



EUROPE



# Improving Public Health Responses to Extreme Weather/ Heat-Waves – EuroHEAT

Meeting Report

Bonn, Germany, 22-23 March, 2007

**Inserm**

Institut national  
de la santé et de la recherche médicale



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## ABSTRACT

EuroHEAT, a DG SANCO co-funded project, aimed to improve public health responses to weather extremes and to heat-waves in particular. As coordinator of the project, the WHO Regional Office for Europe organized an international expert meeting in Bonn to discuss project findings and to develop key policy recommendations for future action. The project assessed the evidence for the health impacts of extreme weather, developed a climate information decision support tool for heat and actions to prevent health impacts. Overall project results are presented in this report. Based on these results, core elements of heat health action plans have been identified and main messages of heat health advice for a range of target groups formulated. The meeting concluded that information on best practice heat health action plans, medium term probability heat forecasting, criteria for decision making, multi-targeted education material and on excess mortality in summer times needs to be made accessible on an information platform. WHO in collaboration with its EuroHEAT partners and the EC is planning to i) clarify the scientific uncertainties surrounding the multi-targeted education material; ii) make available the full information elaborated in this project by early 2008 for planning processes for the summer of 2008; iii) make available for countries guidance for the development of heat health action plans; transform the EuroHEAT web site into an open accessible information platform – in collaboration with the EC Portal.

### Keywords

CLIMATE - adverse effects  
METEOROLOGICAL FACTORS  
GREENHOUSE EFFECT  
ENVIRONMENTAL HEALTH  
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This report summarizes the discussion on the results of the EuroHEAT project. The EuroHEAT project is coordinated by Bettina Menne and Franziska Matthies from the Global Change and Health programme of the WHO Regional Office for Europe.

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## Introduction

In June, 2004, at the 4th Ministerial Conference for Health and the Environment, European Ministers for 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.”<sup>1</sup> Despite the active greenhouse gas mitigation policies that are now being implemented in Europe, some degree of global climate change is inevitable in this century. The Intergovernmental Panel on Climate Change (IPCC) projects that, as a result, heat-waves will increase in number, intensity and duration over most land areas in the 21st century.<sup>2</sup> This trend may be accompanied by increased risk of heat-related mortality and morbidity, especially for the elderly, chronically ill, very young and socially isolated individuals.

The project “Improving public health responses to extreme events” (EuroHEAT) started in 2005 as part of the implementation of the Budapest Ministerial Conference for Environment and Health, and the EC Environment and Health Action Plan. The project was co-funded by the Health and Consumer Protection Directorate General of the European Commission (DG SANCO) and had the general aim of improving public health responses to weather extremes and in particular to heat-waves. Around 100 scientists, scientific advisors, meteorologists, environmental scientists and policy advisors from 20 countries contributed to the project. The project ended in March 2007.

The EU Project CANICULE<sup>3</sup> - Etude de l’impact de la canicule d’août 2003 sur la population européenne started in April 2006 and aimed at estimating the excess mortality cumulated during summer 2003 in sixteen countries. The excess mortality was assessed by month, week and day which allowed comparison of the mortality level observed in other periods of 2003 and the reference periods in which no heat-wave was recorded. Biometeorological characteristics of the heat-wave and particular risk factors for the elderly, such as social isolation or place of residence, are discussed.

The WHO, EC and the Institut National de la Santé et de la Recherche Médicale (INSERM) therefore invited to the meeting, with the aim to:

- discuss the scientific and technical findings of the EuroHEAT project;
- discuss the usefulness and sustainability of the tools developed in the frame of the EuroHEAT project;
- draw future recommendations for action to prevent health impacts from heat.

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1 *Declaration* (2004). Fourth Ministerial Conference on Environment and Health, Budapest, 23-25 June 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.

3 CANICULE – web site: Outline of the project:

[http://ec.europa.eu/health/ph\\_information/dissemination/unexpected/unexpected\\_2\\_en.htm#2](http://ec.europa.eu/health/ph_information/dissemination/unexpected/unexpected_2_en.htm#2)

Almost 100 participants from 23 countries attended the meeting, including representatives from countries from the European region, as well as from the European Commission (EC), the World Meteorological Organisation (WMO), and scientists from around the world (please refer to the annex for the list of participants and the conference programme).

## Key findings and policy messages of the EuroHEAT project

**The adverse health effects of heat-waves are largely preventable.** It was recommended to develop and implement **heat health action plans** at national and regional levels in Europe, in order to prevent, react upon, and contain heat-related risks to health. These plans should include measures for long term prevention, mid-term preparation and short term emergency measures.

### Hot weather can kill and cause illness.

- It became clear during the meeting that summer 2003 had higher death rates than previously estimated. Within the CANICULE project more than 70 000 excess deaths were observed between June and September 2003 (Robine et al, 2008).
- A ten-year analysis in 15 European cities, carried out in the PHEWE<sup>4</sup> project, estimated a 2% increase in mortality in northern cities, and a 3% in southern cities for every 1 °C increase in apparent temperature above the city threshold level.

**There is no standard definition for a heat-wave.** In the EuroHEAT project we defined a heat-wave as a period where maximum apparent temperature ( $T_{app_{max}}$ )<sup>5</sup> and minimum temperature ( $T_{min}$ ) are over the 90th percentile of the monthly distribution for at least two days. Applying this definition, during the heat-wave episodes the percentage increase of mortality estimated was from 7.6% to 33.6% in the nine European cities. Results show a high heterogeneity of the effect between cities and populations.

**Heat-waves characterized by long duration and high intensity have the highest impact on mortality.** Each heat-wave was also characterised by intensity and duration. The impact of heat-waves characterized by longer duration (more than four days) was 1.5 to 5 times higher than for short heat-waves. During the 2003 heat-wave the highest impacts were observed in the cities of Paris and London.

**There is growing evidence that the effects of heat-wave days on mortality are larger during high ozone days and high PM<sub>10</sub> days.** There is no evidence for interaction between heat-wave days and the concentrations of NO<sub>2</sub>, SO<sub>2</sub> and CO. Future heat-wave studies need to adjust for air pollutants in their effect estimates and there is growing evidence that reduction in PM<sub>10</sub> and ozone exposure reduces the risk of dying.

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<sup>4</sup> PHEWE: Assessment and Prevention of acute Health Effects of Weather conditions in Europe  
Web site: <http://www.epiroma.it/phewe/>

<sup>5</sup> 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  $\pm C$

**Some people are more vulnerable<sup>6</sup> to heat stress than others.** In the European cities the greatest effects of heat-waves was in the elderly and the impact on mortality was greater in women than in men. A range of conditions increase the risk of heat stress in an individual, such as diabetes, fluid/electrolyte disorders, and some neurological disorders. However, results between countries are not very consistent, and a wide range of chronic diseases are implicated. There is some evidence that lower income groups in urban areas were more at risk of heat-wave related mortality in August 2003, but many studies also show that there is no modification of the temperature-mortality relationship by socio-economic status. Therefore, it is not clear whether poor urban populations are more at risk from heat-related mortality in Europe.

**Global climate change is projected to further increase the frequency, intensity and duration of heat-waves and attributable deaths.** Public health prevention measures need to take into consideration the additional threat from climate change and be adjusted over time. Measures that are effective now, might not be effective anymore in future decades to come.

**Recommended elements of heat health action plans are:**

- a. Establishment of collaborative mechanisms between bodies and institutions, and a lead body to coordinate responses;
- b. An accurate and timely alert system;
- c. Strategies to reduce individual and community exposure to heat;
- d. Long-term improved urban planning, transport policies and building design to reduce energy consumption;
- e. Particular care for “vulnerable” populations;
- f. Provision of health care, social services and infrastructure;
- g. Heat-related health information strategies;
- h. Real time surveillance, evaluation and monitoring.

**Establishment of multi-purpose collaborative mechanisms between bodies and institutions and a lead body to coordinate responses.** Responsibilities and roles should be made clear for actors in politics, science, health and social professions at the national/regional level. Exploring financial incentives and eventual legislation might be helpful. Exploring linkages with the International Health Regulation for enactment mechanisms and existing national disaster plans is advised.

**Accurate and timely alert systems are essential.** Collaboration with meteorological services is needed to develop heat health warning systems (HHWS), trigger a warning, determine the threshold for action and communicate the risks. There is no best HHWS! It is important that a

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<sup>6</sup> The definition of vulnerability given by Intergovernmental Panel on Climate Change (IPCC) reads: Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity (Parry et al., 2007).

HHWS is targeted to the local needs, and is accurate and timely. Experiences of various countries should be shared.

**The most important action during a heat-wave is the avoidance or reduction of exposure.** There are multiple ways of reducing individual heat exposure. This includes individual behavioural measures, short-, medium- and long-term housing measures and long term improved urban planning, building design and transport and energy policies.

**Particular care for vulnerable populations** It is helpful to identify populations at high risk before the summer and plan and target interventions accordingly. The identification and active care of individuals vulnerable to heat-waves needs to be undertaken at the local level. Community organizations, medical practitioners and care providers play an important role, in advising individuals at high risk from heat related illness and following up persons at particular risk.

**Provision of health care, social services and infrastructure to prevent heat related illness.** This includes summer staff planning, health service provision, infrastructure provision, training of health personnel and other interest groups. It is advisable that care homes and hospitals meet the EU criteria for the thermal indoor environment in order to prevent heat related illness in patients and staff. Emergency departments could be alerted to heat-waves in order to manage an increase in admissions.

**Heat-related health information plan and system.** As heat-waves are likely to occur every summer although in different locations in Europe – it is advisable to have established a communication plan before the summer with population focused advice on: how to protect oneself and others, on how to reduce heat exposure indoors, on how to recognize heat related symptoms; as well as targeted information to particular groups such as health care institutions and care givers. The scientific uncertainty around certain measures, like how much to drink and which drugs interfere with heat, need to be clarified before giving clear targeted advice.

**Real time health surveillance** should be incorporated into the planning process. Real time surveillance is important to detect early impacts of hot weather, to potentially modify interventions and to inform about abnormal outbreaks or clusters of health impacts. The most useful real time data seem to be all cause mortality, emergency calls, emergency department visits, hotlines and GP records, but they need to be available within one to maximum two days.

**Medium term and short term options are available for passive cooling** such as cool paints; external shading; radiant barriers and insulation of buildings. Advice should be given on how to best reduce indoor temperatures, with particular attention to pollutant avoidance and measures to avoid electricity shut-offs and reduced water availability.

**Long-term improved urban planning, building design, energy and transport policies ultimately will reduce heat exposure.** Building design, urban planning, land-use changes and mitigation of climate change through energy efficiency are highly effective but require political will to be implemented. The fact that there are long lead times before the benefits of these measures are apparent may be an argument in favour of early implementation.

**Evaluation and monitoring.** It is important at the end of the summer to evaluate whether the heat health action plan has worked. This includes the a priori definition of process and outcome criteria. Monitoring health outcomes over time in relationship to heat-waves is another important component.

## Suggested future developments

**It is suggested for WHO Regional Office for Europe and the EC to continue to set up an evidence-based intervention platform on extreme events with the goal to share best effective practices, monitor developments and review achievements over the next few years. To this end information should be developed and shared on:**

- a. Best practice heat health action plan, its development and implementation;
- b. Medium term probability heat forecasting and its effectiveness;
- c. Criteria for decision making on when to act and how to act;
- d. Multi-targeted education material including special interest groups;
- e. Excess mortality in summer times.

## Next steps

WHO in collaboration with its partners in the EuroHEAT project:

- Will organize an information event during the Mid-term Review of the Intergovernmental Conference on Environment and Health in Vienna.
- Is currently developing guidance for a prototype heat health action plan. This guidance is planned to be finalized for 2008 and be made available for countries that do not yet have a heat health action plan or that are revising their own plan.
- Is engaging in clarifying the scientific uncertainties surrounding the multi-targeted education material; in particular the interaction of heat with drugs and the advice on drinking and cooling. To this end it will set up small working groups to make evidence based information available in 2008.
- Will make available the full information elaborated in this project by early 2008 for planning processes for the summer of 2008.
- Will transform the EuroHEAT web site information into an open accessible information platform – in collaboration with the EC Portal.

In the frame of the EuroHEAT project, the German Weather Service has developed a climate information tool with medium term heat forecasting. It provides the probability of a forthcoming heat-wave and can support health services in planning. It is advised that the service developed by the German Weather Service (DWD) is tested and evaluated during the year 2007 to be launched in 2008.

The European Commission is aiming at

- Organizing a conference on improving public health responses to extreme weather;
- Preparing a Communication to the European Parliament and the Council on health consequences of climate change for 2008;
- DG SANCO (Directorate General for Health and Consumer Affairs) web site and the EU Health Portal to play an important role in providing necessary real time information on extreme weather preparedness and health consequences during future heat-waves, cold spells and flooding.

For further information please contact: [globalchange@ecr.euro.who.int](mailto:globalchange@ecr.euro.who.int)

## **Welcome addresses**

### ***Bärbel Dieckmann, the Lady Mayor of the City of Bonn***

I should like to extend a warm welcome to the participants of EuroHEAT here in Bonn. The World Health Organization programme on global change and health called this international conference into being with a view to improving public health responses to extreme events.

What better location could there be for this particular debate than the main building of the United Nations Campus. Some thirteen United Nations organizations, including the United Nations Climate Change Secretariat and the WHO European Centre for Environment and Health, work together here under a common banner – The United Nations in Bonn: Working Towards Sustainable Development Worldwide.

Global change is largely about climate change and its effects are felt not only in the world's climate hotspots but increasingly and ever more markedly in Europe. Events such as extreme heat-waves impact on our ecosystems and pose an acute threat to human health – particularly in our ever-expanding cities.

As the Lady Mayor of Bonn and the Chair of the World Mayors Council on Climate Change, I believe our cities have a special obligation. Having contributed significantly to global change, they must now learn to adapt and live with its effects on the environment, our lifestyles and our health. International exchange and cooperation between local administrations is vital: it allows them to combine their experience and lend their expertise in advancing the global debate. I wish you an interesting and fruitful conference and hope you will find time to explore our beautiful city despite your full agenda.

### ***Manfred Schmitz, Representative of the Ministry of Health of North Rhine-Westphalia***

Dear Directors Bertolini and Krzyzanowski as hosts representing the WHO Regional Office for Europe, dear Mister Montserrat representing EU Commission, Honourable Delegates and Colleagues from the various Member States, it is a very special pleasure for me to welcome you today in the name of the Minister of Labour, Health and Social Affairs of North Rhine-Westphalia, Karl-Josef Laumann. The aim of joining you in the Bonn Regional Office for

Europe of the World Health Organization, WHO at the United Nations Campus Bonn is to discuss within your "Final Meeting on Improving Public Health Responses to Extreme Weather."

I am convinced that the choice of Bonn as the location for this meeting is a good choice not only since Bonn is the location of a World Health Organization's Office.

This Meeting is an additional stone in the mosaic of collaboration between Germany and WHO, which has been exemplary to date. It underlines the high esteem in which we hold WHO and its excellent work here in Germany especially in the State of North Rhine-Westphalia and the city of Bonn. The Meeting is furthermore an excellent example of the collaboration between the areas of health and the environment - collaboration, which we hope will continue to be successful in the future for the preparation of the next Ministerial Conference in Rome 2009.

In the past, WHO has accomplished important work, not only in the area of public health; it has, above and beyond that, pushed forward the networking of two areas of policy: health and the environment and the State-Health-Ministry much appreciates and supports this work by WHO. Since the first WHO European Conference on "Environment and Health", held in 1989 in Frankfurt, the world has surely changed; this applies in particular to Germany but also, naturally, to Europe as a whole. German reunification combined with the changes which have taken place in Eastern Europe have been and continue to be, not only important political changes. They also had clear repercussions on health and environmental policy.

As a result, the challenges to be met in environmental health protection have, in some cases, become others. Political priorities have shifted. Climate change has been a top priority issue on the agenda of the last EU Summit held exactly two weeks ago in Brussels under German Presidency as well as bringing the Central and Eastern European States more into our field of vision.

However, the fundamental ideas, as laid down in the 1989 European Charter for Environment and Health, remain unchanged. Even today, the issues in the foreground are:

- preventive action, so that problems do not arise in the first place,
- early detection of new and difficult developments, so as to be able to counteract them in time,
- rapid, appropriate action in dealing with problems which have arisen to avoid damaging repercussions as far as possible, and
- inter-sectoral and cross-border cooperation to be able to join efforts in the identification and solving of problems.

With our "Action Programme Environment and Health" we have considered these aspects in Germany. But such a programme does not only exist on the national level. Additionally on the state level we have become active supporters as well and were able to initiate a number of projects on this basis. This is of special importance within our system of federal organization, where states and local bodies have the legal responsibilities by our constitution to execute the regulations in the field of health and environment. For example nearly all hospitals performing acute care are run and financed at this level.

The extreme weather situations have demonstrated clearly that there is a deficit in this area applying to all regions in Europe. This applies especially to the vulnerable groups of our societies like elderly people and children. Although the problems might not be the same in all regions, there is clearly a great deal left to be done for WHO in order to identify these problems and make recommendations in order to solve them.

Ladies and Gentlemen, I am certain that with this WHO-meeting our joint efforts in the interest of environmental health protection in Europe will continue to develop in a positive direction. I wish us all the utmost success in this our common commitment.

***Antoni Montserrat Moliner, EC representative***

Antoni Montserrat Moliner, the EC representative to the meeting, noted the importance, for the European Commission, of doing something practical to reduce the effects of climate change on human and animal health. The heat-wave of 2003 led to the CANICULE Europe 2003 project. It gathered information on mortality and morbidity, and contributed to a better understanding of what actually happened in 2003. This understanding might help to prevent similar consequences in future. In that respect, EuroHEAT was funded. Excellent work has followed, which helps to set up frameworks for action. Prevention of acute Health Effects of Weather conditions in Europe (PHEWE) and certain other EC projects are related. He underlined the need to gather all this, take an initiative to address Members on the consequences of heat-waves, to urge legal measures (compulsory activities each member should do). At present we are not able to enforce, but we can recommend. A non-legislative mechanism will be in place by the end of 2007. Heat-waves will happen in future. Antoni Montserrat Moliner expressed his hope that summer 2007 will not be as serious as 2003 and stressed the need of cooperation to be champions for addressing the health consequences of climate change.

- Climate change refers to a statistically significant variation in either the mean state of the climate or its variability that persists for extended periods. Over the past 100 years global mean temperature has increased by 0.7 °C and in Europe by about 1.0 °C. The 1990s were the warmest decade over the past 150 years. Temperatures are projected to increase further by 1.4 to 5.8 °C by 2100, with larger increases in Eastern and Southern Europe. Warming-up of the atmosphere is part of the changes in climate and (extreme) weather conditions.
- Current trends, point to the likelihood that extreme weather events (heat-waves, floods, and extreme cold period) are expected to increase in frequency and severity.
- Potential and observed health effects relate to extreme weather conditions as well as to an increase of human and animal diseases. Other health effects can be observed as consequences of exposure to ultra violet radiation (cancer and cataracts), water availability, crop production, wildfires etc.
- The sum of the total effects of climate change on human and animal health may be greater than simply an accumulation of every single effect. The change in risk of a disease or health effect may be influenced by changes across other sectors, e.g., water resources, agriculture, or coastal ecology. This impact is usually complex and difficult to be assessed in terms of risk.

**Suggested initiatives and actions to address the health consequences of climate change**

An integrated approach and a close cooperation between veterinary and public health experts and policy makers are essential to effectively tackle health effects of climate change. Indeed, the human and the animal health impacts of climate change occur simultaneously and present cross-effects.

Heat-waves in Europe are associated with significant morbidity and mortality. An analysis of the 2003 heat-wave in Europe, to be presented at the Conference, estimated that it caused 70 000 deaths in Europe (instead of the 45 000/60 000 recognised previously). These figures highlighted some of the weaknesses in public health responses. Some people are at particular risk of heat stress, including the elderly, children, persons with chronic debilitating diseases, persons undergoing certain treatments, outdoor workers and some dependent or socially isolated individuals. Air pollution is often worse during a hot weather. Because hot weather and air pollution often coincide, it can be difficult to separate the effects of the two exposures. It is possible that hot weather and air pollution interact so that air pollution has greater health effects when the weather is extremely hot.

### **Conference on improving public health responses to extreme weather**

This Conference will consider proposals to be adopted in the near future by Member States in order to improve public health prevention measures over the long term, medium term and during emergencies. The adverse health effects of heat-waves are largely preventable. The conference will consider recommendations on heat-wave plans to be developed by Member States, which will feed into the Commission's work on next year's Communication. These heat-wave plans could include recommendations on: accurate and timely meteorological forecasts, particular care for vulnerable populations, provision of health care, social services and infrastructure, the establishment of a lead agency to coordinate emergency responses, urban planning, energy and transport policies, risk communication mechanisms and others.

This conference will discuss recommendations on how Member States can plan to respond better to heat-waves. Two projects supported by the European Commission's Public Health Programme will be presented at the conference: EuroHEAT (Improving Public Health Responses to Extreme Weather/Heat-Waves) coordinated by WHO Europe, and the 'Study on the impact of the 2003 heat-wave' coordinated by the Institut National de la Santé et de la Recherche Médicale (INSERM), France.

### **Upcoming communication on health consequences of climate change**

The European Commission is preparing for 2008 a Communication to the European Parliament and the Council on Health Consequences of Climate Change. This non legislative initiative is expected to include recommendations to reduce the effects on human and animal health of climate change taking into account: the changes in the means of transmission of certain infectious diseases affecting human and animals; unexpected weather events (essentially heat-waves, but not neglecting possible cold spells and flooding); changes in the dissemination of airborne allergens due to atmospheric changes and the risks due to ultraviolet radiation (UVR).

The Commission Communication on Health Effects of Climate Change foreseen for 2008 aims at establishing a framework to tackle climate change impact on human and animal health at EU level. In order to increase the political visibility of the Communication, this should be announced on the occasion of the Mid-term Review of the Intergovernmental Conference on Environment and Health scheduled in Vienna on 13 to 15 June 2007.

- Further collaboration with relevant Directorate Generals (i.e. ENVI, JRC, RESEARCH, ENERGY) and European Agencies (i.e. European Centre for Disease Prevention and Control [ECDC]) should be carried out to evaluate the potential integration of the necessary information on events and diseases linked to climate change in existing early warning systems (i.e. European Weed Research Society [EWRS]) and communication platforms in course of elaboration by the ECDC.

- DG SANCO (Directorate General for Health and Consumer Affairs) web site and the EU Health Portal could play an important role in providing real time necessary information on extreme weather preparedness and health consequences during future heat-waves, cold spells and flooding.
- Strengthened cooperation with international organizations such as World Health Organization (WHO), World Organization for Animal Health (OIE), Food and Agriculture Organization (FAO) is also to pursue intensively given the important international dimension of the climate change effects.
- Adaptation is the key response strategy to minimize potential impacts of climate change, and to reduce, with the least cost, the adverse effects on health. A debate with member states should be launched by the commission on the practical implementation of this 'adaptation scheme' as well as the adoption of a common approach to key questions.
- Specific actions have to be developed in the various areas of climate change health effects. Measures should include among others:
  - The introduction of recommendations and/or other instruments in the existing EU human public health legal framework;
  - Update of and, where needed, amendments to relevant EU veterinary measures;
  - Identification of most vulnerable population groups during heat-waves and cold spells and adoption of preventive measures to reduce morbidity and mortality within these groups;
  - Further analysis and research on health consequences of extreme cold, flooding and airborne allergens in the framework of the European Seventh Framework Programme (EU FP7).

For further information please visit:

[http://ec.europa.eu/health/ph\\_information/dissemination/unexpected/unexpected\\_en.htm](http://ec.europa.eu/health/ph_information/dissemination/unexpected/unexpected_en.htm)

### ***Roberto Bertollini, WHO Regional Office for Europe***

In June, 2004, European Ministers for Health and the Environment recognized that “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. This demands a proactive and multidisciplinary approach by governments, agencies and international organizations and improved interaction on all levels from local to international. The WHO, through its European Centre for Environment and Health, was invited in collaboration with organizations to support these commitments and to coordinate international activities to this end.

This meeting is the result of a two years project, co-funded by the European Commission: Improving Public Health Responses to Extreme Weather Events. The general objectives of this project were to improve public health responses to weather extremes and in particular heat-waves. A number of methods were used, including epidemiological studies, country surveys, case studies and literature assessments. This allowed to gather a more in depths understanding on the exposure to heat stress, risk factors for mortality and morbidity, interaction with air pollutants, early warning systems, national and regional preparedness planning and available intervention strategies. Results should be reported back at the Intergovernmental Mid-term Review (IMR) in June, 2007.

This meeting is organized around the summary for policy makers and the technical summary distributed to all participants. The scope is to reach consensus on the technical summary – and develop key policy recommendations – to be launched at the end of the two days.

## **Full meeting report**

This part of the meeting report is organized in six sections: The first section is dedicated to information on health impacts of heat and heat-waves, the second deals with the relation between air pollution, heat and health, the third explores risk factors for mortality, and the fourth discusses issues of health impact prevention. Each topic is introduced with a summary of the presented project results, followed by main points discussed in working groups. The implications for the public health response are drawn from the presented results as well as the group work conclusions and contain recommendations where applicable. Each section closes with the questions raised in the plenary discussion. The French project “CANICULE” is introduced in the fifth chapter. The final chapter gives an outlook on future steps and the way forward.

This report is also available on the web site of the Global Change and Health Programme (<http://www.euro.who.int/globalchange>).

## **I. Health impacts of heat and heat-waves**

### **The Impacts of Heat and Heat-Waves – Implication for Policy Making**

*Paola Michelozzi*

The health impacts of hot weather and heat-waves depend upon the level of exposure (frequency, intensity and duration) to heat; the size of the exposed population; the characteristics of the population (susceptibility); and the prevention measures in place. Geographical and temporal variations of the relationship between daily temperature and health outcome are well documented.

A “U- or V-shaped” relationship between daily temperature and mortality has been well documented with mortality rates increases above and below an optimum range of temperatures (between 15 °C and 25 °C in the different countries). Studies published between 1993 and 2003, attributed between 0.7% to 3.6% change in all cause mortality to one degree increase of temperature above a cut point in several European cities (Kunst et al., 1993; Ballester et al., 1997; Michelozzi et al., 2000; Basu & Samet; 2002, Hajat et al., 2002, Pattenden et al. 2003).

The recent Assessment and Prevention of Acute Health Effects of Weather Conditions in Europe (PHEWE) project (Michelozzi et al., 2007), by using the same methodology across 15 European cities, estimated an increase in mortality for every 1 °C increase in apparent temperature above thresholds of about 2% (95% CI: 0.06-3.64) in northern continental cities and about 3% (95% CI: 0.60-5.72) in the Mediterranean cities (Baccini et al., In Press). The strength of the relationship between daily outdoor temperature and health outcomes differs between countries, between cities, and even in the same location from one year to the next. For example, the estimated increase in mortality per 1 °C increase in apparent temperature was 1.5% in Barcelona and more than 5% increase in Athens and Rome.

Most of studies performed before 2003 showed the highest impact on mortality for respiratory and cardiovascular causes. The PHEWE study confirmed these results with the highest effect observed for respiratory mortality in the Mediterranean cities (Baccini et al., In Press). A statistically significant effect of high temperatures on cardiovascular mortality was seen when considering all age groups and in the 75+ age group in Mediterranean cities, while a significant effect in mortality by respiratory causes was observed for both Mediterranean and North Continental cities in all ages and the 75+ age group.

The EuroHEAT study (Michelozzi et al., in press) had the objective to estimate the effect of extreme events (heat-waves) on mortality in a subgroup of PHEWE cities (Athens, Barcelona, Budapest, London, Milan, Munich, Paris, Rome and Valencia). A heat-wave is a prolonged period with unusual high heat load and was defined identifying in each city the extreme temperature values as 90th percentile of the distribution of the maximum apparent and minimum temperature, and classifying heat-waves in terms of intensity and duration. The results indicate that high values of both, maximum apparent and minimum temperature were associated with an increase in mortality and the impact of heat-waves, in terms of increase in daily mortality, was 1.5 to 5 times higher for heat-waves characterized by longer duration. 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. In all cities, the impact of heat-waves on mortality was higher among females than among males.

The intensity, duration and timing of heat-waves have been shown to influence the risk of mortality. In the EuroHEAT study, heat-waves of higher intensity and duration were generally more dangerous (Figure 1).

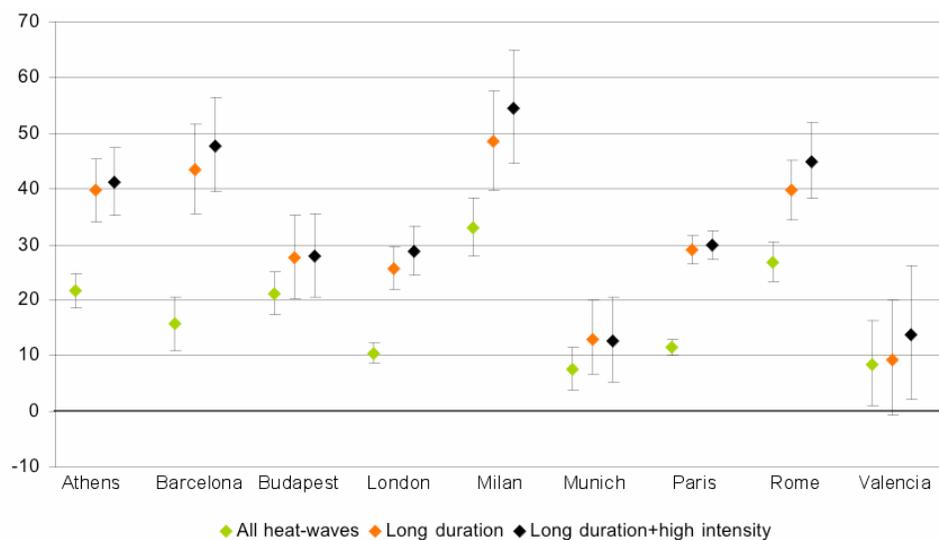


Figure 1: Effect of heat-waves with different characteristics on total mortality among people aged 65+ (% increase and 90% CI) (Michelozzi et al., in press)

High intensity heat-waves produced a higher increase in daily mortality for a given heat-wave duration. Moreover, there is a clear effect of duration, with a stronger effect of heat-waves of long duration, for a given intensity. There were similar patterns in most cities, but not in Munich or Valencia. The first heat-wave of the summer appeared more dangerous only in some cities

(Athens, Budapest and Munich). For subsequent heat-waves, those occurring after a short time interval generally had less effect than those occurring after three or more days.

The burden of heat-wave mortality includes a wide range of causes. Heat stroke is fatal in 10-50% of all cases and may lead to neurological morbidity in 20-30% of patients (Bouchama & Knochel, 2002). Heat stroke is still underreported as causes of death have been further attributed to cardiovascular and respiratory diseases. An increased risk of dying was found among individuals with pre-existing illnesses, e.g. heart disease, cerebrovascular diseases, respiratory diseases, blood and metabolic/endocrine gland disorders, cardio-pulmonary and genitourinary disorders (Stafoggia et al., 2006).

In Europe, the impact on morbidity in terms of hospital admissions is not consistent with the effect observed on mortality, and higher temperatures do not appear to be associated with a significant increase in admissions for cardiovascular disease, as documented in United States cities. In fact, for cardiovascular and cerebrovascular diseases, there were fewer admissions during hot weather. A positive association between high temperatures and respiratory hospital admissions was observed in the PHEWE in most of cities (Michelozzi et al., 2006).

Also results from other studies showed the impact of temperature on hospital admissions to be lower than that observed on mortality. In London no significant excess in hospital admissions was seen during the 1995 heat-wave (Kovats et al. 2004), and only a small increase in admissions in people over 75 years of age was observed in 2003 (Johnson et al., 2005). In France instead, hospitals were overwhelmed during the 2003 heat-wave, and a number of heat stroke cases were reported (Misset et al., 2006). In Spain, an increase in admissions was seen in 2003, with about 40% identified as heat related, but none were diagnosed as having heat stroke (Cajoto et al., 2005).

### ***Understanding the health impacts of hot weather and heat-waves in order to target action***

#### *Group work consensus*

In general, the expert groups agreed on the main messages resulting from the presented research:

- Increased heat leads to mortality and the impact varies by age, sex and risk groups.
- There is a large heterogeneity of the effect in European cities attributable to level of exposure and different susceptibility of the local population.
- In addition to the intensity, the duration of the heat-wave is a key factor.
- Interventions need to be tailored towards different risk groups. More complementarity between the health effects and the actions needed would be beneficial (there is still need for further reviewing).
- Only multi-agency public health responses will be able to spread the information and to coordinate the right interventions. Social networks have to be part of these heat health action plans.
- Information spread publicly is particularly helpful if it contains messages on the correct behaviour, considering issues like drinking and recommendations for cooling (air condition, cooling systems, fans etc.), especially for places where vulnerable groups tend to live such as retirement homes. The exchange of information at regional and national

level, down to the local levels, could possibly be coordinated by an international network or forum.

- A heat health action plan needs to contain a combination of interventions and long-term thinking.
- For an integrated information system a real time surveillance system and the evaluation of heat-wave plans and its interventions could be considered.
- Adaptability to the local context must be there, in order to guide action according to the local needs and specificities. The guidelines have to be understandable and the interventions and actions feasible at local level.

### **Implications for public health response**

The main findings, as summarized above, carry implications for public health interventions and the design of heat health action plans:

- There is large heterogeneity of the effect across investigated cities: higher impact of high temperature on mortality in the Mediterranean than in the north-continental cities.
- Heat-waves characterized by long duration and high intensity have the highest impact on mortality.
- A high impact of unusual “heat-wave episodes” (i.e. in Paris and London during 2003) is observed.
- Apart from daytime heat stress, the lack of low night-time temperatures is also a risk factor.
- It is advisable that Heat Health Warning Systems (HHWS) account for different heat-wave characteristics.
- Public health interventions must be triggered by the risk levels issued by the HHWS.
- Interventions need to be targeted on susceptible population subgroups: people over 75 years, females, people with respiratory diseases and people with other risk factors that increase heat-related susceptibility (lack of self-sufficiency, pre-existing diseases, social isolation, deprivation, housing conditions, etc., as also described in the section on risk factors for heat mortality below).

#### **Q&A raised in the plenary**

*Which heat-wave definition do we have to use?*

The definition of heat-waves as used for heat warnings and for epidemiological studies, respectively, is subject matter of repeated scientific discussions. The definition presented needs to be tested in a larger study area.

*Why do more women die?*

The discussion around the observed difference in mortality by gender could not be concluded and some more work and information is still needed.

*Are the temperature thresholds the same all over Europe?*

No, threshold levels are different for different locations.

*Why is the health impact of heat higher in Mediterranean countries?*

Results of time series analysis show that the highest effect of summer temperatures (higher percent increase in mortality above city-specific threshold level) is among populations living in Mediterranean cities. Cities in the Mediterranean typically have warmer summers and a higher frequency of heat-wave episodes. Threshold at which we observe an impact on health is higher among people who live in Mediterranean regions compared to people residing in Northern European countries. However, if extreme heat wave episodes occur in areas where these conditions are unusual, like in France during summer 2003, the impact on the local population may be greater as they are not used to these conditions and unable to adapt.

*Is heat stroke still underreported?*

Yes, underreporting of heat stroke deaths may be due to the time lag between the emergence of heat stroke and the admission to hospital. Another factor, which is very difficult to measure and to consider, is "sudden death".

## **Thermophysiology, pathophysiology and clinical management of heat related illness**

*Abderrezak Bouchama*

The normal body temperature range (36.1 - 37.1 °C) is maintained by the hypothalamus, which regulates constantly 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 requires a water vapour pressure gradient. When the outdoor temperature is higher than the skin temperature, the only heat loss mechanism is evaporation (sweating). Therefore, any factor that hampers evaporation such as high ambient humidity, reduced air current (no breeze, tight fitting clothes) or drugs with anticholinergic mechanisms will result in rise of body temperature that can culminate in life threatening heat stroke or aggravate chronic medical conditions in vulnerable population (Bouchama and Knochel 2002) (Figure 2).

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. An increase of less than 1 °C is immediately detected by thermo-receptors disseminated through the skin and deep tissues and organs. The thermo receptors 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 blood supplies. These cardiovascular adjustments to accelerate the transport of heat from the core to the periphery for dissipation to the surroundings represent a major load on the cardiovascular system.

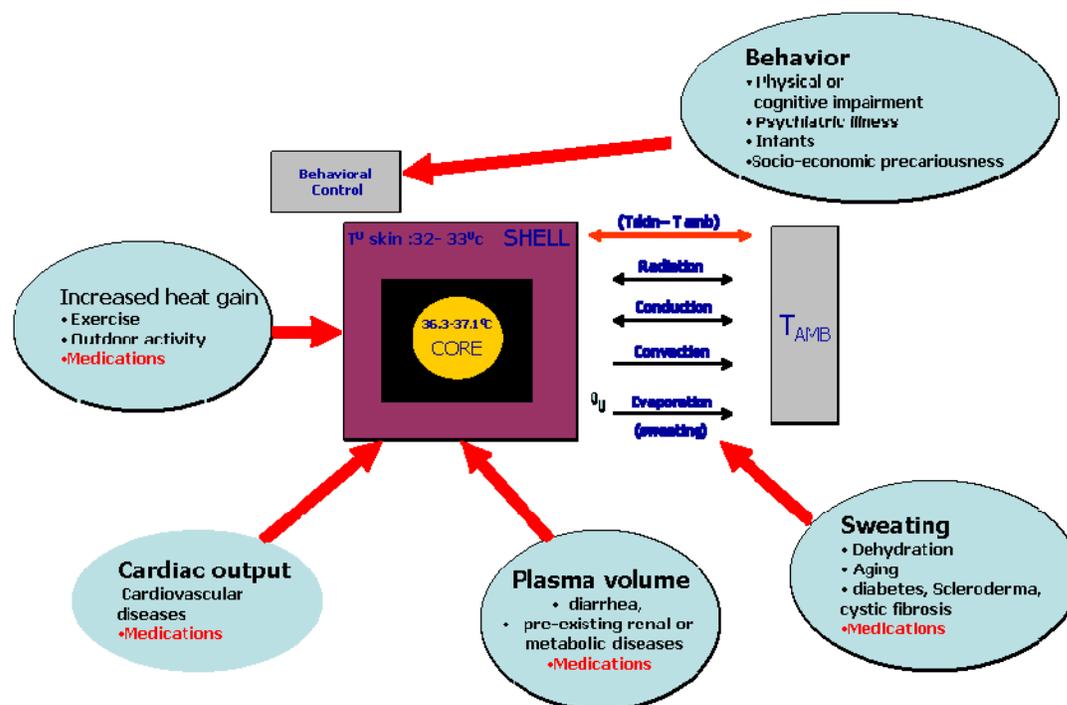


Figure 2: Factors influencing the body's thermoregulation  
(T<sub>AMB</sub> = ambient temperature); (Bouchama, 2007)

### Particular care for vulnerable populations

Heat-waves and hot weather kill and can aggravate existing health conditions. Some people are more at risk of heat-related illness and death than others (Bouchama et al., 2007b). There are two steps: i) to understand who is most at risk and ii) to target interventions at those most at risk.

#### *Inappropriate behaviour can exacerbate the risk*

Inappropriate individual behaviour such as failure to reduce outdoor activities during hot weather, rescheduling exercise to the coolest period of the day, seeking cool environment, increasing fluid intake, and wearing appropriate light-fitting clothes may increase the risk of death during heat-wave. Similarly, very young or very old people who are unable to communicate and therefore rely on third party decisions about drinking and other appropriate adjustments may be at increased risk of heat illnesses and death.

#### *Virtually all chronic diseases present a risk for heat death/illness*

Thermoregulation during severe heat stress requires a healthy cardiovascular system. Initiation of sweating results in the production of up to two litres per hour of sweat rich in sodium and potassium. This is additional stress on the cardiovascular system if the plasma volume is not properly restored. Inability to increase cardiac output because of cardiovascular diseases or heart medications that depress the heart will increase the susceptibility to heat stroke and/or cardiovascular failure and death. Also, inability to increase the skin blood flow because of peripheral vascular diseases e.g. diabetes, atherosclerosis or through certain medications, e.g. sympathomimetics, increases the risk of severe heat illness. Factors that promote excessive fluid

loss such as the presence of diarrhoea or febrile illness in the paediatric population, and pre-existing renal or metabolic disease and taking diuretics in the elderly, may increase the risk of heat-related illness and death. Dehydration, high age and chronic disease (such as diabetes, scleroderma, cystic fibrosis) as well as drugs with anticholinergic properties (see below in more detail), which affect the number and/or function of sweat glands, can increase considerably the risk of hyperthermia and heat stroke.

Virtually, all chronic diseases present a risk for heat death/illness. However, for some conditions more evidence is available such as cardiovascular, psychiatric or pulmonary illness, together with those that are confined to bed, unable to care for themselves or to leave home daily.

*Numerous drugs increase the risk of heat illness*

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 in cardiac output and thereby heat elimination (e.g. Vassallo & Delaney, 1989; Martinez *et al.*, 2002). Anticholinergics, which are present in several widely used medications such as antihistamine, antipsychotic, antispasmodic, antidepressant, and antiparkinson preparations are potent inhibitors of sweating. Antipsychotics, both conventional (Haloperidol, chlorpromazine) and atypical (Clozapine) affect thermoregulation through their peripheral effects on the cholinergic pathway, the thermoregulatory centre and afferent pathways to the hypothalamus. Sympathomimetics increase heat production by increasing motor activity while reducing heat dissipation via peripheral vasoconstriction and decrease of cutaneous blood flow. Drugs with sympathomimetic effects include over-the-counter nasal decongestants (ephedrine, pseudo-ephedrine, phenylephrine), appetite-suppressing drugs, amphetamines, and cocaine.

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

*Heat exposure can also increase medication toxicity and/or decrease their efficacy.* For example dehydration and changes in blood volume distribution associated with the thermoregulatory response to excessive heat exposure can influence drug levels, their kinetics and excretion and hence their pharmacological activity (Weihe, 1973). This may enhance the toxicity especially of those drugs with a narrow therapeutic index, such as digoxin or lithium.

*Finally, high ambient temperatures can adversely affect the efficacy of drugs.* 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. During August 2003, temperatures in drug cupboards and doctor's bags have been measured to rise above 35 and 40 °C degrees, respectively (Table 1; Crichton, 2004).

Agents commonly carried in doctors' bags	Maximum temperatures (°C)																										
<table border="1"> <tr><td>Adrenaline</td><td>Furosemide</td></tr> <tr><td>Benzylpenicillin</td><td>Glucose</td></tr> <tr><td>Cefotaxime</td><td>Hydrocortisone</td></tr> <tr><td>Chlorphenamine</td><td>Naloxone</td></tr> <tr><td>Chlorpromazine</td><td>Pethidine</td></tr> <tr><td>Diamorphine</td><td>Prochlorperazine</td></tr> <tr><td>Diazepam</td><td>Sodium chloride</td></tr> <tr><td>Diclofenac</td><td>Water for injection</td></tr> </table>	Adrenaline	Furosemide	Benzylpenicillin	Glucose	Cefotaxime	Hydrocortisone	Chlorphenamine	Naloxone	Chlorpromazine	Pethidine	Diamorphine	Prochlorperazine	Diazepam	Sodium chloride	Diclofenac	Water for injection	<table border="1"> <thead> <tr> <th data-bbox="829 384 971 436">Date (August 2003)</th> <th data-bbox="995 405 1117 436">Drug cupboard</th> <th data-bbox="1133 405 1198 436">Car A</th> <th data-bbox="1214 405 1279 436">Car B</th> <th data-bbox="1295 405 1422 436">Ambient</th> </tr> </thead> </table>	Date (August 2003)	Drug cupboard	Car A	Car B	Ambient	4	34.0	40.5	45.0	30
Adrenaline	Furosemide																										
Benzylpenicillin	Glucose																										
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Date (August 2003)	Drug cupboard	Car A	Car B	Ambient																							
5	30.0	38.0	41.0	27																							
6	37.0	42.0	46.5	31																							
7	30.5	38.0	42.0	26																							
8	30.0	40.5	44.0	26																							
9	36.5	43.5	49.5	34																							
10	29.5	32.0	35.0	22																							
11	27.5	33.0	37.5	22																							
12	29.0	34.0	37.5	24																							
13	28.5	37.0	42.0	24																							
14	28.0	35.0	41.0	23																							
15	27.5	37.0	40.5	23																							

Table 1: Medicines in doctors' bags and cup boards. This table has been reproduced, with permission from the Royal Society of Medicine, from Crichton, 2004

**Q&A raised in the plenary:**

*Why do older people die?*

Ageing modifies most of the physical mechanisms, e.g. a reduction of sweat, less sense of thirst, which again increase the risk of heat related illness and death.

*What happens in very dry heat?*

The cardiovascular and the thermoregulatory strains under such conditions are high. The cardiovascular system and the sweating mechanisms in the elderly are compromised and the adaptation capability is also weak; therefore, exposure to very dry heat should be of concern.

*What are the right measures in case of heat stroke?*

In case of heat illness and heat stroke immediate cooling is needed, especially for patients with chronic diseases. The duration of cooling is halted when the body temperature reaches a target temperature. Health professionals and the health system need the information about the right cooling measures and when and how to take them. These details should not be included in the materials for the public. Detailed recommendations on best practise cooling methods and duration are given in Bouchama et al., 2007a.

*What should be treated first- the chronic disease or the heat illness?*

Situations may occur when medication of patients with cardiac or respiratory failures contradicts the measures which should be taken for treating heat effects. Normally, the heat illness should be treated first, as excessive heat normally worsens all the other symptoms.

*Are medical professionals aware of heat as a health problem?*

Many general practitioners seem not sufficiently aware that heat is a problem. This becomes obvious when temperatures measured in the emergency bags of doctors are reaching 50 °C, which affects the effectiveness of many drugs.

*What measures should accompany emergency measures?*

It should be noted that emergency measures are advised to be taken in conjunction with long-term measures to prepare for and prevent heat health effects. As access to a cool environment effectively protects from severe heat health effects, the discussion on indoor ventilation and air-conditioning is closely linked to the discussion on the mechanisms of health impacts of heat. Air-conditioning is advised as standard in hospitals and that care and retirement homes be in the position to provide at least one cool room to the residents. Access to cooling should be easy and equitable, however, specific methods for assuring access are still being discussed (see also more results and comments on air conditioning and access to cool places below, pages 28 and 41).

*Is the list of pre-existing diseases complete?*

Virtually, all chronic diseases present a risk for heat death/illness. However, for some conditions more evidence is available such as cardiovascular, psychiatric or pulmonary illness, together with those that are confined to bed, unable to care for themselves or to leave home daily (see also page 21 of this report).

*Open questions, research and development needs:*

A clear position on air conditioning, including standards for hospitals and care homes need to be formulated (see also chapter on reducing exposure below). The use of forced ventilation could not be fully clarified at this stage of the discussion. With respect to housing standards, reference to the European standards needs to be given. Information material for GPs, hospitals and care homes need to be designed along the lines of the findings presented and included in heat health action plans. Guidelines for the clinical treatment of heat stroke as well as curricula and training materials for medical professionals need to be developed.

→ **Implications for public health response include:**

- The identification of people at very high risk;
- The development of effective measures to contact such individuals;
- The identification of individuals who could also be at risk in more types of extreme events, such as floods, winter cold spells, influenza outbreaks;
- The implementation of these measures at local level and in collaboration with relevant local agencies.

In the process of reducing health impacts of heat-waves by identifying and advising individuals at high risk from heat related illness and by providing first treatment, health care professionals play an essential role. It is therefore advised that medical professionals:

- Understand the thermoregulatory and cardiovascular responses to excessive heat exposure;
- Understand the pathogenic mechanisms of heat illnesses, their clinical manifestation, diagnosis and treatment;
- Recognize early signs of heat stroke (a medical emergency) and initiate cooling and resuscitation;
- Be aware of the factors affecting vulnerability to heat-related morbidity and mortality;
- Identify patients at risk and encourage proper education regarding heat illnesses and their prevention. Education of guardians of the old, the infirm and the infants is also important;
- Plan a pre-heat-wave medical assessment including fluid intake, weight changes, medication;

- Be aware of the side-effects of prescribed medication and be vigilant in adjusting dose changes during hot weather; decisions on altering medications or doses during hot weather need to be made on an individual basis;
- Be aware that high ambient 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 cardio-respiratory diseases.

Ultimately they are asked to inform patients about the effects of heat and the side-effects of medications. They also have to consider adjusting the dosage of specific drugs during hot weather. In order to better train medical professionals for dealing with heat related health problems the training curricula for health professionals may need to be adjusted accordingly.

## **II. Determinants for heat related mortality**

### **Determinants for heat mortality – implications for policy making**

#### *Sari Kovats*

A review of published epidemiological literature was undertaken to describe the social and environmental determinants of heat-related mortality in Europe (Kovats and Hajat, 2008). The studies, from both Europe and North America, related to a range of heat exposures, including the impact of individual heat-wave events, heat-related mortality, and recognised heat stroke deaths. Results were summarised for key vulnerability factors: There are important differences in vulnerability between North America and Europe, and between populations in north and south Europe.

The elderly (and the very old) constitute the largest defined group at risk from dying due to a heat-wave. Elderly with dementia are particularly at risk. However, high temperatures have some affect on mortality at all age groups, in most populations in Europe. Some activities, which could improve the care of the elderly, could also increase their ability to cope with heat-waves. This would include regular monitoring, the choice of proper clothing, and accessibility of a cooler environment, appropriate diet and adequate intake of fluids. Pre-existing chronic diseases, in particular mental illness and diseases affecting the cardio-vascular, respiratory, endocrine or renal system can cause an elevated risk of mortality in heat-wave events. Children and babies are also at risk from heat stroke. The low number of deaths reported indicates that public health measures and parents and carers are obviously taking appropriate measures during hot weather. However, heat stroke deaths occurred in children in the 2003 and 2006 heat-waves and clearly public advice must be maintained. Homeless persons and other socially vulnerable and isolated people are at higher risk of dying during heat-waves. Those that are addicted to drugs and alcohol are also in particular danger. For these groups specific interventions measures should be developed and figure 3 shows where in the pathway they could be placed effectively.

Overall, urban populations seem to be more at risk than suburban and rural populations from heat-related mortality. It is, however, not possible to identify excess mortality attributable to a localised heat island effect within cities. There is some evidence that lower income groups in urban areas were more at risk of heat-wave related mortality in August 2003, but many studies also show that there is no modification of the temperature-mortality relationship by socio-economic status in the European context (Kovats and Hajat, 2008). There is very little epidemiological information on how housing quality and characteristics may modify the heat-mortality relationships. Studies from the United States show that central units of air conditioning are an important protective factor in reducing the risk of mortality (Semenza et al., 1996; Kovats and Hajat, 2008).

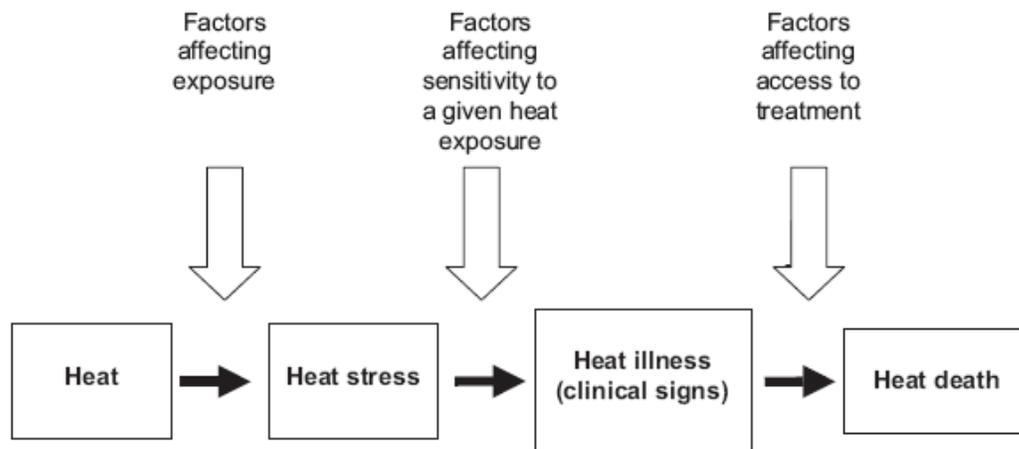


Figure 3: Points along the causal chain from heat exposure to heat death (Kovats and Hajat, 2008).

### ***Implications for public health response***

#### *Group work consensus*

Within Europe, social and environmental determinants are highly heterogeneous and very context specific. This means that general Europe-wide advice cannot be given and local studies are needed to identify important determinants and effective interventions particularly related to housing and social networks.

Important differences in vulnerability within populations have been identified and heat-waves affect a range of different high risk groups. Public health interventions need therefore to be targeted particularly to the elderly, disabled, mentally sick or isolated members of the society. Within the vulnerable groups, individuals at special risk need to be identified, but this can only happen at the local level.

An efficient system for the identification of vulnerable population groups has to be:

- applicable in more types of extreme events, such as floods, winter cold spells, influenza outbreaks ...;
- effective to reduce the number of deaths (but there is still no evaluation system available);
- implemented at local level and must address all people at risk.

There is also a need for more information on why people are dying from heat and to provide this information to the health professionals. The development of a risk score with weighted factors is suggested for the identification of vulnerable individuals.

General practitioners (GPs, primary care providers) have an important role to play in heat health protection by identifying and advising individuals who are at high risk for heat related illness. GPs need to be made aware about factors affecting vulnerability to heat-related morbidity and mortality. During a heat-wave, GPs, social services and/or voluntary agencies are urged to find ways to actively contact high-risk individuals and to implement the correct measures. Health services are also affected by heat-waves. In the framework of a heat plan, emergency departments need to be alerted in time, in order to manage an increase in admissions in case of a heat-wave. It is recommended that care and residential homes have new guidance and elaborate standards for addressing the challenge of heat and the effects on health. This could also include the establishment of cool rooms or cooling devices. Cool temperatures within hospitals can help to prevent heat related illness in patients and staff.

Country experiences with different existing health care systems and the possibilities of identifying vulnerable individuals for targeted interventions during heat-waves were discussed. The heat health warning system in Milan for example strongly involves GPs and the public care systems in identifying and addressing the most vulnerable members of the population. The system in Catalonia relies additionally on self-identification by the vulnerable people (special telephone hot-lines for registration).

In conclusion the roles of the different actors in heat plans have been stressed, as well as their cooperation and possible networking. Important actors identified included social workers, GPs, voluntary organizations, and local authorities (for coordination).

Few critical points of the review were identified:

- The review could benefit from strengthening the methodology with regard to a more systematic and epidemiological approach;
- In the wording a distinction between “vulnerable” and “frail” population groups is suggested (vulnerable is intrinsic, frailty is extrinsic).

Possible barriers to the actual identification of high risk individuals and groups were discussed:

- Only few examples of strategies to identify and specifically target vulnerable population groups and individuals are available and they are not yet evaluated;
- A comprehensive list of vulnerable people may be difficult to get, depending on national data protection laws and other structures (positive example: Rome Risk Score Strategy) and the strategy for the identification of vulnerable people needs to be region specific;
- Even if individuals belonging to a risk group at local level are identified, it remains a challenge to reach them; for example how to tackle the problem of the isolated people confined to bed at home?
- More education and training of the health care professionals in nursing homes is needed;
- Different advice for the prevention of health effects of heat is available in different countries; there is a need for harmonisation, the analysis for which has already been started by EuroHEAT;

- Can the same intervention be useful in different health care systems?
- How specific and how flexible should heat health action plans be?

**Q&A raised in the plenary:**

*What are the uncertainties in defining key determinants of heat related mortality?*

The key determinants for heat related mortality as well as the collection of data vary from country to country and evidence is limited. It is difficult to use a classical epidemiological approach for the investigation of heat related illness or death and data gathering and analysis can be rather problematic. Therefore it is difficult to make definitive statements on the social and environmental determinants for heat-related mortality. The cause effect relationship of heat death is difficult to define, as was already described; heat very often increases pre-existing symptoms and aggravates chronic diseases. Therefore, there is a need for integrated management of chronic diseases.

*Access to cool places: How can people at risk be moved without putting them at further risk?*

Old, poor and isolated people are at highest risk but they are also the ones who are most difficult to find and to address. Very often they do not even have a general practitioner and live in social isolation. The low number of deaths in very young children, who are also considered a physiologically vulnerable group, shows the importance of good care. It is important to sensitize the surrounding social environment of the potential high risk individuals and groups, especially the family members. Further good strategies to actually reach people who live in isolation and are sick and poor, very old or mentally ill, once they have been identified, need to be developed, implemented and evaluated.

*What should care homes do in relation to heat and heat-waves?*

Institutions like care homes, hospitals and nursing homes will have to adjust and clear regulations and standards to prevent heat health effects will be needed. There is also too little information on new requirements for the construction of houses, appropriate building materials, air-conditioning and other related issues.

*Is evacuation of vulnerable people necessary?*

In most countries, however, the evidence base is not sufficiently robust to identify individuals who are at such risk that they need to be evacuated from their homes during a heat-wave, although the example of Paris in 2003 has shown that this can become necessary and urgent in extremely hot weather.

### III. Interaction between heat and air pollution

#### The independent and synergistic short-term effects of temperature and air pollution on health

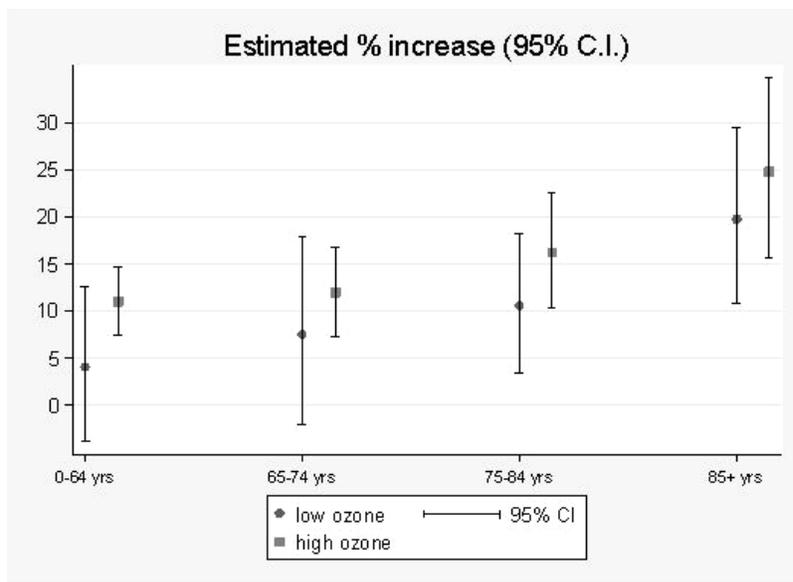
*Klea Katsouyanni*

Air pollution is often worse during a heat-wave as hot, calm weather conditions tend to worsen air pollution. Because hot weather and air pollution often coincide, it can be difficult to separate the health effects of the two exposures. 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.

Several studies from Europe, United States of America and Canada (Kosatsky et al., in press) have found that ozone effects are higher during the summer. This may be explained by the higher ozone concentrations observed during the summer combined with a non-linear response; or by a higher population exposure as people spend more time outdoors in summer; or as an interactive effect. Similar but less pronounced differences have been found for other pollutants (PM<sub>10</sub> [Particulate Matter < 10µm], black smoke, NO<sub>2</sub> [nitrogen dioxide], SO<sub>2</sub> [sulphur dioxide]). Analysing data from 21 European cities, it was found that PM<sub>10</sub> effects were higher in warmer cities. The mortality increase per 10µg/m<sup>3</sup> PM<sub>10</sub>, was 0.3% in cooler cities and 0.8% in warmer cities. The same was not found for other pollutants.

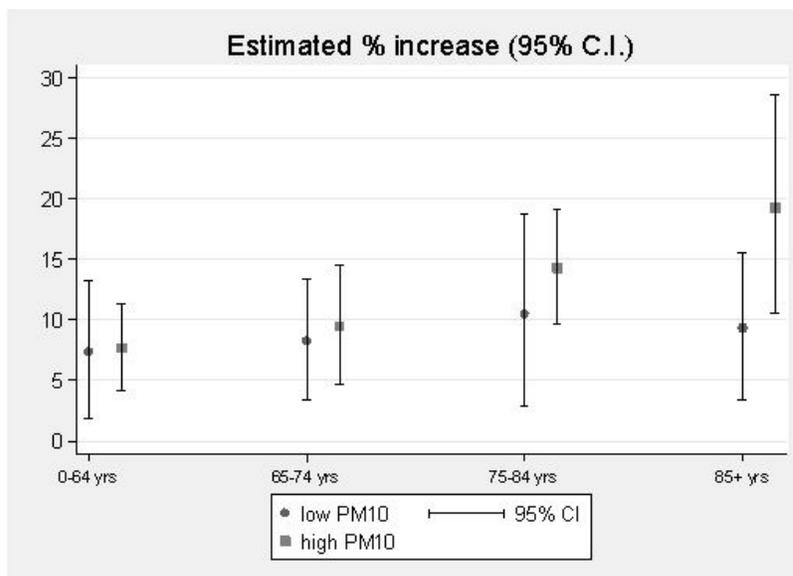
There is increasing evidence for a synergistic effect on mortality between high temperatures and ozone concentrations. A study of a severe heat-wave in Greece, 1987, showed that the heat-wave effects in Athens (which is polluted) were much stronger than in other Greek cities.

- Analyses of daily mortality, meteorological and air pollution data from nine European cities (1987- 2004) in EuroHEAT confirmed that the effects of heat-wave days are much larger for older age groups, and this remains after adjusting for air pollutants (Analitis and Katsouyanni, in press). The effects of heat-wave days on mortality were larger during high ozone days (significant at 0.05 level for ages 75-84 yrs), but this was less evident for those older than 85 (Figure 4a). The fact that the interaction appears less for those older than 85 years of age may be a result of them spending more time indoors where the ozone concentration is much lower. Similarly, the effects of heat-wave days on mortality are larger on days with high PM<sub>10</sub> and significant for age groups 75-84 and 85+ (Figure 4b). 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 particulate matter (PM) into the indoor environment.



Low ozone: at the 25th percentile of the overall distribution of ozone  
High ozone: at the 75th percentile of the overall distribution of ozone

**Figure 4a.** Percent increase in the total daily number of deaths in days with a heat-wave and a “low” or “high” level of ozone, adjusting for barometric pressure, wind speed, calendar month, day of the week, holiday and time trend. Results from random effects meta-analysis.



Low PM<sub>10</sub>: at the 25th percentile of the overall distribution of PM<sub>10</sub>  
High PM<sub>10</sub>: at the 75th percentile of the overall distribution of PM<sub>10</sub>

**Figure 4b.** Percent increase in the total daily number of deaths in days with a heat-wave and a “low” or “high” level of PM<sub>10</sub>, adjusting for barometric pressure, wind speed, calendar month, day of the week, holiday and time trend. Results from random effects meta-analysis.

- When adjusting for PM<sub>10</sub>, the estimates of heat-wave effects on mortality were reduced by about 30% and when adjusting for ozone they were reduced by about 15-25% (depending on the age group). There was no evidence of confounding or interaction between heat-wave days and the concentrations of NO<sub>2</sub>, SO<sub>2</sub> or CO (carbon monoxide).

**Q&A raised in the plenary:**

*What are the limitations of this research?*

The presented results only apply to cities; there is a need to account for the confounding between pollutants

*Are sufficient data available for analysis of effects of air pollution during heat?*

The presentation made very clear, that due to the scarce literature there are problems in the comparability of the existing data. There is definitely a need for a standardized protocol to assemble data and to define their interaction. The EuroHEAT database now includes air pollution data and relates them to the heat-wave definition. Exposure was measured, city specific analysis was carried out and confounders were considered. Combined results were also provided.

*What is the effect of ozone during heat and heat-waves?*

The effect of air pollution appears increased during heat-waves. There are data about the accumulating negative effects of ozone on respiratory diseases but these were not yet fully considered in this study.

*Does air pollution have cumulative effects when different agents interact?*

It is assumed that there is secondary interaction but only one factor already increases the effects by 15-20%.

→ **Implications for public health response**

- It is confirmed that the effects of heat-wave days are more severe for older age groups, and this remains after adjusting for pollutants.
- The effects of heat-wave days on mortality are larger during high ozone days, but this is less evident for those older than 85 years of age. The fact that the interaction appears less for those older than 85 may be a result of them spending more time indoors where ozone is much lower.
- Similarly, the effects of heat-wave days on mortality are larger during high PM<sub>10</sub> days. The fact that, in contrast to ozone exposure, the interaction here seems to affect the elderly may be a result of the high penetration of PM into the indoor environment.
- There is no evidence for interaction between heat-wave days and the concentrations of NO<sub>2</sub>, SO<sub>2</sub> and CO.
- When estimating the effects of heat-waves on health, air pollution concentrations especially of ozone and PM<sub>10</sub> need be taken into account.

- During a heat-wave it is recommended that additional measures be taken to keep air pollution (especially ozone and PM<sub>10</sub>) low. Effective measures need to be further discussed and investigated.
- The results from EuroHEAT are using a larger multi-city database. They are consistent and corroborate those reported from previous literature.

### ***Reduction of exposure to heat and emission of pollutants***

#### *Group work consensus*

It was suggested that possible confounding effects between heat stress on the one hand and concomitant exposure to O<sub>3</sub> and PM on the other be accounted for in the analysis of future studies.

Potential policy options to lower air pollution during heat-waves are needed. They could for example include individual transport reduction measures in favour of public transport in cities. In case this proved to be an effective option, it needs to be clarified whether traffic should be reduced just before the heat-wave or whether it is necessary to restrict traffic for a longer preventive period. For longer lead times, however, good and reliable mid-term weather forecast would be required. Individual exposure to heat may actually be increased when people walk instead of using other means of transport (individual transport by car or public transport).

As pollutant levels are weather related, prediction of air pollution is difficult and the local context has to be considered. Special air pollution alerts on hot days (i.e. lower air quality warning level) and vice-versa could potentially be an effective addition to be considered in heat health action plans. Not all relevant pollutants, however, come from local sources. Wind drift can transport pollutants over larger distances and interfere in an uncontrollable way. Overall, possible negative effects of interventions which are taken to reduce heat or pollutant exposure (including air conditioning) need to be investigated and considered.

Overall, the following recommendations were developed:

- For the long term, reduction of air pollution is important; as long term action the reduction of energy generation from combustion is suggested;
- Personal exposure to heat may coincide with high PM levels, therefore solutions need to be found that reduce both, exposure to heat and emission of pollutants; on hot days, particular concern may be given to the avoidance of air pollution;
- It is advisable that policy makers are aware of the diversity of pollutants which can lead to confounding results in the data gathered.

## **IV. Preventing heat-related health effects**

### **The prevention framework**

*Bettina Menne*

Heat-related illness and death are to a great extent preventable; it is therefore important to implement a portfolio of actions. The analysis of the existing heat plans, review of literature, surveys and studies in the frame of the EuroHEAT project identified a set of core elements of heat action plans for the prevention of heat-related health effects (Matthies et al., in press a):

- a) Establishment of collaborative mechanisms between bodies and institutions and a lead body to coordinate responses;
- b) Accurate and timely meteorological forecasts;
- c) Risk communication mechanisms;
- d) Reduction of exposure to heat;
- e) Provision of health care, social services and infrastructure;
- f) Particular care for vulnerable population groups;
- g) Urban planning, energy and transport policies;
- h) Monitoring and evaluation.

### **Establishment of collaborative mechanisms**

Cooperation between institutions from various sectors and administrative levels is recommended and it is important to decide who is the overall responsible lead body coordinating cooperation and interventions, in particular for a heat-wave event. Co-ordination means to identify command, control and coordination mechanisms, types of joint activities and resource allocation. It means also to be able to mobilize all available resources when an emergency occurs. In most existing heat plans this role is taken on by the Department or Ministry of Health.

Including planning for heat events into national disaster preparedness planning might be advisable but depends on the countries structures and necessities. Feasibility needs to be explored on country level, due to the differences in responsible authorities and administrative structures. Exploring financial incentives and eventual legislation might be needed in some countries. The actual costs of heat prevention depend on the activities foreseen and the organization of the health system and collaborating sectors. Lack of funding and personnel as well as problems with communication are the most common barriers mentioned to inhibit the efficient implementation of heat prevention activities.

Lessons learnt in international emergencies showed, that several/all health sector disciplines and various partners are active stakeholders in developing and implementing the plan. It is useful if they are involved at an early stage of the planning process. Agencies such as education ministries, universities, training institutions, professional bodies and trade associations can make a valuable contribution to ensuring a programme is relevant and has the desired impact on the target audience.

Plans are better operated if they are prepared with regional/local level involvement. This is in particular true during heat emergencies, as the active care of susceptible individuals can only be achieved at the local level. Testing, updating and distributing the plan are important prerequisites for its success. Training key staff and informing all concerned are also recommended.

For heat health action plans, an official link with the national weather service is recommended and has been mentioned in all investigated heat plans. During a heat-wave the lead body is required to trigger specific activities and interventions on the basis of the heat warning issued by the weather service. In countries where a meteorological component of a warning system exists but no actual heat health action plan, no decision-making structures might be defined and no specific interventions triggered.

## **Heat health warning systems and seasonal climate forecasting in Europe**

*Christina Koppe*

Heat early warnings systems are short term alert systems before and during heat-wave events to allow for timely public health responses. Medium range heat information have lead times of 3-10 days and heat health warning systems (HHWS) have lead times of 48 hours to 12 hours. Both can be useful complements of extreme weather early warning for decision makers in the health sector.

The recommended components of HHWS are:

- identifying weather situations that adversely affect human health
- monitoring weather forecasts (meteorological component)
- implementing mechanisms for issuing warnings in case such a weather situation is forecast (communication)
- linking up with and inform the lead body of the heat health action plan in order to trigger public health responses.

Until 2001, only one HHWS was operational in Europe (Lisbon). In 2000, the World Meteorological Organisation chose Rome as a pilot city for the development and implementation of an air-mass based HHWS, which became fully operational in summer 2001. The high numbers of heat related deaths in summer 2003 across Europe, however, resulted in an increase in the number of HHWS.

Hence a survey in spring 2006 showed that HHWS were operational in 16 countries (Figure 5) and that furthermore several countries were planning to implement a HHWS. A more detailed description of the various HHWS across Europe can be found in the chapter by Koppe and Becker (in press) of the EuroHEAT monograph.

The first step to develop a HHWS is to identify weather situations that adversely affect human health (further denoted as heat-wave or heat events). As there are no standard definitions of the terms “heat event” or “heat-wave” the HHWS in Europe use different methods to define and to identify such situations. Most of the systems use air temperature and duration as indicators for a heat-wave. Some systems use more complex methods to encircle heat situations such as synoptic approaches and heat balance approaches. The complex methods require not only air temperature as meteorological input parameter but also other meteorological parameters that allow a more

sophisticated description of the thermal situation such as, for example, humidity, wind speed, and cloud cover (Koppe, 2005; Koppe and Becker, in press).

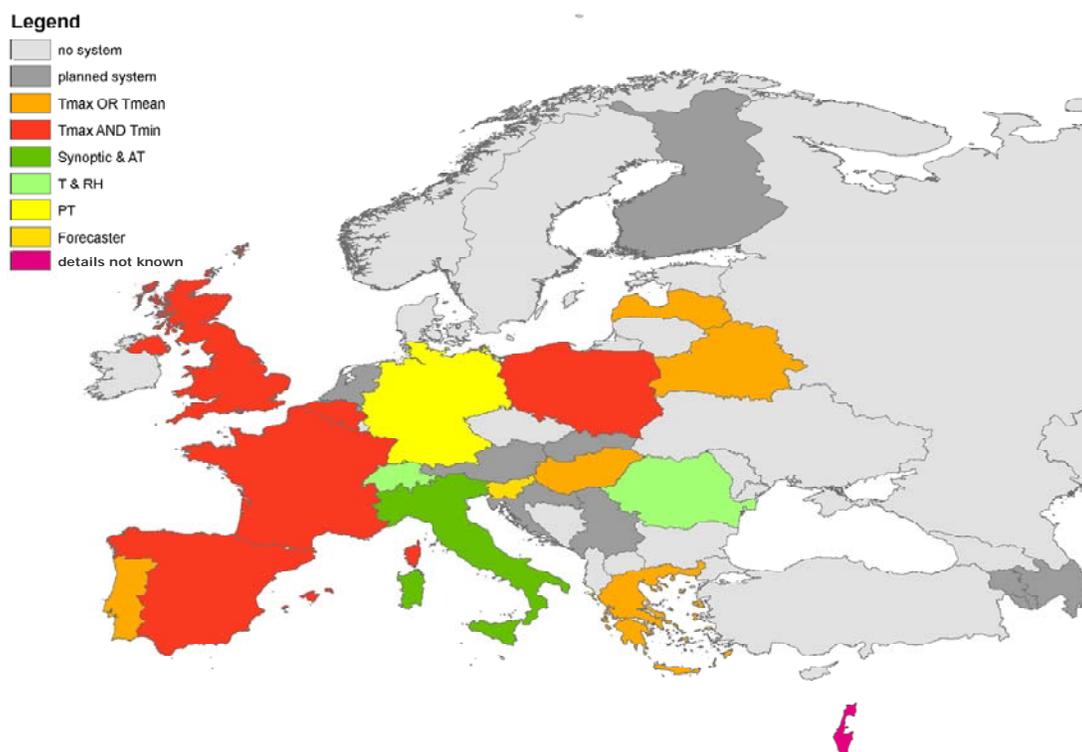


Figure 5: Heat Health Warning Systems in Europe (Koppe and Becker, in press)<sup>7</sup>

The forecast accuracy of indexes based on several meteorological parameters is generally lower than the forecast accuracy of single parameter indexes. Therefore, the use of these complex methods is restricted to forecasts with shorter lead times.

Defining a heat event that triggers a warning depends not only on the relationship between the warning indicator and mortality but also on the scope of the particular warning system and on the set of intervention measures that is activated in case of a warning. If the scope of the system is to prevent heat related health impacts only in case of very extreme heat-waves the threshold for issuing a heat warning will be relatively high. In general such systems also trigger a more

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<sup>7</sup> 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 the 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 document cover a period of time preceding that communication.

complex set of intervention measures than systems that call warnings also in less extreme situations.

There is no best HHWS, but it is important that a HHWS is targeted to the local needs and that it considers local restrictions, that it is accurate and timely. As only very few systems have so far been evaluated no conclusions with regard to effectiveness can yet be drawn. Analysis in EuroHEAT showed that poor communication between the Meteorological Service and the Health Agency can prevent the implementation of an effective system.

### ***Climate information tool***

A web-based climate information decision support tool has been developed by the German Weather Service and provides probabilistic information about the imminent heat situation for the next 9 (14) days at the regional level (Koppe et al., in press). The medium-range heat information is based on the ensemble prediction system of the European Centre for Medium-Range Weather Forecasts (ECMWF). On the web-site: <http://euroheat-project.org/dwd/index.php> the region-specific probabilities for a heat-wave for lead times from 0 (current day) to 9 (extension to 14 days planned) days are displayed (Figure 6). For this a heat-wave is defined by 2m temperature exceeding a variable threshold which depends on the weighted mean of the temperatures during the last 30 days (Figure 7). In addition to the forecast issued at the actual day (this becomes available at 10:40 UTC) also the forecasts issued over the last 10 days can be displayed.

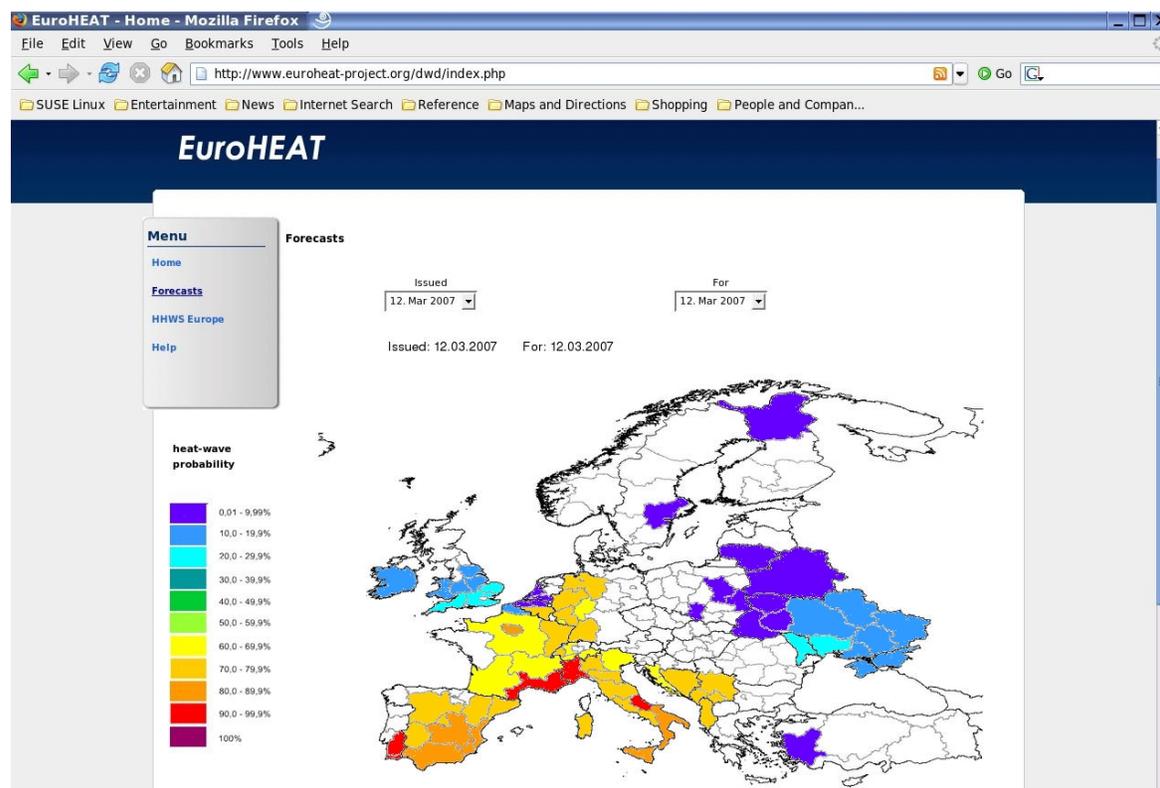


Figure 6: Web-based Climate Information Tool (<http://euroheat-project.org/dwd/index.php>)<sup>8</sup>  
(Koppe et al., in press)

Medium range heat information with lead times of 3-10 (15) days can be a useful complement to HHWS for decision makers to give the health system more time to prepare for an imminent heat-wave and to monitor the situations in neighbouring regions. The target group for this tool are health professionals who are involved in the national/local HHWS and heat action plan rather than the public. As there are links to the web-sites of the national HHWS in Europe the user has quick access to heat warnings issued by other countries. For countries that have no heat warning system or for which the web-site of the system could not be identified the web-sites of the National Meteorological Services are linked, so that the user can at least access the respective weather forecasts.

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<sup>8</sup> 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 the 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 document cover a period of time preceding that communication.

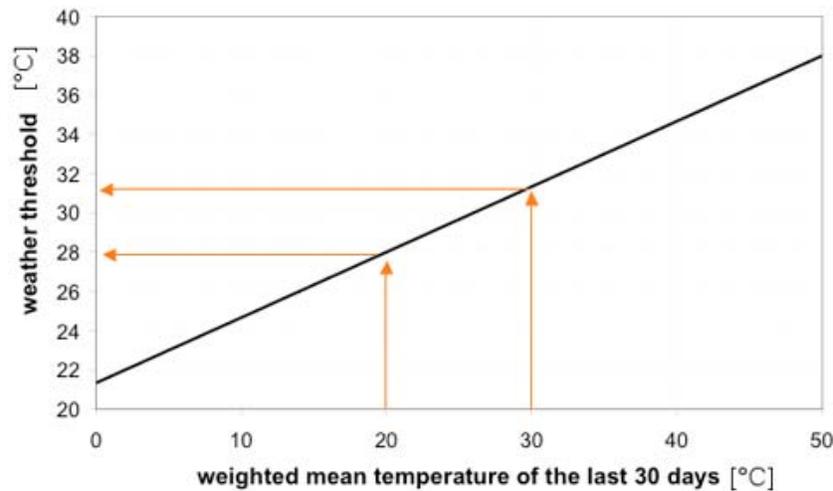


Figure 7: Heat definition as used by the EuroHEAT climate information tool (Koppe et al., in press)

*Comments from the plenary:*

Heat-waves can be predicted at medium range, which is still quite reliable, allowing policy makers and health services to take preventive measures. In general, forecasting gets less and less precise the longer the range of forecasting. The steps to be taken for a good climate information tool are: consideration of the local conditions (in the country), analysis and processing of the data in the model and the application of the model together with the actual weather forecast and the (national) heat health action plan.

***The usefulness of the climate information tool***

*Group work consensus*

The usefulness of the climate information tool for decision makers in the health sector was discussed among experts. Participants distinguished two types of information provided by the climate information tool. The first one was called probabilistic information, which defines the relation between danger and risk. The second one was the so-called deterministic information, which should have the following components:

- the medium range forecast must be related to a possible event;
- it is important to give the information in advance (as early as possible) and the information must be clear;
- the health systems should be in the position to respond to the information given;
- the public should be informed of the risk accordingly.

It is important that the climate information tool aims at avoiding to trigger false alarms as these can lower the interest and the responsiveness of the actors, health professionals and the public over time. The different variables of the tool should not have different accuracy. The stakeholders within the health system would have to define the kind of information, which has proven to be useful for them.

In conclusion, the climate information tool was considered to have potential usefulness. It increases the usefulness of the tool if the information is readily available to decision makers. They could then decide when and how to inform the public about the risk and to provide advice and services to prevent health effects.

Some barriers for the use and application of the climate information tool were also identified:

- Institutional: how to communicate between different institutions (information flow, level of exchange, hierarchies, etc.).
- Technical language of the different disciplines (e.g. meteorologists and physicians).
- The difficulty of taking decisions for action on the basis of various levels of probability.

A pilot phase for testing the climate information tool is recommended for summer 2007.

## **Heat related information strategies**

*Franziska Matthies*

As heat-waves are likely to occur every summer although in different locations in Europe – it is advisable to have established a communication plan before the summer. Information for the public is recommended to focus on: i) how to protect oneself and others; ii) how to reduce heat exposure indoors; and iii) how to recognize heat related symptoms; Specifically targeted information needs to be also given to health care institutions and care givers. The scientific uncertainty around certain measures, like how much to drink and which drugs interfere with heat, need to be clarified before giving clear targeted advice.

Communicating the risks of hot weather and heat-waves and what to do about it are recommended elements of a summer and heat-wave prevention strategy. For this coordination with the media and early involvement of the media is important.

Mass media are used as the most common channel of communication to the public. The actors of the health system, for example general practitioners and pharmacists are also used to disseminate advice and information. The use of the internet may be appropriate for informing medical practitioners, medical and social care associations and managers. New channels of communication such as the internet or the short message systems via mobile telephones can open efficient ways of informing medical professionals or specific people at high risk.

A well structured and tested communication strategy should be developed for the specific target audiences. Educating the media is one way to educate the public. In order to ease competition among mass media and to promote a consistent message, conference calls or hotlines involving the major media outlets are of prime importance. Cooperative programmes between the media and the National Ministries of Health can help to improve public education. For example, in France, short segments in their television weather broadcasts are used to educate the public to improve their understanding of the forecasts.

Unfortunately, there are many examples of communication failures, which have delayed action and undermined public trust and compliance. Some key considerations, based on best practice examples are listed in Box 1.

**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.

**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 must 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, what are the key messages to announce on what persons 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 throughout 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 suggest to follow 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 in the national emergency plan.

Box 1: Key principles of heat risk communication (adapted from WHO, 2005)

An EuroHEAT review of existing educational materials from Catalonia, France, England, Italy (Milan), Hungary, Switzerland, Belgium and federal states of Germany (Bavaria, Baden-Wuerttemberg, Hesse, Rhineland-Palatinate) showed that the content of specific behavioural and medical advice varies across national public health response plans (Matthies et al., in press b). Key messages need to be targeted to medical professionals, hospital and care home managers and staff as well as the public. Messages need to be adjusted to the needs of specific vulnerable population groups such as the elderly and to the specific local context.



Fan-shaped leaflet from the Catalan Health Department with public advice during heat-waves.

Information materials were reviewed. Much of the existing educational material appears to be based on common sense and for some of the advice strong physiological or epidemiological evidence is missing. This is particularly the case for general advice, like “keep cool, and drink plenty of fluids”. Both, drinking too little (resulting in dehydration and hypernatraemia) as well as drinking too much (resulting in overhydration and hyponatraemia) can be a problem. During the extreme heat-wave in France for example, hyponatraemia was reported as cause of illness as people were in fact drinking too much (Ambrosi et al., 2004).

Information on leaflets and posters and in mass media like newspapers, radio and TV need to be reviewed and harmonized with recent research results and recommendations (e.g. the use of fans, the description of symptoms of heat exhaustion and heat stroke as well as first aid measures and treatment). In many European educational leaflets, fans are advised. However, fans should not be used as a primary cooling device during extended periods of excessive heat. Electric fans may provide relief, but when the temperature is above 35 °C, fans may not prevent heat related illness. Fans can contribute to heat exhaustion with additional heat released indoors and forced convection during high heat stress conditions when skin convection is no longer useful.

Also the channels of communication need to be selected according to the patterns of use of the targeted population groups. Feasible practical tips (e.g. for drinking) and important contact details for social and emergency services is particular important information for the elderly.

The EuroHEAT survey showed that key messages are centred around:



- keeping out of the heat;
- keeping the body cool and hydrated;
- being alert, recognizing symptoms of heat exhaustion and heat-stroke and knowing first aid and emergency telephone numbers;
- helping others, especially those belonging to vulnerable population groups.



**Q&A raised in the plenary:**

*What is the adequate use of fans?*

Fans just move the air, which means they do not actually provide real cooling and at a temperature higher than 35 °C they become counterproductive. The turbulence increases evaporation which can lead to dehydration if the person does not drink enough. Clarification of benefits and dangers and safe and specific advice for the use of fans during heat-waves needs to be formulated for useful information materials.

*How many hours a day should people spend in a cool place?*

Spending a few hours in a cool environment has been shown to be protective, although the number of hours needed to provide relief varies according to population sensitivity, making it difficult to formulate specific recommendations (Bouchama et al., 2007b). A definition for a “cool place” would be needed (see also below for the discussion on indoor temperature).

*What exactly should be recommended for drinking?*

No studies seem to have investigated how much a person should drink on days with very high temperatures. A pamphlet issued by the German Federal State of North Rhine Westphalia recommends adding sodium, a fact that was argued a lot, as sodium might interact in a negative way with certain diseases or medicines. The content of salt should be individually defined by the responsible general practitioner. But what happens if the person has no doctor or cannot be reached by this information? There is a need for simple messages, which can be understood by everybody.

***Educational material: key messages and communication strategies***

*Group work consensus*

The group identified the following main elements:

First, it is important to identify the population groups at risk during heat-waves (see above). The risk is a combination of the vulnerability (age, social conditions, health conditions and housing conditions) and the adaptive capacity (determined through social conditions, health conditions and housing conditions). Second, is also essential to be aware of the voluntary care system that could provide services to the identified people at risk. A distinction can be made between partners, family, neighbours and friends and volunteers from voluntary organizations (churches, National Red Cross and Red Crescent Societies etc.). Thirdly, the roles and responsibilities of the professional social and health care systems in supporting people at risk living at home and in professional institutions need to be defined in the matrix of the heat plan.

Three target groups were suggested to receive different, but coherent messages:

- People (individuals) at risk (general population)
- The voluntary care takers of the people at risk
- The professional care and health system

It was suggested for EuroHEAT to make available a final list of key messages. These key messages need to be adapted to local and national contexts and be communicated to the target groups by the respective actor of the national/regional heat action plan according to its communication strategy.

Comments and additional suggestions for key messages for the public included:

### **1. Keep your body cool**

- As there is no available evidence for specific recommendations with regard to amount or type of fluid, salt replacements etc., neither for the public nor for the GP/caregivers, it is preferable to propose advice/recommendations in general terms. This is currently done in most of the national heat plans (pers. communication A. Bouchama). Further research is needed.
- Water scarcity in some regions, particularly during hot and dry periods, could counter-indicate having frequent showers during the day. Highlighting the alternative of wet towels and foot baths during the day (less cumbersome than taking a shower) was suggested.
- 'Air drying' instead of drying with towels could be mentioned as an important cooling effect;
- Give advice to reduce physical activity.

### **2. Keep your house cool**

- Give advice to line the house with wet towels;
- Indoor temperature thresholds (of 26 °C), their relevance and implications for health care institutions were discussed. Defined thresholds would require actions like bringing old people into air-conditioned places or moving the person(s) at risk to other cool places (public places like churches, malls, libraries etc.) once they have no room to go to where the temperature is not reaching the defined threshold. This decision would have major implications for the voluntary and professional care system.

### **3. Care for vulnerable people** (See also section below, page 42)

- Professional care service for vulnerable people who live at home is suggested; this could include the general practitioners and others. The need for general protocols and guidelines for the reduction of heat health impacts was expressed. Once these guidelines are available they should be reviewed and updated every year.
- In preparation of the summer, relatives of vulnerable individuals, for example, could already be alerted in January or February to plan their holidays in such a way to ensure that someone is always available during summer time. A general 'heads-up' communication in May until early June to raise people's awareness of heat-wave risks is a successful action in the United Kingdom.
- Further suggestions for the strengthening of heat related measures included e.g. the establishment of telephone hot lines, where isolated people could be registered, sensitization of family members and social groups, better networking between the health authorities and the voluntary services, more educational guidelines for health services and the other actors and more consideration of the situation in the rural areas. The presented results of the project have not taken into account the population of rural areas to that extent.

## Provision of health care, social services and infrastructure

*Bettina Menne*

The heat-wave in 2003 caused a severe impact particularly on elderly persons in hospital and in residential homes. In France as well as in Italy excess mortality in “retirement homes” were reported during summer 2003 (Hemon and Jouglu, 2003; Bretin et al., 2004; Rozzini et al., 2004; Stafoggia et al., 2006). Increases in heat-related morbidity as well as failures in care were also observed due to lack of cooling facilities. Residents of institutions therefore represent an important target group for heat-wave interventions. In France for example, the government has since recommended that institutions for the elderly have at least one cooled room. It was suggested that housing for elderly people, care homes and hospitals in general aim at meeting the category I requirements for the thermal environment under the Energy Performance of Buildings Directive (European Commission, 2003).

Heat plans should include advice on service delivery, hospital emergency planning, mass casualties’ management and chronic disease treatment during heat. Important elements of preparedness for hospitals and care homes are:

- Preparation of the building and facilities (external shading of building, establishment of a cool room, provision of thermometers, drinking-water and adapted menus)
- Staff planning and working arrangements (rotas, recall and extra help)
- Special care for patients and residents (identification of high risk individuals, adjustment of drugs and treatment)
- Organization for home care (support, contact)
- Health care staff training on identification of heat related health problems, appropriate treatment and cooling techniques

Curricula for specific training modules and seminars for medical professionals need to be designed to improve the knowledge and skills in relation to prevention and treatment of heat health effects. There are many open questions, for which no standardized guidance is available. This includes the treatment of heat stroke, management of chronic diseases during extreme heat, management of nutrition and liquid provision during extreme heat.

Maximum coverage of interventions is among the issues and challenges in service delivery during summer. Social factors such as social isolation further determine vulnerability of individuals in an important way and health care system preparedness needs to take those factors into account, for example through collaboration with social services. Reaching the most vulnerable at home has proven to be difficult and experiences need to be shared and new strategies developed. Countries can identify the most feasible and appropriate options based on data availability and structure of their respective social and health care systems.

In England information for care home managers and staff has been developed (Box 2). The leaflets list who is particularly at risk, describe the health risks and give advice on how to reduce these risks – before and during a heat-wave. In France, based on the different alarm levels of a heat-wave different actions are undertaken. For example the blue and the white plans (in retirement homes or hospital) foresee reinforcement of summer staff, provision of sufficient number of available beds, and perfusion stocks.

### Reducing the risk Before a heatwave

Heatwaves can happen suddenly, and rapid rises in temperature affect vulnerable people **very rapidly**. Make as much use as possible of existing care plans to assess which individuals are at particular risk, and to identify what extra help they might need.

Health and social care providers need to plan ahead to ensure that care and support for people at risk can be accessed in the event of a heatwave. Anyone living alone is likely to need at least daily contact, whether by care workers, volunteers or informal carers. People with mobility or mental health problems, who are on certain medication, or living in accommodation that is hard to keep cool, will probably need extra care and support.

If you are caring for someone in their own home, these are the steps you should take **before** the weather gets hot. Where possible, involve their family and any informal carers in these arrangements.

#### Environment

- Check any south-facing windows, which let in most sunlight, can be shaded, preferably with curtains. Metal Venetian blinds may make things worse.
- Check the person's home or room can be properly ventilated, without causing any additional health risk, discomfort or security problems.
- Consider the possibility of moving the person to a cooler room. People living in top floor accommodation may be at particular risk as heat rises.

Box 2: Heatplan for England: advice for preparedness of retirement and care homes, excerpt (Department of Health, 2007)

Apart from the health system activities, also various other community services such as electricity and water supply need to be considered in heat plans, as electricity cuts and water shortage pose serious additional health threats during hot weather.

## Special care for vulnerable population groups

*Bettina Menne*

Once people at risk have been identified special care and interventions need to be implemented through the local health care (important role of the GPs) and social services. It is important that those who are susceptible can be easily identified for outreach services. Possible methods of identification include local community groups and social services and active registration of individuals with a general practitioner or social services.

Italy has collected experience with so-called “social guardians” (Box 3) and France with voluntary lists asking people to register. In England, the GPs are supposed to generate their own lists of vulnerable patients on the basis of their data.

An effective heat plan needs to find a balance between a population-based approach and a risk population based approach.

In Rome, the intervention programme for the prevention of heat-related health effects is based on a heat/health warning system, the identification of population subgroups susceptible to heat and the surveillance of these persons during the summer months. Susceptible subjects are identified on the basis of demographic and health information retrieved from the population and hospital admission registries. In 2006, following guide-lines of the Health Ministry, General Practitioners (GPs) were involved in the programme. Before summer, each GP received the list of his/her at-risk patients identified through the standardised procedure. These lists were then reviewed and integrated by the GP on the basis of their personal knowledge of the single patient. GPs were invited to perform active surveillance in terms of extra home visits on their at-risk patients during summer months. The intervention showed a good capacity to reduce heat related mortality among the population over 65 years.

Box 3: General Practitioners look after vulnerable individuals – the Italian example

### **Q&A raised in the plenary**

*How to ensure provision of and access to cool space (provision of information and transport)?*

Catalonia gives a good example on how to inform and organize transportation for elderly and isolated people to cool places in collaboration with the Red Cross.

## **Reduction of exposure**

*Simon Hales*

Health outcomes mainly depend on the duration and the intensity of the heat exposure. It is therefore important to take action to reduce exposure as much as possible. A number of measures have been identified that can help keep the indoor environment cool (Hales et al., in press).

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. Most homes have an indoor temperature of between 17 °C to 31 °C. Humans cannot comfortably live in temperatures outside this range. Three main factors are associated with indoor heat exposures: the thermal capacity of buildings, the position of an apartment and the behaviour of the occupants. In France, the risk of death was increased by living in buildings with few rooms, with poor insulation, or with a larger number of windows. Living on upper floors, especially the top floor, or having the bedroom under the roof also increased the risk.

To limit exposure to heat, a number of measures are available. They are divided into short-term (during a heat-wave) medium-term (the summer of the same year) and long-term (years to decades needed to complete) (referred to later). Short-term measures are summarized in table 2.

Short term measures for existing buildings	Comment
Install thermometers to measure indoor temperatures	Useful to measure indoor temperature and take action.
Increase 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 black-outs in summer time!

Table 2: Short term measure to reduce indoor heat (Hales et al., in press)

If it is cooler outside than indoors, opening windows will help reduce indoor temperatures. However, fear of crime or street noise may deter people from opening windows, especially at night.

Fans should not be used as a primary cooling device during extended periods of excessive heat. Electric fans may provide relief, but when the temperature is above 35 °C, fans may not prevent heat related illness. Evaporative coolers are only effective if the humidity is low enough; air conditioners are progressively less efficient with increasing ambient temperature.

Protecting the population at risk from heat, even for a short time, is important in a severe heat-wave. Spending a few hours in a cool environment has been shown to be protective, although the number of hours needed to provide relief varies according to population sensitivity, making it difficult to formulate specific recommendations (Bouchama et al., 2007b). The role of air conditioning as protective factor has been assessed in a number of case control studies, mainly in the United States. For those who can afford it, central air conditioning probably reduces heat related mortality. On the other hand, lack of access to air conditioning is probably partly responsible for the relative vulnerability of poor people in the United States.

In Europe, air conditioning is still comparably uncommon, with 5% of residential households in Europe having air conditioning (1997 data; Revue Pratique du Froid, 2001), but the central air conditioner market is expanding very quickly (Figure 8).

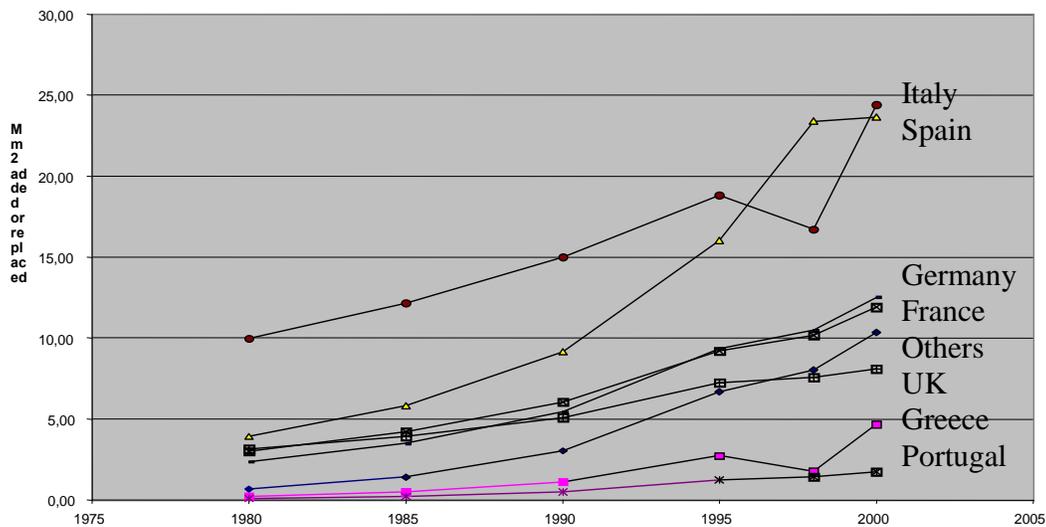


Figure 8: Apparent annual additional building floor area conditioned by 2000 (EECCAC, 2002)

In some countries, power failures are common during heat-waves because of sudden increases in electricity demand, as was reported from Athens in 2002, where the power system was overwhelmed, leading to failures in supply. Where air conditioning is the main strategy employed, power failures will tend to exacerbate the impacts of heat on health.

From a public health perspective, effective alternatives to air conditioning are preferable, especially if they do not rely on electricity supplies, increase energy use, worsen the urban heat island effect, or increase health inequalities. Passive cooling methods such as increasing external shading, use of cool paints can meet these criteria, but their usefulness is dependent upon local factors such as the building type. One simulation study carried out in the United Kingdom found that a combination of passive cooling methods could reduce indoor temperatures to about 2.5 °C below the ambient temperature. With careful design, it is usually possible to reduce indoor summer temperatures without increasing winter heating demand.

Many medium and long term measures can be implemented in order to reduce indoor temperature in a sustainable way:

- Increasing 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
- Identify areas at risk of urban heat island effects
- Restrict living on top floors, or improve roof insulation
- Cool pavements
- Building structures: radiant barriers, insulation
- Energy efficient air conditioning

### ***Reduction of exposure to heat indoors***

#### *Group work consensus*

The threshold for thermal comfort of 26 °C indoors was debated because there are obviously different models of thermal comfort and risk and no consensus could be reached. A threshold level, once it is set, would have major implications. The temperature ranges specified in the standard EN 15251 refer to thermal comfort. If buildings are designed to meet thermal comfort criteria, then they will also be cool enough to avoid heat stress. A temperature of 35 °C at 50% humidity has been used as a threshold for heat stress in one report (Hacker et al., 2005). Trying to specify a single threshold is problematic because different communities have different levels of vulnerability to heat stress, depending on age, sex and other factors. A threshold of 35 °C is fine for healthy adults but no good for frail elderly (e.g. in hospital or care home settings; see also EuroHEAT Technical Summary (WHO Regional Office, in press).

Air conditioning in Europe: Following long discussions among researchers and experts EuroHEAT came to the conclusion that air conditioning be recommended as a short and medium term solution particularly for hospitals as well as care and retirement homes, continuing investigation into alternative measure for the longer term.

### **Long term measures: urban planning, energy and transport policies**

#### *Simon Hales*

Other things being equal, people living in cities are likely to be at higher risk than rural dwellers because of the urban heat island effect, but this issue has not been systematically studied. For example, Athens is often 5 °C hotter than surrounding countryside in the summer months. Excess mortality observed in France ranged from +4% in Lille to +142% in Paris, suggesting that either heat gain by city buildings or traffic patterns may influence it.

Urban planning, land-use changes and mitigation of climate change through energy efficiency are highly effective but potentially costly, and require political will to be implemented. Measures to reduce the urban heat island focus on: increasing green spaces and planting trees in streets (trees provide shade but can also improve air quality); increasing ventilation and air flow between buildings (which also improves air quality); increasing the number of courtyards and other open spaces; increasing the proportion of heat reflected from surfaces (e.g. painting roofs white) and decreasing anthropogenic heat production (e.g. natural space cooling).

The urban heat island is an inevitable consequence of urban development. Appropriate and climate friendly urban planning, however, may help to reduce the magnitude of the urban heat island. For example, the benefits of tree planting projects are: shading, cooling due to evapotranspiration, dust control, runoff control, consumption of carbon dioxide, water conservation. There are many competing priorities for urban planning. In practice, climate issues often have a low impact on urban design. Although urban planners are interested in climatic aspects, the use of climate information is unsystematic.

On the other hand medium and long-term measures could be combined with related public health strategies. For example, changing the design of cities to reduce urban heat island effects by increasing green spaces could encourage active travel as well as reducing energy use and air pollution.

The fact that there are long lead times before the benefits of these measures are apparent may be an argument in favour of early implementation. These measures could be combined with

reductions in air pollution and increases active transport (e.g. walking and cycling), with large potential health benefits. Greenhouse gas mitigation measures are now being implemented in the wider context of global climate change. Without effective mitigation of climate change, short-term measures will be increasingly less useful in reducing heat related health impacts in vulnerable populations.

### ***Housing and health: short-, medium-, long-term recommendations***

#### *Group work consensus*

Short-, medium- and long-term recommendations for housing and urban planning were discussed and further elaborated. The outcomes of this group work are summarized briefly as follows:

Building materials, cooling devices, shading and ventilation are some of the factors that influence the climate in buildings. People are aware that there will have to be changes in the long run, which have to be planned and started now. Still there will be some time passing until all the existing and not appropriate housing stock is eliminated or completely changed and adapted to the upcoming needs of more and longer extreme weather events like heat-waves. Being aware that there must be a change of conception and a general need for adjustment in future urban planning and architecture, the group reviewed the suggested measures for long-, medium and short term in order to overcome the existing gaps.

In addition to the short-, medium- and long-term measures presented in the EuroHEAT findings, it was suggested to:

- install thermometers, heat detectors inside buildings as warning system!
- prepare a manual for ‘do it yourself’ activities around the house.

Legislation, building codes for homes and particularly nursery homes need to be reviewed and adapted. Guidelines should be established and appropriate options described in a catalogue for countries to choose.

Energy management for peak hours is needed to avoid breakdowns. Urban planning will have to consider the new demands for energy of cities and public transport systems in the view of more frequent and more intense heat-waves being projected for the future. Education of urban planners and architects is needed about what is and will be important.

The constraints for the implementation of the measures were seen in the lack of more specific knowledge and the missing risk perception, which still needs more evidence. Policies are usually not long term oriented but with more risk perception there will be more public pressure on the politicians to seek long-term solutions. More education for architects and urban planners is also important for the future. Long-term measures for housing can be seen as priority but the problem regarding the existing stock of old buildings remains. The group mentioned several practical solutions for the intermediate use and adaptation of these old buildings.

Overall, technical measures and behavioural aspects need to be differentiated and long-term measures have to be highlighted.

## Monitoring and evaluation

*Franziska Matthies*

A structured evaluation, comprised of process evaluation as well as outcome evaluation can be integrated into a heat plan (Figure 9). This can facilitate identification of the most effective interventions in a national or local context, as well as barriers to (and opportunities for) implementation. Methods for monitoring and evaluation are still under development. Suggestions will be compiled as guidance for the development of heat health action plans with respect to the definition of performance management standards, including stakeholder involvement and consultations (Matthies et al., in press c).

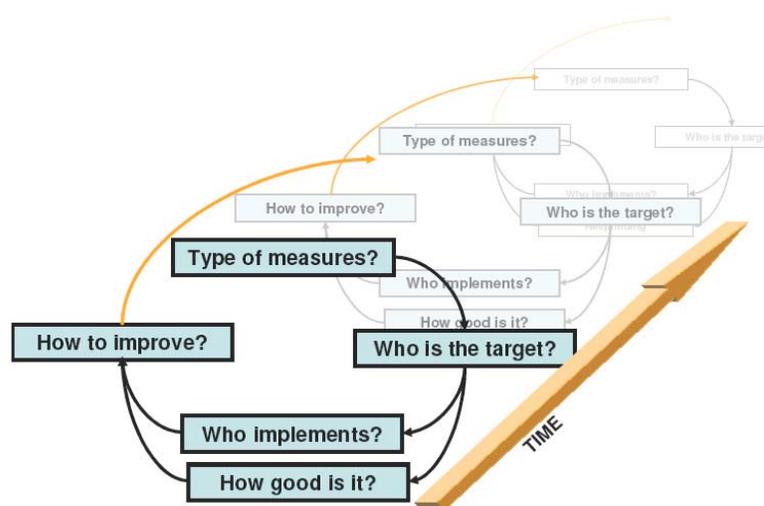


Figure 9: Framework for the development and the assessment of heat health action plans

Feasible measurements for the impact on mortality (outcome evaluation) need to be developed. Long-term evaluation may be needed to demonstrate significant effects on health outcomes.

In addition, real time data systems can inform health decision makers during summer about abnormal outbreaks or clusters of health impacts during a heat-wave and during summer (Paldy et al., in press). However, no information was available to deduce how intervention strategies are changed or adjusted during a heat-wave on the basis of the real time information. In the case of a heat-wave the most useful real time data seemed to be all cause mortality, emergency calls, emergency department visits, hotline calls and GP records. These data, provided they are available within less than 48 hours, can also support the warning system, in case health effects occur without timely warning. In many countries the collection of rapid mortality data is limited; and where syndromic surveillance exists, the systems could be tested on expansion to mortality, general practitioners information and emergency calls. The development and maintenance costs of these systems do not justify focusing on a single syndrome or health outcome; but it can be recommended that existing systems expand to heat related syndromes. The 2003 heat-wave showed that a minimum amount of rapid information is important for the Ministries of Health. Exploring the possibilities to establish a real time (less than 48 hours) standardized collection of mortality data is suggested for all countries. Experiences from France and the United Kingdom

(Leonardi et al., 2006) where real time surveillance systems are in place could be shared for further development.

***Evaluation and monitoring: What should be evaluated, how and by whom?***

*Group work consensus*

Criteria for evaluation and monitoring of the process as well as the outcome of heat action plans were listed and discussed. Particularly the assessment of the effectiveness of interventions is lacking so far and would be important.

There is a need to know the components of a plan and its objectives for the process and for the establishment of a monitoring and evaluation system.

Minimum requirements for evaluation could be:

- Assessment of heat alerts
- Overview of heat-mortality function over a period of time
- Assessment of mortality, morbidity (productivity, use of resources)
- At international level heat-indicators could be introduced; it is however difficult to have consistent indicators across countries
- The heat plan structure – who's responsible, how does the information flow?
- Process evaluation (examples can be drawn from Catalonia, France, England ... Box 4)
- Outcome evaluation – not just mortality and morbidity, but include also non-health related indicators such as productivity, absence from work ...

Monitoring and evaluation can be established for different settings, i.e. collecting mortality data according to settings, e.g. nursing homes, hospitals. Behavioural observations could be a part of the plan, e.g. if there are health behaviour changes which are clearly related to heat.

Suggested methods for monitoring and evaluation are epidemiological studies, surveys and trials.

Outside evaluators could have an important input in the definition and assessment of the right criteria and appropriate actions with the advice from the programme developers. It is important to evaluate heat health action plans periodically at the end of each summer, but a major evaluation is indicated after big events. Real time health data surveillance can be used for the monitoring during summer. Monitoring of process and outcome is suggested on national as well as European level. The WHO EuroHEAT initiative will continue to gather countries for a regular sharing of experiences.

- Italy, Catalonia, France, Portugal: every year the summer season is assessed and a yearly report compiled (mainly process evaluation) (e.g. Department for Civil Protection, 2007; Generalitat de Catalunya, 2007; Direcção-Geral da Saúde, 2005; InVS, 2006; Fouillet et al., 2008)
- Heat-wave plan for England: a questionnaire approach showed that the awareness of medical staff for the heat plan is very high (HPA, 2007)
- Hungarian system – a program was established in order to give alarms and general advice with the goal to reduce total mortality/morbidity. A phone survey was done after the first summer – results have not been good, as there was no felt need for this advice by the public. Still the best way to inform people has been via TV. Knowledge of dangers (risk perception) was very low (Kishonti et al, 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).

Box 4: Examples for first evaluation of European heat plans

## Policy responses and strategies

### *Group work consensus*

1. Every country is recommended to have a heat action plan with quick implementation possibilities on all levels and for all actors (clear roles and responsibilities of actors and defined actions); the core components have been defined, but their sequence is not that important.
2. There is a need for strong coordination and emphasis on the networking between the different actors (especially for communication purposes).
3. Inter-sectoral coordination and networking, formal as well as informal, should use the local climate services for HHWS with accurate forecast systems, including temperature thresholds.
4. A heat health action plan is suggested to include measures for prevention, preparation and emergency.
5. Long term changes in housing, urban planning and medical training need to be initiated now as an integral part of the heat health action plans.
6. The communication plan has to include a clear information system, which has to be accessible for all parties, but addressing them according to their specific needs.
7. Scientific data collecting has to be the base for the information system. The messages for the public have to include and respect the social structures, which could be guaranteed by an involvement of the respective ministries of education (e.g. for the development of information materials for schools).

8. The efficiency of health care institutions could be increased, e.g. by adjusting stock piles in hospitals and through better interlinking with infrastructure of other sectors, such as the energy sector or the water supply sector. Cross-sectoral education could lead to more preparedness for emergency situations.

## V. Excess mortality in Europe in summer 2003: The “CANICULE” project

*Jean-Marie Robine*

### Background

Everyone remembers the 15 000 deaths in France caused by the heat-wave in August 2003, but no one knows the total number of victims throughout Europe.

### Methods

Daily numbers of deaths at a regional level from January 1st 1998 onwards were collected in sixteen European countries. Summer mortality was analysed for the reference period 1998-2002 to set thresholds for extreme values. Variations in daily mortality were examined by calculating the delta between the number of daily deaths observed in 2003 and the reference period. Death frequencies were used to compare countries and regions.

Daily numbers of deaths by gender and age were collected at regional level (NUTS 2)<sup>9</sup>, in all the countries concerned by the summer 2003 heat-wave, i.e. the twelve countries for which there is a report indicating a possible excess mortality and all their surrounding countries (four countries) serving as controls. In order to make the years, countries and regions (NUTS 2) comparable, the death frequency was calculated by dividing, for each year, the daily death number by the annual total. Assuming no seasonal variations or daily fluctuations, it was reasonable to expect 0.27% (100/365) of all annual deaths on any given day. The numbers and daily frequencies were available for each day by gender, age and region (NUTS 2) since January 1st 1998, i.e. 19,098,574 daily mortality counts. The analysis covered (1) the seasonality of deaths in Europe during the 1998-2002 period to define a reference framework and a common summer period. Next, the analysis concentrated on (2) the characteristics of summer daily mortality in Europe during the same period, to set thresholds to identify exceptional days of deficit or excess mortality. We have adopted standard boundaries - the first and third quartile (Q1 and Q3) more or less 1.5\*IQR (inter-quartile range) - to identify the extreme values (mild outliers: Q1-1.5\*IQR; Q3+1.5\*IQR) and more or less 3\*IQR to identify the exceptional extreme values (Q1-3\*IQR; Q3+3\*IQR). This analysis included 9760 summer days (122 days from June 1st to September 30th \* 5 years \* 16 countries).

We firstly examined (3) the variations in daily mortality in all sixteen European countries, by calculating the delta between the number of daily deaths observed during summer 2003 and the average number of deaths on the same day during the five years of 1998-2002 reference period

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<sup>9</sup> The Nomenclature of Territorial Units for Statistics (NUTS)  
[http://en.wikipedia.org/wiki/Category:NUTS\\_2\\_Statistical\\_Regions\\_of\\_Europe](http://en.wikipedia.org/wiki/Category:NUTS_2_Statistical_Regions_of_Europe)

(Figure 10). In order to make the magnitude of the decreased or excess mortality easier to understand, we divided all the daily frequencies by the value of the median of the daily frequency experienced during the summers between 1998 and 2002. This conversion, covering all the key parameters (25th percentile, 75th percentile, threshold values marking the extreme values), rescales all the values observed around the unit. It is therefore immediately possible to interpret the daily mortality on a given day as a multiple of the median value. Maps at NUTS 2 level were produced to specify more accurately the geographical boundaries of different levels of excess mortality within each country. A first map illustrates the importance of excess mortality cumulated over the two weeks of August 3rd-16th (i.e. from Day 215 to Day 228 of the year, DOY) (Figure 11). Lastly (6), a series of ratios shows the distortions in the proportion of deaths of older people (65+, 75+, 85+ and 95+) and in the share of female deaths within the summer daily deaths that occurred at the same time as the 2003 August death peak.

## Findings

More than 70 000 additional deaths occurred in Europe during the summer 2003, including more than 20 000 extra deaths before August. Figure 10 represents the variations in daily mortality during summer 2003 for all the sixteen European countries, using the delta between the number of daily deaths observed during the summer and the average number of deaths, noted on the same day, during the five years in the 1998 to 2002 reference periods. A delta higher than zero therefore indicates a number of daily deaths higher than the average of the last five years and a delta lower than zero the reverse.

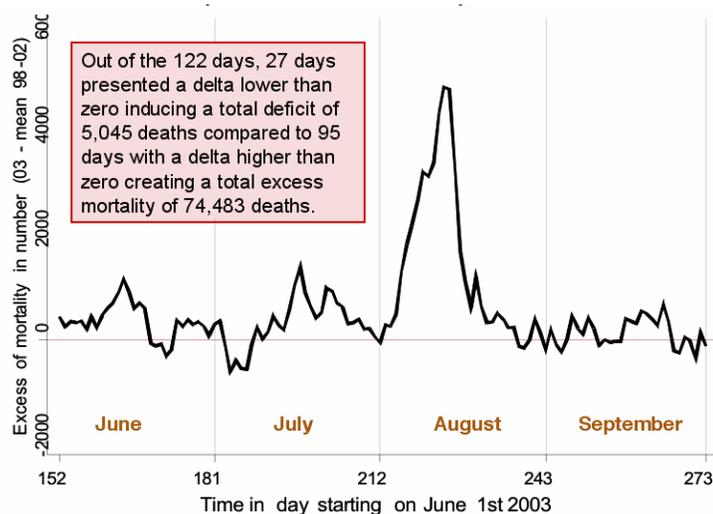


Figure 10: Delta between the number of daily deaths recorded in the summer of 2003 and the average number of deaths recorded on the same day during the 1998–2002 reference period for the sixteen European countries studied. DOY 152, the 152<sup>nd</sup> day of the year corresponds to 1 June, DOY 181 to 30 June, DOY 212 to 31 July, DOY 243 to 31 August and DOY 273 to 30 September (Robine et al., 2008).

\*DOY 152, the 152<sup>nd</sup> Day Of the Year corresponds to June 1<sup>st</sup>, DOY 181 to June 30<sup>th</sup>, DOY 212 to July 31<sup>st</sup>, DOY 243 to August 31<sup>st</sup> and DOY 273 to September 30<sup>th</sup>.

Within the 16 European countries studied, 27 days out of the 122 days of summer 2003 presented a delta lower than zero inducing a total deficit of 5045 deaths compared to 95 days with a delta higher than zero creating a total excess mortality of 74 483 deaths. It is clear that both gaps do not balance

each other. Excess mortality was a characteristic phenomenon throughout summer 2003 and affected a major part of Europe. In particular three main peaks exceeding the threshold of 1000 daily additional deaths are striking: June 13th peak at the end of the second week of summer, July 16th and 21st double peaks during the seventh and eighth weeks and lastly August 12th-13th peak during the eleventh week of summer, which seems exceptional in size.

The third peak centering on August 12th and 13th involves firstly France, Italy, Portugal and Luxembourg. It is also clearly visible in Germany, England and Wales, Belgium and Switzerland.

The mortality crisis of early August extended over the two weeks between August 3rd and 16th - the tenth and eleventh weeks of summer (Figure 11). 15 000 additional deaths were recorded in the countries studied during the tenth week and nearly 24 000 during the eleventh week. The excess mortality ratio in this second week reached the exceptional value of 96.5% in France and very high values in Portugal (+48.9%), Italy (+45.4%), Spain (+41.2%) and Luxembourg (+40.8%). Excess mortality reached 28.9%, 26.7% and 21.6%, respectively, in Germany, Switzerland and Belgium. It exceeded 10% in all countries except Denmark, Poland and Czech Republic. Even in Austria mortality increased by 12.6% in the week of August 10th-16th. Excess mortality persisted at the end of June during the fourth week of summer, in early September during the fourteenth and fifteenth weeks and during the sixteenth and seventeenth weeks, with a slight peak on 22nd of September. It is important to notice that beyond a return to normal, no overall harvesting effect was observed in the weeks and months following the mortality crisis in early August 2003.

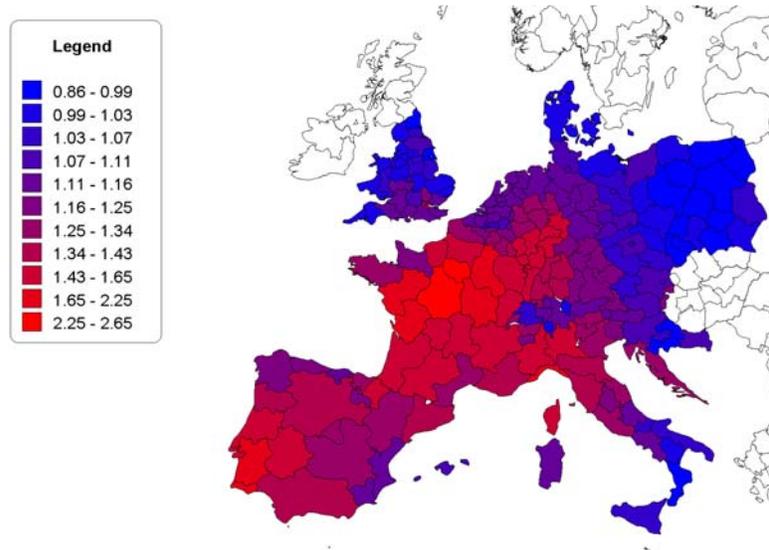


Figure 11: Standardized daily death frequencies (1 means equal to the median death number, 2 means twice the median death number) between 3 and 16 August 2003, in 16 European countries, for 177 NUTS (Robine et al., 2008)

The August mortality crisis caused major distortions in the deaths' age and gender structure. On August 12th, the share of 65+ deaths increased by 9.5% in France, the share of 75+ deaths increased by 16.5%, the share of 85+ deaths by 26.8% and the share of 95+ deaths by 46%. These distortions in the deaths' age structure imply that excess mortality increased as age rose. The

structure of deaths by gender also varied considerably during the mortality crisis. The share of female deaths increased by 21% in France on August 12th and by 14% in Italy on August 13th.

### **Interpretation**

During the summer of 2003, a series of minor mortality crises, most of which remain unnoticed, resulted in a significant number of victims in Europe in addition to the huge number of deaths associated with the August heat-wave. Global warming constitutes a new health threat in an aged Europe, which may be difficult to detect at country level. Centralising the count of daily deaths on an operational geographical scale constitutes a priority for public health in Europe (Robine et al., 2008).

Our observations suggest that a succession of minor crises can co-exist with an exceptional mortality crisis like the one at the beginning of August that none can ignore. These smaller crises pass almost unnoticed and yet the cumulative results over the summer can globally be just as significant. France and Italy thus cumulated the same excess mortality in summer 2003 - +19 490 and +20 089 deaths, respectively -, with very different accumulating profiles. These results suggest that centralizing daily deaths at sufficiently large scale, like grouping regions or countries with small populations, should improve monitoring of summer excess mortality potentially due to global warming.

### **Q&A raised in the plenary**

*Were the 45 000 excess deaths in August 2003 directly related to the heat-wave?*

The figure of 45.000 excess deaths in August, with most of these people dying during the ten hottest days of that month, is striking. The CANICULE project observed the mortality trends country by country and according to age groups and gender, but no general trends were found. Looking at excess mortality across the whole of Europe, it can be stated that excess mortality can be related to the heat-wave. Still, direct comparison of the countries is not possible and regional approaches cannot be easily generalized.

*Why did countries only start activities after the extreme summer in 2003 and why was the CANICULE project only started in 2005 when there have been other extreme hot weather events before?*

The short memory of politicians and researchers in that respect was criticized and the extreme heat in Athens 1997 was recalled as an example.

*Could the excess death rate in September 2003 have been a delayed heat effect?*

The fact that CANICULE researchers are epidemiologists and no climate specialists might explain why local climatic conditions and risk factors in general were not considered.

*Could the CANICULE project be used for the development of prevention plans or for modelling of heat health effects?*

There might be options for better cooperation in future as all data were gathered at European level and can be analysed, shared and used for common purposes.

## VI. Where to go from here? – Opportunities and challenges for the EuroHEAT network – a panel discussion

Representatives from the EC, the Red Cross/Red Crescent Climate Centre, the World Meteorological Organization (WMO), the Portuguese Ministry of Health and the European Public Health Alliance (EPHA) discussed – together with the plenum – future opportunities and challenges for the EuroHEAT network:

- *International partnerships are advocated*

It is suggested to continue to set up in international partnership an evidence-based intervention platform on extreme events with the goal to share best effective practices, monitor developments and review achievements over the next five years.

- *Internationally, harmonized heat health action plans suggested to be implemented on the basis of experiences and lessons learnt*

Overall, the EuroHEAT project and the international conference have provided a basis for action. To facilitate the implementation of harmonized heat health action plans and also for the international information platform as mentioned above, it is suggested to develop and share information on:

- a) Best practice heat health action plan, its development and implementation;
- b) Medium term probability heat forecasting and its effectiveness;
- c) Criteria for decision making on when to act and how to act;
- d) Multi – targeted education material including special interest groups;
- e) Excess mortality in summer times.

The health effects of climate change affect all Member States and it is advised for possibilities to implement heat health warning systems and heat health action plans to be explored, if possible in a harmonized way across the European Region. 90% of the hazards are of meteorological nature. The role of the meteorological organizations has been stressed throughout the meeting and a lot is still to be learnt from each other. A strong cooperation already exists between the World Meteorological Organization (WMO), particularly also through the National Meteorological Services, and the WHO. Visible results of the cooperation are the disaster prevention programmes. Both organizations together have activated a strong lobby for the topic of climate change and adaptation.

The importance of stronger cooperation with the International Federation of Red Cross and Red Crescent Societies (IFRC), international medical associations and non-governmental organizations for the development and implementation of effective public health responses was referred to throughout the meeting.

The EuroHEAT reference heat health action plan could become a theoretical framework for the prevention of health effects of heat and heat-waves, applying the EuroHEAT results also in other regions of the world. More research, trainings and workshops will be needed to build up the required capacity at a global level.

- *Suggestions for national improvements: collaboration and communication between lead body, key agencies, medical and social institutions and the public are important*

National and regional heat health action plans need to consider knowledge on local circumstances. In national heat health warning systems and heat health action plans, the formal link between the national weather services and the health authorities is one of the core elements.

Also on national level, public health responses to heat and heat-waves would greatly benefit from strengthening the cooperation between health authorities, social services, National Societies of the Red Cross and Red Crescent, non-governmental organizations and the communities.

It was suggested to use the term “heat plan” instead of “heat health plan” or “heat health action plan” to allow for a more comprehensive, inter-sectoral and joint approach, maximizing the resources. More multi-sectoral workshops and training opportunities would strengthen the mutual understanding and optimize collaboration.



- *Social services in heat health action plans are an important opportunity*

As heat-wave effects draw special attention to the needs and problems of the elderly in our societies, responses to heat-waves require strong social mobilization. Lessons learnt include that responses to heat-waves cannot only rely on the existing public or official systems but the participation of family members, volunteers and social services need to be increased. The National Red Cross and Red Crescent Societies have a very important role in informing the society and in mobilizing joint forces for social support and assistance among families, neighbours and volunteers. This supports a stronger role for organizations like the Red Cross in national heat health action plans. In addition to mortality and morbidity, effects of heat on wellbeing and quality of life could be included as an important outcome criterion. Policies in the health sector and other sectors need to address the role of vulnerable population groups in general and of the elderly in our societies in particular.

- *Assessing the effectiveness of operational heat health action plans is a challenge*

The meeting has also identified a need for common definitions, for more solid information on heat health effects and responses and the development of appropriate instruments for monitoring and evaluation of the effectiveness of interventions. Prevention of heat related excess mortality is of course the overall goal of a heat health action plan and to be measured as one outcome indicator. However, the methodological answer to the question on how to really measure these results is still to be given.

In Portugal for example, a contingency plan for heat-waves exists and two reviews are carried out every year. Based on these data the plan for the following year is prepared. Still there have been more than 2000 excess deaths (mostly in the 75+ age group) in summer 2006 in spite of the existing plan. Portugal has found that the cooperation between institutions and society is essential. Furthermore, implementation of the heat health action plan needs the commitment at regional and local level.

- *Cost effectiveness of heat health action plans is a convincing argument*

Cost effectiveness of interventions is always a convincing argument; therefore it is suggested to further study cost effectiveness of measures preventing heat health effects. More information on the cost of inaction may also be important for decision makers.

- *Measures to prevent health effects from heat can be both: adaptation measures and mitigation measures*

There is need for considering mitigation within the different measures to reduce adverse effects of heat on health, if possible, avoiding consumption of even more energy. Advice on how to reduce heat exposure indoors can focus on effective alternatives to air conditioning such as various passive cooling methods for buildings. Recommendations on energy and transport need to be formulated as not to counteract the efforts to mitigate climate change. Environmental impacts of interventions have always to be considered. Again collaboration between disciplines (e.g. architecture, urban planning, transport and energy and health) would be in demand for innovative improvements from a public health and environment perspective.

In this respect the EU welcomes professional technical advice and knowledge (e.g. from WHO) in order to identify win-win solutions and practices. Possibly contradicting policies have to be identified and addressed accordingly.

In the longer run climate change and the occurrence of heat-waves will pose implications for urban planning, building design and transport policies. It can be observed that climate change has a potential to bring communities together which never have cooperated before. The focus on heat could be a starting point for a knowledge platform on a wider range of climate change related health topics.

### **Conclusions and next steps discussed in the plenary**

The results of the EuroHEAT project will be presented in the Technical Summary (WHO Regional Office for Europe, in press) and a EuroHEAT monograph in 2008 (Matthies and Menne, in press). Existing heat health action plans already show recognition at high political level, but interventions could also be started at a lower political level, involving for example the policy advisors. The challenge now is to sustain the interest and commitment of the key players in different sectors. Risk of climate change to societies and preparedness and response strategies need to be communicated from the view point of scientists as well as actors from various sectors.



Risk perception of heat-waves and other extreme weather events has increased in Europe and at a global level, which shows that time has come to plan and implement appropriate measures for the prevention of negative health impacts.

Coordination of measures has to be improved at European level. There are already promising instruments and models at hand to provide the players with timely information, forecasts and alerts. Heat action plans make even more sense if they can also be used as strategic tools for other extreme events (such as floods, droughts or epidemics).

Data on health effects of heat (and eventually extended to other extreme weather events) and research results (meteorological, environmental, and physiological) could be administered at a central

level and be made accessible to those who provide health or care services of any kind. Continued collaboration between the EC and the EuroHEAT network is planned, following the objectives of the London and Budapest declarations.

Europe is and will not be suffering the most from health effects of heat-waves. Global responsibility exists for those areas where heat is striking even more, together with drought and overpopulation. Lessons learnt in Europe and examples for good practices need to be communicated and shared with the global community.

### Next steps

The Global Change and Health Programme of the WHO Regional Office for Europe will be aiming at continued advocacy for global change and health issues, supporting the strengthening of surveillance systems to better describe climate related health effects and provide valid and reliable evidence. The health argument is becoming more central to the climate change debate and a strong multi-sectoral knowledge base is important.

WHO in collaboration with its partners in the EuroHEAT project:

- Is currently developing guidance for a prototype heat health action plan. This guidance should be finalized early in 2008 and be made available for countries that do not yet have a heat health action plan or that are revising their own plan.

- Is engaging in clarifying the scientific uncertainties surrounding the multi-targeted education material; in particular the interaction of heat with drugs and the advice on drinking and cooling. To this end it will set up small working groups to make evidence based information available by 2008.
- Will make available the full information elaborated in this project by early 2008 for planning processes for the summer of 2008.
- Will transform the EuroHEAT web site information into an open accessible information platform – in collaboration with the EC Portal.

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## List of acronyms

AQ	Air Quality
CI	confidence interval
CO	carbon monoxide
DGs	Directorate Generals
DG SANCO	Directorate General for Health and Consumer Affairs
DOY	day of the year
DWD	German Weather Service
EC	European Commission
ECDC	European Centre for Disease Prevention and Control
ENVI	Committee on Environment, Public Health and Food Safety
EPHA	European Public Health Alliance
EU FP7	European Seventh Framework Programme
EWRS	European Weed Research Society
FAO	Food and Agriculture Organization
GP	General practitioner
HHWS	Heat Health Warning Systems
IFRC	International Federation of Red Cross and Red Crescent Societies
IMR	Intergovernmental Midterm Review
INSERM	Institut national de la santé et de la recherche médicale
IQR	inter-quartile range
JRC	Joint Research Centre
NGO	Non-Governmental Organization
NMHS	National Meteorological and Hydrological Service
NO <sub>2</sub>	nitrogen dioxide
NUTS	The Nomenclature of Territorial Units for Statistics
O <sub>3</sub>	ozone
OIE	World Organization for Animal Health
PHEWE	Prevention of acute Health Effects of Weather conditions in Europe
PM	Particulate Matter
PM <sub>10</sub>	Particulate Matter < 10 µm
Q1	first quartile
Q3	third quartile
SO <sub>2</sub>	sulphur dioxide
T <sub>AMB</sub>	ambient temperature
WMO	World Meteorological Organization
WHO	World Health Organization
UVR	ultraviolet radiation
UTC	Coordinated Universal Time

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## Annex

### Programme of the Final EuroHEAT Meeting



MEETING ON IMPROVING PUBLIC  
HEALTH RESPONSES TO EXTREME WEATHER

EUR/06/5067942/4  
ENGLISH ONLY  
MARCH 2007

**BONN, GERMANY 22 – 23 MARCH 2007**

## PROGRAMME

**22 March 2007**

**09.00 - 10.00 Official opening**

Manfred Schmitz, Representative of Ministry of Health of Nordrhein Westfalen

Antoni Montserrat Moliner, EC representative

Roberto Bertollini, WHO Regional Office for Europe

Chair: Franklin Apfel

**10.00 - 11.00 The EuroHEAT prevention approach: from evidence to practice**

The impacts of heat and heat-waves – implications for policy making *Paola Michelozzi*

Air pollution, heat and health. *Klea Katsouyanni*

Risk factors for heat mortality – implications for policy making *Sari Kovats*

Questions and answers - plenary discussion

11:00 – 11.30 Coffee is offered

**11.30 - 12.15 EuroHEAT prevention approach: from evidence to practice**

The prevention framework *Bettina Menne, Franziska Matthies and Simon Hales*

Thermophysiology, pathophysiology and clinical management of heat related illness. *Abderrezak Bouchama*

**Questions and answers - plenary discussion**

- 12.30 – 14.00**      ***Science shopping (Lunch with poster exhibition and special scientific presentations)***
- 14.00 - 14.15**      **Introduction of group work session in the afternoon**
- 14.15 – 16.00**      **Group work: Preventing the health effects of heat and heat-waves**

Group 1: Understanding the health impacts of hot weather and heat-waves? (TS: 2.2; 2.4)

Group 2: Housing and health: which short -, medium-, long-term recommendations (TS: 3.2; 3.6)

Group 3: What actions to take for high risk groups and how? (TS: 3.3)

Group 4: Interaction between heat and air pollution: what actions are needed? (TS: 2.3; 3.6)

16.00 – 16.30    Coffee is offered

Chair: Roberto Bertollini

- 16:30 – 16:50**      **The CANICULE project: The excess mortality in summer 2003**  
*Jean Marie Robine*
- 16:50 – 17:30**      **Overall Discussion**

*18.30    Social event: reception (Altes Rathaus, offered by the Mayor of Bonn)*

*20.00    Dinner in Godesburg (bus service is available)*

**23 March 2007**

Chair: Glenn McGregor

- 09.00 – 10.00**      **Presentation of the group results and discussion**
- 10.00 – 10.30**      **Climate information tool**

Heat health warning systems and seasonal climate forecasting in Europe. *Christina Koppe*

- 10.30 - 12.00**      **Group work: Preventing the health effects of heat and heat-waves**

Group 5:    The usefulness of the climate information tool? (TS: 3.1)

Group 6:    What should be the content of educational material and how should it best be available?  
(TS: 3.2; 3.7)

Group 7:    Policy responses and strategies (TS: 3)

Group 8:    Evaluation and monitoring? What should be evaluated, how and by whom? (TS: 3.8)

Coffee is available

**12.00 – 13.00**      **Presentation of the group results and discussion**

**13.00 - 14.00**      *Science shopping (Lunch with poster exhibition and special scientific presentations)*

Chair: Franklin Apfel

**14.00 - 16.00**      **Discussion: Improving Public Health Responses to Extreme Weather – Policy Implications**

Introduced by the presentation of the key policy messages by the advisory committee  
Critical comments are expected by selected panellists.

*16.00*                      *Next steps and Closing of the meeting (Dr Bertollini and JM Robine)*

## List of participants



**FINAL MEETING ON IMPROVING PUBLIC  
HEALTH RESPONSES TO EXTREME WEATHER**

EUR/06/5067942/5  
ENGLISH ONLY  
MARCH 2007

**BONN, GERMANY, 22 – 23 MARCH 2007**

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## Poster session

E. Cadot, F. Canouï, A. Spira. Atelier Parisien de Santé Publique (APSA), Paris, France. *The 2003 heat wave in Paris (France): social isolation impact*

B. Cox, S. Maes. Scientific Institute of Public Health (IPH), Brussels, Belgium. *Mortality surveillance in Belgium: Results Summer 2006*

A. Fouillet<sup>1</sup>, G. Rey<sup>1</sup>, E. Jouglà<sup>2</sup>, D. Hémon<sup>1</sup>. <sup>1</sup>INSERM, U754, IFR69, Epidémiologie environnementale des cancers; <sup>2</sup>INSERM, CépiDc, IFR69, Centre d'épidémiologie sur les causes médicales de Décès. *The relationship between summer daily temperature and mortality in France: 1975 to 2003*

J. Garssen, C. Harmsen. *Recent mild temperatures keep mortality down*

T. Kosatsky<sup>1</sup>, J. Dufresne<sup>1</sup>, L. Richard<sup>2</sup>, A. Renouf<sup>1</sup>, N. Gianetti<sup>3</sup>, J. Bourbeau<sup>3</sup>, M. Julien<sup>4</sup>, J. Braidy<sup>5</sup>, C. Sauvé<sup>4</sup>. <sup>1</sup>Montreal Public Health; <sup>2</sup>School of Nursing, University of Montreal; <sup>3</sup>McGill University Health Centre; <sup>4</sup>Hopital Sacré Coeur; <sup>5</sup>Centre Universitaire de l'Université de Montréal. *Heat awareness and response among persons affected by chronic cardiac and pulmonary disease*

K. Laaidi<sup>1</sup>, E. Baffert<sup>1</sup>, A. Etchevers<sup>1,3</sup>, P. Empereur-Bissonnet<sup>1</sup>, A. Charlemagne<sup>2</sup>, M. Ledrans<sup>1</sup>. <sup>1</sup>Institut de veille sanitaire (InVS / Institut for Health Surveillance); <sup>2</sup>Cemka-Eval (Health consultant); <sup>3</sup>stagiaire Profet. *Evaluation of the National Heat Health Watch Warning System in France*. InVS août 2006

A. Lefranc<sup>1</sup>, A. Le Tertre<sup>1</sup>, S. Medina<sup>1</sup>, D. Eilstein<sup>1</sup>, C. Declercq<sup>2</sup>, L. Pascal, L. Filleul, S. Cassadou, P. Fabre, H. Prouvost, M. D'Helf, J.-F. Jusot, B. Chardon, M. Ledrans. <sup>1</sup>The French Institute for Public Health Surveillance (InVS/Paris); <sup>2</sup>Regional Health Observatory, Lille; <sup>3</sup>Regional Health Observatory, Paris. *Excess deaths during the heat wave in France: Which contribution of air pollution?*

H. Moshhammer. Institute of Environmental Health, CPH, Medical University Vienna. *Health impact of heat waves in Vienna, Austria*

P. J. Nogueira. *Projecto ICARO – Steps of a national surveillance system for heat waves with impact on population's health*

R. Péquignot, J.C. Auffray, C. Berbezier, J.-L. Golmard, J. Belmin. Service de gériatrie, Hôpital Charles Foix and Université Paris 6. *August 2006 heat wave in Ile-de-France: Is mortality related to dependance?*

M. Poumadère. IS/ENSMP. *Heat waves: not only a matter of temperature*

G. Rey<sup>1</sup>, E. Jouglà<sup>2</sup>, A. Fouillet<sup>1</sup>, G. Pavillon<sup>2</sup>, D. Hémon<sup>1</sup>. <sup>1</sup>INSERM, U754, IFR69, Epidémiologie environnementale des cancers; <sup>2</sup>INSERM, CépiDc, IFR69, Centre d'épidémiologie sur les causes médicales de Décès. *The impact of major heat waves on all-cause and cause-specific mortality in France from 1971 to 2003*

**The WHO Regional Office for Europe**

The World Health Organization (WHO) is a specialized agency of the United Nations created in 1948 with the primary responsibility for international health matters and public health. The WHO Regional Office for Europe is one of six regional offices throughout the world, each with its own programme geared to the particular health conditions of the countries it serves.

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EuroHEAT, a DG SANCO co-funded project, aimed to improve public health responses to weather extremes and to heat-waves in particular. As coordinator of the project, the WHO Regional Office for Europe organized an international expert meeting in Bonn to discuss project findings and to develop key policy recommendations for future action. The project assessed the evidence for the health impacts of extreme weather, developed a climate information decision support tool for heat and actions to prevent health impacts. Overall project results are presented in this report. Based on these results, core elements of heat health action plans have been identified and main messages of heat health advice for a range of target groups formulated. The meeting concluded that information on best practice heat health action plans, medium term probability heat forecasting, criteria for decision making, multi-targeted education material and on excess mortality in summer times needs to be made accessible on an information platform. WHO in collaboration with its EuroHEAT partners and the EC is planning to i) clarify the scientific uncertainties surrounding the multi-targeted education material; ii) make available the full information elaborated in this project by early 2008 for planning processes for the summer of 2008; iii) make available for countries guidance for the development of heat health action plans; transform the EuroHEAT web site into an open accessible information platform – in collaboration with the EC Portal.

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