WORLD HEALTH ORGANIZATION
EUROPE

HEAT-HEALTH ACTION PLANS

Guidance

Edited by: Franziska Matthies,
Graham Bickler,
Neus Cardeñosa Marín,
Simon Hales

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ABSTRACT

Climate change is leading to variations in weather patterns and an apparent increase in extreme weather events, including heat-waves. Recent heat-waves in Europe have led to a rise in related mortality but the adverse health effects of hot weather and heat-waves are largely preventable. Prevention requires a portfolio of actions at different levels, including meteorological early warning systems, timely public and medical advice, improvements to housing and urban planning and ensuring that health care and social systems are ready to act. These actions can be integrated into a defined heat–health action plan. This guidance results from the EuroHEAT project on improving public health responses to extreme weather/heat-waves, co-funded by the European Commission. It explains the importance of the development of heat–health action plans, their characteristics and core elements, with examples from several European countries that have begun their implementation and evaluation.

Keywords
CLIMATE – adverse effects
DELIVERY OF HEALTH CARE – organization and administration
RISK MANAGEMENT
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ABBREVIATIONS

General terms, organizations, projects

CECAT	Centre d'Emergències de Catalunya [Emergency Centre of Catalonia] (Spain)
COPD	chronic obstructive pulmonary disease
DG SANCO	Directorate-General for Health and Consumer Affairs (European Commission)
ECMWF	European Centre for Medium-Range Weather Forecasts
EuroHEAT	Project coordinated by the WHO Regional Office for Europe and co-funded by the European Commission (DG SANCO) on improving public health responses to extreme weather/heat-waves
GP	general practitioner
HHWS	heat–health warning system
HPA	Health Protection Agency (United Kingdom)
ICD	International Classification of Diseases
InVS	Institut de Veille Sanitaire [French Institute for Public Health Surveillance] (France)
IPCC	Intergovernmental Panel on Climate Change
NHS	National Health Service (United Kingdom)
NIEH	National Institute of Environmental Health (Budapest, Hungary)
PHEWE	Project funded by the European Union on the "Assessment and Prevention of acute Health Effects of Weather conditions in Europe"
POCS	Pla d'actuació per prevenir els efectes de l'onada de calor sobre la salut [Action Plan to Prevent the Effects of a Heat-Wave on Health]
PROCICAT	Pla Territorial de Protecció Civil de Catalunya [Territorial Plan of Civil Protection of Catalonia]

Technical terms

CI	confidence interval
litre/min	litres per minute
mmHg	unit of pressure equal to one millimetre of mercury
mmol/l	millimolars per litre
NO_2	nitrogen dioxide
PM_{10}	particulate matter with a diameter under 10 μm
SO_2	sulfur dioxide
$Tapp_{max}$	maximum apparent temperature
T_{min}	minimum temperature

FOREWORD

At the Fourth Ministerial Conference on Environment and Health in 2004, European ministers of health and the environment recognized that "the climate is already changing and that the intensity and frequency of extreme weather events, such as floods, heat-waves and cold spells, may change in the future. Recent extreme weather events caused serious health and social problems in Europe, particularly in urban areas".[1] The Intergovernmental Panel on Climate Change (IPCC) projects that heat-waves will increase in number, intensity and duration over most land areas in the 21st century.[2] This trend will increase the risk of heat-related mortality and morbidity, especially for the elderly, chronically ill, very young and socially isolated individuals. The changes are expected to be particularly relevant to cities, especially in central, eastern and southern Europe, which already experience heat-waves. Regions that are currently not used to heat-waves will also begin to experience them, however.

Heat-related health impacts are largely preventable if populations, health and social care systems and public infrastructure are prepared. Health systems need to strengthen their stewardship functions and capacity to work with other sectors in a proactive, multidisciplinary and multisectoral approach with governments, agencies and international organizations. Actions within the health system may include (i) strengthening health security; (ii) advocating health through other sectors; (iii) sharing good practice in intersectoral action; (iv) building capacity in the health workforce; (v) providing intelligence; and (vi) setting an example by "greening" the health services.

Recommendations in this publication are based on results of the two-year project on improving public health responses to extreme weather/heat-waves (EuroHEAT). The project started in 2005 as part of the implementation of the WHO Fourth Ministerial Conference on Environment and Health and the European Environment and Health Action Plan 2004–2010 (European Commission). The project was co-funded by the Directorate-General for Health and Consumers (DG SANCO) of the European Commission and around 100 scientists, scientific advisers, meteorologists, environmental scientists and policy advisers from 20 countries contributed to the project.

This publication addresses policy-makers in the health sector as well as medical professionals. It describes the general principles and core elements of national or regional heat–health action plans, gives options and models for interventions and practical examples and tools from various European countries. These suggestions for countries need to be scrutinized for their respective feasibility and applicability on a national or regional basis and may need to be adapted accordingly. We hope that this guidance will help to develop and implement effective heat–health action plans.

Nedret Emiroglu
Director a.i.
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1 *Declaration* (2004). Copenhagen, WHO Regional Office for Europe, 2004 (EUR/04/5046267/6; http://www.euro.who.int/document/e83335.pdf, accessed 28 March 2008).

2 IPCC (2007). Summary for policymakers. In: ML Parry et al., eds. *Climate change 2007: impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, Cambridge University Press:7–22.

FOREWORD

The health effects of climate change have become a growing area of political and public concern throughout Europe and across the globe. Despite the great efforts made by the European Community and governments worldwide towards effective mitigation, the rapid changes in climate conditions suggest an urgent need for adaptation measures to prevent the negative effects of climate change on health.

The severe health effects, demonstrated by the sharp increase in mortality and hospitalization observed in Europe during the heat-waves of 2003, underline the importance of being prepared. The project on improving public health responses to extreme weather events (EuroHEAT), co-funded by the European Commission public health programme, has demonstrated that most health effects during heat-waves are preventable.

The challenge is to be prepared for the future and to ensure that our actions are sustainable. This guidance on heat–health action plans has been prepared to help Member States to overcome this challenge.

I would like to thank the World Health Organization for producing this guidance and I hope it will be widely used as a contribution towards the protection of citizens' health.

Andrzej Jan Rys
Director of Public Health and Risk Assessment
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EXECUTIVE SUMMARY

Public health outcomes of hot weather and heat-waves depend upon the level of exposure (frequency, severity and duration), the size of the exposed population and the population sensitivity. Heat-waves and hot weather kill and can aggravate existing health conditions. Health effects can appear in all age groups and as a result of a wide range of factors; however, some people are more at risk of heat-related illness and death than others. Variations in risk are related to individual conditions, the level of exposure to hot weather and heat-waves and the ability to adapt to hot weather conditions.

Adverse health effects of hot weather and heat-waves are largely preventable. Prevention requires a portfolio of actions at different levels: from health system preparedness coordinated with meteorological early warning systems to timely public and medical advice and improvements to housing and urban planning. These actions can be integrated in a defined heat–health action plan. There are several principles that should be used in planning for and responding to heat-waves. These are mainly drawn from the general principles of emergency response.

Use existing systems and link to general emergency response arrangements. Many of the approaches to planning for and responding to heat-waves draw on generic emergency planning models. As a rule, creating new systems runs the risk that lessons learnt elsewhere will not be applied and, in crises, tried and tested command and control mechanisms work best. Therefore, it is advisable to use existing local, regional and national systems for emergency response in the planning and response phases of heat-waves.

Adopt a long-term approach. Responding to an emergency is not enough. It is important to plan on a long-term basis to prevent as well as to prepare. For heat-waves, there are important long-term actions that aim to reduce the scale of climate change and others that aim to reduce its impact by adapting the built environment. Both of these are covered in this plan.

Be broad. Nearly all emergency plans require a multi-agency and intersectoral approach, and this is also the case for heat-waves. While many of the actions fall to the health sector, active involvement of other sectors is essential.

Communicate effectively. The effectiveness of any action plan depends on the ability of policy-makers and those responsible for implementation to deliver useful, timely, accessible, consistent and trustworthy information to their target audience and especially to high risk populations. Unfortunately, examples abound of communication failures which have delayed action, undermined public trust and compliance and resulted in unnecessary harm.

Ensure that responses to heat-waves do not exacerbate the problem of climate change. This is an important and heat-wave-specific principle. It would be easy to assume that the solution is widespread use of air conditioning – and there is little doubt that air conditioning can be protective for vulnerable populations. However, air conditioning is energy intensive and adds to greenhouse gas emissions; and there are many ways of adapting the environment and buildings and protecting individuals that are not energy intensive.

Evaluate. This is a key public health principle. The section on evaluation describes why it is difficult to evaluate the effectiveness and appropriateness of heat–health action plans. However, if plans and their implementation are not evaluated, they will not improve and it will be impossible to learn from each year's experience.

Drawn from existing heat–health action plans and literature, core elements for the successful implementation of heat–health action plans are:

- **agreement on a lead body** (to coordinate a multi-purpose collaborative mechanism between bodies and institutions and to direct the response if an emergency occurs);
- **accurate and timely alert systems** (heat–health warning systems trigger warnings, determine the threshold for action and communicate the risks);
- **a heat-related health information plan** (about what is communicated, to whom and when);
- **a reduction in indoor heat exposure (medium- and short-term strategies)** (advice on how to keep indoor temperatures low during heat episodes);
- **particular care for vulnerable population groups;**

- **preparedness of the health and social care system** (staff training and planning, appropriate health care and the physical environment);
- **long-term urban planning** (to address building design and energy and transport policies that will ultimately reduce heat exposure);
- **real-time surveillance and evaluation**.

These elements are not sequential, though some are primarily about planning and others more about response. Implementation of the plan and its elements can be seen as being divided into a disaster planning cycle:

- longer-term development and planning;
- preparation before the summer (pre-summer);
- prevention during the summer (summer);
- specific responses to heat-waves;
- monitoring and evaluation.

Recommendations are intended as suggestions to be scrutinized for their respective feasibility and applicability on a national or regional basis and may need to be adapted accordingly. Chapter 1 explains the importance of the development of heat–health action plans. Chapter 2 goes on to outline the physiological effects of heat on health, explains which population groups are most at risk and describes the interaction between heat and air pollution. The characteristics of an overall heat–health action plan are described in Chapter 3 and the core elements are dealt with in more detail. Each core element is illustrated with specific examples from European countries. More detailed information on key messages for target audiences and medical advice and treatment practices can be found in the annex. Throughout the publication reference is made to the chapters of the forthcoming EuroHEAT monograph, *Preparedness and response to heat-waves in Europe, from evidence to action. Public health response to extreme weather events*, to be published by the WHO Regional Office for Europe, in which the technical background information elaborated by the individual work packages of the project is presented in detail (including scientific literature and research results).

For further information please see the Regional Office web site (http://www.euro.who.int/globalchange).

1. INTRODUCTION

1.1. Climate change, heat-waves and public health responses

Climate change is leading to variations in weather patterns and an apparent change in extreme weather events, including heat-waves (IPCC, 2007). Recent heat-waves in Europe have led to a rise in related mortality but the adverse health effects of hot weather and heat-waves are largely preventable. Prevention requires a portfolio of actions at different levels: from health system preparedness coordinated with meteorological early warning systems to timely public and medical advice and improvements to housing and urban planning. These actions can be integrated in a defined heat–health action plan. Many European countries have taken action mainly by developing and implementing heat–health action plans. However, the death toll in summer 2006 showed that there are still gaps in implementation and that many European countries have not yet developed sufficient actions.

1.2. How to use this guide

This guidance gives models and tools based on research results, experience and lessons learnt. They are intended as suggestions to be scrutinized for their respective feasibility and applicability and may need to be adapted according to local needs. The publication is aimed at ministries of health and regional and local health authorities to support them in designing, improving and implementing heat–health action plans to prevent the negative effects on health caused by heat and heat-waves.

Chapter 2 outlines the short-term relationship between heat and health, explains which population groups are most at risk and describes the interaction between heat and air pollution. The general principles and characteristics of national and regional heat–health action plans are described in Chapter 3 and all core elements are dealt with in more detail. Each core element is illustrated with specific practical examples from European countries (in text boxes) and more detailed information on key messages for target audiences.

Medical advice and treatment practices can be found in the annex. These information sheets can be printed off together or separately, as required. They reflect the current level of evidence and can be used as a basis for the development of information materials for the general public, medical professionals and health services. They should be adapted to the national, regional or local context.

Throughout the publication, reference is made to the chapters of the forthcoming EuroHEAT monograph, *Preparedness and response to heat-waves in Europe, from evidence to action. Public health response to extreme weather events*, in which the technical background information is presented in detail (including scientific literature and research results). This first volume of the forthcoming WHO monograph series on public health responses to extreme weather and climate events tackles the challenges of heat-waves. Recommendations are based on the results of the two-year EuroHEAT project, co-funded by the European Commission (DG SANCO).

Countries are invited to consider this guidance as a proposal and to share their comments and experiences. Further information can be obtained from the Regional Office web site (http://www.euro.who.int/globalchange).

2. HEAT AND HEALTH

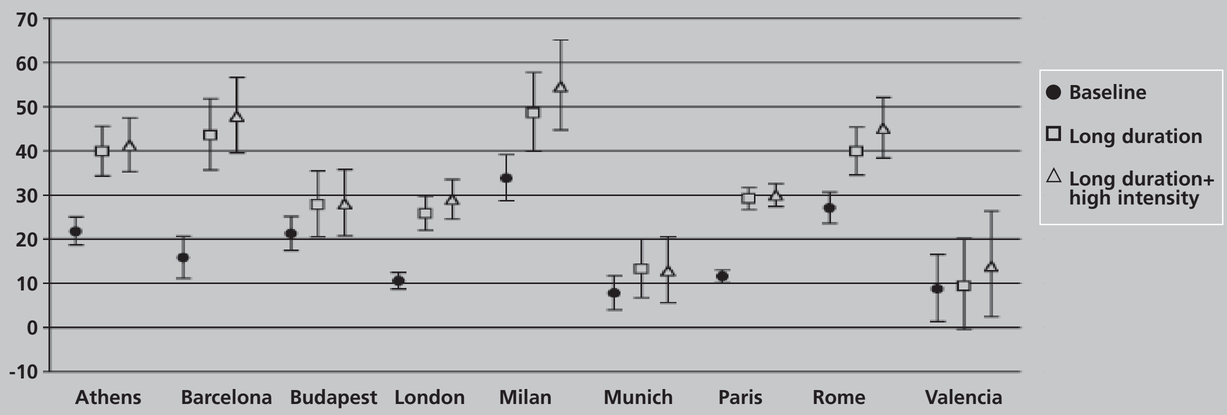
2.1. Short-term relationships between temperatures and health outcomes

Population health outcomes of hot weather and heat-waves depend upon the level of exposure (frequency, severity and duration), the size of the exposed population and the population sensitivity. It is therefore not surprising that the relationship between daily weather and health varies between populations and between studies. For a given city or region there is a general pattern of increase in the number of daily deaths above and below an optimum range of temperatures.

As part of the PHEWE project to assess and prevent acute health effects of weather conditions in Europe, a study of 15 European cities (Michelozzi et al., 2007) estimated an increase in mortality for every 1 °C increase in maximum apparent temperature of about 2% (95% confidence interval (CI): 0.06–3.64) in northern cities and about 3% (95% CI: 0.60–5.72) in the south (Baccini et al., in press). A heat-wave is a prolonged period with an unusually high heat load and, in the EuroHEAT project, this was defined as a period when maximum apparent temperature ($Tapp_{max}$)[3] and minimum temperature (T_{min}) are over the ninetieth percentile of the monthly distribution for at least two days. Applying this definition, the percentage increase in mortality during the heat-wave episodes was estimated at between 7.6% and 33.6% in the nine European cities. Results show a high heterogeneity of the effect between cities and populations (Michelozzi et al., in press).

The EuroHEAT study also classified heat-waves in terms of intensity and duration and those of higher intensity and duration were generally more dangerous. The heat-wave effect was stronger in the elderly and the highest increase in mortality was observed in Athens, Budapest, London, Rome and Valencia, in persons over 75 years old (Fig. 1). In all cities, the impact of heat-waves on mortality was higher among females than among males. For subsequent heat-waves, those occurring after a short time interval

Fig. 1. Effect of heat-waves with different characteristics on total mortality among people aged 65+ (% increase and 90% CI)



Source: Michelozzi et al., in press.

[3] Apparent temperature is a measure of relative discomfort due to combined heat and high humidity. It was developed by Steadman (1979) on the basis of physiological studies on evaporative skin cooling and can be calculated as a combination of air temperature (Temp) and dew point (Dew) in °C.

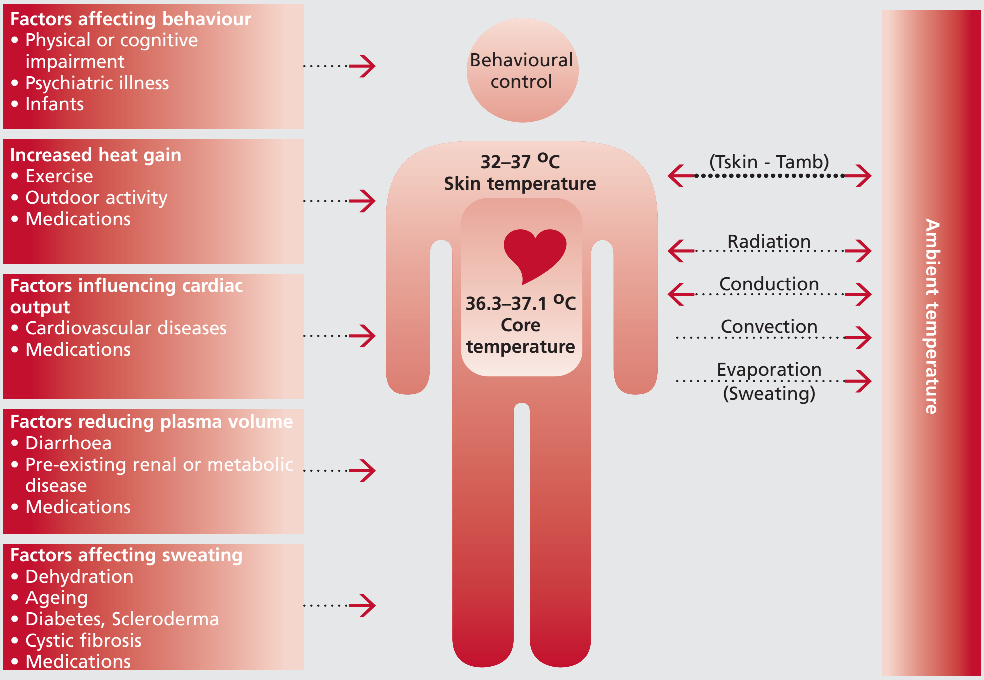
generally had less effect than those occurring after three or more days.

Heat-wave-related mortality results from a wide range of causes (see Box 1).

Box 1. Thermophysiology and heat illnesses

The normal human body temperature range (36.1–37.8 °C) is maintained by the hypothalamus which constantly regulates the production and loss of heat. Heat is lost to the environment by: *(1)* radiation through electromagnetic waves in the form of infrared rays; *(2)* convection through water or air circulating across the skin; *(3)* conduction through cooler objects in direct contact with the skin; and *(4)* evaporation of sweat. Conduction, radiation and convection require a temperature gradient between the skin and its surroundings, and evaporation entails a water vapour pressure gradient. Excessive heat exposure constitutes a major stress for the organism but particularly for the cardiovascular system. When environmental heat overwhelms the body's heat-dissipating mechanisms, core temperature rises.

Factors affecting human thermoregulation and the risk of heat illness



Source: WHO Regional Office for Europe, in press.

An increase of less than 1 °C is immediately detected by thermoreceptors disseminated through the skin, deep tissues and organs. The thermoreceptors convey the information to the hypothalamic thermoregulatory centre, which triggers two powerful responses to increase dissipation of heat: an active increase in skin blood flow and initiation of sweating (through cholinergic pathways). The cutaneous vasodilatation results in marked increases in blood flow to the skin and cardiac output, at the expense of other major systems. When the outdoor temperature is higher than the skin temperature, the only heat loss mechanism available is evaporation (sweating). Therefore, any factor that hampers evaporation, such as high ambient humidity, reduced air currents (no breeze, tight fitting clothes) or drugs with anticholinergic mechanisms, will result in a rise of body temperature that can culminate in life-threatening heatstroke (see figure above) or aggravate chronic medical conditions in vulnerable individuals. Mild and moderate heat-related health problems include heat rash, heat oedema, heat syncope, heat cramps and heat exhaustion. Signs and symptoms as well as the respective medical management are described in information sheets 8 and 9 in Annex.

Heatstroke is fatal in 10–50% of all cases and may lead to neurological morbidity in 20–30% of patients (Bouchama & Knochel, 2002). It is still underreported, as causes of death have been attributed instead to cardiovascular and respiratory diseases. An increased risk of dying was found among individuals with pre-existing illnesses, for example, heart disease, cerebrovascular disease, respiratory diseases, blood and metabolic/endocrine gland disorders, cardiopulmonary and genitourinary disorders.

In general the impact of hot weather on hospital admissions appears to be lower than the impact on mortality (Michelozzi et al., 2006). In European cities, hot temperatures seem to have a rapid effect on mortality in population subgroups and many of the affected individuals may die before getting to hospital. These results are important for understanding preventive actions and interventions for susceptible population groups, especially the elderly and very old people living alone.

2.2. Vulnerable population groups

Heat-waves and hot weather can kill and also aggravate existing health conditions. Health effects can appear in all age groups and as a result of a wide range of factors; however, some people are more at risk of heat-related illness and death than others. Conceptually, we can understand the reasons for variations in risk as related to individual conditions, the level of exposure to hot weather and heat-waves and the ability to adapt to hot weather conditions. This section describes the range of risk factors; the implications for interventions are discussed in Chapter 3. So who is most at risk?

2.2.1. The elderly

A comprehensive literature review (Kovats & Hajat, 2008) showed that the elderly (and the very elderly) constitute the largest defined group at risk of dying due to a heat-wave. Elderly people with dementia are particularly at risk. Ageing decreases tolerance to heat: thirst is sensed late, the sweating reaction is delayed and the number of sweat glands is reduced. The elderly often suffer from co-morbidity, physical and cognitive impairment and need to take multiple medications (information sheet 5). Because many European populations are ageing, these factors are of special concern.

Activities which improve the care of the elderly will improve their ability to cope with heat-waves. This includes regular monitoring, ensuring proper clothing, a cool environment, appropriate diet and adequate intake of fluids (information sheet 4).

2.2.2. Infants and children

Infants and children are sensitive to the effects of high temperatures because their metabolism differs from the metabolism in adults. They also rely on others to regulate their thermal environments and provide adequate fluid intake. Information and advice should thus be addressed to their carers.

2.2.3. People with chronic diseases

Virtually all chronic diseases present a risk of death/illness due to heat (Bouchama et al., 2007) and, since the elderly are more likely to have a chronic medical condition, this is another reason why they are at increased risk. In their literature review, Kovats & Hajat (2008) identified more specific evidence for some conditions than for others, and those where the evidence is strongest are psychiatric disorders, depression, diabetes, pulmonary, cardiovascular and cerebrovascular conditions.

There are several reasons why people with chronic diseases are at increased risk during heat-waves (see also Table 1).

- Any disease that leads to an inability to increase cardiac output, such as cardiovascular disease, will increase the susceptibility to heatstroke and/or cardiovascular failure and death, as thermoregulation during severe heat stress requires a healthy cardiovascular system.
- Peripheral vascular disease, often caused by diabetes or atherosclerosis, may increase the risk of severe heat illness, as it may be hard to increase the blood supply to the skin.
- Diarrhoea or febrile illness, particularly in children, and pre-existing renal or metabolic diseases may increase the risk of heat-related illness and death because these may be associated with excessive fluid loss and dehydration.

- Chronic diseases which affect the number and/or function of sweat glands, such as diabetes, scleroderma and cystic fibrosis, can increase the risk of hyperthermia and heatstroke.
- Any disease or condition that confines someone to bed and reduces their ability to care for themselves or to leave home daily also increases the risk. This is because of a general reduction in the ability to make an appropriate behavioural response to heat (Bouchama et al., 2007).
- Some of the drugs prescribed in connection with these chronic diseases can themselves increase the risk of heat illness (see Box 1 and information sheet 5).

2.2.4. People taking certain medications

Many medications can directly affect the central and peripheral mechanisms of thermoregulation, namely the thermoregulatory centre or afferent and efferent pathways, sweating, cutaneous vasodilatation, and/or increase cardiac output and thereby heat elimination.

Table 1. Conditions which increase the risk of dying in a heat-wave

	Main ICD[a] chapters
Diabetes mellitus, other endocrine disorders	E10–E14
Organic or mental disorders, dementia, Alzheimer's (mild, moderate, severe)	F00–F09
Mental and behavioural disorders due to psychoactive substance use, alcoholism	F10–F19
Schizophrenia, schizotypal and delusional disorders	F20–F29
Extrapyramidal and movement disorders (e.g. Parkinson's disease)	G20–G26
Cardiovascular disease, hypertension, coronary artery disease, heart conduction disorders	I00–I99
Diseases of the respiratory system, chronic lower respiratory disease (COPD, bronchitis)	J00–J99
Diseases of the renal system, renal failure, kidney stones	N00–N39

[a] *International Classification of Diseases*
Note. This table only addresses chronic (long-term conditions) and not acute diseases. Infections, fever, gastroenteritis and skin infections are also risk factors for heat-related mortality (see Kilbourne, 1997).
Source: adapted from Kovats & Hajat, in press.

Medications can also aggravate heat illness (Bouchama, 2007). For example, vasodilators, such as nitrates and calcium channel blockers, can theoretically cause low blood pressure in people who tend to be dehydrated during excessive heat exposure, particularly the elderly.

Dehydration and changes in blood volume distribution can also increase medication toxicity and/or decrease the efficacy by influencing drug levels, drug kinetics and excretion and, hence, the pharmacological activity. This includes drugs with a narrow therapeutic index. Finally, storage of drugs at high ambient temperatures can adversely affect their efficacy, as most manufactured drugs are licensed for storage at temperatures up to 25 °C. This is particularly important for emergency drugs used by practitioners including antibiotics, adrenalins, analgesics and sedatives.

2.2.5. People whose socioeconomic status may make them more vulnerable

It may be that socioeconomic status, including ethnicity, occupation and education, is linked to heat-related health effects (as mainly shown in several studies from the United States and reviewed by Kovats and Hajat (2008)). Social isolation may also indicate higher vulnerability to the health effects of heat and increased social contact may be a protective factor. The effects of social isolation or the role of social networks in coping with hazards is, however, not straightforward and requires further research. The existing information on possible linkages between social and socioeconomic indicators and heat–health effects may still show important indications as to which population groups to include in targeted interventions.

2.2.6. People in certain occupations

Many occupations require people to work in hot conditions, irrespective of the weather, and effective management systems for ensuring health and safety are in place. Air temperature, radiant temperature, air velocity, humidity, clothing and activity are recognized as factors that interact to determine heat stress. Anyone having to work outside in hot weather without appropriate protection, particularly if this involves heavy physical activity, is at increased risk of suffering health effects from heat. Protective clothing, particularly for workers in the emergency services, may become a dangerous hazard. Therefore, certain occupational groups need to be informed about possible measures to prevent heat stress, how to recognize heat stress, heat exhaustion and heatstroke, and what to do.

2.3. Interaction between heat and air pollution

Air pollution is often worse during a heat-wave. Because hot weather and air pollution often coincide, it can be difficult to separate the effects of the two exposures. Two main pollutants are particularly relevant during heat: ozone and PM_{10} (particulate matter with diameter under 10 μm). Ozone levels are highest outdoors, while PM_{10} also penetrates indoors. One possibility is that the effects of heat and air pollution are essentially equivalent to the effect of the two exposures occurring separately (an additive effect). Alternatively, it is plausible that there might be a greater than additive effect of simultaneous exposures to air pollution and heat (a synergistic effect) (Analitis & Katsouyanni, in press).

There is increasing evidence for a synergistic effect on mortality between high temperatures and ozone concentrations. Several studies (from Europe, the United States and Canada) have found that the effects of ozone are higher during the summer (Kosatsky et al., in press). This may be explained by the higher ozone concentrations that occur during summer combined with a nonlinear response; or by a higher population exposure, as people spend more time outdoors in summer; or by an interactive effect. Similarly, the effects of heat-wave days on mortality are greater on days with high PM_{10} levels. The same was not found for other pollutants such as black smoke, NO_2 (nitrogen dioxide) or SO_2 (sulfur dioxide). The fact that, in contrast to ozone exposure, the interaction here seems to affect the elderly as well might be explained by the high penetration of PM_{10} indoors (Analitis & Katsouyanni, in press).

From these findings it seems necessary that every effort should be made to keep levels of ozone and particulates as low as possible during hot weather and perhaps to integrate the monitoring and warning systems for air pollution with those for heat.

3. HEAT–HEALTH ACTION PLANS

Health outcomes depend on the duration, the frequency and the intensity of the heat exposure. It is therefore important to take action to reduce exposure as much and as quickly as possible. A portfolio of measures that may be taken before and during the summer are suggested in preparation for and during heat-waves as part of a structured heat–health action plan. The reduction of heat–health effects will be most effective, however, if long-term measures in the housing, energy and urban sector are also implemented at an early stage.

3.1. General principles applicable to heat–health action plans

Several principles should be used in planning for and responding to heat-waves. These are mainly drawn from the general principles of emergency response.

Use existing systems and link to general emergency response arrangements. Many of the approaches to planning for and responding to heat-waves draw on generic emergency planning models. As a rule, creating new systems runs the risk that lessons learnt elsewhere will not be applied and, in crises, tried and tested command and control mechanisms work best. Therefore, it is advisable to use existing local, regional and national systems for emergency response in the planning and response phases of heat-waves.

Adopt a long-term approach. Responding to an emergency is not enough. It is important to plan on a long-term basis to prevent as well as to prepare. For heat-waves, there are important long-term actions that aim to reduce the scale of climate change and others that aim to reduce the impact of climate change by adapting the built environment. Both of these are covered in this plan.

Be broad. Nearly all emergency plans require a multi-agency and intersectoral approach, and this is also the case for heat-waves. While many of the actions fall to the health sector, active involvement of other sectors is essential.

Communicate effectively. The effectiveness of any action plan depends on the ability of policy-makers and those responsible for implementation to deliver useful, timely, accessible, consistent and trustworthy information to their target audience and especially to high risk populations. Unfortunately, examples abound of communication failures which have delayed action, undermined public trust and compliance and resulted in unnecessary harm. Some key considerations, based on best practice examples are as follows.

- ***Plan.*** It is recommended that risk communication be incorporated into all aspects of heat management plans, including primary prevention activities, event warnings, crisis management and follow-up.
- ***Appreciate that risk communication is a dialogue.*** Early risk communication was directed at informing the public about technical decisions (the "decide and tell" strategy). Today, risk communicators teach that communication is a dialogue. It is usually difficult to change pre-existing beliefs unless those beliefs are explicitly addressed and it is nearly impossible to design successful messages that bridge the gap between the expert and the public without knowing what the public thinks.
- ***Understand public perceptions/beliefs.*** It is the job of the communicator to understand the public's beliefs, opinions and knowledge about specific risks. Such public perception information can be gathered through a combination of formative research and evaluation techniques, including focus groups, panels, opinion polls, in-depth interviews and media monitoring. Such communication "surveillance" can be used to help determine if one concept is more salient to an audience segment than another, and which concepts should eventually be developed into specific messages. Before, during and after heat–health events, the public's concerns need to be appreciated and addressed even if they seem unfounded. Risk communication messages should include specific information about what the public can do to make themselves safer.
- ***Develop trust.*** The overriding goal, especially during a heat–health crisis, is to communicate with the public in ways that build, maintain or restore trust. This is true across cultures, political systems and levels of country development. Evidence shows that public panic is rare, especially when people have been candidly informed. Often, the parameters of trust are established in the first official announcement. This message's timing, candour

and comprehensiveness may make it the most important of all communications.

- *Build capacity.* Heat–health control messages to key target groups are often delivered by communication intermediaries, such as the media, nongovernmental organizations and faith groups. Guidelines, network building and capacity development for these intermediaries, and for spokespeople who work with them, can strengthen plans.
- *Be transparent.* Maintaining the public's trust throughout an event requires transparency (in other words, communication that is candid, easily understood, complete and factually accurate). Transparency characterizes the relationship between the event managers and the public. It allows the public to "view" the information-gathering, risk-assessing and decision-making processes associated with heat–health crisis control.
- *Monitor and evaluate.* As with the rest of the plan, all communication activities need to be monitored and evaluated. Was awareness raised ahead of the crisis? What difference have your communications made? How did your target group(s) respond to the information materials? What could be improved next time?

Ensure that responses to heat-waves do not exacerbate the problem of climate change. This is an important and heat-wave-specific principle. It would be easy to assume that the solution is widespread use of air conditioning and there is little doubt that air conditioning can be protective for vulnerable populations. However, air conditioning is energy intensive and adds to greenhouse gas emissions. There are many ways of adapting the environment and buildings and protecting individuals that are not energy intensive.

Evaluate. This is a key public health principle. The section on evaluation describes why it is difficult to evaluate the effectiveness and appropriateness of heat–health action plans. However, if plans and their implementation are not evaluated, they will not improve and it will be impossible to learn from each year's experience.

3.2. Core elements of heat–health action plans

From existing heat–health action plans and the literature, eight core elements have been identified that are important for successful implementation of heat–health action plans (Matthies et al., in press):

1. **agreement on a lead body** (to coordinate a multi-purpose collaborative mechanism between bodies and institutions and to direct the response if an emergency occurs);
2. **accurate and timely alert systems** (heat–health warning systems trigger warnings, determine the threshold for action and communicate the risks);
3. **a heat-related health information plan** (about what is communicated, to whom and when);
4. **a reduction in indoor heat exposure (medium- and short-term strategies)** (advice on how to keep indoor temperatures low during heat episodes);
5. **particular care for vulnerable population groups**;
6. **preparedness of the health and social care system** (staff training and planning, appropriate health care and the physical environment);
7. **long-term urban planning** (to address building design and energy and transport policies that will ultimately reduce heat exposure);
8. **real-time surveillance and evaluation**.

These eight elements are not sequential, though some are primarily about planning and others more about response. Implementation of the plan and its elements can be seen as being divided into five phases:

1. longer-term development and planning;
2. preparation before the summer (pre-summer);
3. prevention during the summer (summer);
4. specific responses to heat-waves;
5. monitoring and evaluation.

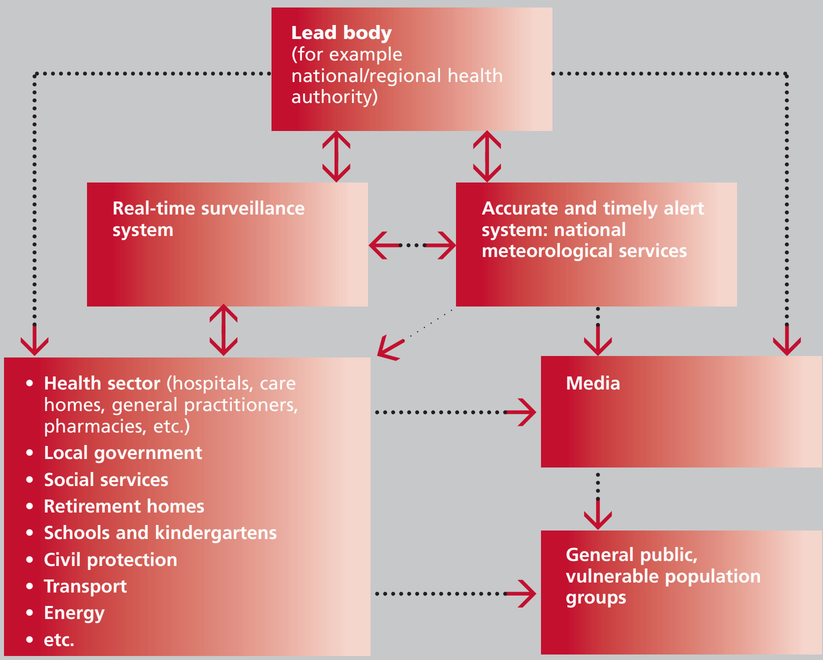
3.2.1. Lead agency and actors: roles and responsibilities

It is important to identify a lead agency. In most countries the lead agency is the health ministry or another health department. However, management of heat-waves requires a multisectoral approach.

A national plan is helpful, but implementation requires regional and local level components (see the generic flowchart, based on plans made in the Region, in Fig. 2). Ideally, the heat plan should be included in national disaster preparedness planning.

It is desirable to have a national coordinating group, including members from the health department, social services, civil protection and meteorological services. Having a representative from the mass media may be a good idea, because this is the most common channel of communication to the public. Cooperative programmes with the media can help to improve public education. This national group has to design the heat plan, coordinate and evaluate it during and after its implementation. Communication and collaboration between the several institutions, groups and actors are important for an effective response to heat. Financial incentives and legislation might be needed in some countries. Lack of funding and personnel as well as problems with communication are the most common barriers to the efficient implementation of heat prevention activities.

Fig. 2. Possible flow of information between lead agency and other actors in heat–health action plans



3.2.2. Heat–health warning systems

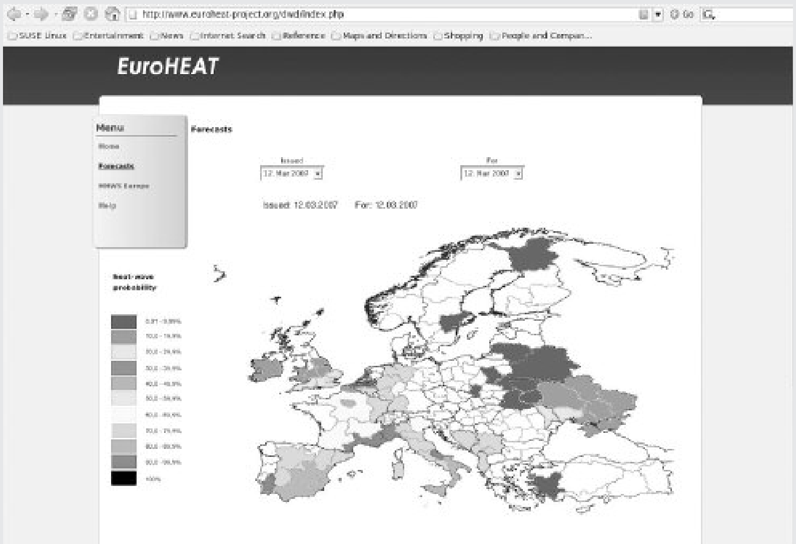
Heat–health warning systems (HHWS) are instruments to prevent negative impacts of the thermal environment on health during heat-waves. They use weather forecasts to predict situations which are – or during the calibration period have been – associated with an increase in mortality (morbidity indicators could also be used if available). The essential and common components of HHWS are identifying weather situations that adversely affect human health, monitoring weather forecasts and implementing mechanisms for issuing warnings in case such a weather situation is forecast through the meteorological services. Sources of information about imminent heat-waves can be found in Box 2 below.

Box 2. Sources of information about forecasts of imminent heat-waves

If there is no HHWS running for your country/region but you would like to have information about forecast or imminent heat-waves you can use the heat forecast that is provided on the EuroHEAT web site (see figure below, and http://www.euroheat-project.org/dwd). On this web site a nine-day probabilistic forecast is provided for all over Europe. The heat-wave probability is calculated based on a 51-member ensemble forecast which is provided by the European Centre for Medium-Range Weather Forecasts (ECMWF). The forecast is updated and available every day at around 11:45 (mean European summer time).

Information about the weather situation can be also obtained by your national meteorological service (http://www.wmo.ch/web-en/member.html).

Probabilistic heat forecast



Source: Koppe, Becker & McGregor, in press.[4]

[4] On 3 June 2006, the Permanent Representative of the Republic of Serbia to the United Nations and other international organizations in Geneva informed the Acting Director-General of WHO that "the membership of the state union Serbia and Montenegro in the United Nations, including all organs and the organizations of the United Nations system, is continued by the Republic of Serbia on the basis of Article 60 of the Constitutional Charter of Serbia and Montenegro, activated by the Declaration of Independence adopted by the National Assembly of Montenegro on 3 June 2006". Estimates used or referred to, as well as maps published in this publication, cover a period of time preceding that communication.

The level of the warning threshold should depend on the local relationship between temperature and mortality, on the aim of the HHWS and the interventions that are triggered during a warning situation (Koppe & Becker, in press).

3.2.3. Heat-related health information plan

Communicating the risks of hot weather and heat-waves and giving behavioural advice are recommended elements of a summer heat-wave prevention strategy. As heat-waves are likely to occur every summer in different locations in Europe it is advisable to develop a well-structured and tested communication strategy for the specific target audiences in advance of the summer. The target audience, the means of communication, the contents and the time the information is to be delivered should be defined (see information sheet 7 for important principles of heat risk communication).

For information materials targeted at the public, six main categories of key messages have been defined (Matthies, Bouchama & Menne, in press):

1. keeping the home cool
2. keeping out of the heat
3. keeping the body cool and hydrated
4. helping others
5. what to do if you have a health problem
6. what to do when others feel unwell.

Please refer to information sheets 1–4 for key messages for (1) the public; (2) vulnerable population groups; (3) general practitioners (GPs); and (4) care home managers. The information sheets also summarize possible adverse effects of drugs during hot weather (5) and give some advice on fluid intake (6).

3.2.3.1. Disseminate information material

General recommendations have to be disseminated at the beginning and during the summer to limit the effect of heat on health. This can be achieved by means of leaflets, web sites and media spots (radio, television). Mass media are the most common channel of communication to the public. Cooperative programmes between the media and the national ministries of health can help to improve public education. The actors of the health system, for example GPs and pharmacists, can also disseminate advice and information. The channels of communication need to be selected according to the patterns of use of the targeted population groups.

The use of the Internet, for example, may be appropriate for informing medical practitioners, medical and social care associations and managers, but those individuals most at risk may not be the most frequent users.

New channels of communication, such as the Internet or the short message systems via mobile telephones, can be explored and considered as efficient ways of informing medical professionals or specific people at high risk. A study in Hungary evaluating the communication strategy through telephone interviews showed that television advertisements are generally well accepted by the public and that the usefulness of the Internet needs to be reviewed (Kishonti, Páldy & Bobvos, 2006).

One of the most vulnerable population groups for heat–health effects are the elderly (Kovats & Hajat, 2008; in press) and they therefore need to be targeted specifically in information campaigns. A leaflet for the elderly may differ slightly in the selection of messages according to the specific risks and needs of this target group. Information for the elderly should contain feasible practical tips (for instance related to fluid intake) and important contact details for social and emergency services.

However, particularly for the elderly, the socially isolated and the homeless, passive information through leaflets and brochures has proven not to be sufficient and other more active approaches need to accompany any public health measures, for instance a buddy system, home visits and daily phone calls.

Catalonia (Spain) provides an example for a structured communication plan within the action plan and the timing and means of dissemination (Box 3).

Box 3. Communication within the Action Plan to Prevent the Effects of a Heat-Wave on Health (POCS) in Catalonia (Spain)

Why is good communication needed?
The action plan aimed at preventing the effects of a heat-wave on health (POCS), implemented in Catalonia in 2004, is an interministerial plan which comprises different groups of professionals. These include public health services, primary health teams, hospitals, social care services, town councils, weather forecast services, pharmacies and security forces. Developing two lines of communication is of utmost importance: an internal plan requiring all these groups to provide the necessary information and contribute to their coordination, and another addressed to the public and particularly to certain risk groups. Both plans will be progressively implemented as different stages are triggered.

Examples
Reporting actions to reduce the negative effects of a heat-wave on health for the population in Catalonia may be divided into three extensive groups:
- advice for the public, with the issue of leaflets and fans, and regular updates concerning Sanitat Respon helpline fact sheets; except for dependent people, prevention largely rests with the individual;
- advice for health care professionals working with at-risk population (primary care trusts, mental health centres, health and social care centres and hospitals);
- advice for residential and nursing homes and social care services within a municipality.

The plan is put into practice as follows:
- in action stage 0 (June) information is disseminated to the public through leaflets and a press conference and broadcasted through radio and television programmes to make available health advice;
- in stage 1 (July) weekly records of temperature and mortality data are released; advice on preventive measures is distributed and there is special focus on discussions about vulnerable groups in primary health trusts; data available through the Sanitat Respon helpline is also updated; there is also collaboration between pharmacy offices to distribute advice and information;
- if stage 2 is triggered (warnings on sustained temperature increases), together with the above-mentioned reporting measures, a warning will also be broadcast by the mass media; if necessary, the public will be informed about provision of special assistance services and health and emergency services.

Source: Generalitat de Catalunya, 2007a.

3.2.3.2. Heat-wave response

Communication is an integral part of managing risks. Communication about risk involves an interactive process of exchange of information, concepts or concerns relating to risks or hazards, among individuals, groups and institutions. Establishing a dialogue as early as possible provides several benefits. Therefore, at the beginning, there is a need to provide information and knowledge. This will increase awareness and concern on the part of the different actors. When public awareness is raised, often by a triggering event, it is important to take action in the form of communication with the public.

The strategy for communicating needs to be tailored to the groups concerned, and may take a variety of forms to be most effective. The strategy relating to the means of communication should be prepared before the heat-wave. The media can be an effective tool to increase problem awareness, to broadcast information through clear messages and to increase individual participation. In the United Kingdom, the media are used to get advice to people quickly. One of the challenges for risk communication is the lack of awareness of the public about heat-wave effects. The other challenge is to ensure that decisions about measures (to set levels, preventive and support measures) are properly based on the best scientific evidence. For instance, the main focus of public health response in Hungary is the communication strategy for the public and vulnerable population groups (Kishonti, Páldy & Bobvos, 2006).

An assessment of cooling areas needs to be made in the municipality so that information about places available can be given to the population. There is concern, however, about the risks involved in transferring or evacuating high risk people (Box 4).

Box 4. Emergency response to heat-waves in Catalonia (Spain)

It is important that the municipality has action procedures in the event of alert and emergency such as described below. These procedures may be included in the corresponding municipality Emergency Plan.
Town council social care services, in cooperation with primary care trusts, shall:

- contact at-risk individuals or people responsible for them (according to a verified census) to report on warning situations caused by a heat-wave and to give advice on how to reduce negative effects caused by heat;
- forecast, if necessary, the transfer of an affected person to a cool area (included in the town council inventory); find out which people require additional support or help.

Through social care services and primary health trusts, they will also:

- report to the public on the emergency situation and give appropriate orders (if necessary, with advice on moving to cool spots), according to the regional civil protection plan (PROCICAT) which will establish the evacuation plan from clinical indications;
- enable the basic needs of people hosted in cool centres to be met (in collaboration with the Red Cross);
- help to move affected people who are disabled by using the necessary emergency resources of the municipality (in collaboration with the Red Cross);
- report significant difficulties and keep in contact with the Emergency Centre of Catalonia (CECAT) for as long as the emergency lasts.

Information reporting
According to the procedure established by the town council, the person receiving this report shall distribute this information to:

- the mayor of the municipality;
- the head of the local police;
- the person responsible for health care services in the municipality;
- the person responsible for social care services in the municipality;
- other appropriate people, as decided by the town council.

Each of the people who have been informed, following the decision of the town council, shall act according to the procedure foreseen for this type of emergency.

Procedures when emergency strikes
It is important that the municipality has procedures in case of alert and emergency as described below. These measures may be included in the corresponding Municipal Emergency Plan.

- In order to provide different reception centres for vulnerable populations during the heat-wave, the town hall lists those centres in (or near) its municipality where at-risk groups can rest if necessary. Data provided by each centre should be the following:
  - name of the centre;
  - address and telephone numbers;
  - capacity of the building;
  - contact person and telephone numbers (24 hours).

It is important to know how these centres work and ensure basic supplies, in case they need to be used (availability of running water, food, etc. (in collaboration with the Red Cross).

- There should be a record of transport available to take people at risk to air-conditioned centres. Some people at risk will be able to go to the centre independently or with the help of a relative or friend. Others, however, will need the town hall's assistance to get to the centre. The town hall should have a record of all means available to take at-risk groups who need help to air-conditioned centres. Affected people who cannot travel independently should be assisted using municipal resources necessary for the emergency (in collaboration with the Red Cross).
- At-risk groups should be given advice on how to protect themselves. People should be informed about the emergency situation and given adequate instructions (advice to go to air-conditioned areas, if necessary), in accordance with PROCICAT, by social care services and health care centres. These will outline the Evacuation Plan based on medical indications. Information can be found in primary health care centres and on the Ministry of Health's web site (http://www.gencat.net/salut/depsan/units/sanitat/html/ca/dir438/doc10726.html – in Catalan).
- The town hall should report significant events and contact the emergency centre (CECAT).

A software program will enable town halls to easily prepare the census of groups at risk during a heat-wave and to record air-conditioned centres and means of transport for at-risk people to these centres. This software can be downloaded free of charge from the web sites of the Associació Catalana de Municipis i Comarques (http://www.associacio.net – in Catalan) or Federació de Municipis de Catalunya (http://www.fmc.cat – in Catalan).

Source: Generalitat de Catalunya, 2007a.

3.2.4. Reduce indoor heat exposure

There is very little epidemiological information on how housing quality and characteristics modify heat–mortality relationships. Studies from the United States (see Hales et al., in press) suggest that central air conditioning is an important protective factor, but that use of cooling fans is not protective. Housing types vary considerably across Europe and housing in central to northern Europe is not well adapted for hot weather.

3.2.4.1. Passive cooling

Recent European Union studies have predicted a dramatic increase of cooling energy demand in Europe between 1990 and 2020 (see Hales et al., in press). This increase is mostly due to three factors: (1) inappropriately constructed buildings, (2) growing internal heat loads and (3) an inappropriate translation of people's comfort needs into temperature, humidity and air quality requirements. By improving these conditions the unnecessary part of the cooling demand can be reduced or avoided. Some passive cooling technologies can be applied to existing buildings.

The main steps to achieve sustainable summer comfort in buildings are: (1) the definition of the thermal comfort objectives; (2) intervention in the site layout; (3) control of heat gains at the building envelope; (4) control of heat transfer through the building envelope; (5) reduction in internal heat loads; (6) allowing for local and individual adaptation; (7) the use of passive means to remove energy from the building; (8) thermal mass control; (9) the use of high efficiency conventional active cooling plants, if necessary; and (10) operation, maintenance and performance monitoring especially in new and office buildings. The new European standard EN 15251[5] introduces adaptive comfort models based on the requirements of the occupants in naturally ventilated buildings (European Commission, 2003).

Passive cooling can be applied to existing and new residential, office and hospital buildings. Site layout measures include vegetation, water ponds or moving water, fountains and shading. Such measures lead to a reduction of annual cooling demand by 2–8%, and peak cooling demand by 2–10%. Depending on other factors, heat gains at the building envelope can potentially be reduced by sun shading devices, glazing, ensuring that the building is effectively air tight, reflective painting of roofs and walls, radiant barriers on roofs and walls, ventilated roofs, double skin facades and insulation. Thermal mass can be used to modulate heat gains and to decouple the daily heat gains from the nocturnal heat rejection.

Passive cooling of existing buildings can be achieved using natural ventilation, evaporative cooling, high thermal mass and night ventilation. Additionally, occupant behaviour and the use of low-energy equipment indoors (to reduce the amount of heat produced indoors) can further keep the indoor temperature down (Table 2). Where possible, the combination of all these elements allows for comfortable conditions to be maintained with minimal use of energy.

Thanks to these passive cooling measures, the room temperatures can be reduced by 2–5 °C or more. These measures are well known from old traditional houses in the Mediterranean regions.

[5] The European Standard EN 15251 specifies the main parameters for the calculation of energy used in buildings, the evaluation and monitoring of the indoor environment and the display of energy characteristics, as recommended in the European Energy Performance of Buildings Directive (European Commission, 2003).

Table 2. Summary of recommendations and options for urban planning and housing

Measure	Examples	Advantages	Disadvantages
Short-term measures	Advice on behaviour Access to cool spaces Mobile evaporative coolers Room air conditioners	Cheap, immediate benefit Can be implemented by individuals	Inherently inequitable increase in energy use and greenhouse gas emissions May be of limited public health benefit Potential adverse health impacts of room air conditioners, e.g. airborne infections
Medium-term measures	Increased albedo of building envelope External shading Insulation Decreasing internal heat load Passive cooling technologies Efficient active cooling	Can be designed without increase in energy consumption and implemented at building or city scales Synergetic effects throughout the year	Advance planning needed Selection of measures at the building scale needs to consider local circumstances Moderately expensive Potential risk to "design buildings for the heat-wave" forgetting the rest of the year
Long-term measures	Building regulations Urban planning Land-use changes Mitigation of climate change	Reduced energy consumption and greenhouse gas emissions Can be combined with active mobility and air pollution reductions Inherently equitable, with major potential health benefits	Costly Long lead times Requires political will (in the case of climate change mitigation, even at international level)

Source: Hales et al., in press.

3.2.5. Particular care for vulnerable population groups

3.2.5.1. Target population

Identification and localization of the most vulnerable population groups – isolated people, the elderly, the homeless – is an important preparatory measure to strengthen active outreach activities to these groups during the summer; local community groups or GPs may contribute to this aim (Kovats & Hajat, 2008).

Box 5 shows an example of how the susceptible subgroups are identified and how the surveillance programme focused on these population groups is activated.

Box 5. Identification of susceptible population and active surveillance programme in Rome (Italy)

The identification of vulnerable population subgroups is carried out by the Department of Epidemiology, Local Health Authority, Rome-E using current surveillance systems, considering risk factors, both socio-demographic characteristics and medical conditions. An individual risk score is calculated according to the subject's characteristics (see table below).

Susceptible population: selection criteria

Individual characteristics	Sources
Age (≥65) Gender (female) Family/marital status (living alone)	Population register
Health conditions:* • metabolic/endocrine gland disorders • diseases of the central nervous system • cardiovascular diseases • chronic pulmonary diseases • liver diseases • renal failure • psychoses • depression • conduction disorders • cerebrovascular disease.	Hospital admission records
Social conditions: • low socioeconomic level • poor educational level • social isolation.	Defined on the basis of census data 2001

**Source*: Michelozzi et al., 2005; Stafoggia et al., 2006.

Warning bulletins are produced by the Italian Department for Civil Protection; the local coordination centre receives the bulletin and activates the local information network. Local prevention programmes and intervention strategies are activated when a warning is issued. GPs play a central role in prevention programmes implemented to reduce the risk of heat-attributable health problems among the most vulnerable subjects. GPs review the lists of susceptible people selected through current surveillance systems and include patients considered at risk but identified by the procedure. GPs actively monitor patients most at risk through specific interventions: changes in pharmacological treatment, phone calls and home visits, home-based treatments and facilitated access to nursing and residential homes.

Source: Lazio Region, 2007.

3.2.5.2. GPs and health care centres

It is recommended that GPs include pre-summer medical assessment and advice in routine care, including on fluid intake, weight changes and medication relevant to heat. Patients need to be advised of the side-effects of the medications prescribed and doctors should consider adjusting dosages during hot weather. Decisions on changes in medications or dosing during hot weather need to be made on an individual basis (Box 6).

During the summer, health care centres with the help of social services may have to actively contact identified people at risk and intensify this follow-up during a heat-wave.

It is important to make hospital admissions easier mainly for elderly people and to communicate with GPs about their patients discharge from hospital, in order to promote better surveillance.

Box 6. A proactive approach by GPs – What GPs should know and do

Doctors should:

- understand the thermoregulatory and haemodynamic responses to excessive heat exposure;
- understand the mechanisms of heat illnesses, their clinical manifestations, diagnosis and treatment;
- recognize early signs of heatstroke, which is a medical emergency;
- initiate proper cooling and resuscitative measures (for early signs and out-of-hospital treatment please see the separate information sheet (9) on treatment of heatstroke and other mild heat related illnesses);
- be aware of the risk and protective factors in heat-wave-related illness;
- identify the patients at risk and encourage proper education regarding heat illnesses and their prevention; education of guardians of the old and infirm and infants is also important;
- include a pre-summer medical assessment and advice relevant to heat into routine care for people with chronic disease (reduction of heat exposure, fluid intake, medication);
- be aware of the potential side-effects of the medicines prescribed and adjust dose, if necessary, during hot weather and heat-waves;
- make decisions on an individual basis, since there are – according to current knowledge – no standards or formal advice for alteration in medications during hot weather;
- be aware that high temperatures can adversely affect the efficacy of drugs, as most manufactured drugs are licensed for storage at temperatures up to 25 °C; ensure that emergency drugs are stored and transported at proper temperature;
- be prepared to monitor drug therapy and fluid intake, especially in the old and infirm and those with advanced cardiac diseases.

Education and counselling of patients

Advice to patients should stress the importance of adhering to the recommendations spelt out in the leaflet for the general public. In addition, individual adjustments of behaviour (particularly for patients with chronic diseases), medication and fluid intake may be necessary according to clinical status. Contact details of social and medical services, helplines and emergency services should be made available.

Source: adapted from Bouchama, 2007.

3.2.5.3. At home

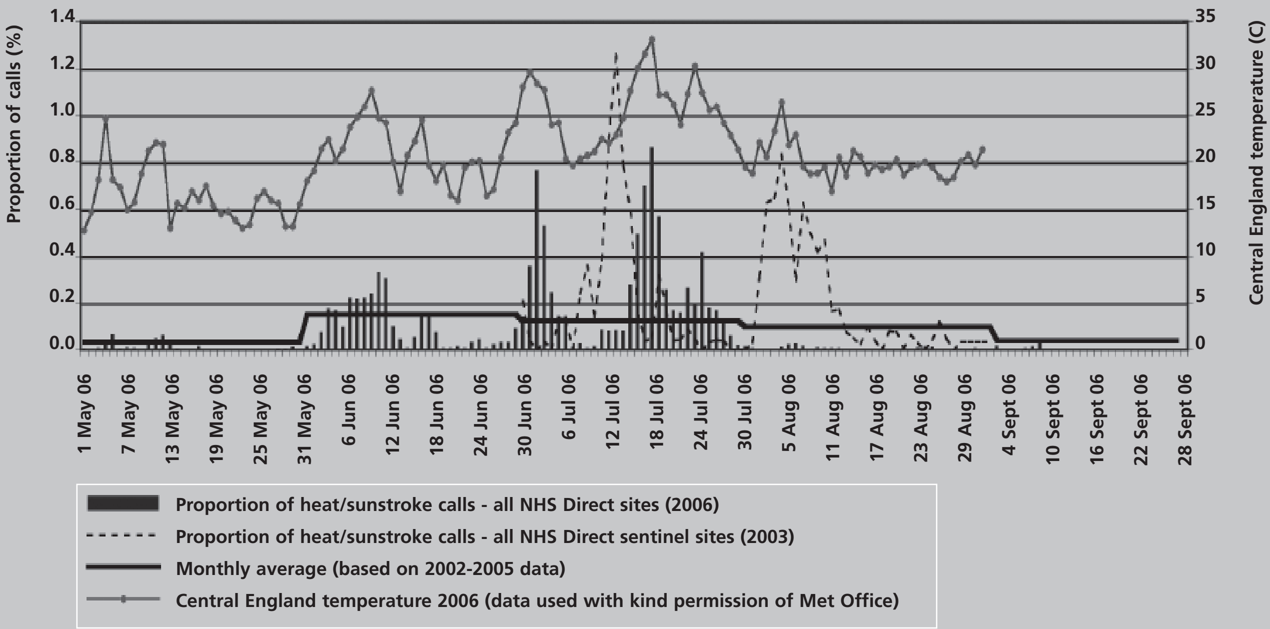
The control of fragile patients can be reinforced with a home care programme. During the summer period, services helping vulnerable elderly and isolated people at home, namely by regular visits and phone calls, need to be activated. Social isolation is a big problem in Europe and collaboration with social services (for example through coordination of nurse services, health care centres, associations and social services) may be helpful. During a heat-wave, these services have to be increased and upgraded.

3.2.5.4. Activation of a telephone service

The setting up of a telephone hotline during the summer period can help to provide information and advice to any member of the population that requests it. Coordination with health and social services could help to detect vulnerable people. Permanent contact with the medical emergency service allows people with specific problems to be diverted to suitable health care centres if necessary.

Fig. 3 gives an example of the use of the NHS Direct helpline in the United Kingdom in relation to hot temperatures.

Fig. 3. Daily NHS Direct "heat/sunstroke" calls as a proportion of total calls for summer 2006 and 2003



Monthly average of the proportion of heat/sunstroke calls (2003–2005) and Central England temperature (representative of a roughly triangular area of the United Kingdom enclosed by Bristol, Lancashire and London)

Source: NHS Direct, 2006.

3.2.5.5. Evacuation

The evidence is not yet sufficiently strong to argue for evacuation of persons from their homes, although in periods of extremely hot weather this may become necessary (as shown in Paris in 2003).

Emergency resources and coordination with the civil protection agencies can be activated, if necessary, to move isolated fragile people to cool places (see also Box 4).

3.2.6. Preparedness of health care and social services

An operational plan on the specific procedures hospitals, clinics, retirement and nursing homes should adopt before and during the summer period and during heat-waves needs to be defined. Actions taken need to be linked to heat–health warnings issued. Care homes and residential care need to have guidance and standards for addressing heat–health, including the provision of a cool room.

These standards should include general preventive measures during the whole summer, specific measures for target populations during the summer, communication mechanisms with social services and the crisis management plan linked with the general heat plan in case of alert levels.

Health services are also affected by heat-waves. The thermal environment in hospitals should be in accordance with European Union regulations (European Standard EN 15251, European Commission, 2003) to prevent illness in patients and staff. Furthermore, in order to reduce exposure to heat, hospitals, clinics, retirement and nursing homes could consider:

- adding shutters and external curtains to southerly exposed rooms to reduce direct exposure;
- installing thermal isolation materials on roofs and windows (for example double glazing);
- using plants and trees to create shading and reduce heat absorption and exposure;
- providing air conditioning, especially in patient common areas, specific wards with more severe cases, emergency departments and intensive care units.

During heat-waves, hospitals, clinics and health care services need to have a heat response plan which involves specific clinical care and health treatments, staff planning and provision of air conditioning to high risk patients and specific hospital wards (Box 7).

Box 7. Specific actions for hospitals and health care services during heat-waves: an example from Italy

The following list of specific actions can contribute to protecting patients and staff from heat–health effects during heat alerts:
- identify and actively monitor high risk patients during heat-wave episodes to identify symptoms associated with heat;
- adapt pharmacological treatments;
- postpone non-emergency surgery;
- ensure bed availability especially in emergency departments;
- increase medical care staff to ensure full coverage in case of an increase in admissions;
- activate procedures to guarantee an adequate health and social assistance for hospital discharge of high risk patients or postpone discharge till after the heat-wave;
- ensure high risk patients are placed in rooms with air conditioning; less critical patients should at least have access to an area with air conditioning during the hottest hours of the day;
- increase liquid intake of patients;
- modify diet accordingly with increased fruit and vegetables;
- adjust patient bed and personal clothing.

Furthermore, retirement and nursing home staff should increase monitoring of high risk patients, adjust treatments and ensure acclimatized areas during the hottest hours for all patients and particularly in rooms with high risk patients.

(See also information sheet 4 in the Annex)

Source: Lazio Region, 2007.

When health care facilities, retirement and care homes are developing measures for improved cooling, it may be advisable to consider ways of reducing the overall carbon footprint of the facility or institution.

Some countries have started to think of solutions and suggestions can be retrieved from the NHS Confederation web site (http://www.nhsconfed.org).

The heat risk implies adapted clinical care of patients. It is important to ensure that medical professionals know what to do to prevent the health impacts of heat on vulnerable population groups and individuals at particular risk. Training of health care professionals needs to address this special risk and the objectives of the training could include:

- updating of knowledge on heat pathologies;
- identification of at-risk people and situations;
- knowledge of prevention measures and principles of care (or nursing);
- knowledge of warning systems and health organizations in case of a crisis; and
- knowledge of drugs (at-risk drugs, how to adapt the treatment, correct storage of drugs).

It needs to be stressed that – to our knowledge – no formal advice on the treatment of chronic diseases during hot weather exists, and decisions need to be taken by medical professionals on an individual basis. Each city has its own local identity and infrastructures upon which prevention programmes should be built. Information presented in this publication serves as an overview of factors that can be considered. Box 6 and information sheet 3 suggest some practical guidance steps for GPs. Information sheet 5 lists drugs to be considered in relation to treatment and information sheets 8 and 9 describe best practice for the treatment of heatstroke.

3.2.7. Urban planning and building design

Because people spend most of their lives indoors and tend to shelter indoors during hot weather, the indoor climate is of particular importance for policy interventions. Adaptation strategies focus on improving urban planning and reducing urban heat islands, reducing indoor heat stress, developing heat plans and HHWS (Hales et al., in press). In parallel, there is a renewed interest in energy efficiency measures as a policy response to the problem of climate change.

Solar radiation absorbed by the city structure increases its surface temperature and contributes to an increase in ambient temperature. Lower surface temperatures decrease the temperature of the ambient air, which can have significant impacts on cooling energy consumption in urban areas. Decreasing the absorbed solar radiation involves appropriate solar control and shading in the urban environment as well as increasing the heat reflected from the surface (albedo). Urban areas are characterized by a relatively reduced effective albedo because darker buildings and urban surfaces absorb solar radiation, and because of the multiple reflections inside urban canyons. Increased shading in the urban environment may be achieved through increased use of green areas as well as using artificial shading devices.

Increased urban albedo may be achieved by using high reflectivity materials. White and coloured materials presenting a high reflectivity to solar radiation as well as high emissivity values[6] have been recently developed and are commercially available. Large-scale changes in urban albedo may have important indirect effects on the city scale. Localized afternoon air temperatures on summer days can be lowered by as much as 4 °C. However, this requires a long-term policy involving legislative measures that will promote the use of cool materials for roofs and pavements, information and dissemination measures that will inform engineers and decision-makers on the advantages of increased albedo materials and possibly financial incentives.

Trees can provide solar protection to buildings during the summer period while evapotranspiration from trees can reduce urban temperatures. The importance of green spaces to decrease urban temperatures has been stressed by many researchers. Trees create a favourable thermal balance for humans and enhance outdoor thermal comfort. Protection from solar radiation using trees has a large physiological effect in reducing heat stress, while shading does not involve any expenditure of energy or water for irrigation, unlike almost all the systems that can lower the temperatures in an outside area. Parks can reduce urban temperatures, depending on the park size and the distance to the park. Parks need to have a size of at least one hectare to have a significant climatic effect. Planted and green roofs can contribute substantially to decreased urban temperatures. Green roofs present much lower temperatures than hard surfaces and decrease the ambient temperature through convection and evapotranspiration.

[6] Emissivity is a measure of a material's ability to absorb and radiate energy (such as heat).

Planted roofs can also decrease the cooling load of buildings and improve indoor comfort. The presence of a large mass of water in the urban environment helps to decrease the air temperature because of convection and evaporation. Ponds and fountains can be effective cooling systems in open spaces because of their ability to keep water temperatures lower than air temperature.

3.2.8. Real-time surveillance

3.2.8.1. Setting up a surveillance system for health outcomes

Communication and collaboration between several institutions, groups and actors are important for an effective health system response to heat. These groups require timely health data (less than 48 hours) for monitoring the health impacts of heat-waves and the effectiveness of the interventions (all-cause mortality data, hospital admissions, public health line phone calls, GP's records on morbidity data, ambulance calls, fire brigade interventions and emergency department visits (Páldy et al., in press).

Any statistical excess needs to be further investigated. This analysis can be communicated to health and other professionals, via the Internet and/or a weekly bulletin, and to the public through the mass media.

Adaptation of existing available systems can reduce the cost. Real-time health data are monitored in several regions/countries having heat–health action plans: for example Catalonia (Spain), England (United Kingdom), France, Hungary, Portugal and Italy. Boxes 8–10 show examples from France, England and Italy.

Box 8. Heat-wave and syndromic surveillance: experience in France

Following the 2003 heat-wave, a syndromic surveillance system based on emergency departments admissions and crude mortality was developed in France (see table below). In 2006, France experienced a heat-wave lasting 19 days (11–28 July). To monitor the health impact of hot weather indicators were developed covering the total number of daily cases of three pathologies linked to high temperatures (hyperthermia, dehydration and hyponatraemia). The correlation between the indicators and temperature showed that emergency departments are a very relevant source of information for environmental health impact surveillance. Concerning mortality, a significant increase during the heat-wave period was observed and the excess deaths observed were 1553, with a final estimation from all the French cities' data. It is important to dissociate the rapid reports given to the Ministry of Health from the syndromic data, and the final estimation of mortality, which is made later and from a different source (Josseran et al., 2006; Empereur-Bissonet et al., 2006; InVS, 2007).

Health indicators

Actors	Indicators
Emergency medical services	Number of calls/cases
On-duty medical units	Total number of emergency care unit visits Total number of emergency care unit visits for children under 1 year Total number of emergency care unit visits for people > 75 years Number of hospital admissions after emergency care unit visits
Fire brigade	Number of calls with deaths
Civil registry office	Number of deaths and day of death

Source: Laaidi et al., 2005.

Box 9. An example of a surveillance system: United Kingdom

Two systems are operational in the United Kingdom: NHS Direct and the Health Protection Agency (HPA) run a syndromic surveillance system where data from all 23 NHS Direct sites in England and Wales are analysed each weekday on a variety of syndromes (including heat/sunstroke) reported by callers. Monthly summer baselines are derived and any unusual increase in heat/sunstroke calls above this baseline are reported. Data are analysed by region, age group and call outcome. A weekly bulletin is circulated to a public health audience. The second system is a GP-based surveillance scheme which analyses data from a GP practice system, collecting "key" morbidity indicators. Each week a bulletin is produced for use by local health protection teams, though if there is an urgent public health need for data to be produced more quickly on certain respiratory indicators (though not at present covering heat-wave indicators), then these can be produced daily. In 2006 the following results from the surveillance schemes were observed.

NHS Direct: between 1 May and 15 September 2006, 1474 heat/sunstroke calls were received by NHS Direct in England and Wales out of 1 739 768 total symptomatic calls (0.08%). There were four distinct peaks in heat/sunstroke calls, as a proportion of total calls, on the 11 June (52 calls, 0.3%), 3 July (109 calls, 0.8%), 19 July (115 calls, 0.9%) and 26 July (26 calls, 0.4%). These four peaks occurred on the same day or one day after peaks in the Central England temperature. Over the summer all NHS Direct sites handled heat/sunstroke calls, with the highest proportions of calls in Wales (80 calls, 0.11%), the West Midlands (162 calls, 0.11%) and the South East (297 calls, 0.10%) regions. Of the 1474 heat/sunstroke calls 164 (11%) were about children under 5 years old, 1299 (89%) about the 5–74 year-old age group and 0% about those aged over 74. NHS Direct has relatively low call rates from old people.

During the two periods in which "heat–health" response levels 2 and 3 were activated the Primary Care Surveillance Team issued additional daily NHS Direct heat/sunstroke bulletins, as follows: daily bulletins were distributed on the 4 and 5 July in response to heat–health watch level 2 (weekend 1–2 July) and level 3 (3–4 July). Daily bulletins were distributed on the 17–21 and 24–28 July in response to heat–health level 2 (16, 22–24, 28 July) and level 3 (17–19, 21, 25–26 July).

A comparison was made between the total national NHS Direct call rate (calls answered) during the two severe heat episodes (30 June – 6 July 2006; 15–28 July 2006) and call rates for the same periods during 2004 and 2005 (adjusted for year-on-year growth in total calls). There were no severe heat episodes during July 2004 and July 2005 (the baseline period). During the 30 June – 6 July episode the total NHS Direct call rate was 6.0% (7547 calls) above baseline and during the 15–28 July 2006 episode it was 0.8% (1926 calls) above baseline.

GP consultations: there were three distinct peaks in heatstroke consultations in week 24/06 (12–18 June: 12 cases – 0.3 per 100 000), week 27/06 (3–9 July: 20 cases – 0.5 per 100 000) and week 29/06 (17–23 July: 30 cases, 0.9 per 100 000). During these peaks the regions with the highest rates were the South West (highest region during weeks 23 and 27) and East Midlands (highest region during week 29).

Source: HPA Primary Care Surveillance Team, 2008.

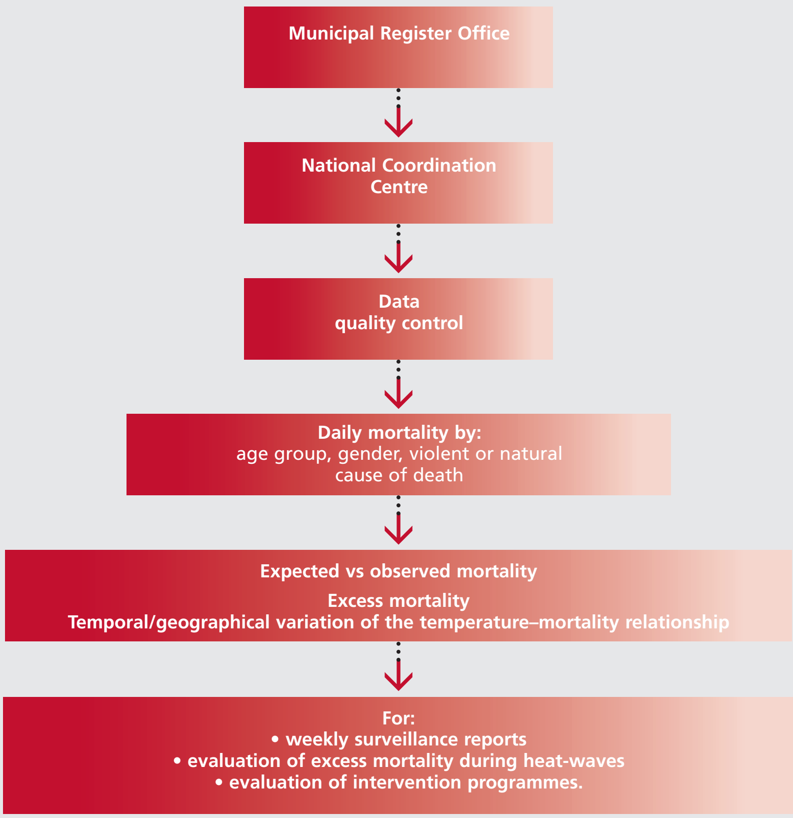
Box 10. National real-time mortality surveillance system: Italy

In Italy, a surveillance system was introduced (see figure below) to have a near real-time monitoring of mortality during the summer. The systems were developed in collaboration with local municipalities from May to September and in 2007 were activated in 29 cities. Everyday mortality counts for the resident population in the city were sent by local registry offices to the national centre. Daily counts can be considered complete 72 hours after the day of death is recorded.

Standardized datasets were constructed for each city, inclusive of mortality by gender and age group (0–64, 65–74 and 75+). Daily excess mortality was calculated as the difference between daily baseline and observed values. This allowed for the constant surveillance of daily mortality, the identification of increases in mortality associated with heat-waves. Data from the surveillance system are also used for the evaluation of the effectiveness of the warning system in terms of reduction in mortality.

During the second half of July a heat-wave affected the whole of Italy with peak temperatures of 38–40 °C, especially in the south. Warning systems issued level 2 and 3 warnings in many cities between the 16 and 26 July. The surveillance system showed that the impact on mortality was more contained in the north (percentage variation between 8% and 19%) compared to the centre (10–41%) and south (11–56%). If we consider mortality during the entire summer season (1 May – 15 September) an excess was observed in Milan, Naples, Rome, Bari and Catania with the percentage increase ranging from 18% to 8%.

Flow chart of the Italian mortality surveillance system



Source: Department for Civil Protection, 2007.

3.2.9 Evaluation

In general, the development of an evidence base to promote health and reduce health inequalities depends on high quality evaluations that can support decision-makers with information about the types of programmes that can be developed and implemented to ensure the most effective use of resources. This section aims to highlight the possibilities for European heat–health action plans to contribute to this by following the general principles of good public health evaluations and by promoting a social approach to plans and evaluation methods.

Why evaluate? It is important to:

- ensure that activities are having the intended effects (effectiveness);
- determine whether activities are cost effective (efficiency);
- establish whether activities are acceptable to the target population (social acceptability); and
- ensure that evaluation features at all stages of the planning, development, implementation and review of programmes.

However, heat–health action plans are extremely difficult to evaluate for several reasons:

- they vary widely in structure, partner agencies and the specific interventions that are deployed during heat-waves as well as before or during the summer season;
- they change from year to year in response to events and the changing priorities of partner agencies;
- heat-waves are rare events and the impact of each heat-wave is different; and
- heat-related deaths are nonspecific and can be difficult to identify.

As a result, there is little published information on formal (quantitative or qualitative) assessments of the effectiveness of systems as a whole or on individual intervention measures.

To develop the evidence base for heat–health protection and to ensure that plans are as effective and efficient as possible, it is essential that heat-wave plans are evaluated and that the evaluations are published. Heat–health action plans need to target the most vulnerable in society in order to ensure they do not suffer excess morbidity or mortality during heat-waves. It is therefore recommended that heat-wave evaluations include an assessment of how successful plans have been in reaching these groups.

It is increasingly recognized that social approaches to the development and delivery of public health interventions have the potential to increase the effectiveness of programmes aiming to promote health and reduce health inequalities. Social approaches recognize that solutions to major public health problems are complex. They also promote the need to employ community-based models to affect the broader, social, environmental and economic factors which influence and underpin relative inequalities in health.

It is important therefore that heat-wave evaluation frameworks develop a broad approach to assessing the impact of their programmes and initiatives. These broad frameworks will make explicit a range of short-, medium- and long-term indicators of success and take account of the wider determinants of health. They will ask questions not only about what works to reduce excess mortality, but also for whom and in what context, and will employ a range of methodologies and techniques to understand the critical processes and infrastructures that need to be in place in order for programmes to be successful. In other words a holistic approach to evaluation is recommended.

The following section describes ways in which heat–health action plans can be evaluated. In doing this, the starting point is that such evaluations are generic in that they draw on the general principles used to evaluate any public health intervention. It concludes with some suggestions for minimum standards for evaluation plans.

3.2.9.1. Process evaluation

In process evaluations, the focus is on whether the plan was implemented to the expected standards. This is often done on the basis of surveys of partner agencies to explore their awareness of the plan, what they did and whether this was in accordance with the plan. In England, the HPA evaluated the plan by surveying five types of health and social care organizations via a mix of self-completed and telephone questionnaires to explore awareness of the heat-wave plan and their responses to it (Box 11). They also organized a multi-agency seminar of organizations involved with the heat-wave plan and key experts on public health, environmental epidemiology and whether to share research and ideas on heat and health and the evaluation of the heat-wave plan. Catalonia assesses the implementation of the heat plan following each summer (Box 12).

Box 11. Process evaluation – the example of the National Heatwave Plan for England (United Kingdom)

The Department of Health for England first produced a national heat-wave plan in 2004. It gives advice on measures to be taken during heat-waves, and within it there are four "heat–health watch" levels: (1) awareness, (2) alert, (3) heat-wave, (4) emergency. In 2006 alert level 3 was reached for the first time and, following this, the Department of Health asked the HPA to undertake an evaluation of the plan.

The evaluation aimed:

- to provide a rapid overview of mortality and morbidity in the period when the heat-wave plan was in operation;
- to assess the level of implementation of the plan across health and social care organizations in England;
- to assess the effectiveness of the heat-wave plan; and
- to assess surveillance and information resources and possible needs.

The evaluation had three parts:

Part 1 – Epidemiological study

Meteorological information was summarized to describe the summer 2006 weather, the temperature by day and region and where and when temperature thresholds were observed in relation to the response levels within the heat-wave plan.

Mortality and morbidity data were analysed to explore the relationship between mortality and temperature, and the predicted mortality associated with observed air pollution levels.

Primary care data were analysed for the impact of heat on NHS Direct calls and GP consultations.

Part 2 – Evaluation survey

Five types of health and social care organizations were (non-randomly) sampled via a mix of self-completed and telephone questionnaires to explore awareness of the heat-wave plan and their responses to it.

Part 3 – Multi-agency seminar

A multi-agency seminar of organizations involved with the heat-wave plan and key experts on public health, environmental epidemiology and weather was organized to share research and ideas on heat and health and the evaluation of the heat-wave plan. The seminar involved presentations and group discussion leading to a consensus view of the key issues, conclusions and recommendations.

The 2006 heat-wave was less severe, both in impact and weather than the 2003 heat-wave and the evaluation showed that there was high awareness of the plan in the main organizations and a positive response to the plan. Many organizations also stated that the plan assisted them in the heat-wave situation. The report included a number of recommendations to the Department of Health including how to improve communication, revisiting definitions of and the expectations for caring for vulnerable individuals and revisiting the measures and thresholds that the plan and the associated levels are based around. The study also identified areas where further research would be beneficial. These included further epidemiological studies on heat-waves and associated effects and research to determine the most appropriate ways to evaluate interventions.

Source: HPA, 2007.

Box 12. Process evaluation – the example of Catalonia (Spain)

In 2004, the Department of Health in Catalonia implemented for the first time an action plan to prevent the effects of heat-waves on health (POCS). This plan gives advice on actions to be implemented during the summer and during heat-waves.

In the plan there are three action levels: level 0 – awareness; level 1 – summer actions; level 2 –when a heat-wave is forecast (level 2.0: alert; 2.1: heat-wave; 2.3: emergency).

This action plan is updated every year with new data available and as a result of the evaluation of the actions taken during the implementation of the plan.

The evaluation had five parts.

Part 1 – Epidemiological study

Mortality (data on natural deaths, data on coroner certified deaths, and hospital mortality in four observer hospitals in Catalonia) and morbidity (data on hospital emergencies, hospital casualty admissions, hospital admissions in the four observer hospitals in Catalonia) data were analysed to explore the relationship with temperature and compared to data of previous years.

Part 2 – Distribution of informative material

The Department of Health and the Department of Social and Civic Action showed the numbers of materials edited (fans, leaflets) and how they had been distributed (primary health care centres, hospitals, mental health centres, support team to the Home Care Programme, pharmacies, city councils, public homes for the elderly, public day centres for the elderly and private homes and private day centres for the elderly which collaborate with the Department of Social and Civic Action).

Part 3 – Actions developed in primary health care centres and in collaboration with social health care centres

All health centres answered a questionnaire to explore the level of implementation of the plan in their centres (updated census of vulnerable people, number of vulnerable people attended at home and in the health care centres, contact with social services, divulgation of preventive measures).

Part 4 – Actions developed by Sanitat Respon (heat phone line)

Sanitat Respon reported the actions implemented during the period, the number of calls attended, the number of patients included in the monitoring programme for susceptible patients and the number of follow-up calls.

Part 5 – Actions developed by the Department of Social and Civic Action

The Department of Social and Civic Action reported the assessment of the level of implementation of the air-conditioning programme in public retirement homes and the implementation of preventive measures.

A multi-agency seminar of all organizations involved with the POCS is organized after the summer period every year to present the evaluation of the heat-wave plan and to share ideas to improve the heat-wave plan for the next year. The evaluation document is published on the web site of the Public Health Department.

Source: Generalitat de Catalunya, 2007b.

3.2.9.2. Outcome evaluation

There is limited evidence from studies on the evaluation of warning systems and heat–health action plans, especially in terms of health outcomes.

Mortality is the only outcome variable for which the impact of heat has been observed and documented extensively (for example, Michelozzi et al., 2007; Baccini et al., in press) and it can be used to evaluate impacts as a response to prevention programmes and adaptation strategies. For example, temporal variations in the temperature–mortality relationship within a city can give an indication of the change/reduction of the impact of heat on health. It is reasonable to suppose that for the same levels of exposure, short-term variations in mortality levels can be attributable to the introduction of warning systems and heat–health action plans, so long as other known confounders or explanations have been considered (see examples from Italy in boxes 10 and 13).

Box 13. Outcome evaluation in nursing homes – active monitoring in Rome and the Lazio Region (Italy)

Monitoring susceptible subgroups at whom prevention is targeted is an important part of evaluation. An example is the active monitoring during the summer period of the elderly and ill residing in nursing homes and Alzheimer residences in Rome and the Lazio Region. Specific guidelines are set up and an active collaboration between nursing structures, GPs and geriatric hospital wards is established to reduce the impact of heat on health. At the beginning of summer, constant medical supervision of patients is carried out. Information is retrieved from all structures on the presence/absence of specific heat–health plans for personnel, the specific characteristics of the nursing home (for example availability of air conditioning, etc.), the presence of medical personnel (always or on some specific days), and the health status of patients. Throughout the summer, mortality rates and hospital admission rates for nursing home patients are evaluated.

Source: Lazio Region, 2007.

However, it is not possible to directly compare the impacts of heat-waves in terms of numbers of deaths, either in different cities or in the same city over time, and it is even harder to be confident that the plan or specific measures within it led to any observed changes in mortality (Kovats & Ebi, 2006). For example, fewer heat-related deaths occurred in Chicago during the 1999 heat-wave compared to the 1995 event and some of this reduction was attributed to the successful implementation of prevention measures, such as the opening of cooling centres (Palecki, Changnon & Kunkel, 2001). As well as an increase in the use of air conditioning by vulnerable groups between the two events, there would also have been an increase in the general level of awareness of the impacts of heat-waves and how to respond effectively. Similarly, an observed decline in heat-related mortality in Marseille (France) following the introduction of a preventive campaign based on warning messages cannot be robustly attributed to that intervention (Delaroziere & Sanmarco, 2004). An evaluation of the Canadian hot weather response plan focused primarily on the possible impact of different thresholds for interventions (Smoyer-Tomic & Rainham, 2001).

Despite these difficulties, more formal outcome assessment can usefully be undertaken retrospectively. The health outcome that is both measurable and sensitive to temperature is daily mortality, although other measures could be used (for example emergency hospital admissions, contact with primary care services or helplines).

The number of prevented deaths can be estimated as the difference between the observed deaths and the numbers expected during the heat-wave (based on previous quantification of the temperature–mortality relationship). Estimates can be broken down by major age categories and can be generated for all deaths and for deaths specifically associated with heat-waves.

Another approach is to compare deaths on hot (heat-wave) days with and without warnings. If information is available about the quality and success of implementing the heat-wave plan in different areas, then the prevented mortality could be compared across these different areas as another measure of effectiveness.

A third approach is to more formally compare interventions in different areas. It would be unethical to provide no heat–health protection in a given area. However, given the level of uncertainty around effectiveness for specific interventions, it would be appropriate to compare different strategies in different areas within a given city or district, or even to randomly allocate interventions at the community level.

The measurement of intermediate outcomes is also desirable, such as changes in behaviour related to heat-waves. Community-based surveys have been undertaken to determine changes in knowledge, perception and heat-related behaviour (Sheridan, 2006; Kishonti, Páldy & Bobvos, 2006; see Box 14).

Box 14. How aware is the public of heat–health advice? – some examples

In the Hungarian system, the goal was to reduce total mortality and morbidity by giving general advice and alarms. A phone survey was conducted after the first summer which showed that in general advice was not heeded. The best channel for getting information across was via television. Population knowledge of the dangers was very low (Kishonti, Páldy & Bobvos, 2006).

Studies in Canada and the United States have shown that the vulnerable elderly in cities appear to be aware of imminent hot weather and of conventional recommendations for dealing with the heat (Sheridan, 2006).

Appropriate sampling needs to be undertaken to reach the more vulnerable members of the community who are most at risk of heat-related mortality, and particular care is needed in the analysis of self-reported changes in behaviour. Qualitative research is essential to ensure that those most in need of advice and assistance are included in the evaluation.

The cost–effectiveness of HHWS is a consideration for decision-makers. Ebi et al. (2004) used willingness to pay to assess the cost–benefit of the Philadelphia hot weather warning system, but assumed the system to be mostly effective in preventing heat-related deaths. On these assumptions, the system was highly cost effective.

3.2.9.3. Minimum standards for evaluations

This section considers the general features of good evaluations. It should not be seen as a definitive guide about how to evaluate heat-waves; rather it provides some pointers that can be drawn on as appropriate.

In general, good evaluations should:

- state clearly the aims and objectives of the initiative or programme;
- articulate the short-, medium- and long-term outcomes associated with the programme;
- involve some form of stakeholder involvement to inform the evaluation in relation to the areas it should cover;
- draw on a variety of disciplines and methods for their appropriateness to the evaluation;
- use expert opinion as well as more objective methods.

As regards how evaluations should be organized, the following features are helpful:

- externally organized evaluations (but with input from those who developed the programme) are more likely to be and to be seen as objective;
- regular evaluations – at the end of each summer – are helpful;
- undertaking a focused evaluation after a major heat event is essential;
- having a routine monitoring element during the summer with real-time surveillance of health data and other outcomes adds responsiveness.

One of the classical evaluation models (Donabedian, 1988) addresses structures, processes and outcomes. Structural considerations should include:

- whether there is a national plan;
- what the components of the plan are;
- whether the objectives of each component and responsibility for them are described;
- if the plan includes an HHWS and, if so, whether it is described clearly.

Process considerations should include:

- whether key messages were provided to the population;
- if the population was aware of the plan and its messages;
- whether warnings were issued at the right time;
- whether the organizations and professionals acted appropriately and if they followed the plan;

- whether the organizations and professionals found the plan helpful.

Outcome considerations should include:

- mortality – daily temperatures and deaths before, during and after heat-wave periods, mortality in different settings such as care homes;
- morbidity;
- health care utilization;
- non-health-related outcomes such as productivity and work absence;
- an assessment of the temperature–mortality function;
- health behaviour changes related to heat.

In undertaking any evaluation, a wide range of methods are possible. These include:

- epidemiological studies;
- surveys – of organizations and the population (these could be phone surveys, postal questionnaires or face-to-face interviews);
- textual analysis;
- analysis of routine data.

3.3. Summary

Heat–health action plans are becoming an increasing necessity for many European countries due to changing weather patterns. They aim to reduce the increased mortality associated with heat-waves through issuing heat–health warnings, encouraging careful planning across relevant sectors, raising awareness among the public and medical professionals and mobilizing resources to counteract the effects of heat on health. The recommendations above are aimed to help local, regional and national governments prepare action plans to suit their own needs.

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WEB LINKS TO SELECTED EUROPEAN HEAT-HEALTH ACTION PLANS

Catalonia
Generalitat de Catalunya, Department de Salut, Dirrecio General de Salut Publica (2007). Action plan to prevent the effects of a heat-wave on health (POCS)
(http://www.gencat.net/salut/depsan/units/sanitat/pdf/pocs2007en.pdf, accessed 11 February 2008)

France
Ministère de la Santé, de la Jeunesse, des Sports et de la Vie Associative. Canicule et chaleurs extremes: Plan Canicule [Heat-waves and extreme heat: Heat-wave Plan]
(http://www.sante.gouv.fr/canicule/accueil/accueil.htm, accessed 12 February 2008 – in French)

Italy
Minstero della Salute. Estate sicura: vincere il caldo [Save summer: beat the heat]
(http://www.ministerosalute.it/emergenzaCaldo/paginaInternaMenuEmergenzaCaldo.jsp?id=413&menu=strumentieservizi, accessed 12 February 2008 – in Italian)

Netherlands
Ministerie van Volksgezondheid, Welzijn en Sport. Nationaal Hitteplan [National Heatplan]
(http://www.minvws.nl/images/nationaal-hitteplan_tcm19-149891.pdf, accessed on 28 March 2008 – in Dutch)

Portugal
Direcção-Geral da Saúde. Plano de contigência, Ondas de Calor [Contingency plan, heat-waves]
(http://centrodeemergencia.blogs.com/portugal/files/plano_de_contigencia_para_ondas_de_calor.pdf, accessed 12 February 2008 – in Portuguese)

Spain
Ministerio de Sanidad y Consumo. Plan de prevención frente a las altas temperaturas [Prevention plan for when high temperatures occur]
(http://www.msc.es/ciudadanos/saludAmbLaboral/planPrevencionAltTemp.htm, accessed 12 February 2008 – in Spanish)

United Kingdom
Department of Health. Heatwave: Plan for England – protecting health and reducing harm from extreme heat and heatwaves
(http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_084670, accessed 4 June 2008)

ANNEX
PUBLIC HEALTH RESPONSE TO HEAT-WAVES: A SET OF INFORMATION SHEETS

1. Recommendations for the public during heat-waves
2. Vulnerable population groups
3. Recommendations for general practitioners
4. Some recommendations for retirement and care home managers
5. Adverse effects of drugs during hot weather
6. Considerations for medical professionals regarding drinking recommendations during hot weather and heat-waves
7. Key principles of heat risk communication
8. Mild and moderate heat illnesses and their management
9. Management of life-threatening heatstroke
10. Reducing indoor temperatures during hot weather

1. Recommendations for the public during heat-waves

Keep your home cool

During the day, close windows and shutters (if available) especially those facing the sun. Open windows and shutters at night when the outside temperature is lower, if safe to do so.
If your residence is air conditioned, close the doors and windows.
Electric fans may provide relief, but when the temperature is above 35 °C, fans may not prevent heat-related illness. It is important to drink fluids.

Keep out of the heat

Move to the coolest room in the home, especially at night. If it is not possible to keep your home cool, spend 2–3 hours of the day in a cool place (e.g. air-conditioned public building).
Avoid going outside during the hottest time of the day.
Avoid strenuous physical activity.
Stay in the shade.
Do not leave children or animals in a parked vehicle.

Keep the body cool and hydrated

Take cool showers or baths.
Alternatives include cold packs and wraps, towels, sponging, foot baths, etc.
Wear light, loose fitting clothes of natural materials. If you go outside wear a wide brimmed hat or cap and sunglasses.
Drink regularly and avoid beverages with sugar or alcohol.

Help others

If anyone you know is at risk, help them to get advice and support. Elderly or sick people living alone should be visited at least daily.
If the person is taking medication, check with the treating doctor how they can influence the thermoregulation and the fluid balance.

If you have a health problem:

- keep medicines below 25 °C or in the fridge (read the storage instructions on the packaging);
- seek medical advice if you are suffering from a chronic medical condition or taking multiple medications.

If you or others feel unwell:

- try to get help if you feel dizzy, weak, anxious or have intense thirst and headache; move to a cool place as soon as possible and measure your body temperature;
- drink some water or fruit juice to rehydrate;
- rest immediately in a cool place if you have painful muscular spasms, most often in the legs, arms or abdomen, in many cases after sustained exercise during very hot weather, and drink oral rehydration solutions containing electrolytes; medical attention is needed if heat cramps are sustained for more than one hour;
- consult your medical doctor if you feel unusual symptoms or if symptoms persist.

△ If one of your family members or people you assist presents hot dry skin and delirium, convulsions and/or unconsciousness call the doctor/ambulance immediately. While waiting for the doctor/ambulance move him/her to a cool place and put him/her in a horizontal position and elevate legs and hips, remove clothing and initiate external cooling, such as with cold packs on the neck, axillae and groin, continuous fanning and spraying the skin with water at 25–30 °C. Measure the body temperature. Do not give acetylsalicylic acid or paracetamol. Position unconscious person on their side.

FOR SERVICE PROVIDERS

Information on helplines, social services, ambulances, cool spaces and transport needs to be provided on the information material!!

Provide access to cool spaces and ensure active assistance for those most at risk.

2. Vulnerable population groups

In addition to the general information, information for the elderly (and the very elderly) and people with chronic diseases (see table below for more detail) should contain:

- practical tips (e.g. for keeping cool and well hydrated);
- first aid treatment; and
- important contact details for social and medical services as well as the ambulance.

Other population groups that may need to be considered for specific information may include workers, athletes, tourists and parents of infants. Particularly for the elderly, the socially isolated and the homeless, passive information through leaflets and brochures has proven not to be sufficiently effective and other more active approaches need to accompany any public health measures, such as a buddy system, visits and phone calls.

Conditions which increase the risk of dying in a heat-wave

	Main ICD[a] chapters
Diabetes mellitus, other endocrine disorders	E10–E14
Organic mental disorders, dementia, Alzheimer's	F00–F09
Mental and behavioural disorders due to psychoactive substance use, alcoholism	F10–F19
Schizophrenia, schizotypal and delusional disorders	F20–F29
Extrapyramidal and movement disorders (e.g. Parkinson's disease)	G20–G26
Cardiovascular disease, hypertension, coronary artery disease, heart conduction disorders	I00–I99
Diseases of the respiratory system, chronic lower respiratory disease (COPD, bronchitis)	J00–J99
Diseases of the renal system, renal failure, kidney stones	N00–N39

[a] *International Classification of Diseases*

Note. This table only addresses chronic (long-term conditions) and not acute diseases. Infections, fever, gastroenteritis and skin infections are also risk factors for heat-related mortality (see EM Kilbourne (1997). Heat waves and hot environments. In: E Noji, ed. *The public health consequences of disasters*. New York, Oxford University Press:245–269).

3. Recommendations for general practitioners

Develop a proactive approach by:

- understanding the thermoregulatory and haemodynamic responses to excessive heat exposure;
- understanding the mechanisms of heat illnesses, their clinical manifestations, diagnosis and treatment;
- recognizing early signs of heatstroke, which is a medical emergency;
- initiating proper cooling and resuscitative measures (for early signs and out-of-hospital treatment please see the separate information sheet on treatment of heatstroke and other mild heat-related illnesses);
- being aware of the risk and protective factors in heat-wave-related illness;
- identifying the patients at risk and encouraging proper education regarding heat illnesses and their prevention (education of guardians of the old and infirm and infants is important);
- including a pre-summer medical assessment and advice relevant to heat into routine care for people with chronic disease (reduction of heat exposure, fluid intake, medication);
- being aware of the potential side effects of the medicines prescribed and adjusting dose if necessary, during hot weather and heat-waves;
- making decisions on an individual basis, since there are – according to current knowledge – no standards or formal advice for alteration in medications during hot weather;
- being aware that high temperatures can adversely affect the efficacy of drugs, as most manufactured drugs are licensed for storage at temperatures up to 25 °C; ensuring that emergency drugs are stored and transported at proper temperature;
- being prepared to monitor drug therapy and fluid intake, especially in the old and infirm and those with advanced cardiac diseases.

Educate, counsel and inform patients regarding:

- the importance of adhering to the recommendations spelt out in the leaflet for the public;
- individual adjustments of behaviour, medication and fluid intake according to clinical status;
- contact details of social and medical services, helplines and emergency services

Source: adapted from A Bouchama (2007). *Thermophysiology, pathophysiology and clinical management of heat related illness*. Riyadh, King Faisal Specialist Hospital and Research Centre.

4. Some recommendations for retirement and care home managers

See information sheet 1 (recommendations for the public during heat-waves) for advice on how to keep the facilities cool and ensure that patients and residents keep out of the heat, cool and hydrated.

Monitor indoor temperatures. Provide at least one cool room (e.g. air-conditioned room below 25 °C). Move residents to this cool area for several hours each day.

Ask general practitioners to review clinical management of residents at risk, for example due to chronic disease.

Monitor fluid intake. Offer non-alcoholic, unsweetened beverages.

Monitor body temperature, pulse rate, blood pressure and hydration.

Monitor closely for any early signs of heat illness and initiate appropriate treatment.

Inform and train staff and increase staffing levels if necessary.

Source:adapted from existing European heat-health action plans.

5. Adverse effects of drugs during hot weather

Mechanism	Examples
Drugs can: • directly affect the central and peripheral mechanisms of thermoregulation; • affect afferent and efferent pathways, sweating, cutaneous vasodilatation; • affect cardiac output and thereby heat elimination.	Drugs with anticholinergic effects are potent inhibitors of sweating. Antipsychotic drugs may in addition interfere with the central control of the body temperature.
Drugs can aggravate heat illness.	Vasodilators including nitrates and calcium channel blockers can worsen hypotension in vulnerable patients.
Heat exposure can increase toxicity and/or decrease the efficacy of drugs.	Toxicity of drugs with a narrow therapeutic index, such as digoxin or lithium, may be enhanced.
Dehydration and changes in blood volume distribution associated with excessive heat exposure and the thermoregulatory response can influence drug levels, their kinetics and excretion and hence their pharmacological activity.	

△ Drugs need to be stored and transported at temperatures below 25 °C or in the fridge if indicated. High ambient temperatures can adversely affect the efficacy of drugs, as most manufactured drugs are licensed for storage at temperatures up to 25 °C. This is particularly important for emergency drugs including antibiotics, adrenergic drugs, insulin, analgesics and sedatives.

Source: adapted from A Bouchama (2007). *Thermophysiology, pathophysiology and clinical management of heat related illness*. Riyadh, King Faisal Specialist Hospital and Research Centre; and from existing European heat–health action plans.

6. Considerations for medical professionals regarding drinking recommendations during hot weather and heat-waves

“Drinking a lot” means ingesting the volume of water needed to compensate for the fluid deficit (essentially the urine and sweat losses) by approximately 150%.[a]

During hot weather and heat-waves, people have to drink even if they do not feel thirsty! This is particularly true for the elderly who have a decreased perception of thirst.

Excessive drinking of pure water can lead to severe hyponatraemia, potentially leading to complications like stroke and death. The addition of sodium chloride and other soluble substances in the beverage (20–50 mmol/l of beverage) decreases the urinary water loss and facilitates the recovery of the fluid balance.[a]

Each individual older person or patient needs to receive personalized drinking recommendations depending on his or her health status. Individuals can be differentiated as follows:

- healthy old adults;
- vulnerable people, whose risks are increased in cases of heat stress through haemoconcentration (increased viscosity, red cell and platelet counts) and possible coronary thrombosis, cerebrovascular ischaemia and renal insufficiency;[b]
- patients with a history of stroke, hypertension, diabetes, coronary events, renal insufficiency or dementia.

Guidance has to be adapted, accessible and understandable to various categories of people: the lay public, health care professionals and medical staff.

[a] RL Sharp (2006). Role of sodium in fluid homeostasis with exercise. *Journal of the American College of Nutrition*, 25:231S–239S.
[b] D Raphael et al. (1995). Frailty: a public health perspective. *Canadian Journal of Public Health*, 86 (4):224–227.

7. Key principles of heat risk communication

Trust

The overriding goal is to communicate with the public in ways that build, maintain or restore trust.

Announcing early

The parameters of trust are established in the first official announcement. This message's timing, candour and comprehensiveness may make it the most important of all communications.

Transparency

Maintaining the public's trust throughout an event requires transparency (communication that is candid, easily understood, complete and factually accurate). Transparency characterizes the relationship between the event managers and the public. It allows the public to view the information-gathering, risk-assessing and decision-making processes associated with extreme events response.

Understanding the public

Understanding the public is critical to effective communication. It is usually difficult to change pre-existing beliefs unless those beliefs are explicitly addressed. And it is nearly impossible to design successful messages that bridge the gap between the expert and the public without knowing what people think. Early risk communication was directed at informing the public about technical decisions (known as the "decide and tell" strategy). Today, risk communicators teach that crisis communication is a dialogue. It is the job of the communicator to understand the public's beliefs, opinions and knowledge about specific risks.

This task is sometimes called "communications surveillance". The public's concerns need to be appreciated even if they seem unfounded.

What can the individual do? Risk communication messages should include information about what the public can do to become safer. It is important to agree with the media at the beginning of the season as to what the key messages to be announced are, concerning what people or health professionals should do in order to avoid health impacts during heat-waves. Once a heat warning is issued these messages could be repeated through all channels.

The content of specific behavioural and medical advice varies across public health response plans and cultures. It has been stressed by researchers that passive dissemination of advice may not be sufficient to reach those people most at risk and they suggest following the example of some public health response plans that integrate and strengthen active identification and care of people at risk. To ensure service delivery, it may be effective to merge preparedness plans for various kinds of extreme events into the national emergency plan.

Source: adapted from WHO Regional Office for Europe (2005). *Health and climate change: the now and how – a policy action guide*. Copenhagen, WHO Regional Office for Europe (http://www.euro.who.int/document/E87872.pdf, accessed 28 March 2008).

8. Mild and moderate heat illnesses and their management

Medical condition	Signs and symptoms/ mechanisms	Management
Heat rash	Small red itchy papules appear on the face, neck, upper chest, under breast, groin and scrotum areas. This can affect any age but is prevalent in young children. Infection with Staphylococcus can occur. It is attributed to heavy sweating during hot and humid weather.	Rash subsides with no specific treatment. Minimize sweating by staying in an air-conditioned environment, taking frequent showers and wearing light clothes. Keep the affected area dry. Topical antihistamine and antiseptic preparations can be used to reduce discomfort and prevent secondary infection.
Heat oedema	Oedema of the lower limbs, usually ankles, appears at the start of the hot season. This is attributed to heat-induced peripheral vasodilatation and retention of water and salt.	Treatment is not required as oedema usually subsides following acclimatization. Diuretics are not advised.
Heat syncope	This involves brief loss of consciousness or orthostatic dizziness. It is common in patients with cardiovascular diseases or taking diuretics, before acclimatization takes place. It is attributed to dehydration, peripheral vasodilatation and decreased venous return resulting in reduced cardiac output.	The patient should rest in a cool place and be placed in a supine position with legs and hips elevated to increase venous return. Other serious causes of syncope need to be ruled out.
Heat cramps	Painful muscular spasms occur, most often in the legs, arms or abdomen, usually at the end of sustained exercise. This can be attributed to dehydration, loss of electrolytes through heavy sweating and muscle fatigue.	Immediate rest in a cool place is advised. Stretch muscles and massage gently. Oral rehydration may be needed using a solution containing electrolytes. Medical attention should be sought if heat cramps are sustained for more than one hour.
Heat exhaustion	Symptoms include intense thirst, weakness, discomfort, anxiety, dizziness, fainting and headache. Core temperature may be normal, subnormal or slightly elevated (less than 40 °C). Pulse is thready with postural hypotension and rapid shallow breathing. There is no mental status alteration. This can be attributed to water and/or salt depletion resulting from exposure to high environmental heat or strenuous physical exercise.	Move to a cool shaded room or air-conditioned place. The patient should be undressed. Apply cold wet sheet or cold water spray and use fan if available. Lie the patient down and raise legs and hips to increase venous return. Start oral hydration. If nausea prevents oral intake of fluids, consider intravenous hydration. If hyperthermia above 39 °C or impaired mental status or sustained hypotension occur, treat as heatstroke and transfer to hospital.

Source: adapted and updated from A Bouchama, JP Knochel (2002). Heat stroke. *New England Journal of Medicine*, 346:1978–1988; and JP Knochel, G Reed (1994). Disorders of heat regulation. In: MH Maxwell, CR Kleeman, RG Narins, eds. *Clinical disorders of fluid and electrolyte metabolism*, 5th ed. New York, McGraw-Hill Inc.:1549–1590.

9. Management of life-threatening heatstroke

Condition	Intervention	Goal
Out-of-hospital		
Exposure to heat stress (heat-wave, summer season and/or strenuous exercise).	Measure core temperature (rectal probe). If > 40 °C, move to a cooler place, remove clothing, initiate external cooling:† cold packs on the neck, axillae and groin, continuous fanning (or keep ambulance windows open) while skin is sprayed with water at 25–30 °C.	Diagnose heatstroke.* Lower core temperature to < 39.4 °C. Promote cooling by conduction, maintain currents of air. Promote cooling by evaporation.
Changes in mental status (anxiety, delirium, seizures, coma).	Position unconscious patients on their side and clear airway. Administer oxygen 4 l/min. Give isotonic crystalloid (normal saline). Rapidly transfer to an emergency department.	Minimize risk of aspiration. Increase arterial oxygen saturation to > 90%. Ensure volume expansion.
In-hospital		
Hyperthermia	Confirm diagnosis with thermometer calibrated to measure high temperatures (40–47 °C). Monitor skin and rectal temperature; continue cooling.	Keep skin temperature >30 °C. Stop cooling when rectal temperature is <39.4 °C.‡
Seizures	Consider benzodiazepines.	Control seizures.
Respiratory failure	Consider elective intubation (for impaired gag and cough reflexes or respiratory function deterioration).	Protect airway and augment oxygenation (arterial oxygen saturation to > 90%).
Hypotension§	Administer volume expanders, add vasopressors and consider central venous pressure monitoring.	Increase mean arterial pressure >60 mm Hg, restore organ perfusion and tissue oxygenation (consciousness, urinary output, lactate level).
Rhabdomyolysis	Expand volume with normal saline, intravenous furosemide and mannitol or intravenous sodium bicarbonate. Monitor serum potassium and calcium and treat even modest hyperkalaemia.	Prevent myoglobin induced renal injury. Promote renal blood flow and diuresis. Ensure urine alkalinization.
Post-cooling		Prevent life-threatening cardiac arrhythmia.
Multiple organ system dysfunction	Use nonspecific supportive therapy.	Aid recovery of organ function.

* Diagnosis of heatstroke should be suspected in any patient with mental status changes during heat stress even if the temperature is < 40 °C.
† No evidence of one cooling technique superiority over another. Non-invasive techniques that are easy to apply, well-tolerated and less likely to cause cutaneous vasoconstriction are preferred. Antipyretics such as aspirin and acetaminophen should be avoided because of their potential to aggravate the coagulopathy and liver injury of heatstroke.
‡ There is no evidence to support specific endpoint temperature to halt cooling. However, a rectal temperature of 39.4 °C has been used in large series and proved to be safe.
§ Hypotension usually responds to volume and cooling. Vasodilatory shock and primary myocardial dysfunction may underline sustained hypotension refractory to volume expansion. Therapy should be individualized and guided by clinical response.

Source: updated from A Bouchama, JP Knochel (2002). Heat stroke. *New England Journal of Medicine*, 346:1978–1988; A Bouchama, M Dehbi, E Carballo-Chaves (2007). Cooling and haemodynamic management in heatstroke: practical recommendations. Critical Care, 11(3), available online at http://ccforum.com/content/11/3/R54 (accessed 1 April 2008).

10. Reducing indoor temperatures during hot weather

Short-term measures for existing buildings

Measures	Comment
Thermometers to measure indoor temperatures	These are useful to measure indoor temperature and to show when action needs to be taken.
Increased external shading	External shading of windows reduces solar heat gains; internal shading of windows to avoid solar loads inside the room is always advisable.
Electric fans	Electric fans may provide relief, but when the temperature is above 35 °C, fans may not prevent heat-related illness – it is important to drink enough fluids.
Mobile evaporative coolers	The cooling effect of evaporative coolers increases with temperature and decreases with relative humidity of the air.
Local air conditioning	Air conditioners provide relief. Please note that if you buy or install air conditioning please use an air conditioner that is as energy efficient as possible. Proper cleaning and maintenance is important to avoid health impacts. Be aware of electricity blackouts in summer time!

In order to reduce indoor temperature in a sustainable way, there are various possible medium- and long-term measures to increase reflection of heat from the surface (albedo) of the building through:

- cool paints (light coloured surfaces present much lower surface temperatures than dark ones);
- coloured material with high reflectivity, such as coating;
- natural reflecting materials.

For a broader range of possibilities (including urban planning and land-use change) please see the publication Heat-waves: risks and responses (2004). Copenhagen, WHO Regional Office for Europe (http://www.euro.who.int/document/E82629.pdf)).

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HEAT–HEALTH ACTION PLANS

Climate change is leading to variations in weather patterns and an apparent increase in extreme weather events, including heat-waves. Recent heat-waves in Europe have led to a rise in related mortality but the adverse health effects of hot weather and heat-waves are largely preventable. Prevention requires a portfolio of actions at different levels, including meteorological early warning systems, timely public and medical advice, improvements to housing and urban planning and ensuring that health care and social systems are ready to act. These actions can be integrated into a defined heat–health action plan. This guidance results from the EuroHEAT project on improving public health responses to extreme weather/heat-waves, co-funded by the European Commission. It explains the importance of the development of heat–health action plans, their characteristics and core elements, with examples from several European countries that have begun their implementation and evaluation.

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