the method (i.e., excess incidence or attributed outcomes) used to quantify EHEs' health impacts. Although summing the results across different groups of locations minimizes some of the initial distinctions in the studies, some of the location-specific results in *Table 2.2* show that significant differences can result from applying different methods to essentially the same mortality and meteorological data.

Second, both studies' results show significant regional variation: EHEs have the greatest impact in the Northeast and Midwest and the least impact in the South and Southwest. This result is consistent with hypotheses that populations in the most vulnerable areas are not as acclimatized to elevated temperatures and that structures in less susceptible areas

Table 2.2 Estimates of heat-attributable deaths per summer and mortality rates in select U.S. metropolitan areas

Standard Metropolitan Statistical Area (SMSA)	Deaths[1] (Estimated average summertime heat-attributable deaths from 1990 population)	Deaths[2] (Estimated average summertime heat-attributable deaths from 1990 population)	Mortality Rate[1] (Estimated heat-attributable deaths per 100,000, 1990s baseline)	Mortality Rate[2] (Estimated heat-attributable deaths per 100,000, 1990s baseline)
Birmingham	42	N/A	5.00	N/A
Providence	47	N/A	4.14	N/A
Hartford	38	N/A	3.28	N/A
St. Louis	79	0	3.17	0.00
Kansas City	49	0	3.10	0.00
Buffalo	33	19	2.78	1.63
Indianapolis	36	N/A	2.61	N/A
Memphis	25	N/A	2.48	N/A
Columbus	33	N/A	2.45	N/A
Minneapolis	59	0	2.32	0.00
Chicago	191	193	2.32	2.34
Philadelphia	129	71	2.19	1.21
Denver	42	22	2.12	1.09
Detroit	110	124	2.12	2.39
Greensboro	22	0	2.10	0.00
Nassau, New York City, Newark	362	552	1.85	2.82
Louisville	17	N/A	1.79	N/A
Boston	96	56	1.76	1.03
Pittsburgh	39	40	1.63	1.69
New Orleans	20	30	1.56	2.31
Tampa	28	0	1.35	0.00
Baltimore; Washington, D.C.	84	40	1.25	0.59
Cleveland	29	23	1.01	0.80
Dallas	36	0	0.89	0.00
Atlanta	25	75	0.84	2.51
Cincinnati	14	0	0.77	0.00
Portland	9	32	0.50	1.76
Los Angeles and Riverside	72	216	0.50	1.50
San Francisco	28	138	0.45	2.21
San Antonio	4	N/A	0.30	N/A
Houston	7	0	0.19	0.00
Seattle	5	96	0.17	3.27
Jacksonville	0	N/A	0.00	N/A
Miami, Fort Lauderdale	0	0	0.00	0.00
Phoenix	0	6	0.00	0.30
Salt Lake City	0	N/A	0.00	N/A
San Diego	0	N/A	0.00	N/A
Norfolk	N/A	0	N/A	0.00
Charlotte	N/A	0	N/A	0.00
Total	**1,810**	**1,733**		

Note: N/A, not applicable, refers to a metropolitan area not examined in one of the studies.

1. Kalkstein and Greene, 1997.

2. Davis et al., 2003a.

Chapter 2

are better designed to accommodate elevated temperatures. However, fewer locations were evaluated in the South and Southwest because of the studies' population selection criteria, so support for these hypotheses remains qualified. This regional result is more evident in *Figure 2.3*, which presents the Kalkstein and Greene *(1997)* results along with a similar result for Toronto *(N. Day, personal communication, Toronto Public Health, 2005)*.

EHE-attributable mortality estimates from specific EHEs are also available:

- **Chicago, 1995, mid-July EHE:** The county coroner certified 465 heat-related deaths in Chicago (Cook County, Illinois) from July 11 to July 27, 1995 *(CDC, 1995)*. More than 700 deaths in Chicago were eventually attributed to this EHE *(e.g., Palecki et al., 2001)*. The difference reflects deaths directly attributed to heat by the medical examiner *(CDC, 1995)* and estimates of the total excess mortality attributable to the EHE based on studies of daily mortality patterns *(Palecki et al., 2001)*.

- **Philadelphia, 1993, early-July EHE:** The county coroner certified 118 heat-related deaths in Philadelphia from July 6 to July 14, 1993 *(CDC, 1994)*.

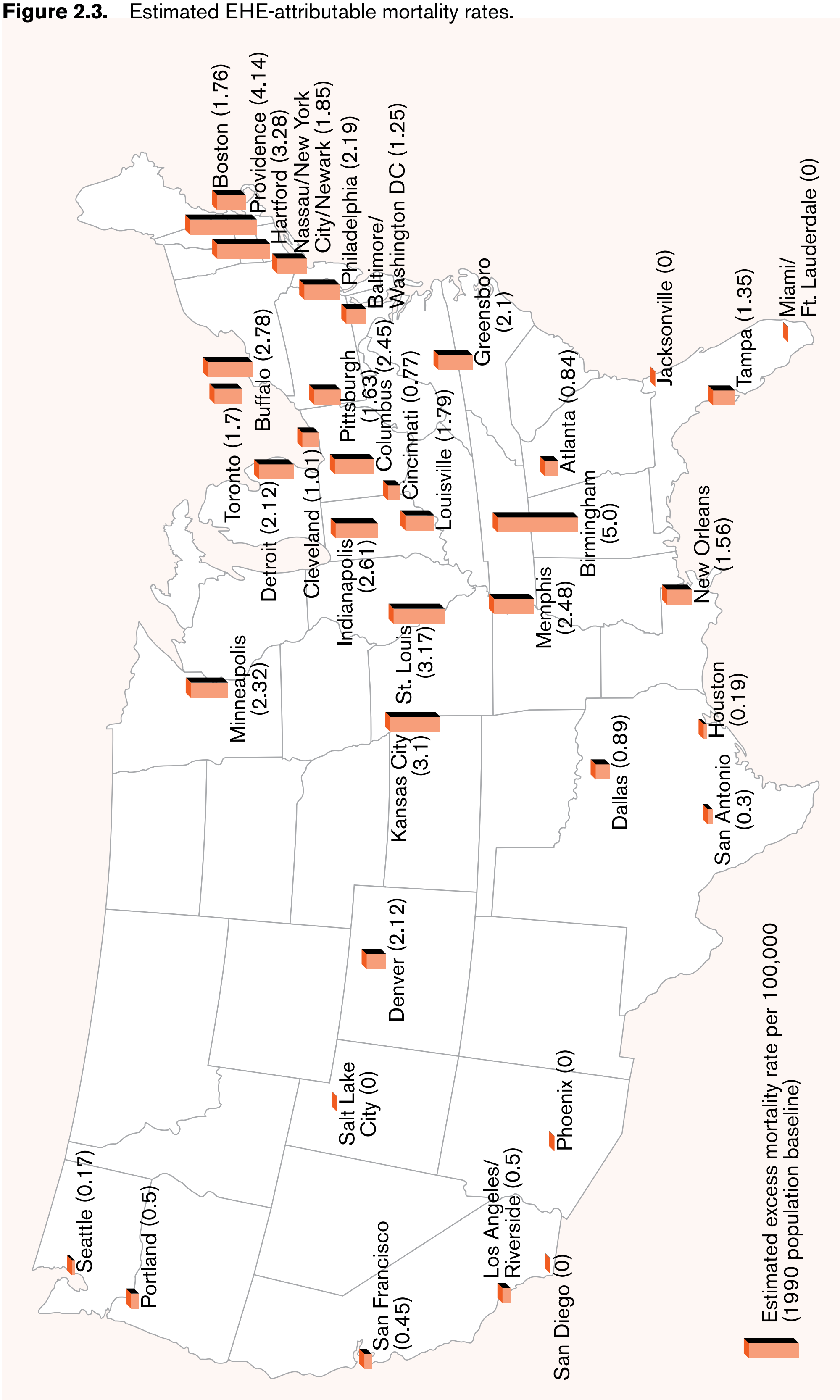
These estimates demonstrate that an EHE in the United States can easily be responsible for hundreds of deaths in a large metropolitan area.

2.3.2 EHEs and U.S. morbidity

EHE morbidity studies are relatively rare because of a lack of suitable daily time-series data. Further, when such studies are attempted, only the most severe morbidity outcomes (emergency room visits and hospitalizations) tend to be evaluated because of the limited number of locations where patients can be seen and be treated.

One of the few U.S. EHE morbidity studies examined Chicago hospital admissions during the July 1995 EHE. Semenza et al. *(1999)* calculated that this EHE was responsible for more than 1,000 hospital admissions, and anecdotal evidence strongly suggests that this EHE increased the incidence of Chicago emergency room visits. Specifically, the *Natural Disaster Survey Report: July 1995 Heat Wave (NOAA, 1995)* reported that on the second day of the EHE, only a few Chicago emergency rooms were directing ambulances to other facilities because of crowding (i.e., operating in bypass status), but by the fourth day, 18 city emergency rooms were doing so.

Figure 2.3. Estimated EHE-attributable mortality rates.



Note: Locations shown with a value of 0 may have deaths that are attributed to excessive heat exposure. This result simply means that there has not been a measurable increase in mortality from any cause during EHEs compared to other summertime periods.

Sources: Original mortality estimates from Kalkstein and Greene (1997). Converted to rates with the 1990 Census population estimates for the SMSAs. Toronto results from personal communication with N. Day, Toronto Public Health (2005).

Chapter 2

In summary, available evidence suggests that EHEs increase morbidity incidence. More complete assessments of EHE impacts, including evaluations of EHE impacts on less severe outcomes, may require carefully designed retrospective surveys in affected populations.

2.4 Identifying Characteristics that Affect EHE Health Risks

Several factors can increase health risks during an EHE: the EHE's meteorological conditions, demographic characteristics, personal behavioral choices, and regional characteristics.

2.4.1 Meteorological conditions

When the weather gets hotter, the risk of losing control of one's internal temperature increases. Heat index tables such as the one in *Table 2.3* are commonly used to capture interactions among several meteorological variables to provide a measure of how hot it feels. Even heat index table results are sensitive, however, to the particular meteorological variables measured. For example, heat index results, including those in *Table 2.3*, often assume measurements are taken in a shaded location with light wind. As a result, most heat index tables also note that exposure to direct sunlight can increase heat index values by up to 15°F. These table notes may also state that exposure to hot dry winds can further increase health risks by promoting rapid dehydration, although a quantitative measure of these conditions' impact is not provided *(NWS Forecast Office, Pueblo, Colorado, 2004)*. Ultimately, a change in any meteorological variable that increases heat index values or promotes dehydration will increase the individual's health risk.

EHE conditions represent a "shock" that can overwhelm typical responses to elevated temperatures. All else being equal, the shock value and the health risks increase the earlier in the summer the EHE occurs *(Kalkstein and Davis, 1989; Sheridan and Kalkstein, 1998)* because residents adapt, to some degree, to warmer summer conditions over the season. Similarly, health risks increase with the duration of the EHE measured as the number of consecutive EHE days *(Greene and Kalkstein, 1996)* and the amount of time spent above minimum temperature thresholds *(Kalkstein and Davis, 1989)*.

Table 2.3. Heat index values (°F)[3, 4]

Temperature (°F)	Relative Humidity (%)					
	90	80	70	60	50	40
80	85	84	82	81	80	79
85	101	96	92	90	86	84
90	121	113	105	99	94	90
95		133	122	113	105	98
100			142	129	118	109
105				148	133	121
110						135

3. Heat index values were not given for the temperature and relative humidity combinations that have blank cells.

4. Heat index values can be up to 15°F higher with exposure to direct sunlight. Heat index values assume calm wind conditions; hot dry winds can also increase heat index values.

Source: NWS Forecast Office, Pueblo, Colorado, 2004.

2.4.2 Demographic sensitivities

Individuals possessing any combination of the following characteristics or conditions are at greater risk for experiencing an EHE-attributable adverse health outcome:

- **Physical constraints:** It is difficult for some people to increase their circulation and perspiration during an EHE to help them remain cool. This at-risk group includes infants, older people (age 65 and older, who may also be less likely to recognize symptoms of excessive heat exposure), the obese, the bedridden, those with underlying medical conditions (e.g., heart disease, diabetes), those taking certain medications (e.g., for high blood pressure, depression, insomnia), and individuals under the influence of drugs or alcohol.

- **Mobility constraints:** People with mobility constraints are at higher risk during EHEs if the constraints limit their ability to access appropriately cooled locations. This group includes the very young and the bedridden.

- **Cognitive impairments:** People with mental illnesses, with cognitive disorders, or under the influence of drugs or alcohol may be unable to make rational decisions that would help limit their exposure to excessive heat or to recognize symptoms of excessive heat exposure.

- **Economic constraints:** The poor may be disproportionately at risk during EHEs if their homes lack air conditioning or they are less likely to use available air conditioning because of the cost *(NWS, 2004)*. In addition, if the poor disproportionately reside in high crime areas, fear of crime can increase their risks by hindering their willingness to take appropriate responses [e.g., opening doors and windows for circulation, visiting cooling shelters *(American Medical Association Council on Scientific Affairs, 1997)*].

- **Social isolation:** Socially isolated individuals are less likely to recognize symptoms of excessive heat exposure. This can delay or prevent treatment and result in more serious health outcomes. Members of this group, which include the homeless and those living alone, may also be less willing or able to reach out to others for help.

2.4.3 Behavioral choices

In addition to demographic characteristics, the choices individuals make during an EHE can have a profound effect on the health risks they face. Examples of personal choices that can increase an individual's health risks during an EHE include the following *(American Medical Association Council on Scientific Affairs, 1997; CDC 2004a,c; NWS, 2004)*:

- **Wearing inappropriate clothing:** Heavy, dark clothing can keep the body hot and limit cooling from evaporation of perspiration. Clothing that exposes skin to the sun increases the risk of sunburn, which limits the potential for evaporative cooling.

- **Failing to stay adequately hydrated:** During EHE conditions, we rely heavily on perspiration to regulate our body temperature. Without enough water consumption, perspiration will be inadequate or even cease and body temperature will rise.

- **Consuming alcohol:** Alcohol is a diuretic and thus limits perspiration. It can also impair judgment and result in excessive exposure to the elevated temperatures.

- **Engaging in outdoor activities:** Any activities that increase exposure to the sun or generate additional body heat (e.g., attending outdoor events, exercising, outdoor labor) increase the amount of body heat that must be dissipated.

- **Eating inappropriate meals:** Eating hot and heavy (e.g., high-protein) foods will increase the metabolic rate and increase the amount of body heat that must be dissipated.

2.4.4 Regional factors

Finally, regional characteristics can help determine an individual's health risks during EHEs. These characteristics include:

- **Geographic location:** Climate variability is largely a function of location, and increased variability has been associated with elevated heat-attributable mortality rates *(Chestnut et al., 1998)*.

- **Urbanization and urban design:** As buildings, especially those with dark roofs, and dark paving materials replace vegetation in urban areas, the heat absorbed during the day increases and cooling from shade and evaporation of water from soil and leaves is lost. Urban areas can also have reduced air flow because of tall buildings, and increased amounts of waste heat generated from vehicles, factories, and air conditioners. These factors can contribute to the development of an urban heat island, which has higher daytime maximum temperatures and less nighttime cooling than surrounding rural areas (see *Figure 2.4*). Urban heat islands can increase health risks during EHEs by increasing the potential maximum temperature residents are exposed to and the length of time that they are exposed to elevated temperatures.

- **Residential location:** Residents on the upper floors of buildings will feel the effects of rising heat. This can elevate room temperatures and make it more difficult to maintain a consistent internal temperature if air conditioning is not available or is not used, or if ventilation is restricted.

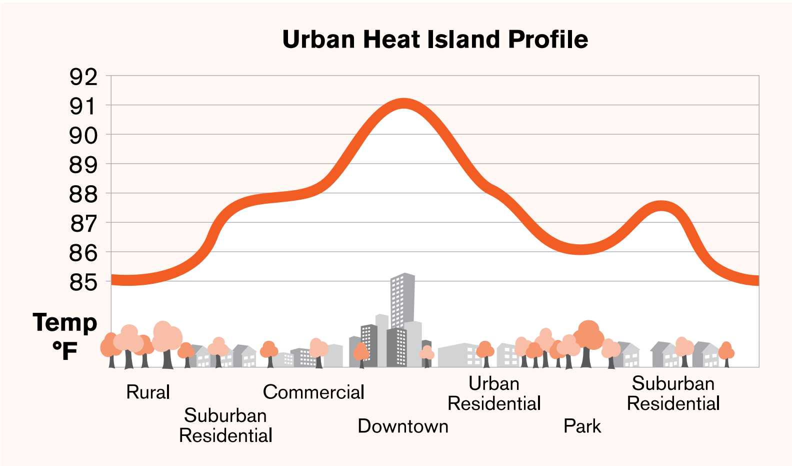


Figure 2.4. Impact of the urban heat island on ambient temperatures.

Source: U.S. EPA, 2006.

Table 2.4 summarizes the factors that increase the risk of an individual getting sick or dying from an EHE.

Table 2.4. Factors that increase an individual's risk of experiencing an EHE-attributable adverse health outcome

Meteorological Characteristics
► Increased temperature
► Increased relative humidity
► Dry, hot winds
Demographic Characteristics
► Physical constraints (including underlying medical conditions)
► Mobility constraints
► Cognitive impairments
► Economic constraints
► Social isolation
Behavioral Choices
► Wearing inappropriate clothing
► Failing to stay adequately hydrated
► Consuming alcohol
► Engaging in outdoor activities
► Eating heavy and/or hot foods
Regional Characteristics
► Living in an area with a variable climate
► Living in an urban area
► Living on the upper floors of buildings

3 Summary of Current EHE Notification & Response Programs

Effective EHE notification and response programs draw on available local resources and recognize local constraints to minimize increases in morbidity and mortality during EHEs. As a result, effective EHE notification and response programs can vary.

This chapter summarizes the current range of observed response actions to EHE conditions. Not all of these actions will be feasible or appropriate for every location. This summary is intended to provide parties wanting to develop or enhance an EHE notification and response program with a "menu" of possible actions to consider.

This summary has a number of caveats. First, the reviewed EHE programs were selected to provide an illustrative rather than all-inclusive set of notification and response actions. As a result, specific actions that are important components of other effective EHE programs may have been omitted. Second, our exclusion of specific actions in this summary is not a judgment on their potential benefit. In fact, developing and evaluating notification and response actions in response to local conditions is strongly encouraged.

This chapter first summarizes actions incorporated in the EHE programs we reviewed. This is followed by narratives that offer insight into how and why the reviewed programs were developed, and summarize critical lessons their administrators have learned over time. The chapter also describes several short-term responses that the city of Phoenix, Arizona, implemented during the EHE in the southwestern and central United States in July 2005. These Phoenix responses are included to highlight actions that can be taken with relatively short notice to address exceptional EHEs even if a formal EHE program has not been developed. Finally, the chapter reviews evidence from studies that have attempted to quantify the impact of EHE notification and response programs. Although limited, such studies provide some perspective on the potential benefits of EHE notification and response programs.

3.1 Elements in Select EHE Programs

On the following page, *Table 3.1* summarizes the actions Philadelphia and Toronto incorporated in their EHE notification and response programs. These programs were selected because they are widely recognized as benchmarks for those considering developing a comprehensive EHE program.

Following *Table 3.1*, the individual elements are described in greater detail.

Table 3.1. Summary of confirmed EHE program elements in Philadelphia and Toronto

Program elements	Philadelphia[5]	Toronto[6]
Prediction see 3.1.1, p. 23		
Ensure access to weather forecasts capable of predicting EHE conditions 1-5 days in advance	✓	✓
Risk assessment see 3.1.2, p. 23		
Coordinate transfer and evaluation of weather forecasts by EHE program personnel	✓	✓
Develop quantitative estimates of the EHE's potential health impact	✓	✓
Use the broader criteria to identify heat-attributable deaths	✓	✓
Develop information on high-risk individuals	✓	
Develop an accessible record on facilities and locations with concentrations of high-risk individuals	✓	✓
Notification and response see 3.1.3, p. 24		
Coordinate public broadcasts of information about the anticipated timing, severity, and duration of EHE conditions and availability and hours of any public cooling centers	✓	✓
Coordinate public distribution and broadcast of heat exposure symptoms and tips on how to stay cool during an EHE	✓	✓
Operate informational phone lines that can be used to report heat-related health concerns	✓	✓
Designate public buildings or specific private buildings with air conditioning as public cooling shelters and provide transportation	✓	✓
Extend hours of operation at community centers with air conditioning	✓	
Arrange for extra staffing of emergency support services	✓	
Directly contact and evaluate the environmental conditions and health status of known high-risk individuals and locations likely to have concentrations of these individuals	✓	✓
Increase outreach efforts to the homeless and establish provisions for their protective removal to cooling shelters	✓	✓
Suspend utility shutoffs	✓	✓
Reschedule public events to avoid large outdoor gatherings when possible	✓	
Mitigation see 3.1.4, p. 26		
Develop and promote actions to reduce effects of urban heat islands	Not evaluated	

5. NOAA, 1995; Kalkstein, 2002.

6. Kalkstein, 2002; personal communications, M. Vittiglio and N. Day, Toronto Public Health, 2005.

3.1.1 EHE prediction

▶ Ensure access to weather forecasts capable of predicting EHE conditions 1-5 days in advance

Forecasting the development and characteristics of an EHE is a critical element of both EHE risk assessment and notification and response activities. In the United States, NWS forecasts provide national coverage, so any location could incorporate this element into an EHE program. Toronto and Philadelphia both use a sophisticated, air mass-based heat health system developed by the Center for Climatic Research at the University of Delaware to evaluate meteorological forecast data in terms of the potential to increase the number of daily deaths above average levels *(Sheridan and Kalkstein, 2004)*.

3.1.2 EHE risk assessment

▶ Coordinate transfer and evaluation of weather forecasts by EHE program personnel

In some locations, EHE program personnel may need to review forecast data to determine whether location-specific criteria for EHE conditions are satisfied and, potentially, how the forecast conditions match with any established EHE severity criteria. Establishing forecast transfer and evaluation protocols involves specifying under what conditions forecasters (e.g., the NWS) forward information to local officials (and confirm receipt) and identifying who within the EHE program reviews and evaluates the information. Alternatively, electronic systems can be established to retrieve and review forecast data from meteorologists and notify EHE program personnel if certain criteria are satisfied.

▶ Develop quantitative estimates of the EHE's potential health impacts

Several locations with EHE notification and response programs, including Philadelphia and Toronto, have integrated heat health watch/warning systems that use meteorological forecast data as inputs to health impact models, which identify when forecast conditions could result in excess mortality and then estimate the potential number or probability of heat-attributable deaths *(Sheridan and Kalkstein, 2004)*. These quantitative health impact estimates are then used in both cities to determine if and what type of heat emergency is declared. These determinations affect the type and scope of notification and response activities that will be implemented.

▶ Use the broader criteria to identify heat-attributable deaths

Medical examiners can use the criteria in Donoghue et al. *(1997)* to define heat-attributable deaths and to provide the public with more accurate reporting of an EHE's health impacts. This information can increase public awareness and appreciation of the health risks of the conditions, which may improve compliance with recommended actions.

▶ Develop information on high-risk individuals

Recognizing that some individuals have an elevated risk facilitates notifying and responding to these individuals (e.g., older individuals, the homeless) to achieve the greatest public health benefit for a given resource commitment. Easily accessible contact information for these individuals during an EHE can help the program prioritize assessment and intervention efforts. In some locations such as Chicago, the development of information on high-risk individuals has been expanded beyond persons known to public agencies. It includes people and organizations who can identify high-risk individuals so they can be a part of any active assessment and intervention program efforts.

▶ **Develop an accessible record of facilities and locations with concentrations of high-risk individuals**

A database or list of high-risk facilities and locations would complement a list of high-risk individuals. This list could help prioritize active assessment efforts during an EHE (e.g., visiting retirement homes) to coordinate EHE notification activities through combinations of fax, email, or telephone contact trees. For example, in Toronto, more than 800 community agencies are notified of EHE conditions through a fax/call-out tree.

3.1.3 EHE notification and response

Coordinate public broadcasts of information about the anticipated timing, severity, and duration of EHE conditions, and availability and hours of any public cooling centers

Effective public notification of forecast EHE conditions helps eliminate the risk of an EHE taking a population by surprise. More specifically, notifying the public of anticipated EHE conditions will enable many residents to prepare and will enable public assessment and intervention actions to concentrate on known high-risk individuals and locations. Likewise, advance public notification about the availability of cooling centers will increase the likelihood that at-risk individuals can take advantage of these services.

▶ **Coordinate public distribution and broadcast of heat exposure symptoms and tips on how to stay cool during EHEs**

Publicly broadcasting cooling tips and symptoms of excessive heat exposure will complement similar broadcasts about forecast EHE conditions and help residents develop appropriate EHE responses (e.g., seek air-conditioned locations, minimize direct sun exposure, reschedule outdoor gatherings). When possible, this action would include providing this information before and throughout the summer to public meeting areas (e.g., churches, recreation centers, libraries, schools), arranging periodic broadcasts through available media, and developing EHE Internet sites.

▶ **Operate informational phone lines that can be used to report heat-related health concerns**

Telephone help lines give real-time advice and information that can help people stay safe and avoid serious outcomes. This phone system either can be activated when an EHE is forecast (e.g., Philadelphia's or Toronto's Heat Lines), or can be a more general, full-time system (e.g., a 311 line) staffed during EHEs by personnel with the information and ability to access and direct other intervention resources (e.g., emergency medical staff) as needed.

▶ **Designate public buildings or specific private buildings with air conditioning (e.g., shopping malls, movie theaters) as public cooling shelters and provide transportation if necessary**

Spending time in an air-conditioned environment during an EHE is one of the most effective means of reducing one's risk of overheating. By designating specific public buildings with air conditioning as cooling shelters, and by providing information on large private buildings with air conditioning where the public can freely congregate (e.g., shopping malls and movie theaters), local officials can increase the awareness and use of these resources to minimize an EHE's health impacts. Providing free public transportation to those locations during an EHE also recognizes that many with the greatest need for the shelters may have limited access to personal transportation and limited financial resources.

▶ **Extend hours of operation at community centers with air conditioning**

Many of those at greatest risk during an EHE may already frequently visit specific air-conditioned public locations (e.g., child care and senior centers). Extending the hours of operation at these and other public locations with air conditioning during EHEs increases the opportunity for high-risk individuals to spend time in an air-conditioned environment.

▶ **Arrange for extra staffing of emergency support services**

EHEs will place additional burdens on emergency medical and social support services through increased activity focused on preventing adverse health outcomes and increased need for medical services. Increasing the staffing of emergency medical and social support services in response to an EHE forecast increases the opportunity to avert some outcomes with intervention and assessment activities or at least have them addressed at an earlier and less severe stage by preventing the emergency medical system from becoming overwhelmed.

▶ **Directly contact and evaluate the environmental conditions and health status of known high-risk individuals and locations likely to have concentrations of these individuals**

High-risk individuals need to be contacted directly and, preferably, observed several times a day during EHEs to ensure that cooling tips are being followed (e.g., fluids are being consumed, appropriate clothing is being worn) and that any symptoms of overexposure are recognized and alleviated as early as possible. This labor-intensive action is offset by a reduction in the number and severity of adverse health outcomes among the high-risk population. The individuals to be contacted and locations to be visited would be identified in the risk assessment component of the EHE program *(see Section 3.1.2)*.

▶ **Increase outreach efforts to the homeless and establish provisions for their protective removal to cooling shelters**

The homeless are vulnerable during EHEs, so additional effort must be devoted to homeless outreach and evaluation during an EHE, especially during the day. This increased outreach effort should be supported by authorization for officials to move individuals believed to be experiencing medical difficulties or at extreme risk to cooling shelters for observation and treatment.

- **Suspend utility shutoffs**
  Suspending utility service during an EHE could significantly increase the risk of exposure to elevated temperatures. As a result, many local governments require local utilities to suspend shutoffs during EHEs if they do not already have their own shutoff suspension guidelines. However, suspending utility shutoffs during an EHE does not ensure that at-risk individuals with access to air conditioning will use it.

- **Reschedule public events to avoid large outdoor gatherings, when possible**
  When an EHE is forecast, there are likely to be previously scheduled outdoor activities involving large gatherings of individuals (e.g., youth league games, outdoor camps, concerts). If these activities take place as scheduled, many people may experience significant heat exposure. To the extent that local officials have control over how these events proceed (e.g., through permits or use of facilities), efforts should be made to reschedule the event or, when rescheduling is not feasible, require more medical staff and "cool zones" for attendees.

3.1.4 EHE mitigation

- **Develop and promote actions to reduce effects of urban heat islands**
  Urban heat islands can increase daytime temperatures and limit nighttime cooling. This can increase the severity and duration of urban residents' exposure to high-heat conditions and increase their risk for experiencing a heat-attributable adverse health outcome. Programs and actions that increase urban vegetation and the reflectiveness of urban surfaces help address this problem.

3.2 Case Studies in the Development and Implementation of EHE Programs

This section uses case studies from Philadelphia, Toronto, and Phoenix to show how different forces can drive the development and implementation of EHE notification and response programs and summarizes the lessons learned over time in these locations. These insights are especially useful because these programs cover a broad geographic spectrum and reflect varying degrees of active program coordination.

3.2.1 Philadelphia

Overview

Philadelphia's EHE notification and response program is often viewed as a benchmark for integrated, urban EHE programs. Philadelphia has a long history of EHE impacts, with references to heat-attributable deaths recorded since colonial times. The development of this program demonstrates how an exceptional meteorological event can combine with seemingly minor bureaucratic adjustments to create significant public interest and support for an EHE notification and response program.

This EHE program's development also demonstrates the importance of institutional support and shows how response actions can be matched to program partners based on their areas of expertise. Finally, the program highlights the benefits of incorporating a system for active program review and adjustment to respond to needs, constraints, and opportunities as they arise.

Development of Philadelphia's EHE program

Philadelphia's EHE notification and response program is a direct response to observable public health impacts from specific EHEs combined with the public recognition of these risks and institutional support to develop an effective response to avoid similar outcomes in the future.

In the summer of 1991, more than 20 deaths in Philadelphia were attributed to excessive heat exposure. In response, the city established and began to convene meetings of a Heat Task Force under the direction of Health Department staff. The Health Department identified original task force participants by informally assessing public and private organizations that served at-risk individuals during an EHE or provided Philadelphia with critical infrastructure and medical services (e.g., electric and water utilities and emergency medical service providers).

The Heat Task Force continued to meet through the spring of 1993, but had made little progress in developing what would be recognized as an EHE notification and response program. Then, from July 4 to July 14, 1993, Philadelphia experienced EHE conditions characterized by minimum daily high temperatures of at least 90°F. By July 6, the risks were apparent and publicly recognized as the city health commissioner announced that people were dying because of EHE conditions.

At the same time, informal discussions between Health Department staff and Southeastern Pennsylvania Red Cross board members led to the establishment of the *Heatline*, a telephone hotline, to handle calls from residents with heat-related questions and concerns. The *Heatline*, which represented the extent of the city's direct response actions to the EHE, operated for five days, and its number was widely reported by local media.

Perhaps the most critical aspect of the July EHE, in terms of its contribution to the development of the current EHE program, was that the city medical examiner broke from requiring a core body temperature in excess of 105°F for listing a death as heat related. Instead, deaths were listed as heat related if the core temperature criterion was satisfied or if a body was "found in an enclosed environment with a high ambient temperature without adequate cooling devices and the individual had been known to be alive at the onset of the heat wave" *(Donoghue et al., 1997)*.

This change resulted in the medical examiner classifying 105 deaths during the July 1993 EHE as heat related. In contrast, for all of July, New York City and Washington, D.C., which had experienced similar meteorological conditions, reported three and two heat-related deaths, respectively, using solely the core temperature criterion.

This finding and its public reporting made the impact of excessive heat in Philadelphia a topic of considerable local and national media interest, including references to Philadelphia as the "Heat Death capital of the world." In addition, the contrast between the number of heat-related deaths reported in Philadelphia and the totals from surrounding counties and other urban centers led to a request by state and other officials for a CDC investigation into the appropriateness of the coding criterion the Philadelphia medical examiner used. The resulting investigation ultimately concluded that the criterion was appropriate and the associated estimates of heat-attributable mortality were accurate.

Following the CDC investigation, and with increased public attention on the health risks of EHE conditions, staff at Philadelphia's Health Department became aware of work under the direction of Dr. Laurence Kalkstein of the University of Delaware to develop a system that would identify weather conditions expected to increase daily mortality. Ultimately, this interest led to the development by the summer of 1995 of a computerized system capable of forecasting EHE conditions up to two days in advance.

Over this period, spurred by the events of 1993, the Philadelphia Heat Task Force began preparing EHE response plans that identified lead agencies, secured formal commitments of support from relevant departments, and worked on developing a system for integrated communications between program participants.

As the July 1995 EHE developed in the Midwest and the scope of its health impact began to emerge (eventually more than 700 deaths in Chicago would be classified as heat related), the Philadelphia Hot Weather-Health Watch/Warning System was announced at a meeting with EPA and Philadelphia Health Department officials. This system was initially implemented as the EHE moved eastward into Philadelphia.

Philadelphia's Hot Weather-Health Watch/Warning System response actions
Philadelphia's initial EHE program implemented combinations of the following actions depending on the predicted severity of the EHE *(NOAA, 1995; Kalkstein et al., 1996)*:

- **Media announcements:** Local news media were notified of any EHE notification made by the health commissioner. Media were also given background information on how to minimize exposure to heat during the event and encouraged to broadcast it as part of any heat-related stories.
- **Buddy system advocacy:** Media messages included recommendations for friends, relatives, neighbors, and block captains (see discussion below) to check on local high-risk residents (e.g., sick and older individuals) throughout the day during the event.
- **Heatline activation:** The same phone system staffed by the Red Cross that was developed for the 1993 EHE was part of the formal program rollout.
- **Home visits by Health Department staff** (currently a county sanitarian and nurse make up each field team)**:** Individuals were identified from calls received on the Heatline.
- **Halt to service shutoffs:** Agreements were reached with the respective utilities that electrical and water service would not be shut off for nonpayment during periods for which the Health Department issued a high heat warning.
- **Increased emergency medical service staffing:** Increased numbers of staff with the city's Fire Department and Emergency Medical Services were on duty for the duration of the high heat period.
- **Increased outreach to the homeless:** Activities that involved identifying homeless individuals and providing shelter were extended to daytime hours to minimize their exposure to the most severe conditions.

- **Cooling shelters/senior refuge:** Hours of operation at air-conditioned senior centers were extended to provide a refuge for those otherwise lacking access to air conditioning.

- **Outreach:** The Heatline phone number was displayed on the Crown Lights display in downtown Philadelphia (an electronic billboard on top of the Philadelphia Electric Company building that is visible over a large area).

Two notable aspects of the Philadelphia Watch/Warning System that warrant additional discussion are its use of block captains and its use of field assessment teams from the Health Department to evaluate high-risk individuals during EHEs.

Philadelphia's block captains are a critical point of interaction between the public and the Health Department during EHEs. Block captains are volunteers elected by residents of their block to help coordinate neighborhood improvement projects with the city. Philadelphia currently has about 5,000 block captains. They can both identify and evaluate the health status of high-risk and hard-to-reach individuals in their residential area during an EHE. Although block captains are not required to contact specific individuals during a declared EHE, anecdotal evidence suggests that many do. Their actions most likely benefit others and, during declared heat events, news crews frequently record and broadcast block captains checking on the status of high-risk individuals in their area, spreading the message to check on those at risk.

The second notable aspect of Philadelphia's program is its coordinated use of field teams composed of city Health Department staff in follow-up visits to at-risk individuals identified from *Heatline* calls. Teams assembled during a declared heat event currently consist of a sanitarian and a nurse who have been temporarily reassigned from their typical duties. This reallocation of staff reflects a belief that a more immediate and more significant public health risk is being addressed.

Adjustments and lessons learned

Since 1995, a number of relatively minor changes have been made in the response elements of Philadelphia's EHE program, including the following:

- Transferring the *Heatline*'s operation from the Red Cross to the Philadelphia Corporation for Aging (PCA) and using the PCA's *Senior Line* number to double as the *Heatline*. When EHEs are announced, the hours of operation for the *Senior Line/Heatline* are expanded from between 8 A.M. and 5 P.M. to between 8 A.M. and midnight.

- Adding nurses to the on-call *Heatline* staff to handle calls with specific medical questions.

- Mailing heat information to block captains to distribute in their areas.

- Increasing the forecast period for the spatial synoptic classification (SSC)-based Heat Health Watch Warning System from 2.5 days (60 hours) to 5.0 days (120 hours).

Philadelphia's experience demonstrates the importance of public recognition of EHE health risks and of continued support from upper levels of government for developing an EHE notification and response program. The city's program also shows that matching responsibilities of program elements with program partners who already perform similar tasks is critical for achieving a wide range of response actions. Specific examples of this matching in the Philadelphia program include shifting the *Heatline* from the Red Cross to the PCA, staffing field teams with temporarily reassigned Health Department personnel, and incorporating the city's existing block captain program to create a community-based buddy system capable of evaluating the status of high-risk individuals.

3.2.2 Toronto

Overview

Toronto is one of several North American locations with an EHE notification and response program that is driven by calculations of potential excess mortality or mortality probability based on forecast meteorological conditions. Toronto Public Health's EHE program uses these results to determine when heat warnings should be issued and what type of message to communicate.

Toronto's EHE program is of special interest because it evolved primarily as a proactive, precautionary response to a perceived public health risk by local politicians. This is in contrast to most of the other highly active and integrated programs, which typically originated as responses to EHEs that triggered recognizable increases in daily mortality and morbidity. In addition, Toronto's program is an example of how an effective program can be developed by drawing general lessons from other locations and tailoring implementation to respond to local opportunities and challenges. Finally, the routine, structured process of performance review, needs assessment, and adjustment of the Toronto EHE program is noteworthy.

Development of the Toronto EHE program

The origins of Toronto's EHE program can be traced to 1998 and the Mayor's Task Force on Homelessness. This effort established a lead role for Toronto Public Health to identify and develop responses to the health issues faced by the city's homeless. In the spring of 1999, the Task Group asked Toronto Public Health to establish temperature thresholds that would be used to initiate health alerts and trigger additional homeless interventions (e.g., increasing daytime staff and efforts to get the homeless indoors).

To address this task, Toronto Public Health staff reviewed information from several EHE programs in the United States, including those in Philadelphia and Chicago. This review increased awareness of the demographic and physical characteristics that increase EHE vulnerability and highlighted the potential for an effective EHE program. Most importantly, this review increased awareness among officials that, although the homeless were especially vulnerable to EHE conditions, the presence of other high-risk subpopulations meant that EHEs should be recognized as a much larger threat to public health.

Development of an EHE prediction system similar to the one used in Philadelphia and several other U.S. cities began in 2000. The Toronto prediction system was completed and became active on June 18, 2001, in time to assist in forecasting the EHE that occurred in August of that year. Initial program elements focused on issuing a media release any time EHE conditions were forecast that contained information about the health risks of the conditions and appropriate responses. These announcements were also used to trigger increased intervention activities directed at the homeless population.

With the program's development, Toronto Public Health also established a Hot Weather Response Committee to develop, monitor, and update its Hot Weather Response Plan. The committee is a partnership of representatives from various city departments and agencies working with potentially vulnerable populations. Every year, before the hot season, the committee discusses and finalizes the contributions and roles each agency will assume during the coming summer. Using a call-out tree, Toronto Public Health coordinates the plan and notifies the committee and a list of more than 800 agencies of an EHE. Each agency and city department implements its part of the plan.

Adjustments and lessons learned

In the fall of each year, the Hot Weather Response Committee meets to assess the performance of the system and program. The focus of this meeting is on identifying areas and items that could be added or improved to enhance the program's performance. This active review process has resulted in these changes to the program:

- Having the Red Cross operate an informational heat-health telephone line during declared heat advisories
- Coordinating the city's emergency medical service (EMS) with the health line to address specific medical questions, conduct follow-up visits with all callers to evaluate conditions in their residences, and to take individuals to cooling centers when needed
- Providing functional drinking water fountains in city parks
- Extending the hours of operation of city pools
- Providing transit tokens to those who have been evaluated by street patrol teams and are found to be in need of a cooling center.

Less formal program adjustments over time have included coordinating with other city officials to evaluate and, when necessary, relax enforcement of certain ordinances to allow compliance with cooling tips provided during EHEs. For example, the city relaxes enforcement of late-night park closure rules, because many residents who lack air conditioning visit Toronto's parks at night during EHE conditions.

Finally, a critical component of the Toronto EHE program has involved working to increase public education and awareness of EHEs and their health risks. To this end, Toronto Public Health holds an annual media event in mid-May at which Health Department, Red Cross, and EMS staff members are available to answer EHE questions from the media.

3.2.3 Phoenix

Summer in Phoenix is, by any measure, hot. Daily high temperatures above 100°F are routine, temperatures up to 110°F are common, and temperatures above 120°F are possible. Although residents over time physically adapt to some extent to Phoenix's high heat, summer conditions can still be quite variable. Despite Phoenix routinely experiencing life-threatening summertime temperatures, studies of excess heat mortality there have consistently found little evidence of any major heat-attributable excess mortality impacts *(e.g., Kalkstein and Greene, 1997; Davis et al., 2003a,b)*.[7]

Although definitive explanations for this result cannot yet be offered, it seems likely that this can be attributed to significant local experience in responding to elevated temperatures, relatively low humidity, extensive access to air conditioning, widespread public recognition of the health risks during EHE conditions, and a willingness to make appropriate adjustments to minimize heat exposure. These findings suggest the importance of having a public that understands the health risks inherent in EHEs and knows how to minimize their health impacts.

Still, in mid-July 2005, much of the southwestern and central United States experienced consecutive days of hot weather that broke all-time high temperature records in many locations. During this period, Phoenix was a focus of media attention because of the duration of the conditions (all but 3 days in the 2-week period through July 21 reached 110°F) and because several deaths were attributed to the heat *(Associated Press, 2005)*. Extreme high temperatures like those experienced in July 2005, however, create potentially life-threatening conditions for anyone experiencing unmitigated exposure, regardless of adaptation. As a result, it is not surprising that the majority of deaths in Phoenix attributed to the heat were of homeless individuals. Phoenix's sudden increase in heat-attributable deaths in July 2005 should be viewed as a reflection of how an exceptionally severe and long-lasting EHE can overwhelm even highly adapted populations.

Before the 2005 summer, Phoenix's EHE program consisted mainly of relying on the local NWS forecast office to predict dangerous conditions and the local media to broadcast warnings and advice for limiting heat exposure. Although Phoenix is covered by an operating SSC-based EHE prediction system, developed with funding by NOAA's NWS and the local electrical utility to help guide utility shutoff decisions, there was minimal interest in incorporating this available information into a broader EHE notification and response program.

Adjustments and lessons learned

Phoenix's public response to the July 2005 EHE conditions largely focused on opening homeless shelters during daytime hours, bringing homeless individuals to these and other locations with air conditioning, and providing donated bottled water. Given the general prevalence of air conditioning in Phoenix, this targeted action may be the most effective approach for limiting the health risks and impacts of an especially severe EHE.

7 *A lack of evidence of a heat-mortality relationship in these studies does not mean that excessive heat is not reported as a contributing factor in deaths in Phoenix during the summer; in fact, heat-related deaths are routinely reported. This finding simply means there has not previously been a measurable increase in all-cause mortality rates in Phoenix when the heat reaches exceptional levels.*

This action also demonstrates how a location that generally lacks a formal EHE program can take immediate steps to reduce the risks and health impacts of an especially severe EHE.

In addition, the July 2005 EHE in Phoenix triggered a review of the county's response plans to EHE warnings issued by the local NWS office. Although this review is ongoing, the revised plan is expected to clearly define a set of actions the county will take after an NWS announcement.

3.3 Evidence on the Performance of EHE Programs

Few studies have evaluated the efficacy of EHE notification and response programs. This reflects the difficulty of developing these studies (e.g., issues in identifying case and control locations and accounting for variation in populations and EHE conditions) and, in many cases, the brevity of existing operating EHE programs.

One study in Philadelphia *(Ebi et al., 2004)* used regression analysis to quantify the impact of publicly announcing forecast EHE conditions on EHE-attributable excess mortality from 1995 to 1998. This study was possible largely because, at the time, the city and the regional NWS forecast office independently evaluated forecast data for anticipated EHE conditions. As a result, during this period there were days when the city's criteria called for an EHE warning but the NWS would not issue one, days when the city's system would suggest a warning be issued and the NWS would issue one, and days when the NWS would issue a warning when the city's system did not call for a warning.

Ebi et al. *(2004)* found that for each day Philadelphia issued an EHE warning based on the SSC system recommendation, expected mortality was reduced by roughly 2.6 lives per day and this mortality reduction was experienced for the 3 days following the last issued heat warning. This result was statistically significant at the 8% level, which the authors note is equivalent to saying there was a 92% chance that the system saved at least one life during this period. It is estimated that the system saved 117 lives during the study period. To place this result in a cost-benefit framework, the authors report an estimated cost, primarily for wages of extra emergency medical staff, of $10,000 for each day a heat advisory is issued. In contrast, EPA routinely assumed a value per avoided statistical life year lost of $6 million in regulatory impact assessments at the time of the study.

The other formal study that examined the effectiveness of EHE programs, Palecki et al. *(2001)*, compared the health impacts of EHEs in 1995 and 1999 in Chicago and St. Louis. The basis for evaluating the effectiveness of EHE programs in this study is provided mainly by the contrast of the impacts of the events in Chicago, which lacked an EHE notification and response program in 1995 but then developed one, which became active in 1999. The authors take care to note that there were differences in the duration, intensity, and meteorological conditions preceding the two EHEs, but they focus primarily on the fact that 700 deaths were attributed to the 1995 EHE in Chicago compared to roughly 100 deaths from the 1999 event. The authors then argue that much of this sharp reduction in mortality can be attributed to the effectiveness of Chicago's EHE program, which, among other actions, included reminding the public of the toll the 1995 EHE had taken to convey the risks of the 1999 conditions.

Additional anecdotal evidence from Philadelphia supports the contention that the city's EHE program has had a beneficial public health impact. Specifically, although more than 100 deaths in Philadelphia were attributed to the July 1993 EHE, the 1995 EHE experienced in the city resulted in only 60-70 heat-attributable deaths after the city's EHE program was implemented that summer *[personal communication, Jerry Libby, Philadelphia Health Promotion Department (retired), September 27, 2005]*. This reduced mortality is even more notable given the higher temperatures and longer duration of the 1995 event.

These results provide limited quantitative evidence that EHE notification and response programs can demonstrably improve public health.

4 Summary Recommendations for EHE Notification & Response Programs

A central theme of this guidebook is the importance of accounting for local conditions and populations when defining EHE conditions and developing and implementing EHE notification and response programs. Despite the recognized difficulty of addressing all combinations of program needs, opportunities, and constraints that users of this guidebook may encounter, general recommendations that draw on available data, research results, and experience with EHE programs can be made.

The foundation for these recommendations is the recognition that EHEs are but one of a much larger group of extreme meteorological events (e.g., blizzards, floods, hurricanes, tornadoes) and anthropogenic conditions (i.e., urban smog) that can adversely affect public health. These recommendations are organized according to data needs and actions that we believe an EHE notification and response program must address to provide public health benefits. Specifically, the recommendations are organized into the following general areas: EHE definition and forecasting, public education and awareness of EHE risk factors and health impacts, EHE response preparation, EHE response actions, and EHE program review and evolution.

Each area has two categories of recommendations. Strongly recommended actions address information or actions we believe an EHE notification and response program must address to help minimize heat-attributable public health impacts. The second category of recommendations offers guidance on additional actions or data development that could enhance the public health effectiveness of an EHE program once the program has addressed the strongly recommended actions.

4.1 EHE Definition and Forecasting

As with notification and response programs for other extreme meteorological events, the effectiveness of an EHE notification and response program will initially be constrained by its ability to define and accurately forecast the relevant meteorological conditions. The recommendations in this section are intended to ensure timely access to locally relevant EHE forecast information.

4.1.1 EHE criteria must reflect local conditions

Many established meteorological criteria are used to determine whether forecast or existing conditions can be labeled as a certain type of extreme meteorological event (e.g., using maximum sustained wind speeds to identify and categorize hurricane conditions). A distinguishing feature for most of these criteria is that they do not vary by location.

In contrast, this guidebook's Technical Working Group (TWG) strongly recommends that EHE criteria be defined based on a review of local meteorological data. For example, a criterion that defines anticipated EHE conditions on all days with a forecast maximum temperature of 100°F or greater would not be useful in locations where this temperature has never been observed or in areas where such temperatures are common. In contrast, a criterion that announces anticipated EHE conditions any time the forecast daily maximum temperature is greater than the 95th percentile value for that day from the past 30 years would allow for variation by location.

Chapter 4

Incorporating evidence of heat-attributable adverse health impacts from analyses of health outcomes and weather conditions can enhance EHE criteria development. Thus analyses of historical meteorological conditions should incorporate available health outcome data (e.g., regression-based analyses of daily mortality as a function of meteorological variables or air masses). Adding additional control variables that have been identified as affecting the number of heat-attributable health outcomes (e.g., time of season, prior EHEs in the season) would enhance the results of these analyses. Further, the results of any enhanced weather-health outcome analyses could be used in a predictive fashion to calculate the potential health impact of forecast conditions. These predictive models could then provide a basis for defining EHE conditions based on predicted changes in health outcomes.

4.1.2 Ensure access to timely meteorological forecasts

An effective EHE notification and response program requires access to reliable meteorological forecasts to provide lead time for implementing program elements.

To forecast EHEs, we strongly recommend that local officials in the United States use and evaluate the meteorological data in the NWS' 5-day regional forecasts.

To enhance EHE forecasting, we recommend developing systems that electronically retrieve and evaluate revised NWS forecast data as they become available. For example, the University of Delaware's Center for Climatic Research has developed automated computer systems for existing EHE notification and response programs that retrieve NWS forecasts as they are updated, assess the forecast data against EHE criteria over the 5-day forecast period, and notify EHE program managers when EHE criteria are satisfied.

The TWG also recommends that cities not use surveillance-based systems as the primary means for identifying EHE conditions. Specifically, systems that rely on observable increases in the demand for medical services such as ambulance calls or demand for emergency room services to identify EHE conditions are not recommended. Although such systems may have a role in determining appropriate resource allocation during an EHE, they are of little value as a forecast tool because they do not provide the necessary lead time for implementing EHE responses.

4.2 Public Education and Awareness of EHE Risk Factors and Health Impacts

A significant source of the public health impacts of EHEs is that individuals either fail to adequately recognize the danger associated with EHE conditions or make poor response choices during EHEs. This is tragically reflected by conclusions that most EHE-attributable deaths are preventable *(CDC, 2004a,c)*. This conclusion also suggests that there is a significant need for continued and enhanced public education about the EHE-attributable risks and health impacts.

4.2.1 Increase and improve EHE notification and public education

The TWG strongly recommends there be a formal system for notifying the public when EHE conditions are forecast. At a minimum, announcements made using this system should include information on the anticipated arrival, duration, and severity of the forecast EHE. In addition, these announcements need to provide the public with information about critical EHE risk factors (e.g., being very young or old, using certain medications, having physical or mental impairments that restrict mobility, or lacking the ability to respond to environmental changes), the symptoms of excessive heat exposure, and recommended response actions (e.g., seek air-conditioned locations, stay hydrated). These announcements can be conveyed to the public through usual methods such as television, radio, and newspapers, and by using established health alert networks such as those operated by some state health departments (e.g., Minnesota). EHE information could also be periodically distributed through other avenues such as fliers in newspapers, local magazines, and church and civic group literature at the start of and periodically throughout the EHE season. Announcements should describe basic precautionary steps individuals can take to limit the health risks: stay hydrated; spend time in air-conditioned environments; wear loose-fitting, light-colored clothing; check on individuals with high-risk characteristics *[see Rudnick (2002) and U.S. EPA Aging Initiative (2004) for more detailed information]*. The announcements should also suggest appropriate responses when symptoms of excessive heat exposure are observed.

One way to enhance the public education program for EHE risks, impacts, and personal response strategies is to repeatedly present a clear and consistent message to varied audiences. An example of such an effort is Toronto Public Health's hosting of an EHE media day each May before the start of the summer heat season. During this event, Toronto Public Health provides the media with information about the city's EHE notification and response program and answers questions about the health risks and impacts of EHEs. This event maintains media interest in the program and generally results in reporting that keeps EHEs in the public's eye.

An example of another broad-based educational activity that could be pursued is EHE education programs for schools. These programs would help inform a vulnerable segment of the population about risks and appropriate responses and could potentially provide an effective means of having central messages repeated and adopted by a range of households.

EHE education should also be specifically directed at first responders and local emergency management personnel as well as to those who care for older individuals, the very young, the homeless, and the physically and mentally challenged. This targeted education would inform critical response personnel and caregivers about the health risks EHEs pose to members of the vulnerable groups they look after and emphasize the need for active assessment and intervention to prevent adverse health outcomes.

4.2.2 Provide information on proper use of portable electric fans during EHEs

The TWG also strongly recommends that, as part of a public education program, cities emphasize that portable electric fans are not the simple cooling solution they appear to be. Because of the limits of conduction and convection, using a portable electric fan alone when heat index temperatures exceed 99°F actually increases the heat stress the body must respond to by blowing air that is warmer than the ideal body temperature over the skin surface *(American Medical Association Council on Scientific Affairs, 1997; CDC, 2004c)*. In these conditions, portable electric fans provide a cooling effect by evaporating sweat. The increased circulation of hot air and increased sweat evaporation can, however, speed the onset of heat-attributable conditions (e.g., heat exhaustion).

Thus, portable electric fans need to be used with caution and under specific circumstances during an EHE, such as exhausting hot air from a room or drawing in cooler air through an open window. Generally, portable electric fans may not be a practical and safe cooling mechanism during an EHE in homes that are already hot and are not air-conditioned; their use should be discouraged unless the fans are bringing in significantly cooler air from outside the dwelling. If a resident must stay in these dwellings, and if they are unable to access an air-conditioned environment, safer cooling approaches would include taking frequent cool showers and drinking cool, nonalcoholic fluids (e.g., ice water). Because of the importance of this issue, and the contradictory messages people may have received about using portable electric fans during EHEs, Appendix B provides a series of guidelines for fan use during EHEs.

Finally, public officials should review the various educational messages about EHEs for consistency with other messages and information on other issues. For example, recommendations against letting cars idle to control ozone concentrations would be inconsistent with EHE recommendations to stay in air-conditioned environments whenever possible. Public officials can recognize any potentially conflicting messages and then make clear statements about which message should take precedence during an EHE.

4.3 EHE Response Preparation

Preparations for an EHE can be distinguished according to when they are initiated relative to the development of the EHE. Long-term preparations address actions that need to be initiated well before an EHE is forecast because of the time needed to reach necessary agreements, develop systems, or secure supplies and personnel. Short-term preparations are actions that need to be taken when a multiday forecast anticipates EHE conditions. This section focuses on long-term preparations; *Section 4.4* covers short-term preparation actions.

4.3.1 Develop a clear plan of action identifying roles and responsibilities

Defining the structure, relationships, and responsibilities for those supporting an EHE notification and response program (e.g., health departments, utilities, homeless advocates) is an essential long-term action. More generally, this action requires establishing a means for planning and communication among the program supporters so that available resources are used most efficiently and potentially conflicting messages from program participants are clarified.

To achieve this coordination, the TWG strongly recommends establishing periodic meetings among program participants, distributing materials electronically, and designating points of contact for each participating group or agency. Variations across locations in the structure and expertise of agencies and the presence of different private organizations make it problematic to offer specific recommendations about recommended organizational structures for an EHE program. However, because EHEs are a threat to public health, relevant public health agencies can and should play a significant, but not necessarily the lead, role in developing and managing an EHE program. In addition, local emergency management agencies, street and sanitation departments, and health code enforcement staff typically have significant contact with the public. As a result, their information distribution networks and staffs could, depending on local conditions, be a valuable resource to consider in EHE response planning.

Finally, nonprofits such as the Red Cross, homeless outreach programs, area agencies on aging, and senior centers should be actively recruited to become EHE program partners to incorporate their expertise in identifying, communicating with, and providing services to populations that are at high risk during EHEs.

When developing a plan of action, we also strongly recommend EHE program partners pay particular attention to the potential for public recommendations that could conflict during an EHE and provide clear guidance regarding priorities. For example, environmental organizations may generally recommend against idling cars for extended periods of time to improve air quality. This message could be modified to note that if idling is necessary to stay in an air-conditioned environment during an EHE, it is acceptable and preferable to exposing the occupants to the heat.

4.3.2 Develop long-term urban planning programs to minimize heat island formation

Although not the focus of this guidebook, the TWG strongly recommends urban design and development programs be reviewed with a goal of promoting actions that will help control the development of urban heat islands. The longer timeframes envisioned for implementing any actions result in these actions being viewed as part of the EHE preparation actions. However, effective implementation of specific actions designed to mitigate urban heat islands, such as programs to increase the reflectiveness of urban surfaces, increase urban vegetation, and modify behavior, is likely to require a significant public education component.

4.4 EHE Response Actions

This section covers activities that should be initiated after meteorological forecasts identify an impending EHE or EHE conditions have been announced. Four essential recommendations involve these short-term EHE response actions:

- The public should be encouraged to spend time in available air-conditioned buildings (e.g., shopping centers, movie theaters, senior centers, libraries). To the extent these types of buildings have air conditioning, they are also generally capable of accommodating sudden increases in public use for short periods of time (e.g., a few days) without significant difficulty.

- EHE program partners should reallocate resources to address critical short-term needs of the EHE that are likely to provide a significant public health benefit. For example, this could involve shifting some public health inspectors from inspecting dining facilities to visiting nursing homes or supporting home environment assessments for individuals who may call available non-911 help lines. Other examples could include having homeless agencies emphasize providing daytime services and interventions during the EHE instead of nighttime services when conditions will generally be cooler.

- Once a forecast for EHE conditions has been aired, the locality should prohibit the suspension of electric and water services. For this reason, all meetings related to the EHE program should include representatives from local utility companies who have been solicited as program partners.

- Local medical examiners should be directed to use the guidelines set forth by Donoghue et al. *(1997)* for classifying heat-related deaths. Although statistical analyses of total daily mortality can and should be used to identify and quantify increases in mortality attributable to the EHE, using the Donoghue et al. guidelines will improve the accuracy of estimates of heat-attributable deaths for those who base these estimates solely on the information from death certificates.

Additional recommendations for response actions that could provide additional public health benefits include:

- Conducting direct assessments of high-risk individuals during EHEs to check for signs of excessive heat exposure

- Increasing the extent and duration of public access to air-conditioned settings

- Increasing the capacity of the emergency medical system to respond to increased surveillance and treatment demands.

Each of these additional recommendations for enhancing short-term responses is discussed below.

EHE health risks are not equally distributed among the population. Therefore, the TWG recommends that enhanced program responses include direct assessments of the health and environments of those at greatest risk during the EHE. Increasing home visits, using telephone check-in systems, and operating toll-free lines to provide advice or receive reports of concerns can alert EHE program staff to individuals who may be at the greatest risk or experiencing health problems during the EHE and help avoid more serious health outcomes.

Spending time in an air-conditioned environment has long been recognized and advocated as the most effective means of preventing heat-attributable health impacts during an EHE. To increase the potential time spent in air-conditioned locations, we also recommend the hours of operation and number of air-conditioned locations (e.g., senior centers, libraries) made publicly available be increased during an EHE. Providing free transportation to these locations could also increase their use.

Finally, regardless of the extent of preparations and response implemented for an EHE, it is likely that the onset of EHE conditions will result in an increase in the demand for emergency medical services in the form of 911 calls, visits to emergency room facilities, and increased volume and need for medical examiner staff and services. The TWG therefore recommends additional staffing of emergency medical personnel to increase the number of people who can receive treatment at any given time, reduce waiting times for treatment, or both. Existing local and state mutual aid agreements and state emergency medical assistance compacts as well as the resources of state and local emergency management agencies, the Federal Emergency Management Agency, the Medical Reserve Corps, and the National Disaster Medical System may be available to help meet some of these needs. The applicability and availability of these resources need to be evaluated, however, and contacts must be established before the onset of EHE conditions.

Appendix C provides one-page summaries of the critical actions individuals and EHE program partners can and should take once EHE conditions are forecast or are being experienced.

4.5 Review EHE Programs to Address Changing Needs, Opportunities, and Constraints

Over time, the constraints and opportunities faced by an EHE notification and response program will shift and experience will be gained in developing working relationships between program partners and in responding to different types of meteorological conditions. Finally, the relative importance of EHEs as a public health threat could change over time.

As a result, the TWG strongly recommends establishing a regular and formal review of the program's performance. For example, in the fall, when the risk of an EHE has diminished, program partners should evaluate past performance and make recommendations to improve the notification and response program. Alternatively, hypothetical "table-top" exercises could be conducted that allow program partners to work through how they would respond to alternative EHE scenarios in order to identify problems with current preparation and response activities and develop solutions.

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Appendix B: Use of Portable Electric Fans During Excessive Heat Events

The widespread availability and ease of using portable electric fans draw many people to use them for personal cooling during an EHE. Portable electric fans can, however, increase the circulation of hot air, which increases thermal stress and health risks during EHE conditions.

As a result, portable electric fans need to be used with caution and under specific circumstances during an EHE. Here is a list of Do's and Don't's for their use:

Do

- Use a portable electric fan in or next to an open window so heat can exhaust to the outside (box fans are best).
- Use a portable electric fan to bring in cooler air from the outside.
- Plug your portable electric fan directly into a wall outlet. If you need an extension cord, check that it is UL (Underwriter Laboratories) approved in the United States or CSA (Canadian Standards Approved) approved in Canada.

Don't

- Use a portable electric fan in a closed room without windows or doors open to the outside.
- Believe that portable electric fans cool air. They don't. They just move the air around and keep you cool by helping to evaporate your sweat.
- Use a portable electric fan to blow extremely hot air on yourself. This can accelerate the risk of heat exhaustion.
- Use a fan as a substitute for spending time in an air-conditioned facility during an EHE.

If you are afraid to open your window to use a portable electric fan, choose other ways to keep cool (e.g., cool showers, spend time in an air-conditioned location).

Sources: Philadelphia Office of Mental Health & Mental Retardation, 2002; Toronto Public Health, 2002.

Quick Tips for Responding to Excessive Heat Events

For the Public

Do

- Use air conditioners or spend time in air-conditioned locations such as malls and libraries
- Use portable electric fans to exhaust hot air from rooms or draw in cooler air
- Take a cool bath or shower
- Minimize direct exposure to the sun
- Stay hydrated – regularly drink water or other nonalcoholic fluids
- Eat light, cool, easy-to-digest foods such as fruit or salads
- Wear loose fitting, light-colored clothes
- Check on older, sick, or frail people who may need help responding to the heat
- Know the symptoms of excessive heat exposure and the appropriate responses.

Don't

- Direct the flow of portable electric fans toward yourself when room temperature is hotter than 90°F
- Leave children and pets alone in cars for any amount of time
- Drink alcohol to try to stay cool
- Eat heavy, hot, or hard-to-digest foods
- Wear heavy, dark clothing.

Useful Community Interventions

For Public Officials

Send a clear public message

- Communicate that EHEs are dangerous and conditions can be life-threatening. In the event of conflicting environmental safety recommendations, emphasize that health protection should be the first priority.

Inform the public of anticipated EHE conditions

- When will EHE conditions be dangerous?
- How long will EHE conditions last?
- How hot will it FEEL at specific times during the day (e.g., 8 A.M., 12 P.M., 4 P.M., 8 P.M.)?

Assist those at greatest risk

- Assess locations with vulnerable populations, such as nursing homes and public housing
- Staff additional emergency medical personnel to address the anticipated increase in demand
- Shift/expand homeless intervention services to cover daytime hours
- Open cooling centers to offer relief for people without air conditioning and urge the public to use them.

Provide access to additional sources of information

- Provide toll-free numbers and Web site addresses for heat exposure symptoms and responses
- Open hotlines to report concerns about individuals who may be at risk
- Coordinate broadcasts of EHE response information in newspapers and on television and radio.

Excessive Heat Events Guidebook

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