



**World Health
Organization**

REGIONAL OFFICE FOR **Europe**



Climate change, extreme weather events and public health - Meeting report

29 – 30 November 2010

Bonn, Germany

**Umwelt
Bundes
Amt** 
Für Mensch und Umwelt



Federal Ministry for the
Environment, Nature Conservation
and Nuclear Safety



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ABSTRACT

The WHO Regional Office for Europe and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany, co-organized an international and national expert meeting with technical support from the German Federal Environment Agency (UBA) and the German Meteorological Service (DWD), to discuss the effects of climate change and extreme weather events on public health and the draft public health handbooks developed by WHO to address and prevent these effects. The main outcomes of, and recommendations from, the meeting are contained in this report.

Keywords

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We would also like to express our thanks for the presentations elaborated and given by: Paul Becker (Meteorological Service, Germany), Bettina Menne (WHO Regional Office for Europe) and Hans-Guido Mücke (Federal Environment Agency, Germany).

The meeting was funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), Germany, and co-organized by BMU and the WHO Regional Office for Europe. Technical support was given by the German Federal Environment Agency (UBA) and the German Meteorological Service (DWD).

This report summarizes the discussions on the draft cold weather prevention and flood public health handbooks and the current Heat-Health Action Plans Guidance. The development of these documents is coordinated by Bettina Menne and Franziska Matthies (Climate change, green health services and sustainable development programme, WHO Regional Office for Europe).

Contributions from all participants (listed in annex 1 to this meeting report) to the improvement of the draft public health handbooks as well as the success of the meeting and the discussion of important future steps at a national as well as international level, are greatly acknowledged.

INTRODUCTION

Over recent years it has become clear that warming of the climate system is unequivocal. Climate change has already affected human health. Major concerns are extreme weather events such as heat-waves, cold spells, floods and windstorms. Taking steps to tackle the root causes of climate change, understand the health co-benefits of action, invest in healthy environments, and advocate health-related developments is vital in order to reduce the burden of disease and promote population health.

Evidence is growing that some weather events are likely to become more frequent, more widespread and/or more intense during the 21st century (IPCC, 2007). European populations are directly exposed to climate change through changing weather patterns and indirectly through changes in water, air, food quality and quantity, ecosystems, agriculture, livelihoods and infrastructure (Confalonieri et al., 2007). These direct and indirect exposures can result in a variety of health impacts, most of which are anticipated to be negative and will profoundly worsen if current accelerating trends continue unabated. Many health impacts resulting from extreme weather events can potentially be prevented through early warning systems and public health preparedness and response action.

A series of international conferences on extreme weather events and preparedness and response were initiated in Bratislava in 2004. Adaptation options and adaptation strategies to reduce the health impact of climate change and preparedness and response plans for extreme weather events have already been developed and applied in numerous member States, in particular for heat and heat-waves and floods and windstorms. Overarching guidance for the development of heat-health action plans has been published by WHO in 2008 and handbooks for preparedness plans for floods/windstorms and cold-waves are currently under development in collaboration with international experts.

At the sixty-second World Health Assembly, in 2009, Ministers of Health called for intensified action to protect health from climate change, including awareness raising, the development of regional and national action plans, and increased support to strengthen health system adaptive capacities. European member States have worked together and presented a European Framework for Action for cooperation between environment and health to protect health from climate change. This framework for action and its policy brief was welcomed at the Fifth Ministerial Conference on Environment and Health held in Parma, Italy in March 2010.

In order to advance the Framework for Action Germany, together with the WHO Regional Office for Europe, supported and organized an international meeting with the aim to review the international experience in adaptation to climate change with focus on extreme weather events.

The meeting took place in Bonn, Germany on 29 and 30 November 2010 and was organized in conjunction with the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), Germany, with technical support from the German Federal Environment Agency (UBA) and the German Meteorological Service (DWD). A national

meeting organized by the BMU was held in parallel with the international meeting in order to facilitate information exchange. The title of this joint meeting was “Climate change, extreme weather events and public health”. The key aims of the meeting were:

- To share international and national experiences on preparedness and response plans for extreme weather events;
- To discuss and approve public health messages and measures for action plans for floods/windstorms and cold;
- To review, update and improve the guidance for the development of heat-health action plans;
- To discuss integration of specific action plans for extreme weather events in all hazard disaster preparedness plans; and
- To evaluate the applicability of international results, guidance material and public health relevant action for the development of a national adaptation strategy in Germany.

The meeting was attended by scientific experts from a variety of areas and sectors such as meteorology, disaster management, health facility preparedness, epidemiology and physiology, energy and water supply and housing, as well as by representatives from the European Commission, European Agencies, NGOs and other international partners. A full list of participants can be found in Annex I to this report.

WELCOME ADDRESSES

Mr Jürgen Becker, State Secretary at the Federal Environment Ministry (BMU)

Mr Becker welcomed the participants to the meeting and expressed his appreciation for the work of the BMU and WHO Regional Office for Europe in organizing and preparing for the meeting. Extreme weather events represent a growing problem for public health, as they could become increasingly frequent. Some countries have already begun to address the issues related to climate change and public health, including precautionary and awareness-raising activities. However other countries might still not have the capacity to do so and rely on international solidarity and cooperation. Intensive discussion is required in order to trigger awareness-raising activities and encourage dialogue between stakeholders.

Dr Srdan Matic, WHO Regional Office for Europe

Dr Matic emphasized the longstanding and close cooperation between the WHO Regional Office for Europe and Government of Germany in the sphere of the environment and health. At the Fifth Ministerial Conference for Health and the Environment in Parma, Italy, in April 2010, the European Regional Framework for Action for protecting health from climate change (WHO, 2010a), which addresses the health impacts of climate change and the development of public health adaptation strategies, was welcomed. Many areas and people in

Europe remain vulnerable to climate change and extreme weather events, such as river basin flooding, cold-waves and heat-waves, and over recent years there had been a marked increase in these events. Systematic investment in changing how people live, work and travel is vital if adaptation policies are to be successful. It is also important to address existing social inequalities in order to ensure that all sectors of the population have the ability to protect themselves from extreme weather events. This meeting represents a good opportunity to review, discuss and improve the draft handbooks giving guidance on how to protect the population from health effects of extreme weather events such as cold-waves, floods and heat-waves and fires. The guidance for the development of heat-health action plans (Matthies et al., 2008) requires updating in view of experiences in many countries.

OPENING PRESENTATIONS

Heat, storms, and floods: is our climate becoming increasingly extreme?

Dr Paul Becker, German Meteorological Service (DWD)

In 2010, there had been a number of extreme weather events, including the heat-waves in the Russian Federation and other European countries, and heavy precipitation and flooding in India and Pakistan. Looking at the trends for the different types of events, it can be noticed that the frequency and intensity of hot days and heat waves has already increased in many parts of the world and it is likely that this trend will continue in the future (Fig. 1).

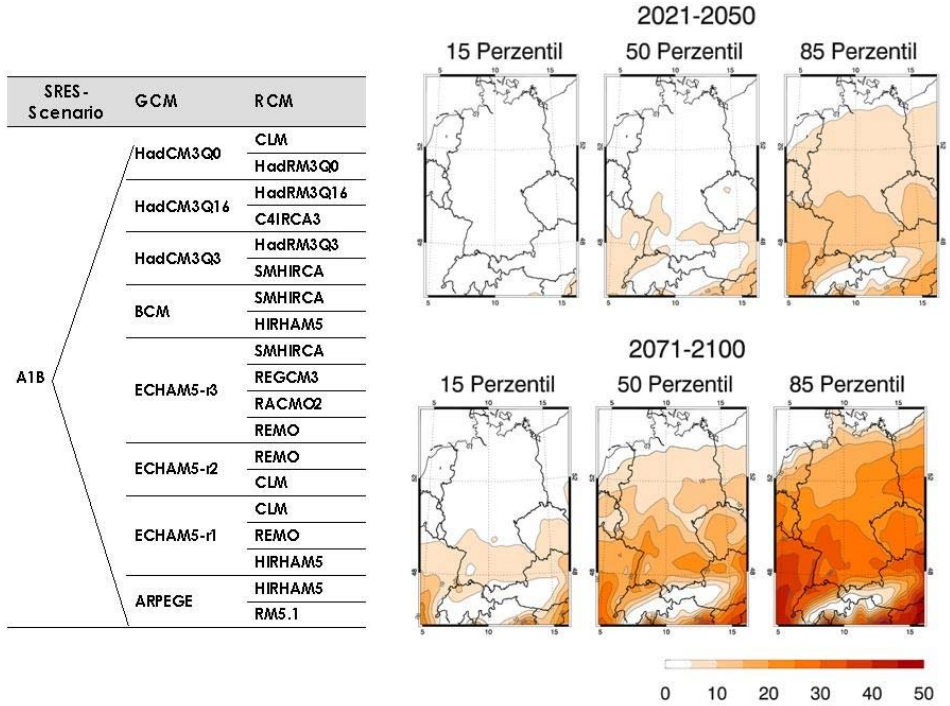


Fig. 1 – Projections of the number of hot days (Tmax > 30°C) in Germany between 2021 and 2100 based on an ensemble of regional climate models (Source:DWD 2010).

At the same time, the number of cold days has decreased during the last decades. However, it is important to be aware that there are regional differences in the trends. With regard to storms, there is no clear trend emerging either in Europe or globally. Trends in heavy precipitation events are often difficult to calculate accurately owing to the lack of data in sufficient resolution (in space and in time) (Fig. 2).

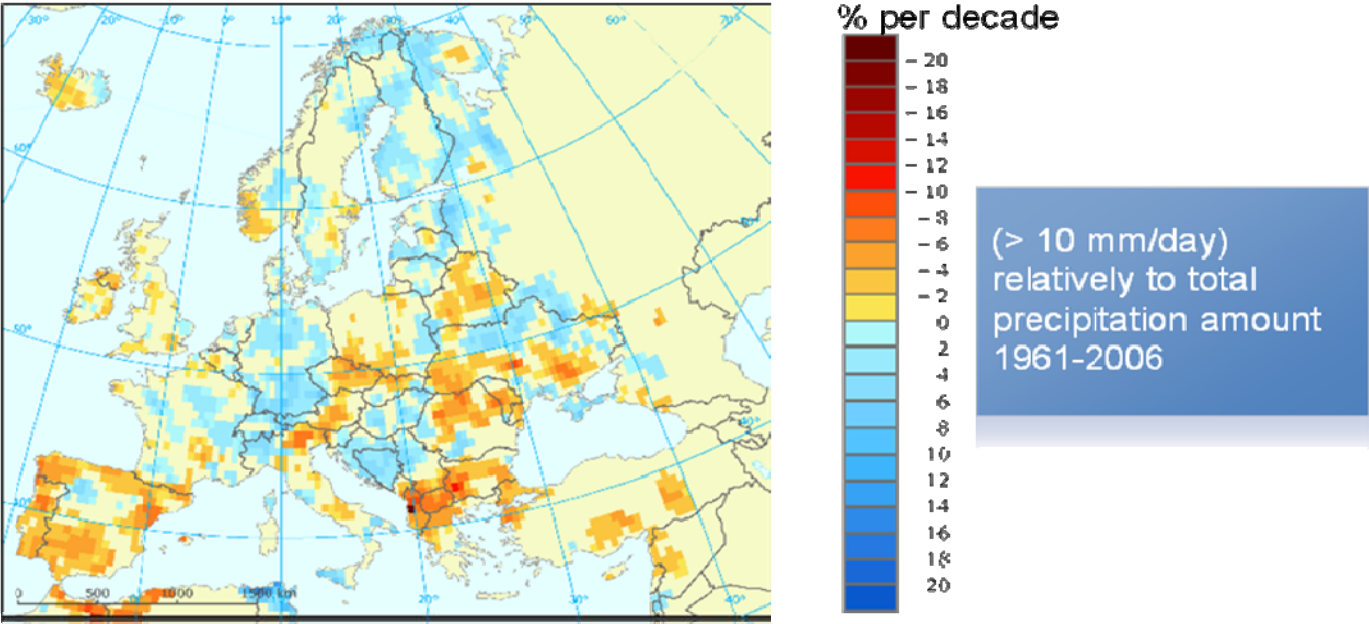


Fig. 2 – Changes in the spatial distribution of heavy precipitation (> 10mm/day) (Source: van Engelen et al., 2008)

The social and economic impacts of extreme weather events continue to be seen and felt around the globe. Germany has a strategy in place to cope with severe weather events, having defined and established plans for many of the sectors that would be affected by such events. For example, in reaction to the heat-wave 2003, a rapid alert system has been installed in Germany and other European countries, which alerts vulnerable sections of the population, such as the elderly, via the media or via direct contact with nursing homes. During the 2006 heat-wave, the media had played a vital role in alerting and advising the public, however the key issue with media involvement is that if extreme weather events last for prolonged periods, the media would lose interest in the story.

In summary, for the WHO European Region it is projected that the number of hot days and average temperatures are likely to increase over the coming decades. Projecting changes in other extreme weather events represents a key challenge for climate modellers, because there is even more uncertainty in the projection of extreme winds or extreme precipitation events than in the projection of temperature.

Changes of extreme weather events and impacts on health

Dr Bettina Menne, WHO Regional Office for Europe

In recent years, many countries in the WHO European Region have experienced major heat-waves, floods and droughts that have led to deaths and human suffering, social disruption and a substantial burden to health systems. Evidence is growing that some extreme weather events are likely become more frequent, more widespread and/or more intense during the 21st century, and that further increase in temperature, changes in precipitation patterns and sea level rise are expected (IPCC, 2007). These changes will have a wider effect on the socioeconomic development, ecosystems, food production, water, agriculture and settlements (IPCC, 2007).

Temperature extremes

Episodes of extreme temperature can affect health significantly, and they present a challenge for health systems. Heat-waves have increased in duration and frequency, and severe impacts on public health have been observed across Europe. The temperature – mortality functions vary widely among cities across Europe, and usually show a v-shape. The threshold temperature is 29.4 °C for Mediterranean cities and 23.3 °C for northern European cities (Fig. 3). The estimated overall change in all natural mortality associated with a 1°C increase in maximum apparent temperature above the city-specific threshold was 3.12% (95% credibility interval _ 0.60% to 5.72%) in the Mediterranean region and 1.84% (0.06% to 3.64%) in the north-continental region. Stronger associations were found between heat and mortality from respiratory diseases, and in the elderly (Baccini et al., 2008 and WHO, 2009).

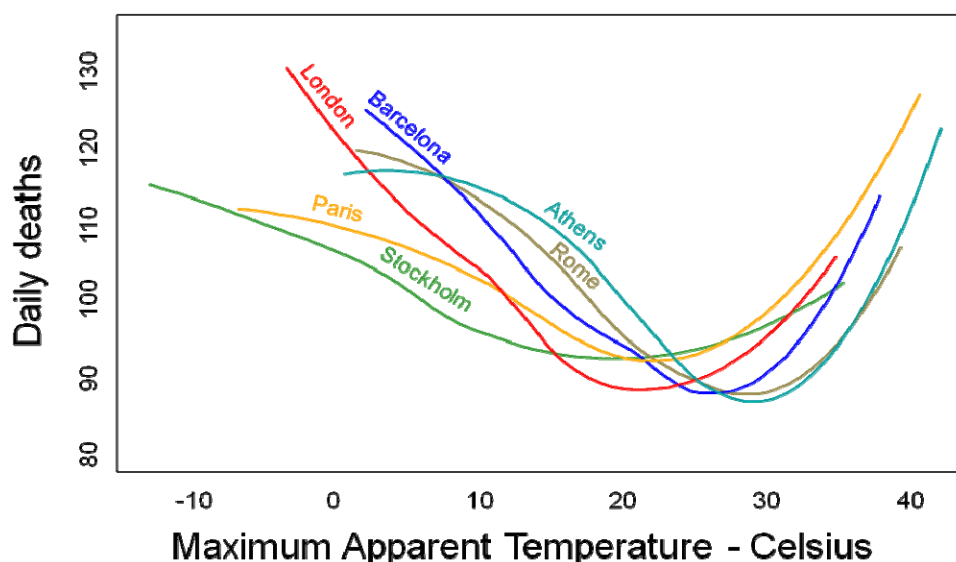


Fig. 3 – Temperature-mortality relationship in Several European cities. *Source: Baccini et al., 2008*

Evidence had shown that patients suffering from chronic diseases were more likely to die during heat-waves than during normal weather patterns. It was also important to note that in some countries in Europe, socio-economic inequalities could increase the risk of dying from

heat. The most recent major heat-wave occurred in the Russian Federation during the summer 2010, with severe wild fires exacerbating the overall situation (Box 1).

Box 1: Heat-wave, wild fires and mortality in the Russian Federation in summer 2010

In summer 2010, the western part of the Russian Federation experienced extreme heat: high temperatures exceeded the long-term average norm by more than 5°C, lasted over one and a half months and affected over 101 million people. Moscow, for example, experienced an unprecedented wave of continuous heat for 53 consecutive days, with unusual average daily maximum temperatures of approximately 30,8°C. The heat broke 19 daily average temperature records, dating back to weather observations since 1885. The health risks were exacerbated through severe and extensive wild fires that accompanied the heat-waves from the end of July, favoured through the anomalous weather conditions. More than 20,000 forest fires over an area of 2800 km² were recorded and the Russian Federation authorities reported high concentrations of carbon monoxide and particulate matter. Exposure to particulate matter is one of the main public health threats from short-term exposures to wildfire smoke (WHO, 2010b). In particular, fine airborne particles (PM_{2.5}) penetrate deep into the respiratory tract and may cause a whole range of health problems, such as aggravation of pre-existing respiratory (e.g. asthma) and cardiovascular diseases. Exposure to particulate matter can cause persistent cough, phlegm, wheezing and difficulty in breathing. Particles can also affect healthy people, causing respiratory symptoms, transient reductions in lung function and pulmonary inflammation.

Based on official monthly governmental reports (the Russian Federation's State Statistical Service -www.gks.ru), a preliminary assessment of heat-wave effects on mortality was carried out. The analysis showed that cumulative excess deaths in July and August of 2010 amounted to 54,000 compared to the same period in 2009. The relative increase in monthly total mortality rates was 50-60% in some regions. In Moscow, the first half of the year 2010 was characterized by lower mortality, compared with the same months of 2009. Yet, in July and August of 2010 it increased by 11,000 deaths (an increase of 60% compared to 2009). It included 5,951 deaths from cardiovascular diseases, 339 deaths from respiratory diseases and 101 deaths from suicide (Revich, 2010 and 2011).

In the affected areas of the Russian Federation, the population was advised to stay indoors and if possible in air-conditioned rooms with adequate particle filtration. When going outside and when exposed to higher concentrations of particulate matter, facemasks were recommended for protection.

It is important to note, however, that although global temperatures are increasing, extreme cold weather events are not disappearing. In the WHO European Region this is of particular concern. Winter mortality in Mediterranean countries is higher than that in northern European countries, and deaths often occur several days or a few weeks after the coldest day of any cold period (Table 1).

	Mediterranean Region	North-Central Region
	% increase (95% CI)	% increase (95% CI)
Total mortality		
Random pooled estimate	1.6 (1.4, 1.8)	1.1 (1.0, 1.3)
Fixed pooled estimate	1.6 (1.4, 1.8)	1.2* (1.0, 1.3)
CVD mortality		
Random pooled estimate	2.3 (2.0, 2.6)	1.4 (1.2, 1.6)
Fixed pooled estimate	2.3 (2.0, 2.6)	1.4 (1.2, 1.6)
Cerebrovascular mortality		
Random pooled estimate	2.0 (1.4, 2.7)	0.9 (0.5, 1.3)
Fixed pooled estimate	2.0 (1.4, 2.7)	0.9 (0.5, 1.3)
Respiratory mortality		
Random pooled estimate	2.8 (1.6, 4.0)	3.7 (2.9, 4.4)
Fixed pooled estimate	3.0* (2.3, 3.7)	3.9* (3.4, 4.3)

Table 1: Percentage increase of daily mortality (all ages) for a 1 degree decrease of temperature registered in 7 and 8 cities of the Mediterranean and the North-Central Region, respectively, from October to March.

Source: elaborated from Analitis et al., 2008

Flooding

The European Environment Agency (EEA) estimated that between 1998 and 2002 100 flooding events occurred accounting for about 700 deaths in Europe, with the displacement of about half a million people and an estimated €25 billion in insured economic costs (WHO, 2010). It is projected that the effects of future climate change is likely to increase precipitation pattern. The immediate health impacts of flooding are tangible – death, injury, infections – but the health effects of displacement, destruction of homes, and longevity of recovery and water shortages are less visible and more complex (WHO and HPA, forthcoming). A whole set of measures for the preparedness for and response to flood events are know and implemented – in different ways and to varying extent – across the WHO European Region. However, in view of climate change, current measures available might have to be revised and/or intensified.

Economic costs and benefits

The Projection of Economic impacts of climate change in Sectors of the European Union based on bottom-up Analysis (PESETA) project anticipates that the value of excess deaths is estimated at €50 billion annually (when valuing each excess death) and €120 billion (when valuing the loss of a year of life), in 2080. The greatest impact anticipated are in Central and Southern Europe (Ciscar, J.C. et al., 2009). More information on the damage costs and adaptation costs for human health are required, to help to guide the planning and decision-making process.

In conclusion, health impacts of climate change related changes in extreme weather events can be observed in the WHO European Region today. Those health impacts can largely be prevented through improved preparedness and response planning. The WHO Regional Office for Europe is planning to publish and update, respectively, public health preparedness and response handbooks that aim at offering guidance to Member States on the development of respective plans and measures. Experts are consulted on the draft handbooks for cold waves and floods as well as the published guidance for the development of heat-health action plans (Matthies et al., 2008) during the meeting.

Activities by the German Federal Environment Agency (UBA) on adaptation to climate change

Dr Hans-Guido, UBA

In Germany, the Federal Environment Agency (UBA) has invested a high level of resources in developing measures to address the issue of climate change and public health, in particular through establishing the national Competence Centre on Climate Impacts and Adaptation¹, which created a catalogue of climate change and health data that is and will be used by all decision-making bodies. A climate change adaptation plan has been developed, including measures such as awareness-raising at both national and local levels. The plan involved 15 sectors, including health, and included a database for sharing the information between stakeholders, rapid alert system and climate change guide for small and medium-sized businesses, which provides advice on issues such as pest control, the health impacts of organisms such as pollen, and adaptation measures. A national conference on the impacts of weather extremes was held in September 2010 in which the need to optimize appropriate adaptation measures was discussed. It was agreed that it is vital to learn from the experiences of the heat health warning system and to establish further early warning systems.

UBA set up a pilot study to discuss the effectiveness and efficiency of the health-related measures and their role in society in Germany. Therefore, an analysis of the heat

¹ (KomPass;
http://www.anpassung.net/cln_117/nn_700710/DE/Service/ueber__kompas/ueber__kompas__node.html?__nnn=true)

health warning system and UV index was carried out, using data from a survey in Lower Saxony (Augustin et al., 2010). The study was implemented for three key sectors of the population: nursing homes, kindergartens and elderly people living in single households. The heat-health warning system was well-received by some nursing homes, and were interpreted as a principally appropriate instrument for health-related adaptation. Although, for example 55% of 213 nursing homes felt that the alerts were unnecessary as they would have taken the precautionary measures anyway, because of the prediction of the weather forecasts from the media. However, in single households, the system was relatively unknown. The key challenges remaining for further initiatives are how to ensure that the information reaches people, which communication media to use and how to ensure the recipients change their behaviour on receiving the data. Additionally, the perception of early warning information on UV radiation, using UV indices, was studied in 157 kindergartens. Concerning the UV index, the results showed that nearly half of the kindergartens (~ 47%) did not know anything about this index, and about 48% felt that the UV index is difficult to understand and they are unsure how to use the information (Fig. 4).

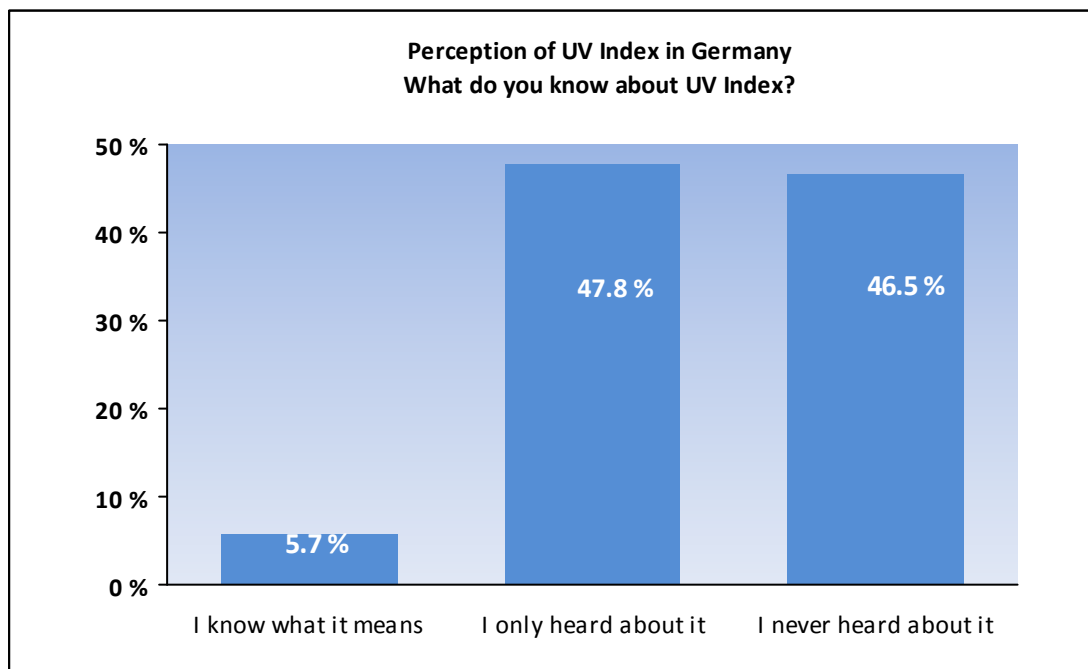


Fig. 4 – Graph showing the extent that those questioned were familiar with the UV index (Source: Augustin et al., 2010).

PUBLIC HEALTH PREPAREDNESS FOR AND RESPONSE TO EXTREME WEATHER EVENTS FROM NATIONAL AND INTERNATIONAL PERSPECTIVES

During the meeting, participants were divided into six working groups: three national working groups, and three international working groups. The working groups met twice during the meeting and subsequently reported on their discussions in plenary. The working

groups focused on different subject areas and, thus on the different draft handbook documents that were prepared and provided to participants prior to the meeting. The national working groups met to discuss both the situation in Germany and the draft handbook and were divided as follows: thermal load, wind and water, and ozone and air quality. The international working groups only discussed the draft handbooks and were divided into groups based on those documents: heat-waves, cold-waves and floods and storms.

The national working groups were provided with a series of questions to focus on and discuss. Those questions were as follows:

- What are the (potential) risks for health?
- What are the risks in Germany and how serious are they?
- In which area is acute need for action?
- Which established structures are effective? Where are changes needed?
- Where are (specific, acute) gaps of knowledge?

The objectives of the discussion within the international working groups were:

- To review and improve the draft handbooks for flood and cold public health prevention; and
- To update and improve the guidance for the development of heat-health action plans.

The expected final outcomes of the discussion were a public health preparedness and response handbook, both for floods and for cold winters and cold-waves as well as an updated heat-health action plan guidance document.

Background documents and draft handbooks

Protecting human health from cold and extreme cold events

Definitions of cold and extreme cold vary depending on the region or climate zone. For example, an extreme cold event in southern Europe would likely be seen as normal for countries in northern Europe. Extreme cold events can have a number of significant impacts on human health, and can depend on a number of factors: the length of the cold spell; the rate of temperature change; and other weather-related factors such as air quality, humidity or wind. Cold exposure can result in various cold-related diseases, typical symptoms and complaints as well as injuries and accidents (as summarized in figure 5), including circulatory changes, respiratory and cardiovascular problems. Cold-related adverse conditions outdoors can lead to more injuries through slips and falls.

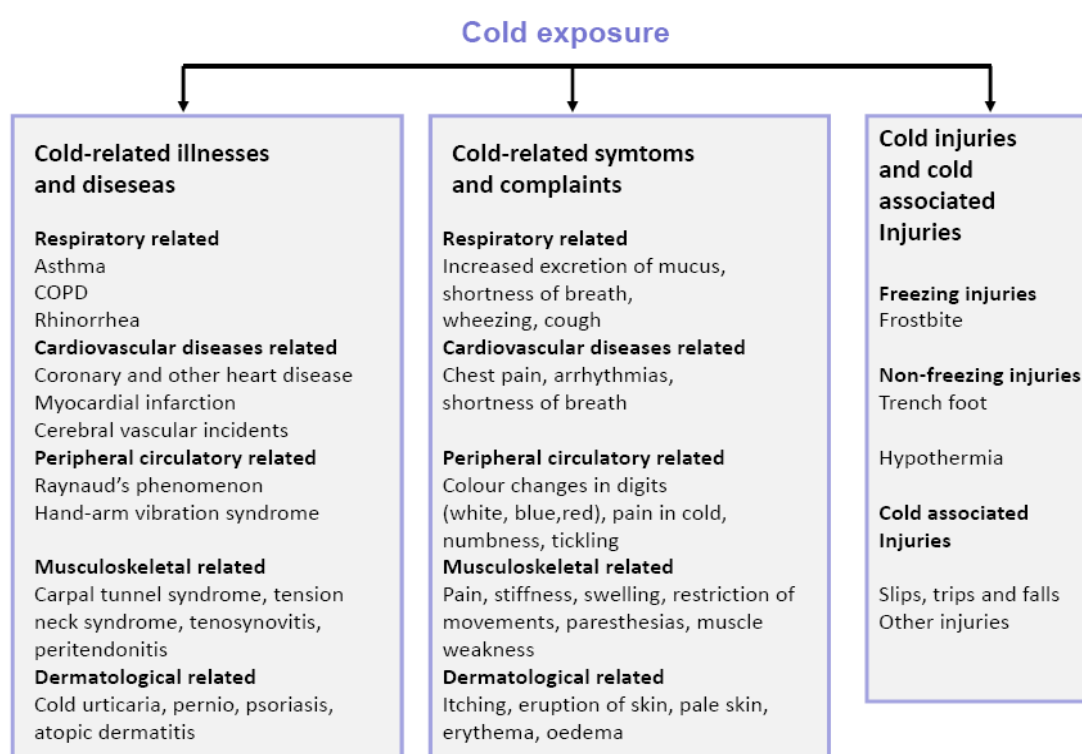


Fig. 5 – The effects of cold exposure on human health (Source: Mäkinen & Hassi 2009).

Population groups that are particularly vulnerable to extreme cold events include the elderly; infants, children and teenagers; people with chronic diseases or physical or mental limitations; and those with a lower socioeconomic status, such as the homeless. The impact of cold weather on the health sector includes effects on hospital and emergency services, primary care, mental health care services, health protection and immunization campaigns, and community and social care.

Many of the impacts of cold weather on health are preventable, whether by individual action, or action by health-care professionals or governments. Individual actions include wearing appropriate clothing for the weather, consumption of hot drinks and meals, and ensuring that elderly people or other vulnerable individuals in the area do not need to go outside and that their indoor conditions are safe (i.e. warm enough). At local and national levels, early warning systems and awareness-raising campaigns are vital. Other actions include risk assessment at workplaces, assisting vulnerable population groups, and providing guidance and collaborating with a range of other institutions and sectors such as social care, the educational sector or the transport sector.

Heat-Health Action Plans Guidance

The Heat-Health Action Plans Guidance was first published by WHO Regional Office for Europe in 2008 (Matthies et al., 2008). It contains guidance for countries on the development of health-related action plans to address the impacts of extreme heat events.

The impacts of heat-waves on public health are dependent upon the level of exposure (frequency, severity and duration of the heat-wave); the size of the population and the population sensitivity. Health effects can occur in all age groups, however, there are a number of population groups that are particularly vulnerable to the impacts of heat-waves, including the elderly, infants and children, people with chronic diseases, people taking certain medications and people with lower socioeconomic status. The impacts of heat-waves can include dehydration, heatstroke, increased air pollution, and exacerbation of pre-existing conditions. The health impacts of heat-waves can include dehydration, heat exhaustion and heatstroke, exacerbation of pre-existing health conditions and respiratory problems due to increased air pollution.

Public health prevention requires a portfolio of actions at different levels: from health system preparedness coordinated with meteorological early warning systems to timely public and medical advice and improvements to housing and urban planning. These actions can be integrated in a defined heat–health action plan. There are several common principles in emergency planning that can be followed when planning for and responding to heat-waves. Examples of these principles include using existing systems, using a long term approach and evaluation mechanisms. Eight core elements for the structure and implementation of a heat health action plans have been identified, including alert systems, a communication plan, measures for the reduction of exposure and care for vulnerable population groups. Long-term measures focus on housing and urban planning.

The suggested core elements as well as the specific actions and measures described in the guidance booklet need to be reviewed and improved, updated and expanded as deemed appropriate following the review and discussions at the meeting.

Guidance Plans for the Health Impact of Flooding

Flooding can have a number of significant immediate and long-term impacts on human health. The immediate impacts include death, infection and injury. The long-term impacts are often less visible, such as psychological impacts, the disruption of health-care services, the destruction of homes, water shortages or contaminated water supply and displacement.. There are a number of population groups which are particularly at risk from the impacts of flooding, including the elderly, the young, those of lower social or economic status, and those suffering from chronic diseases.

There are a number of actions that can be taken to help prevent, or at the very least alleviate, the effects of flooding. At the governmental level these can include taking steps to reduce climate change, not building on flood plains, coastal management and sustainable land management. Multisector involvement is vital to ensure the success of preventative measures such as early warning systems, evacuation plans and the building of flood defences. From the perspective of the health sector, key activities such as the protection of health infrastructure, awareness-raising and communication campaigns and public health measures such as ensuring the provision of clean drinking-water after a flood, were vital. Continuous provision of health care and treatment during and after the flood and assisting the clean-up operation and reducing the length and level of disruption are the two most important long-term required actions. A broad and long-term approach ensures effective preparedness for flooding should include measures related to the built environment, land use and other sectors.

The development of international handbooks and examples and experiences from Germany: working groups results

There were six working groups: three national groups and three international groups. The national working groups held discussions on both national issues and the draft handbooks, while the international groups focused solely on the draft handbooks. Comments from both sets of groups on the draft handbooks are included in the relevant sections, while Germany-specific reports are contained in separate sections. The questions addressed in each of the working groups are listed above.

Air hygiene and UV radiation in Germany

The working group on air hygiene discussed two main issues: ozone pollution and ultra-violet (UV) radiation. Ozone-related health issues affect almost 10 to 15% of the population in Germany (Wagner und Höpfe, 1998). There is a significant need for further research on long term impacts of exposure to ozone and on understanding the impacts of the low level exposures on the incidence and prevalence of chronic diseases. With regard to levels of UV radiation, further study is required of the impacts of exposure to high and increasing UV radiation levels. One known impact of over-exposure to UV was cancer; however low levels of vitamin D were also known to cause other health issues, such as heart attacks. Since

the main source of vitamin D production is the sun's rays, research into safe levels of UV exposure is still necessary. Furthermore, the amount of UV radiation needed for life and how UV will change in future as a result of climate change should be incorporated into climate models. Quantitative data on the components of air is needed in addition to pre-existing qualitative data. In addition, the WHO Air Quality Guidelines (2005) might provide helpful background information for the development of early warning systems for forest fires and air pollution episodes that might cause health impacts in exposed individuals.

Other key aspects that require improvement are networking and communication at the national and international level. It is important that national-level programmes be linked at ministerial level, while at the international level coordination with international organizations and cooperation with the European Commission Directorate-General Environment, Health, Research and Development and the Joint Research Centre, is essential in order to prevent duplication of work and save valuable financial resources. One way to promote this coordination and collaboration would be to establish accessible share points for databases of information that all interested parties could access. It is also important that models and forecasts are maintained and kept up-to-date. Further development of messages and advice for the public is also required. Information and advice on levels of air pollution could be communicated to the public in a similar way to weather forecasts. In order to do this, indices would have to be developed that were easy to understand and easy to record.

Issues and questions raised during plenary session

How could the issue of air quality and climate change be addressed?

There is evidence for the link between air quality and climate change-related weather phenomena (e.g. heat-waves (WHO, 2009)). All research on the issue was funded by public funding or institutions, and it was suggested that all data should be registered in a way that makes them internationally accessible (e.g. for external verification). The German KomPass system could potentially be adapted to the international level in order to avoid duplication of work.

Public health preparedness for and response to extreme events in relation to wind and water in Germany

The national working group on wind and water had discussed events such as heavy precipitation, flash flooding and severe storms. In Germany, there is limited scope for experiencing severe storms; however it is important to note that lessons could be learned from those countries that did experience such phenomena. For example, health hazards, such as the risk of drowning, should be included in all flood action plans. Further information on the discussions of this group is included in the section on the public health handbook for flood prevention section below.

Issues and questions raised during plenary session

Were there any data available on the psychological impacts of flooding?

There is increasing documented evidence for psychological effects of flooding, including long-term mental health effects and a reasonable amount of evidence-based data are being made available in the WHO/HPA background document on health impacts of floods. However, for Germany no empirical data were available and a need for more evidence-based data and case studies on the mental health impacts of floods (including long-term impacts) to be published in order to contribute to the understanding of the issue and improve public health preparedness and response was identified.

Public health preparedness for and response to extreme thermal loads in Germany

The national working group on thermal load focused on several main issues. First, with regard to assessment of the impact of different temperatures on people, it was suggested that more information on the weather conditions should be included. This meant that analysis would be most successful if models were used that include all physiological relevant meteorological parameters instead of temperature alone and heat flows between the atmospheric environment and the human body were taken into account. Definition and analysis of risk factors should be based on diseases that are known to be linked to heat and that are mentioned in various WHO documentation on the subject. Furthermore, health risks should include social and economic aspects, as they are known to be linked to health. It is also vital to encourage people to change their behaviour.

Most of the discussion was structured around two main overarching questions:

- 1) How has the immediate response to heat-waves looked like in terms of public health and what can it look like?
- 2) How does overall planning (e.g. building codes, urban design ...) need to consider and include the projected increase in frequency of heat-waves?

Potential risks in Germany were discussed in this framework, taking into account both the current climate situation and projected climate change. Europe is expected to experience longer, more intense and more frequent heat-waves over the coming years. Therefore, analysis of the impact of heat on health is recommended to take such changes into account. Also, it is important for urban planning to consider these developments with regard to heat and heat-waves in order to improve urban environments for these conditions. Finally, it is essential to evaluate measures with regard to their overall effectiveness, as well as their efficacy in avoiding mortality and morbidity from extreme hot or cold events, particularly through reaching at risk population groups but also through advising the general public and improving their well-being.

The communication of heat warnings and advice from the German meteorological service needs to reach all target groups. Teaching of communication skills needs to be included in professional training for health professionals and other relevant occupations, such as teachers. Well designed communication strategies can help to raise awareness of climate change effects and effective adaptive measures.

Issues and questions raised during plenary session

What should be done to help those who are unable to take preventative measures by themselves?

Reaching vulnerable populations was often one of the most difficult aspects of preventive measures. For example in the former Yugoslav Republic of Macedonia, it was explained that providing advice for the Roma population was particularly difficult as even the written Roma language was not widely used. Therefore, nongovernmental organizations are instrumental for this work as they are able to provide information using a personal “door-to-door” method. However, it is clear that different methods are required in order to reach the different vulnerable population groups in different contexts and that advice needs to be tailored to the requirements of specific patient and at risk groups.

Guidance for the Development of Heat-Health Action Plans

Discussion of the Guidance for the Development of Heat-Health Action Plans had focused on elements that were missing from the document published in 2008 (Matthies et al., 2008) and the lessons learnt from using the document in a number of Member States of the WHO European Region. The document provided useful guidance for the development of national plans, for example in Croatia (draft plan available) and the former Yugoslav Republic of Macedonia (Action plan piloted in summer 2010), but there are a number of issues that needed to be updated. It had been agreed that three key areas of the document required further development:

- Risk factors;
- Education and communication;
- Requirements for standards for measures and reporting;

Current gaps in research were discussed, and a list of areas that require further study has been compiled (please see below for more details).

Risk factors

Further information on socioeconomic risk factors was required within a new edition of the guidance document so that socioeconomic factors can be taken into account when preparing an action plan for heat-waves. The document is also lacking in detail on heat-related illnesses and the biological mechanisms of conditions that increase the risk of heat-related illness.

A framework for a risk assessment system, which takes into account and assesses the level of risk for different population groups and provided advice on the interventions required for each

case will be developed for the new edition of the guidance document for heat-health action plans. This framework will be added as an additional information sheet to the annex.

Education and Communication

Education and communication are key elements for any heat-health action plan. Education materials on the issue could be introduced in schools. Furthermore, it is important to analyse how useful the information provided to different population groups actually is. This will allow the development of group-specific materials, helping to ensure that the key messages reached the right people. The guidance document should therefore include suggestions for specific population groups. For medical professionals, for example, it could suggest that heat-related issues be added to the training curriculum. Simulation exercises are a useful tool to ensure that measures were implemented fully and advice was understood. These exercises help to identify gaps and ensure that the measures were sufficient. To improve the annexed information sheets, sheets tailored to specific target audiences such as migrants, outdoor workers and tourists should be added.

Requirements for standards

International standards need to be developed for measures in two areas:

- a) Monitoring and evaluation, showing the pros, cons and limitations of measures to allow using the guidance document to make informed decisions on which indicators to use when analysing the success of such action plans; and
- b) Treatment protocols for practical activities, for example on cooling of patients during heat-waves.

Suggestions made with regard to the requirements for standards do not preclude pre-existing standards, such as occupational health and safety standards. They rather were required to work in conjunction with the pre-existing standards and it was stressed that existing standards need to be mentioned in more detail in the updated document and that proposed and existing standards need to work concurrently.

Gaps in research

Further research into the impacts of heat-waves would be useful in, *inter alia*, the following areas: socioeconomic differences; younger age groups; reproductive issues; heat-waves and suicides; geographical differences; the short and long-term effects of heat-waves; the economic costs; and the usefulness of face masks in the event of high air pollution.

Lessons learned

The current guidance document is a good document that has worked well and provided useful guidance for the development of heat-health action plans since it was published. In particular, the structure of the document, with its focus on emergency response, vulnerable populations and flexibility, has been instrumental in its success. However the document still requires further development.

Specific suggestions on how to improve the document included: more guidance on responses to heat-waves; case studies on the use of the guidance document, including how the guidance was applied to specific action plans; and information on the levels of effectiveness of the plans.

Cold weather prevention: a public health handbook

Members of the international working group on cold spells discussed two documents during their meeting. The first was the technical background document on the impact of cold on health, and the second, the draft toolkit entitled “Cold weather prevention: a public health toolkit”. The background document provides solid and accurate information on the impacts of cold weather on health and is an important source of information. The discussions of the draft handbook focused on two issues: points that require amendments and areas that required further discussion and development.

Proposed amendments to the draft handbook

Ideally, the handbook document should be shortened substantially. One suggestion was to use hyperlinks in the online version, in order to maintain access to all of the information. The health sector was confirmed as the target audience, taking influence on other sectors involved in the protection of the population during cold-waves. In addition, it was suggested for the document to be renamed as an information pack or handbook, rather than a toolkit as the main objectives of the document is to identify and define prevention measures and assist users in identifying any gaps in their health response system rather than describing specific methodologies (which in fact need to be tailored to the respective national or regional context). The proposed title was “Information pack to prevent the impacts of the cold seasons and cold spells”. It is important to build on pre-existing public health response systems for both long-term and emergency planning, as the current systems are a solid basis for additional work and this would avoid any duplication of efforts. Normally, national planning is required to address two events: cold seasons in general and extreme cold weather events. To ensure that this would be successful, the importance of networking, at the international, national and local level, was emphasized. It is also vital that the document has a public health perspective and includes suggestions of collaboration activities with other sectors, such as housing, energy, local government and social services. The main objective of public health measures includes improving the overall awareness in the population apart from targeting the most vulnerable population groups. The annexed information sheets need to be reviewed and adjusted so that they do not state the obvious and messages are short and clear. As additional information a sheet addressed to emergency services.

Areas for further discussion

Three key issues in the document were identified that require further discussion. First, the need to evaluate the prevention measures to ensure that they are sufficient, particularly those warning systems and prevention measures aimed at specific subgroups. Second, the information and advice in the document on how to handle emergency situations such as power

failures during extreme cold events. Third, it is vital that information sheets with key public health messages are finalized for use as soon as possible.

A public health handbook for flood preparedness and response

A number of consensus points had been reached in the discussion of the draft flood handbook and some areas require further work and discussion.

Consensus points

It is vital that the health sector be included as a key actor and play a prominent role in any planning and delivery of flood prevention strategies, using the WHO ‘all-hazard approach’ as a basis.

A new, more pragmatic and usable definition of flooding is required in order to increase the efficiency and effectiveness of the document and the measures contained therein. The following definition was proposed: “A flood is an increase of water that has a significant impact on human life and well-being”.

A new title was suggested for the draft document: “Planning for health and flooding: a handbook”, as the word toolkit does not accurately reflect the contents of the draft document. Furthermore, participants advocated the use of concepts, such as vulnerability, resilience and prevention, in the document. The technical background document was a vital evidence base for the handbook and therefore it would be welcomed if it was published as an annex to, or alongside, the final version of the handbook.

Areas of further work and discussion

The handbook needs to aim at describing increased collaboration with other sectors; information sheets for emergency planners are important additional annex to the document. Similar information sheets would also be essential in the heat guidance document and the cold handbook. Furthermore, as the documents are ‘living’ documents, and the information and advice contained in them could evolve and change based on new research, it was suggested that the documents be subject to a biennial revision cycle in order to update the information and identify any gaps.

Participants had identified two key research gaps in relation to flood preparedness and response: a) the long-term effect of health impacts on those who have been victims of flooding and b) a standardized method for documenting all hazard events and collecting data, in order to facilitate data comparison and information sharing.

From a national perspective, it was pointed out that the handbook for planning for health and flooding contained many similar aspects to the German flood action plan, however in general there is a distinct need for further research into optimizing weather forecasts, as well as a need to establish empirical data for health hazards. Moreover, with regard to targeting at-risk groups, it is important that more work should be done to identify those

groups, ensure that those groups can be and are being reached, and work in conjunction with emergency services to develop an assessment system for at-risk groups.

GENERAL ISSUES AND QUESTIONS RAISED DURING PLENARY

Common factors and issues between the different public health handbooks

It is important to look at the common requirements and elements of all handbook documents. A holistic approach is vital for emergency planning; taking into account the different factors that could affect public health during emergency situations. This would also be in line with the WHO all hazard approach. Climate change has, and will continue to have, a significant effect on public health, particularly through extreme weather events. However, it is important to recognize that the seriousness of effects is determined by other factors, such as land-use planning, housing, all hazard preparedness planning, etc.

Inclusion of targeting activities in the handbooks

Planning for extreme heat events needs to contain elements focusing on specific high-risk target groups. The planned activities would require specific and precise measures to ensure that the target groups are reached successfully.

In order for the plans to be effective, only a few high-risk groups can be targeted, rather than providing blanket advice for all groups. Although there was general consensus on this issue, it was pointed out that some high-risk groups are extremely large and the general advice provided would be sufficient to provide accessible and usable information and guidance. However, some patient categories face specific issues, such as bed-bound patients who require daily care.

A scoring system for diseases has been developed in Italy using risk factor analysis. The system has provided a list of chronic diseases that cause increased risk during extreme weather events. This list and the socioeconomic situations of patients are taken into account when targeting groups and patients. The United Kingdom has also developed a system working with general practitioners and using communication media such as text messaging. The system means that health professionals can have instant access to information on at-risk patient groups. Similar systems using text messaging, the internet, telephone and e-mail have also been developed in other countries, such as Germany and Finland. However, it is important to note that interventions will vary from country to country. It was also highlighted that the system used in the United Kingdom relies on patients being able to act on the advice that they were given.

Are droughts taken into account in the handbooks and national planning, particularly with regard to water quality?

Although it was agreed that droughts were not the immediate key impact of heat-waves, a question was raised regarding the inclusion of factors such as water quality and power supply in the guidance document. Issues such as power failure as the result of low river

flows are taken into account in planning for extreme weather events in Germany, for example. Drought and water treatment have also been discussed with regard to the flood handbook. It was suggested that these issues were also included in the Heat-Health Action Plan in order to prepare contingency plans to address such eventualities. A key problem with the wild fires in the Russian Federation during 2010 was that plans might need to be upgraded to cope with such a scale of fires.

How can the results of the discussions and proposals be integrated into the WHO all hazards approach?

The WHO all hazards approach is a very useful tool. It could be expanded to taking into account more risk factors. The main issues with the approach are communication, with both stakeholders and vulnerable groups, and information sharing, which could be improved through the development of a communication and information strategy for stakeholders with regard to risk factors. However, information and data are not easily available and often information is recorded in different formats across countries. A standardized system would facilitate and ensure that all stakeholders could access the relevant information and plans.

The European Community is in the process of developing a European clearing house to allow the sharing of knowledge and data related to vulnerable population groups, vulnerability assessments, good practices and adaptation activities, which would be available during 2012. However, further assistance from European Union (EU) member States is required to ensure that the data is provided in a timely manner and that information on the clearing house is disseminated to the relevant stakeholders and users. Regarding the integration of non-EU but WHO Member States into the clearing house, it was explained that for the eastern European WHO member States, WHO is working in conjunction with the European Centre for Disease Control and the European Environment Agency to establish a framework for action on inter-agency collaboration in order to facilitate information sharing between Member States.

CONCLUDING DISCUSSION AND NEXT STEPS

The discussions held during the meeting had been extremely useful and interesting, particularly the feedback from the different working groups. It was agreed that

- ✓ Early warning systems for extreme weather events are vital to ensure action can be taken.
- ✓ Both the public and health-care professionals require further education and information on what action needs to be taken and how to use the information provided by such systems. As discussed in previous meetings and described in earlier documents, education of health-care professionals is suggested to be extended to include the effects of extreme weather events on human health and how to address them.

- ✓ Collaboration with other sectors, such as construction, education and housing is important to be enhanced.
- ✓ It is vital that the needs of different countries are communicated to the programme Climate change, greening health services and sustainable development (CGS) at the WHO Regional Office for Europe and to other sectors and relevant stakeholders within the countries Member States might want to consider adjusting their health-care systems and infrastructure to take into account the guidance provided in the draft handbooks.
- ✓ Information sheets are important tools for emergency planners and they need to be drafted and/or updated as soon as possible.
- ✓ Estimating the economic costs and benefits of the implementation of action plans for extreme weather events is still scarce and needs to be addressed.

Next steps

WHO will be taking the following steps:

- ✓ The cold and floods public health handbooks will be amended to take into account the suggestions made during the meeting, and final draft versions distributed for comment at a later date.
- ✓ All information sheets will be reviewed, revised and made available for comments.
- ✓ The Guidance for the development of heat-health action plans will be updated and the final version distributed for comment at a later date.
- ✓ A conference will be held during 2011 to discuss the economic costs of climate change and to develop tools to allow estimation of the costs of health-related damages caused by climate change and subsequent health-related adaptation measures.
- ✓ Partnerships will be strengthened through active networking and collaboration.
- ✓ Member states will be supported in developing and implementing early warning systems and preparedness and response action through technical advice and capacity building.

Closure of the meeting

The Chair pointed out that it had been a challenge to have both national and international working groups working alongside each other on the different extreme weather events and respective public health preparedness and response issues. The results of all the discussions, however, were very encouraging. In order to develop successful action plans and

to make the best use of existing knowledge and best practices, it was vital that national and international viewpoint were interlinked. The meeting represented a significant step forward in that regard.

The meeting was formally closed and all the participants were thanked for their valuable contributions.

REFERENCES

- Analitits, A. et al. (2008) Effects of Cold Weather on Mortality: Results from 15 European Cities within the PHEWE Project. *Am. J. Epidemiol.* 168 (12): 1397-1408
- Augustin, J., Paesel, H.K., Mücke, H.-G., Straff, W. (2010): Erste Ergebnisse einer Untersuchung von gesundheitlichen Anpassungsmaßnahmen an den Klimawandel am Beispiel des Hitzewarnsystems und UV-Index. Vortragsabstrakt anlässlich der 4. Jahrestagung der GHUP 2010 in Aachen; *Umweltmed Forsch Prax.* 15 (Nr.5), S. 250-251, 2010
- Baccini et al. (2008) Heat effects on mortality in 15 European cities. *Epidemiology*, Vol 19, No 5, pp 711-719.
- Ciscar, J.C. et al (2009). Climate change impacts in Europe. Final report of the PESETA research project. 2009. Available at: <http://peseta.jrc.ec.europa.eu/>
- Confalonieri U et al (2007). Human health. In: *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, 2007.
- EEA, JRC, WHO (2008). Impacts of Europe's changing climate – indicator-based assessment. Available at: http://www.eea.europa.eu/publications/eea_report_2008_4
- German Federal Environment Agency (UBA), Germany (2009). *Klimawandel und Gesundheit: Informations und Ueberwachungssysteme in Deutschland.*
- IPCC (2007). Fourth Assessment Report. *Climate Change 2007: Synthesis Report, Summary for policy-makers.* Intergovernmental Panel on Climate Change. Available at: <http://www.ipcc.ch/>
- WHO (2005) WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulphur dioxide: Global update 2005. Available at: http://www.who.int/phe/health_topics/outdoorair_aqg/en/
- Mäkinen TM, Hassi J. (2009) Health problems in cold work. *Ind Health.* Jul; 47(3):207-20
- Matthies F et al. (eds) (2008). Heat health action plans – a guidance document. WHO Regional Office for Europe, Copenhagen, Denmark. Available at: Available at: Available at: http://www.euro.who.int/_data/assets/pdf_file/0006/95919/E91347.pdf
- Revich, B. (2010). Heat –wave and mortality. No439-440; Available at: www.demoscope.ru
- Revich B. (2011). Heat–wave, air quality and mortality in the Russian Federation's Europe, 2010: Preliminary assessment. *Human Ecology*, 2011, No 3, in press (Russian)

van Engelen, A, Klein Tank, A, van der Schrier, G and Klok, L (2008). European Climate Assessment & Dataset (ECA&D), Report 2008, "Towards an operational system for assessing observed changes in climate extremes". KNMI, De Bilt, The Netherlands, 68pp.

Wagner, H.M. und Höppe, P. (1998). Anorganische Gase/Ozon. Handbuch der Umweltmedizin, Kapitel VI-1, S. 1-41. EcoMed-Verlag, Landsberg, Germany.

WHO (2009). Improving public health responses to extreme weather/heat-waves – EuroHEAT; Technical Summary. WHO Regional Office for Europe, Copenhagen, Denmark.

Available at: http://www.euro.who.int/_data/assets/pdf_file/0010/95914/E92474.pdf

WHO (2010a). Protecting health in an environment challenged by climate change: European Regional Framework for Action. WHO Regional Office for Europe, Copenhagen, Denmark. Available at:

http://www.euro.who.int/_data/assets/pdf_file/0005/95882/Parma_EH_Conf_edoc06rev1.pdf

WHO (2010b). Wildfires and heat-wave in the Russian Federation – Public Health Advice. WHO Regional Office for Europe, Copenhagen, Denmark. Available at: http://www.euro.who.int/_data/assets/pdf_file/0012/120090/190810_EN_Russia_wildfire_advisory.pdfalth impact for flooding (title to be confirmed)

WHO and HPA (forthcoming). Guidance plans for the he. WHO Regional Office for Europe, Copenhagen, Denmark

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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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The WHO Regional Office for Europe and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany, co-organized an international and national expert meeting with technical support from the German Federal Environment Agency (UBA) and the German Meteorological Service (DWD), to discuss the effects of climate change and extreme weather events on public health and the draft public health handbooks developed by WHO to address and prevent these effects. The main outcomes of, and recommendations from, the meeting are contained in this report.

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