WORLD HEALTH ORGANIZATION
EUROPE

Protecting HEALTH in Europe from climate change

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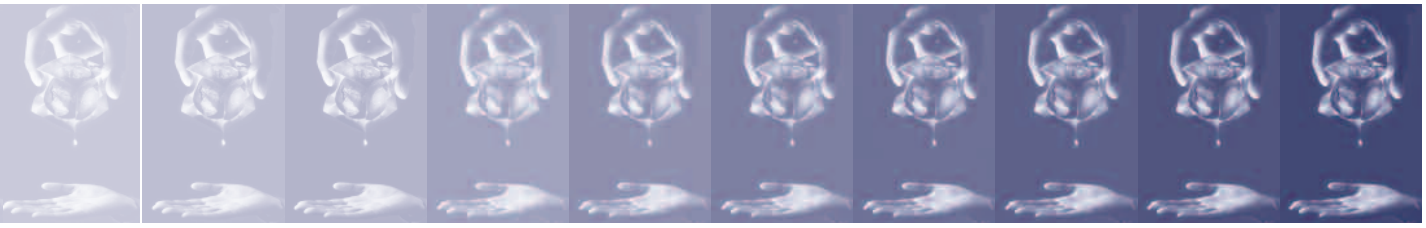

Editors: Bettina Menne, Franklin Apfel, Sari Kovats and Francesca Racioppi

ABSTRACT

There is now scientific consensus that climate change affects health through changing weather patterns (for example, more intense and frequent extreme events) and indirectly through changes in water, air, food quality and quantity, ecosystems, agriculture, livelihoods and infrastructure. The effects will be unevenly distributed, and the people at greatest risk include the poor, very young, elderly and/or ill. Climate change can also pose a threat to health security. Failure to respond could be very costly in terms of disease, health care expenditure and lost productivity. This publication intends to stimulate debate and support an active response by providing up-to-date information on the health effects, as well as practical guidance on specific actions that decision-makers at different levels in health and other sectors can take now.

As long as climate change is not too rapid or strong, many of the health effects can be controlled by strengthening health systems. This can include strengthening preparedness, public health services and health security, advocating action in other sectors to benefit health, better informing citizens and leading by example. Health systems need to strengthen their capacity to assess potential climate-related health effects, to review their capacities to cope, and develop and implement adaptation and mitigation strategies, and to strengthen a range of key areas of work – from disease surveillance and control to disaster risk reduction – that are essential for rapid detection of and action against climate-related risks.

Keywords
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RISK MANAGEMENT
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FOREWORD

There is growing evidence and scientific consensus that climate change is real. Over the past years, many countries across the WHO European Region have experienced increasing numbers of heat-waves, floods and/or droughts, which resulted in tens of thousands of deaths. Climate change has been related to the increasing frequency and severity of these events.

For the future, higher temperatures, sea-level rise, further melting of ice, snow and the frozen ground, as well as an increased number of drought, heat-wave and heavy precipitation events, are expected. These climate phenomena are expected to affect food productivity, water quantity and quality, air quality and the distribution of plants and animal species. These changes have already affected health and are likely to continue to do so. For example heat-, flood- and drought-related mortality and morbidity are likely to increase; changes in the distribution of plant species and animals are likely to contribute to changing ranges of infectious diseases and allergic disorders; and higher concentrations of ground-level ozone and particulate matter in urban areas increase the frequency of cardiorespiratory diseases. The populations in the Region considered to be at greatest risk are those living in big cities, mountain areas and water-stressed and coastal areas. In every country, regardless of the level of national wealth, people who are poor, very young, old or sick will be more at risk.

World Health Day 2008, dedicated to protecting health from climate change, provides an opportunity for everyone to place health at the centre of local, national and international dialogues, plans and actions related to climate change, by raising awareness of current and potential climate-related effects on health and highlighting the pivotal role that health systems can play in responding to this new challenge.

Critical in the years to come will be the capacity of health systems to develop and implement adaptation and mitigation strategies and to strengthen a range of key areas of work – from disease surveillance and control and research, to disaster risk reduction – that are essential elements of the capacity for rapid detection of and action to protect health from climate change.

Health systems also need to strengthen their stewardship functions and capacity to work with other sectors to promote policies beneficial for health, the environment and the economy directly and immediately. Savings from reduced health care costs of treating diseases related to climate change and lost productivity often match or exceed the costs of tackling the hazard itself.

By putting its evidence-based knowledge, credibility and capacity to advocate health with different actors at the service of action in national and international processes, the health sector can play an important, new and proactive role in protecting health from consequences of climate change. This publication addresses policy-makers in the health and other sectors at all levels of government. We at WHO hope that this summary of current knowledge on the links between health and climate-change-related events will help to identify opportunities to respond to this global challenge and to inspire action now.

Marc Danzon
WHO Regional Director for Europe

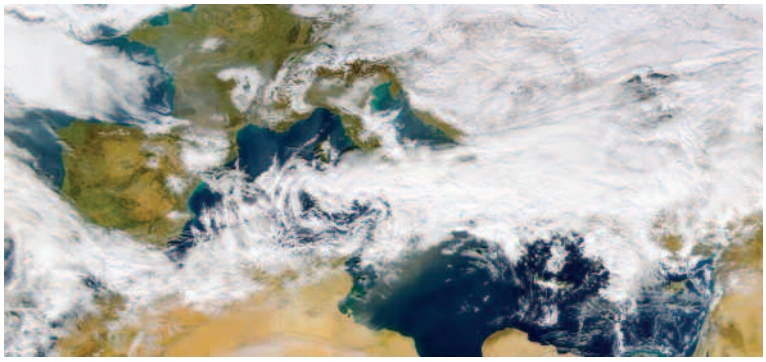
INTRODUCTION

There is now a strong, global scientific consensus that the climate is changing and that if current trends of global warming continue, rising temperatures and sea levels and more frequent extreme weather events (heat-waves, storms, floods, droughts, cyclones, etc.) could lead to severe shortages of food and water, loss of shelter and livelihoods, and extinction of plant and animal species *(1)*. In its fourth assessment report, the United Nations Intergovernmental Panel on Climate Change (IPCC) concluded that globally:

> The health status of millions of people is projected to be affected through, for example, increases in malnutrition; increased deaths, diseases and injury due to extremes; increased burden of diarrhoeal diseases; increased frequency of cardio-respiratory diseases due to higher concentrations of ground-level ozone in urban areas related to climate change; and the altered spatial distribution of some infectious diseases.

In the WHO European Region, many countries experienced major heat-waves, floods and droughts that have led to deaths and human suffering, social disruption and a substantial burden to health systems. Changes in the spatial distribution of some infectious disease vectors and changes in pollen seasonality have been observed *(2)*. Evidence is growing that some weather events will 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 *(1)*. These changes will affect socioeconomic development, affect ecosystems, food production, water, agriculture and settlements *(1)*.

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 *(2)*. These direct and indirect exposures can result in a variety of health impacts, as outlined in Fig. 1. Climate change is challenging health systems across the Region to address its immediate health consequences (adaptation), as well as to identify, advocate and implement effective mitigation strategies.[1]



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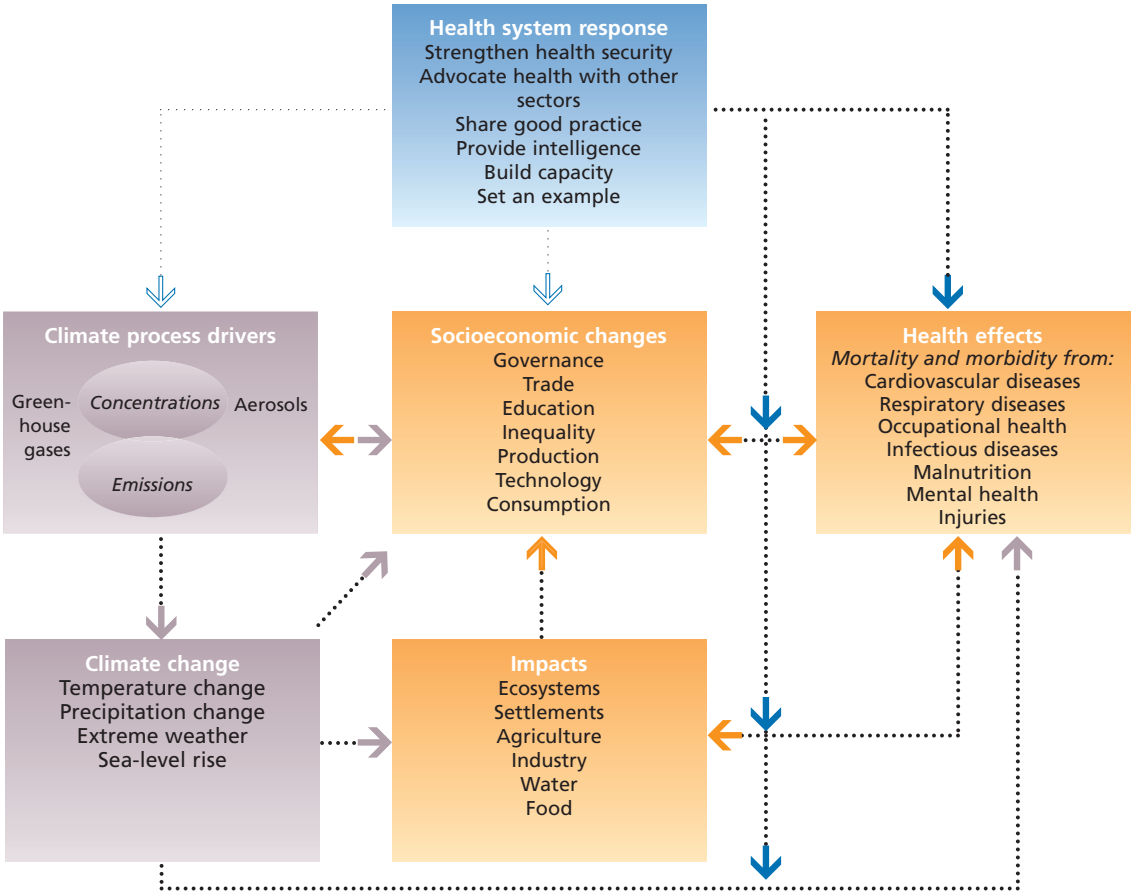
[1] In the terminology of the United Nations Framework Convention on Climate Change *(3)*, **mitigation** refers to actions that limit the amount and rate of climate change by constraining the emissions of greenhouse gases or enhancing their sinks. **Adaptation** refers to initiatives and measures to reduce the vulnerability of natural and human systems to actual or expected effects of climate change.

Fig. 1. The relationship between climate change, its drivers, effects on systems and socioeconomic development, health, mitigation and adaptation



Although climate change could have some short-term benefits for health in some parts of the Region, such as reduced winter mortality due to increases in temperature, most health impacts are anticipated to be negative and profoundly worsen if current accelerating trends continue unabated *(1,2)*.

This publication focuses on the current and projected health effects related to climate change and on the challenges they present to health systems in the WHO European Region. It provides up-to-date information and practical guidance on specific actions that can be taken now, at different levels, to protect health from climate change. It also highlights the opportunity of strengthening the links and developing synergy with other instruments, such as those developed to address health security. In doing so, it aims at bringing considerations about climate change on the agenda of health system governance, while bringing health considerations on the agenda of those responsible for addressing climate change in other sectors.

What is the problem?

Populations in Europe are exposed to climate change through changing weather patterns (for example more intense and frequent extreme events) and indirectly through changes in water, air, food quality and quantity, ecosystems, agriculture, livelihoods and infrastructure *(2)* (see Fig. 1).

What do we know?

Information on the health effects of climate change derives from a range of studies, which include a few climate–health impact models and studies on future projections of health effects, and:

empirical studies (e.g. health impacts of individual extreme events); spatial studies, where climate is an explanatory variable in the distribution of the disease or the disease vector; temporal studies assessing the health effects of inter-annual climate variability, of short-term (daily, weekly) changes in temperature or rainfall, and of longer-term (decadal) changes in the context of detecting early effects of climate change; experimental laboratory and field studies of vector, pathogen, or plant (allergen) biology; intervention studies that investigate the effectiveness of public-health measures to protect people from climate hazards *(2)*.

Several countries have conducted health-impact assessments of climate change in Europe; a few countries have developed national adaptation plans, including health.

From these studies and assessments we can expect that projected trends in climate-change-related exposures of importance to human health are likely to:

- increase heat-wave-related health impacts;
- continue cold-related health effects in particular in populations with lack of access to continuous energy;
- increase flood-related health impacts;
- increase malnutrition in areas already affected;
- change foodborne disease patterns;
- change the distribution of infectious diseases and potentially contribute to the establishment of tropical and subtropical species;
- increase the burden of waterborne diseases, in populations where water, sanitation and personal hygiene standards are already low; and
- increase the frequency of respiratory diseases due to higher concentrations of ground-level ozone concentrations in urban areas and changes in pollen distribution related to climate change

These health effects will be unevenly experienced between and within different countries in the WHO European Region. Whether and how they will be experienced will depend on the adaptive capacity and actions of health systems and access different populations have to these services. Some of the measures might be efficient enough under current climates but might need to be strengthened or revised under much stronger or accelerated climate change. Continued and intensified research on climate-related health effects and adaptation, focusing particularly on the identification and evaluation of potential threats and options for effective protective interventions, will be critically important.

What is the problem?

There is global scientific consensus that "warming of the climate system is unequivocal" *(1)*.

What do we know?

Global trends

The global average surface temperature has risen about 0.74 °C over the past 100 years; widespread melting of snow and ice, and rising global average sea level have been observed. These changes have already had noticeable effects on many natural systems, including many marine and terrestrial ecosystems, such as the earlier timing of spring, bird migration and poleward and upward shifts in ranges in plant and animal species *(4)*.

Globally, widespread changes in extreme temperatures and precipitation have been observed over the last 50 years: cold days, cold nights and frost have become less frequent, and hot days, hot nights and heat-waves more frequent *(1)* (Table 1).

Table 1. Global direction and trends in extreme weather events and health

Phenomenon and trend	Projections for the 21st century	Benefits or risks to human health
Over most land areas, warmer days and nights, more hot days and nights and fewer cold days and nights	Virtually certain	Reduced mortality from decreased cold exposure
Increase in frequency of warm spells/heat-waves over most land areas	Very likely	Increased risk of heat-related mortality, especially for the elderly, chronically ill, very young and socially isolated
Increase in frequency of heavy precipitation events over most areas	Very likely	Increased risk of deaths, injuries, infectious, respiratory and skin diseases, and mental health problems
Increase in drought areas	Likely	Increased risk of food and water shortages, malnutrition and water- and foodborne diseases
Increased incidence of extreme high sea levels (excluding tsunamis)	Likely	Increased risk of deaths and injuries from drowning and of negative migration-related health effects

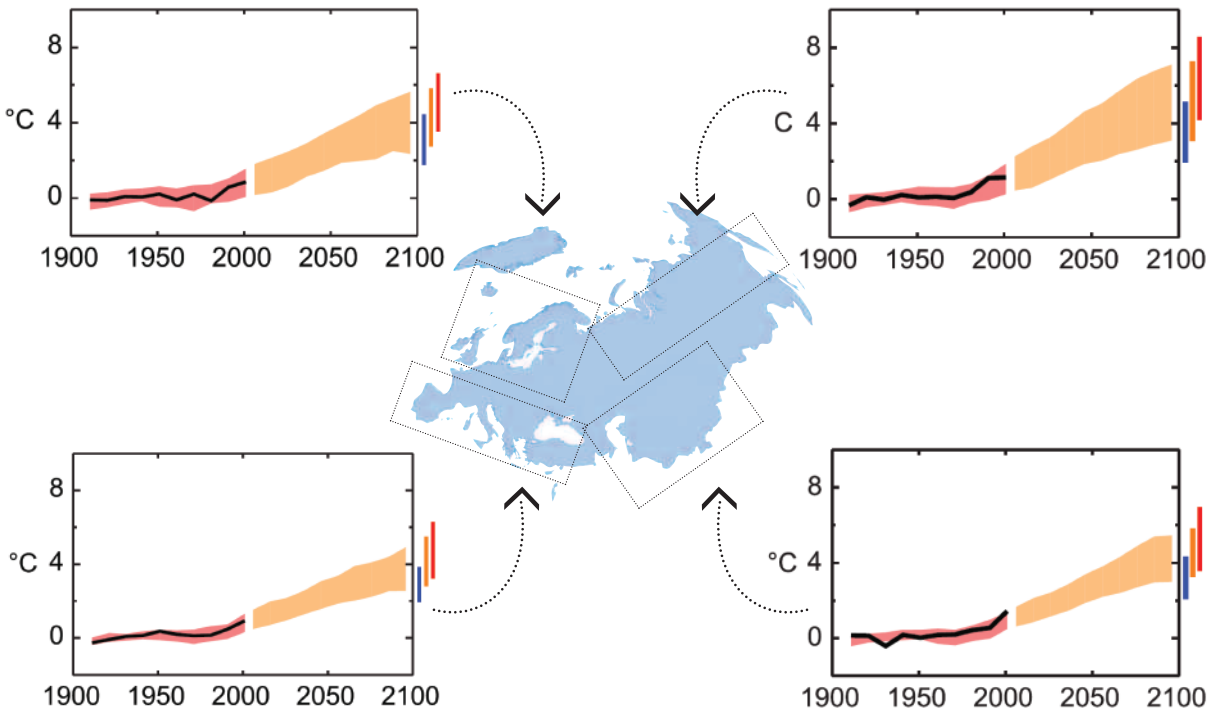
Source: adapted from *Climate change, 2007 (1)*.

The European Region encompasses a wide range of climates, from the Arctic to the arid regions of central Asia to the Mediterranean. Since 1905, precipitation increased in northern Europe and northern and central Asia, and drier weather has been noted in the Mediterranean *(5)*. Heat-waves and heavy precipitation events have become more frequent. Rapid thawing of the permafrost, with decreased depths of frozen ground, threatens many cities and settlements.

Projected climatic changes in the WHO European Region

Projections for the cumulative increase in annual mean temperature from the 1980–1999 period to the 2080–2099 period vary from 2.3 °C to more than 6 °C, depending on the underlying assumptions and scenarios *(6)* (Fig. 2).

Fig. 2. Temperature anomalies in four parts of the WHO European Region, with respect to 1901–1950 and as projected for 2001 to 2100



Note. Temperature anomalies with respect to 1901 to 1950 for four Europe land regions for 1906 to 2005 (black line) and as simulated (red envelope) by multi-model data set (MMD) models incorporating known climate-forcing mechanisms; and as projected for 2001 to 2100 by MMD models of the (the Special Report on Emission Scenarios (SRES)) A1B scenario (orange envelope). The bars at the end of the orange envelope represent the range of projected changes for 2091 to 2100 for the B1 (blue), A1B (orange) and A2 scenarios (red).

Source: Christensen *(6)*.

In summary, the following changes are expected *(6)*.

- In northern Europe, winter minimum temperatures are expected to increase, annual precipitation is projected to increase as well as the frequency of extreme precipitation events.
- In southern and central Europe, higher-than-average summer temperatures are expected, annual precipitation is expected to decrease, although extreme precipitation events will not reduce; the risk of drought events will increase as well as the risk of water stress.
- In central Asia, warming well above the global mean is anticipated; risk of increased drought frequency is expected; water stress and reduced crop availability are expected in arid and semi-arid areas.
- In the Arctic, warming well above the global mean is anticipated. Some projections have the Arctic late-summer sea ice disappearing almost entirely towards the end of the 21st century and anticipate further rapid thawing of the frozen ground.

What is the problem?

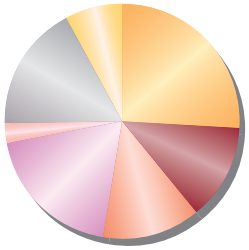
There is global scientific consensus that *(1)*: most of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas (GHG) concentrations. The largest sources of GHG emissions in the WHO European Region are energy consumption and transportation *(7)*.

What do we know?

Human dependence on fossil fuels, such as oil, coal and gas, has increased GHG emissions. GHGs admit heat from the sun more readily than they let it out, leading to a rise in the earth's temperature, also called *global warming*. Global GHG emissions increased by 70% between 1970 and 2004 *(1)*. In 2005, the atmospheric concentrations of carbon dioxide (CO_2) and methane (CH_4) greatly exceeded the natural level of concentration in the previous 650 000 years. Worldwide, the largest increases in GHG emissions since 1970 have come from the energy sector, followed by industry, forestry, agriculture and transport (Fig. 3).

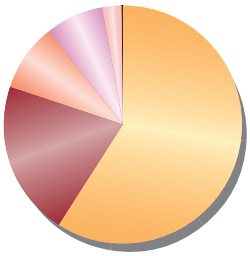
Fig. 3. GHG emissions by sector, globally and in the countries belonging to the European Union

Global data, 2004



Energy supply	25.9%
Transport	13.2%
Agriculture	13.5%
Industry	19.4%
Waste and wastewater	2.7%
Forestry	17.4%
Residential and commercial buildings	7.9%
Solvent use	0%

European data (EU15), 2005



Energy supply	59.1%
Transport	21.0%
Agriculture	9.2%
Industry	7.9%
Waste	2.6%
Forestry	0%
Residential and commercial buildings	0%
Solvent use	0.2%

Source: data from *Climate change 2007 (1)* and *Greenhouse gas and emission trends and projections globally in Europe 2007 (7)*.

Most GHGs that cause climate change originate in richer industrialized countries, while the countries and social groups that are most vulnerable to the adverse health effects of climate – due to widespread malnutrition, poor education and weak health-system infrastructure – tend to be those that have contributed least to the problem.

What are the responses at the global and regional level?

Confronting the magnitude of climate change and of its driving forces requires global solidarity, global solutions, and a portfolio of technologies and policies to stabilize GHGs *(1)*. Many options for reducing global GHG emissions through international cooperation exist. Globally, the ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC) *(3)* is to stabilize GHG concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system *(7)*.

The IPCC *(1)*, in its government-approved synthesis report, concludes, that:

> While studies use different methodologies, there is high agreement and much evidence that in all analysed world regions near-term health co-benefits from reduced air pollution, as a result of actions to reduce GHG emissions, can be substantial, and may offset a substantial fraction of mitigation costs.

The extent of these benefits will very much depend on choices made in the energy, transport and other sectors on how to reduce GHGs. Many of the proposed policies and measures will need to be assessed for their health impacts on today's and future generations.

Thirty-seven of the fifty-three Member States in the WHO European Region have agreed to adopt the policies and measures outlined under the UNFCCC *(3)* and its Kyoto Protocol *(8)*. Most have agreed on reducing GHG emissions an average of 5% by 2012 in comparison to 1990 levels. The latest IPCC data point to the need for greater reductions.

The European Union (EU) has been taking a proactive role in this process. The EU's integrated energy and climate change package, which the European Council endorsed in March 2007, aims to limit the rise in global average temperature to no more than 2 ^{o}C above preindustrial levels. Between the numerous measures proposed, the EU intends to increase energy efficiency by 20% and increase the renewable portion of energy it uses to at least 20% by 2020 *(9)*.

The UNFCCC *(3)* highlights the need for adaptation policies. The Nairobi work programme on impacts, vulnerability and adaptation to climate change *(10)* was developed to help countries improve their understanding of climate change and increase their ability to make informed decisions on how to adapt successfully. A number of countries have developed national adaptation plans.

Several mechanisms exist to enable European countries to help developing countries: for example, through technological development, technology transfer, joint implementation mechanisms, clean development mechanisms, research, and by using CO_2 auctioning revenues for mitigation and adaptation.

REDUCING HEALTH EFFECTS FROM HEAT AND HEAT-WAVES

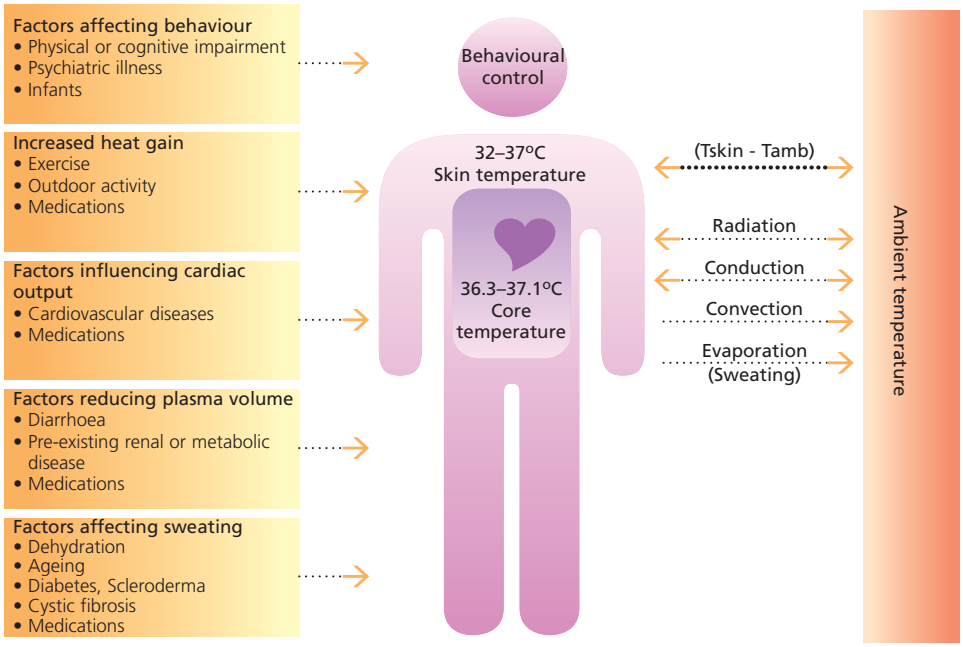
What is the problem?

Heat-wave-related deaths are an emerging problem in summer in the Region. An increase in the frequency and intensity of heat-waves could further aggravate this problem *(9)*.

What do we know?

Heat is a natural hazard, and much is known about the effects of high temperatures on the human body *(11)* (Fig. 4).

Fig. 4. Factors affecting human thermoregulation and the risk of heat illness



Source: data from Matthies et al *(11)*.

Episodes of extreme temperature can affect health significantly, and they present a challenge for health systems (Box 1). For instance, in the summer of 2003, a severe heat-wave struck much of western Europe. Twelve European countries reported more than 70 000 excess deaths compared to averages for five years before *(12)*. There is little information from eastern European countries on the effects of heat-waves on health.

For populations in the EU, mortality has been estimated to increase 1–4% for each one-degree increase of temperature above a cut-off point. During heat-waves, deaths increase from a range of causes. Elderly people are most at risk because ageing impairs the body's physiological capacity to regulate its own temperature (thermoregulation).

Box 1. Heat-waves: a continuing challenge to governments

Several studies showed that the:

> health impact of the heat-wave in 2003 was "unforeseen", that surveillance of heat-wave mortality was inadequate, and that the limited public health response was due to a lack of experts, the limited capacity of public health agencies and poor exchange of information among public agencies *(2)*.

Every year since 2003, countries have reported heat emergencies. For example, the Government of The former Yugoslav Republic of Macedonia declared a nationwide heat-wave emergency in 2007. The very high temperatures in hospitals and emergency care units was the major problem. Heat-avoidance messages were issued to the general public via television, radio and newspapers, and information for health professionals was distributed throughout the country.

Children, people with chronic diseases, and those confined to bed, need particular care during extremely hot weather *(13)*. The PESETA (Projection of Economic impacts of climate change in Sectors of the European Union based on bottom-up Analysis) project *(14)* estimates 86 000 extra deaths per year in EU countries with a global mean temperature increase of 3ºC in 2071–2100 relative to 1961–1990. Increasing numbers of older adults in the population will increase the proportion of the population at risk *(15)*.

Major heat-wave events are also associated with other health hazards – such as air pollution, wildfires and failures in water, food or electricity supply. All have implications for the public health response. Heat-waves may have larger effects on mortality during high-ozone days, highlighting the interaction between climate change and air pollution.

How can we adapt?

The EuroHEAT project *(16)* concluded that heat-related illnesses and deaths are largely preventable. In the long term, the most important measure to take is improving urban planning and architecture, energy and transport policies. Such improvements should begin now, as the lead time for policy development is very long *(11)*.

One of the most effective health-system preparations for this emergency is the development and implementation of heat health action plans, with components such as *(11)*:

- accurate, timely weather-related health alerts;
- strategies to reduce individual and community exposure to heat, especially among vulnerable populations;
- plans for the provision of health care, social services and infrastructure;
- heat-related health information strategies; and
- real-time surveillance, evaluation and monitoring.

Important elements of health-service preparedness for heat-waves include *(11)*:

- health facility infrastructure: external shading of buildings, energy-efficient cooling facilities, provision of thermometers, sufficient drinking-water and appropriately adapted menus, and energy-efficient buildings;
- appropriate staff scheduling and working arrangements;
- special care for patients and residents (identification of individuals at risk, adjustment of drugs and treatment) and organization of home care (support and contact); and
- staff training in identifying heat-related health problems and appropriate treatment and cooling techniques.

Every year, before summer arrives, it is also important to advise the public on keeping homes cool, staying out of the heat, keeping the body cool and hydrated, and helping others (measures to take if others have a health problem or feel unwell because of the heat).

REDUCING HEALTH EFFECTS FROM COLD WEATHER AND COLD WAVES

What is the problem?

Cold weather still threatens the health of many European populations. In a changing climate, warmer days and nights and fewer cold days and nights are projected *(1)*.

What do we know?

In temperate countries, there is a seasonal variation of mortality. Most European countries have 5–30% higher death rates in winter than in summer. Persons with cardiovascular diseases are more at risk, in winter, because of the cold-induced tendency for blood to clot. However, overall winter mortality rates are falling in some European countries. Several studies have attributed this decrease to improved home heating, better general health and improved prevention and treatment of winter infections *(2)*.

In temperate countries, cold waves continue to be a problem. Low temperatures can be reached in a few hours and extend over long periods. Cold-wave exposure may occur accidentally outdoors (affecting, for example, alcohol abusers, homeless people or workers), or indoors, in areas where electricity or heating systems fail or do not work continuously (Box 2).

Box 2. Cold wave in Tajikistan, 2008

The recent cold wave in central Asia gives an example of possible health consequences. In 2008, Tajikistan had the coldest winter for 30 years, with electric-power generation impaired through frozen inlet streams. As a consequence, health services and households did not have energy for prolonged periods. A rapid health assessment showed a sharp increase in the number of cases of severe burns and frostbite, a 50% increase in hospital admissions from acute respiratory infections, maternal and infant morbidity compared to the same period in 2007.

Populations who do not have access to commercial energy face the problem of how to heat and cook.They often use solid fossil fuels such as coal or wood. The indoor use of solid fossil fuels for heating presents a major health threat in at least 14 of the 53 countries in the European Region, and some population groups face these problems in at least 6 additional countries. Household solid-fuel use accounted for about 13 000 deaths among children aged 0–4 in 2004. An estimated 9000 lives or more could be saved each year if households could climb the so-called energy ladder, shifting from solid fuels to cleaner liquid or gas fuels *(17)*.

How can we adapt?

Residential access to clean, affordable and reliable energy is fundamental to promote and protect the populations' health status, consistent with the aims of the Millennium Development Goals. In some countries, incentives and subsidies to protect the poorer segments of society have been promoted through governments concern for health (see Box 3).

Box 3. Warm Front: the impact of housing improvement in England and Wales, United Kingdom *(18)*

Motivated by health considerations as well as the desire to reduce emissions and energy consumption, the Government launched the Warm Front initiative in 2000. This grant programme provides thermal insulation and heating packages. A national evaluation found:

- reductions in relative humidity, condensation and visible mould growth
- some evidence for improvement in mental well-being
- reduced vulnerability to winter- and cold-related mortality from cardiovascular diseases.

The Warm Front project, had thus some positive impacts for human health and well-being, but there was little evidence that improvements altered household energy consumption, as many households actually opted for increased thermal comfort rather than energy savings.

Health care infrastructure will need to be able to perform all desired functions in a climate that may change to include greater extremes of heat, cold, storms and precipitation *(19)*. Important elements of health-service preparedness for cold waves include special care for patients and residents (identification of individuals at risk), organization of home care, emergency medical services, provision of treatment and staff training and ensuring well-equipped health facilities (i.e. size, materials and location of the building; thermal insulation; heating and cooling systems, electric-power availability).

To understand how beneficial other sectors' measures are in improving health, health impact assessment and raising awareness on those choices that have health benefits are essential. Public information campaigns to affect people's behaviour with respect to appropriate heating, cooling and ventilation should remain a priority issue, regardless of infrastructure improvements.

REDUCING HEALTH EFFECTS FROM FLOODS

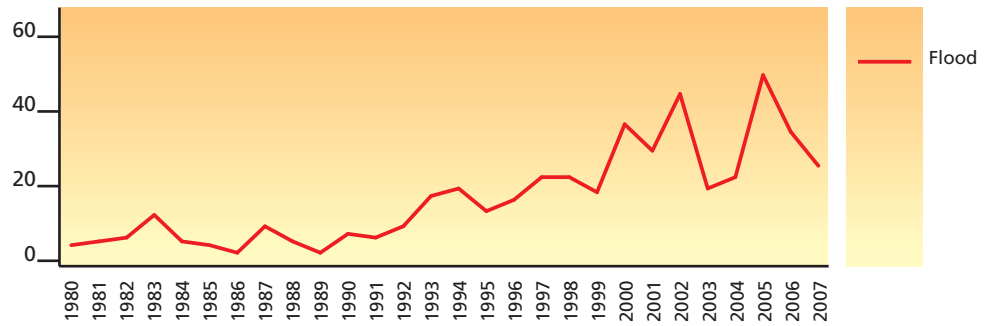
What is the problem?

Floods in the European Region have had a wide range of health effects. Climate change is projected to increase the risk of floods in river and coastal areas.

What do we know?

The frequency of flooding in the European Region has been observed to be increasing overall; so has the frequency of heavy rainfall and very high river flows. Flooding is the most common natural disaster in the European Region *(19)* (Fig. 5).

Fig. 5. Number of flood events, since 1980



Source: EM-DAT. Emergency Events Database [online database] *(19)*.

With climate change, winter floods are likely to increase throughout the European Region. Coastal flooding related to increasing storminess and sea-level rise is likely to threaten up to 1.6 million additional people annually in the EU alone. The potential health effects of flooding include *(20)*:

- direct health effects: drowning, injuries (cuts, sprains, laceration, punctures, electric injuries, etc.), diarrhoeal diseases, vector-borne diseases (including those borne by rodents), respiratory infections, skin and eye infections, and mental health problems; and
- other effects with health consequences: damage to infrastructure for health care and water and sanitation, crops (and/or disruption of food supply) and property (lack of shelter), disruption of livelihood and population displacement.

The limited data available on flood events from a few event-based epidemiological studies show that the greatest burden of mortality is from drowning, heart attacks, hypothermia, trauma and vehicle-related accidents in the immediate term *(21)*. Studies of the long-term health effects of floods are lacking *(22)*.

How can we adapt?

Communities' vulnerability to health-related flood hazards is closely related to the public's awareness of them, economic conditions, legislation (e.g. zoning of flood risk areas) and its enforcement, urban housing development, river-bank maintenance, channelization systems, dams, early warning systems, institutional response capacity and recovery planning.

Experience in the European Region points to the need to shift emphasis from disaster response to long-term risk management. The approach should include health impact assessments of structural measures to combat flooding, building regulations in flood-prone areas and insurance policies. Hospitals, ambulance stations, retirement homes, schools and kindergartens in these areas are at particular risk, and evacuating patients and other vulnerable groups may represent a special challenge. Table 2 lists useful general health service measures, including flood-proofing infrastructure and safeguarding the provision of electricity, water and sanitation, as well as preparing populations in areas at risk *(21,22)*.

Table 2. Health system planning for flood preparedness

Type of activities	Health outcome and preventive measures
Pre-flood activities	Long-term risk management: flood health prevention as part of multipurpose planning Inter-institutional coordination Infrastructure flood-proofing Service planning risk zoning, risk mapping of health care and social care facilities, availability of communication and transport possibilities; emergency medical service preparedness, water and food supply planning for emergencies, evacuation organization, etc.) Awareness-raising campaigns targeting different groups in areas at risk
Health protection during floods	Prevention and treatment of respiratory problems, infectious diseases, injuries, mental health problems and skin and eye diseases Possible extra vaccinations for the general population Distribution of "boil water" notices, general hygiene advice and information on preventing mould, snake bites and electrocution Outbreak investigation where appropriate Enhanced health surveillance Water and food provision Treatment for mould and other pathogenic exposures
Long-term health protection	Post-flood counselling (for anxiety and depression, for example) Medical assistance Enhanced cause-related surveillance Research for future preparedness and response

Source: adapted from Meusel et al. *(21)* and *Health and climate change: the now and how (22)*.

PROTECTING NUTRITION AND FOOD SAFETY IN A CHANGING CLIMATE

What is the problem?

An increase in the frequency of droughts, heat-waves and floods may lead to loss of food production and exacerbate malnutrition in some regions. Crop productivity is projected to decrease in some areas in Europe. Hotter summers may threaten food safety and shorten growing seasons.

What do we know?

Projected changes in the frequency and severity of extreme climate events have significant consequences for food production, and food insecurity. Recent studies indicate that climate change scenarios that include increased frequency of heat stress, droughts and flooding events reduce crop yields and livestock productivity, creating the possibility for surprises. Climate variability and change also change the risks of fires, and pest and pathogen outbreaks, with negative consequences for food, fibre and forestry *(23)*. Consequences, include increases of food prices and changing food markets. Droughts in central Asia have been associated with damage to child growth and malnutrition.

Changes in food production are a particular concern in central Asia, where climate change may affect food security. Crop yields could decrease up to 30% in central Asia by the middle of the 21st century *(23)*. Declines in food production will directly influence food security and household poverty levels, particularly in countries that depend heavily on agriculture. The impact will be greatest on the rural poor, whose survival is closely linked to food production and who are less able to make up losses by purchasing food.

Climate change threatens food safety. Higher temperatures favour the growth of bacteria in food, such as *Salmonella* spp. (Fig. 6).

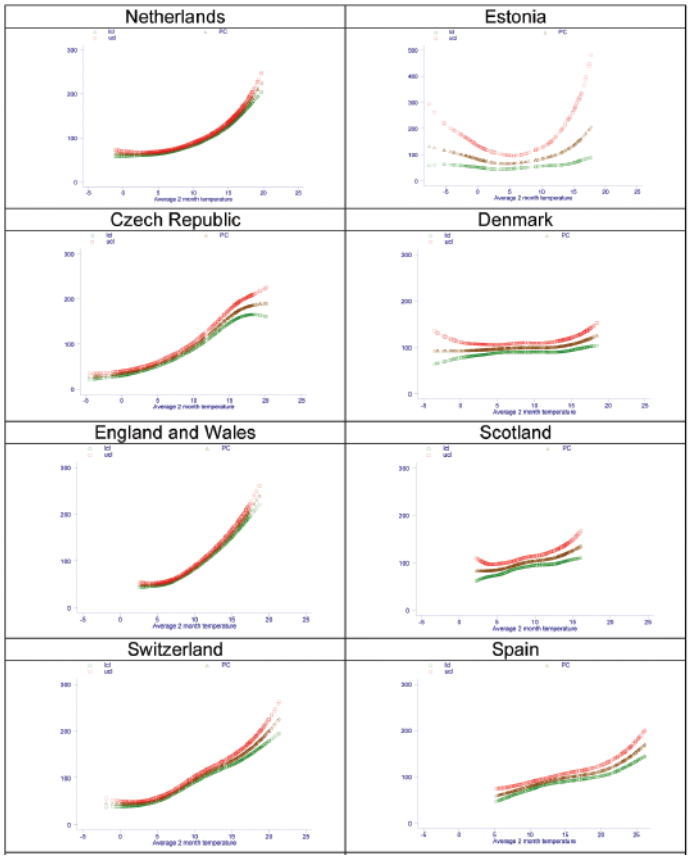
Weather can affect human behaviour, such as food consumption and preparation practices, which again can increase the risk of foodborne diseases. Refrigeration failure is more likely to occur during hot weather. During the heat-wave in 2003, interruption of the cold chain led to serious food-safety problems. In addition, warmer weather and milder winters will favour flies and other pests that affect food safety. Further, food safety is an important economic concern affecting consumer confidence and choice.

How can we adapt?

Several actions can contribute in reducing risks to malnutrition and food safety from climate-related events. Health-system preparedness planning includes: being informed about drought, heat-wave, floods early warning, understanding of areas most at risk, development of community supporting mechanisms and partnerships, and sharing of information.

At the level of the Region, the WHO Second European Action Plan on Food and Nutrition Policy sets goals and targets to reduce the health burden associated with food and nutrition: diet-related noncommunicable

Fig. 6. Relationships between temperature and salmonellosis by country, full model adjusted for season, trend and holidays



Note. Temperature (°C) is on the x-axis (0–9-week average), and salmonellosis cases are on the y-axis (percentage of the average number of cases).

Source: Kovats et al. *(24)*.

diseases, micronutrient deficiencies and foodborne diseases *(25)*. The Plan provides a number of elements that help in adapting to climate change, such as strengthening surveillance and monitoring systems to detect changes and analyse trends in foodborne and nutrition-related diseases, and communicating risks related to food safety and nutrition.

At the national and local levels, the most important mechanisms to prevent and control foodborne diseases are early detection, surveillance and monitoring, risk assessment from farm to fork, management and communication and being prepared for potential outbreaks.

Contamination of food products usually arises from improper practices at some point during the journey from farm to fork. Providing education and timely information to producers, food handlers and consumers on the best ways to handle food and avoid foodborne diseases is essential. Foodborne disease outbreaks can be prevented by using safe water and raw materials, keeping food clean and at safe temperatures, cooking food thoroughly, and keeping raw and cooked food separated.

What is the problem?

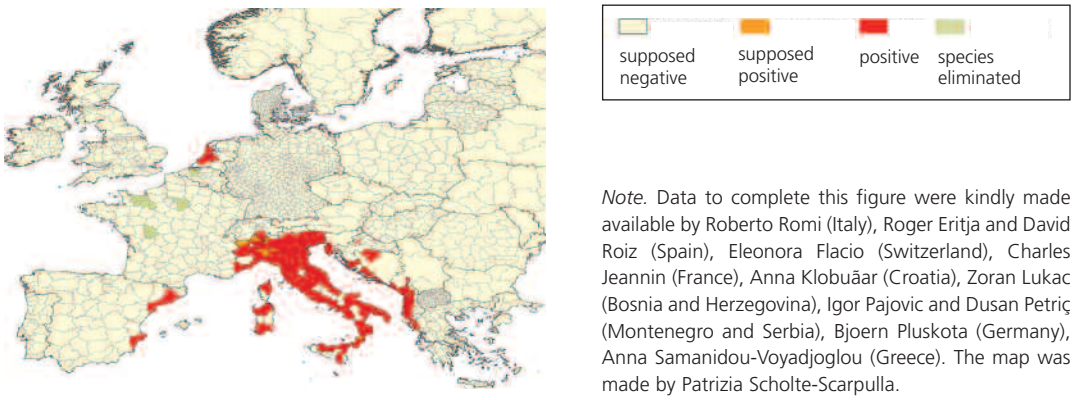
Climate change is likely to cause changes in ecological systems that will affect the risk of infectious diseases in the European Region, including the seasonal activity of local vectors and the establishment of tropical and subtropical species *(2,26)*.

What do we know?

Shifts in the global and regional distribution and behaviour of insect and bird species are early signs that biological systems are already responding to climate change. In 2007, the IPCC projected that climate change would lead to changes in infectious disease transmission by vectors such as mosquitoes and ticks, as a result of changes in their geographic ranges, seasons of activity and population sizes *(2)*.

The movement of people and goods, changes in hosts and land use will continue to affect patterns of infectious disease in the Region. Chikungunya virus has been introduced into the Region by travellers returning from endemic countries *(27)*. The presence of a suitable vector would allow for local outbreaks. An example is the tiger mosquito, *Aedes albopictus*, which has substantially extended its range in Europe over the last 15 years (Fig. 7) and presents reasons for concern about the transmission of other viral diseases *(28)*.

Fig. 7. Presence of *Stegomyia albopicta* (*Aedes albopictus*)



Note. Data to complete this figure were kindly made available by Roberto Romi (Italy), Roger Eritja and David Roiz (Spain), Eleonora Flacio (Switzerland), Charles Jeannin (France), Anna Klobuăar (Croatia), Zoran Lukac (Bosnia and Herzegovina), Igor Pajovic and Dusan Petriç (Montenegro and Serbia), Bjoern Pluskota (Germany), Anna Samanidou-Voyadjoglou (Greece). The map was made by Patrizia Scholte-Scarpulla.

Source: Scholte & Schaffner *(28)*.

Several climate-change-related models estimate an increase of malaria risk. For example, in the United Kingdom it was estimated that, with temperature increases, the risk of local malaria transmission could increase by 8–15% by 2050. In Portugal, the number of days suitable for survival of malaria vectors is projected to increase. Nevertheless, there is agreement that the risk of transmission of malaria related to localized climate change is very small. Risks are greater in the countries where importation of malaria coincides with socioeconomic degradation, the disintegration of health and social services, uncontrolled cross-border migration and lack of environmental management for mosquito control *(2,26)*.

The limit of tick distribution in the European Region is shifting northwards and to higher altitudes. Changing seasonal climates and longer spring-to-autumn periods will enable further expansion of the range of Lyme disease, and may increase the risk in endemic areas depending on other local conditions *(29)*. Another important vector-borne disease in southern Europe is visceral leishmaniasis, transmitted by sandflies. The disease has been reported in dogs (reservoir hosts) further north, although the possibility of previous underreporting cannot be excluded. Changes in the geographical distribution of the sandfly vector have been reported in several European countries *(30)*.

The role of climate change in the future epidemiology of other diseases is uncertain. The impact of climate change on bird migration patterns may play a role in the distribution of West Nile fever *(31)* and prolong the active season (and thus the incidence) of Toscana virus, while milder weather conditions that favour tick reproduction may influence the distribution of Crimean-Congo haemorrhagic fever *(32)*.

How can we adapt?

Early detection of any outbreak and improved public health surveillance and response are essential elements in adapting to climate change. The International Health Regulations *(33)* provide a global platform for early detection of climate-related events and strengthening of public health surveillance and response capacities (Box 4).

Box 4. International Health Regulations (IHR) *(33)*

The 2005 IHR entered into force on 15 June 2007. The revised IHR are an innovative set of rules and procedures agreed by 193 countries to make the world more secure from threats to global health. They established an agreed framework of commitments and responsibilities for countries and WHO.

Under the revised IHR, countries will be required to report all events that could result in public health emergencies of international concern, including those caused by chemical agents, radioactive materials and contaminated food. The IHR are particularly important with regard to climate change, as they allow early identification of potential crises. The new IHR not only improve national management of infectious disease outbreaks and public health emergencies but also provide international warning.

In the European Region, all malaria-affected countries have endorsed the Tashkent Declaration *(34)*, which aims to curtail indigenous malaria transmission by 2015. At present, 6 of the 53 Member States in the WHO European Region (Azerbaijan, Georgia, Kyrgyzstan, Tajikistan, Turkey and Uzbekistan) report indigenous malaria transmission *(35)*. Climate change may challenge the great progress made towards eliminating malaria countries and increase the risk of localized outbreaks in others.

Locally integrated vector-control measures will need to be revised and strengthened, including environmental management (e.g. improving the design and operation of projects to develop water resources) and personal protection/preventive strategies.

Health professionals and systems must prepare to identify and respond to potential new disease outbreaks, ensure adequate logistics and supplies (e.g. pharmaceuticals, vaccines) are available where required, and develop links with veterinary services. Enhanced intersectoral collaboration is needed to improve practices for vector surveillance and control, as well as capacities for surveillance and diagnosis. Advice on how residents can protect themselves from diseases is also necessary in areas of potential disease transmission.

REDUCING THE RISK OF WATERBORNE DISEASES

What is the problem?

The risk of outbreaks of waterborne diseases increases where water, sanitation and personal hygiene standards are low. Climate change is likely to increase heavy precipitation events, reduce the amount of fresh water in parts of the European Region and reduce water quality.

What do we know?

Four main issues should be considered when evaluating the relationship between health outcomes and exposure to changes in rainfall and water availability and quality:

1. links between water availability, household access to improved water and the health burden due to diarrhoeal diseases;
2. the role of extreme rainfall (intense rainfall or drought) in facilitating waterborne outbreaks;
3. effects of temperature and runoff on microbiological and chemical contamination of coastal, recreational and surface waters; and
4. direct effects of temperature on the incidence of diarrhoeal disease *(2)*.

Water stress is expected to increase across central and southern Europe and central Asia. It has been estimated that the percentage of the EU's area under high water stress is likely to increase from 19% today to 35% by the 2070s, and the number of additional people affected by the 2070s is expected to be 16–44 million. Freshwater availability in central Asia is likely to decrease, while summer water flows in southern Europe and some parts of central and eastern Europe may be reduced by up to 80%. Loss of fresh water could have serious implications for health, if not managed appropriately and equitably *(36)*.

Access to safe water in Europe is unequally distributed. For example in central Asia, total access to water supply is around 70%, but only 25% of the rural population has access to water supply. Even where high access to water is available, in many cases, the supply is not continuous and does not meet the microbial and/or chemical standards set by WHO. The risk of outbreaks of waterborne diseases increases where water, sanitation and personal hygiene standards are low. The burden of disease attributable to poor-quality water, sanitation and hygiene is estimated to be 5.3% of all deaths in children aged 0–14 years in the Region *(37)*.

Reductions in rainfall lead to low river flows, reducing effluent dilution and leading to increased pathogen loading. Extreme rainfall and runoff events may increase the total microbial load in watercourses and drinking-water reservoirs. The seasonal contamination of surface water in early spring in Europe may explain some of the seasonality in sporadic cases of waterborne diseases such as cryptosporidiosis and campylobacteriosis *(2)*.

Further, increasing temperatures and changing water composition create new ecological niches that allow pathogens to invade new areas. Reduced dilution, increased pathogen load and the presence of opportunistic pathogenic invader organisms and their toxins will all present new and increasing challenges to water-treatment plants.

Climate change is also likely to affect the quality of coastal waters, by changing either natural ecosystems or the quality of the waters draining into coastal zones. Recreational users of bathing waters, including tourists, may face poorer water quality and higher risk of infection. An additional area of concern is the production of seafood in aquaculture, which takes place in coastal zones.

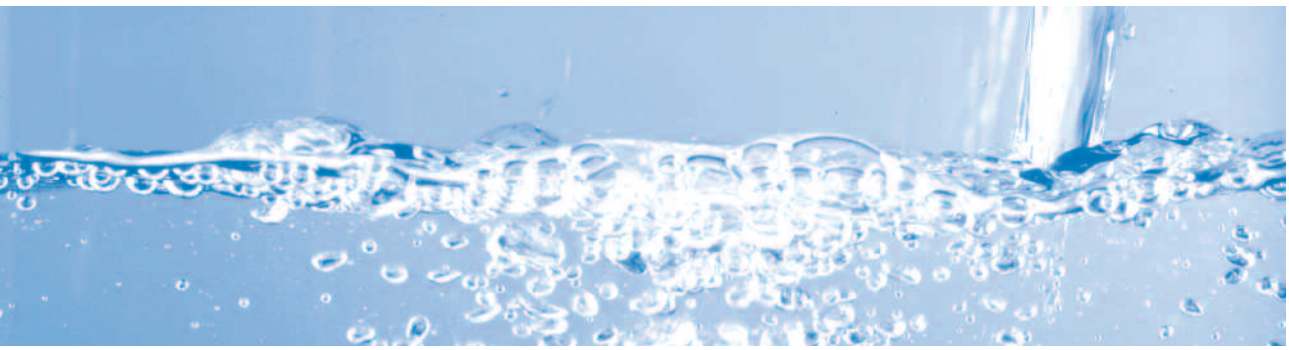
How can we adapt?

At the level of the Region, incorporating climate-related water-safety concerns and approaches into legally binding instruments such as the WHO–United Nations Economic Commission for Europe (UNECE) Protocol on Water and Health *(38)*, will be important. The Protocol aims to prevent waterborne diseases, ensure access to safe drinking-water, provide sanitation services and establish common standards for surveillance systems and contingency plans to detect and prevent waterborne disease outbreaks. Under the Protocol, A task force has been created to address issues related to extreme weather events.

The first of the four regional priority goals of the Children's Environment and Health Action Plan for Europe (CEHAPE) is preventing and significantly reducing morbidity and mortality arising from water-related gastrointestinal disorders *(39)*. Achieving this will help communities and populations address similar climate change challenges more easily.

Water-safety plans are suggested to be revised for changing climate conditions. These plans will need to include ensuring safe drinking-water from source to tap through enhanced risk assessment and management.

Improved management of water demand in the context of fully integrated planning for river-basin management will become imperative as a first coping mechanism, but it is unlikely to satisfy all the needs created by demographic growth, rising living standards and economic development. Alternative strategies will need to be explored, including reusing treated wastewater, using grey water, harvesting rainwater and, where economically viable, desalinization.



REDUCING RESPIRATORY DISEASES

What is the problem?

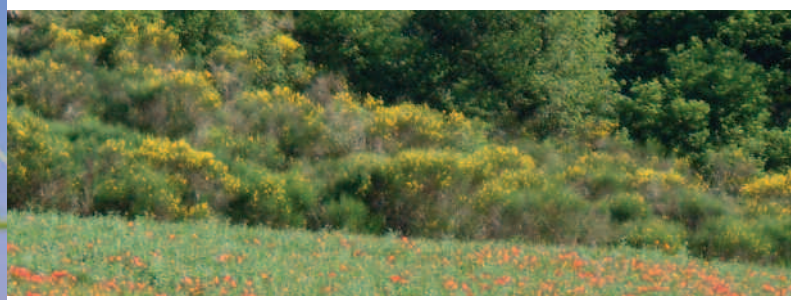
Respiratory diseases are affected by climate change, through changes in air quality, more frequent heat-waves and an earlier onset of the spring pollen season in the northern hemisphere.

What do we know?

Future ambient concentrations of air pollutants hazardous to health will depend on trends in both emissions of primary and precursor pollutants and meteorological factors that affect the dispersal of pollutants and secondary chemical atmospheric processes. Future climate change may increase ozone pollution in the Region due to higher temperatures and weaker atmospheric circulation *(40)*. Changes in wind patterns and increased desertification increase the long-range transport of air pollutants, including aerosols, ozone, desert dust, mould spores and pesticides. Changes in the mean and variability of temperature and precipitation are projected to increase the frequency and severity of fires *(2)*.

The air pollutants of greatest concern to health are ozone and particulate matter (PM). Ozone causes 20 000 premature deaths and 200 million person-days of acute respiratory symptoms per year in the EU while high levels of man-made PM shorten each EU citizen's life expectancy by over 8 months on average. In the European Region, 13 000 premature deaths in children aged 0–4 years have been observed from PM *(37, 41)*.

Ozone concentrations in the United Kingdom are estimated to be likely to increase with a changing climate. This will increase attributable deaths and hospital admissions: up to about 1500 extra deaths *(42)*. The EuroHEAT project found that respiratory and cardiovascular deaths are higher during heat-waves when ozone and PM pollution are high *(11)*.



Climate change has caused an earlier onset of the spring pollen season in the northern hemisphere: by around 15 days over the last three decades. It is reasonable to conclude that allergenic diseases caused by pollen also appear earlier in the year *(2)*. More research is needed to understand the effects of climate change on respiratory diseases.

How can we adapt?

Reducing climate-sensitive respiratory diseases means reducing people's exposure to hazardous air pollutants, anticipating potential events and preparing the health services. On the European level, several international conventions and agreements provide mechanisms for action. The Convention on Long-range Transboundary Air Pollution, for example, requires full implementation for pollution reduction *(43)*. The enforcement of this instrument and other relevant conventions and agreements clearly needs to be strengthened, as health effects from air pollution across the EU are still projected to be very large in 2020.

Taking action now will help ensure that children and adolescents live in an environment with clean air, thereby, in line with the CEHAPE goals, substantially reducing their morbidity and mortality from acute and chronic respiratory disorders due to outdoor and indoor air pollution *(39)*.

At the national level, reducing the health impact of air pollution related to climate change requires reviewing and in some cases strengthening national policies and programmes on air quality management, in accordance with the WHO air quality guidelines *(44)*. Monitoring PM to assess population exposure can help local authorities to make plans to improve air quality. If pollution levels (measured as concentrations of PM_{10} – PM with a diameter under 10 μm) could be decreased to the EU guideline level of 40 μg/m^3 set for 2005, more than a third of the premature deaths in children aged 0–4 years would be prevented *(37)*.

Policies to reduce GHGs might affect health; one example is the increased use of diesel fuels and biodiesel. Increased use can result in increased emissions of and exposure to fine PM, thereby potentially increasing health problems. This adverse effect would be further aggravated if biodiesel were gradually to replace petrol *(45)*.

Preparedness of health systems can be strengthened through a heat-wave and pollen warning system, as well as preparedness of health professionals and health services.

At the local level, action to reduce the health impact of pollution during heat-waves should include alerting vulnerable populations to the need to reduce vigorous exercise during such periods, especially in the middle of the day when ozone levels are high, and to avoid the most polluted places, such as busy roads.

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POPULATIONS MOST AT RISK

What is the problem?

Some populations are more vulnerable to climate change and will suffer more harmful health effects than others.

What do we know?

Climate change will affect everybody, but everyone in the European Region will not be equally vulnerable. Vulnerability to weather and climate change depends on people's personal characteristics (e.g. age, income, education, health status), their broader social and environmental contexts, their access to resources (e.g. health services) and their level of exposure to climate change. Geographically, the populations considered to be at greatest risk are those living in large cities or areas that are mountainous, water-stressed or near a coast. Children are particularly vulnerable because of their physiological and cognitive immaturity and their greater potential for long-term exposure (Table 3).

Table 3. How the differences between children and adults make children more susceptible to the effects of climate change

Type of difference	Internal sources of difference	External sources of greater sensitivity
Metabolic	Greater respiratory rate	Air pollution, allergens
	Greater metabolic rate	Malnutrition, thermal extremes
	Greater water demand per unit of body mass	Gastrointestinal illnesses, dehydration
Behavioural	Greater outdoor time	Infectious diseases, air pollution, ultraviolet (UV)
	Greater vigorous activity	radiation, thermal extremes, allergens
	Less ability to avoid unhealthy situations	UV radiation, thermal extremes
	Less ability to swim	Drowning
Physiological	Greater surface areas	Air pollution, UV radiation
	Less detoxifying capacity	Infectious diseases, Air pollution, UV radiation
	Less skin development	UV radiation thermal extremes
	Reduced immunity	Infectious diseases, allergens, mycotoxins
Temporal	Greater latency for genetic/long-term effects	UV radiation, malnutrition, allergens
Developmental	Undergoing development	Malnutrition, psychosocial trauma, morbidity and quality of life compromised

Source: Bunyavanich S et al. *(46)*.

Heat and heat-waves primarily affect old and young people. Workers are at risk, too. Working in hot environments diminishes one's ability to carry out physical tasks and mental abilities, increases the risk of

accidents and, if prolonged, can lead to heat exhaustion or heat stroke (see Box 5) *(2)*. Elderly workers with chronic diseases, disabled workers with limited cardiovascular adaptability and pregnant workers with increased body metabolism are at heightened risk from increased temperatures in the work environment.

The working population is also directly affected by the consequences of extreme weather events. Emergency workers and volunteers, such as firefighters, police officers and health care workers, can be exposed to special risks. For instance, people fighting wildfires are exposed to extreme heat and toxic fumes, vapours and gases. Those engaged in flood relief run an increased risk of hypothermia, electrocution, drowning and other dangers.

Box 5. Protecting workers from heat-waves: The former Yugoslav Republic of Macedonia

During the heat-wave in July 2007, the Government of The former Yugoslav Republic of Macedonia implemented joint action by different departments. Vulnerable workers in agriculture and other outdoor sectors (such as construction workers, bus and taxi drivers, police officers, market and street vendors, outdoor cleaners and gardeners) were identified. Working hours were shortened and adjusted. Pregnant workers were exempted from work. Health institutions were advised to keep temperatures below 26 ºC. Fluid intake, adequate nutrition and proper application of personal protective equipment were recommended. The Labour Inspectorate enforced controls and made inspections, particularly on construction sites and at other workplaces with heightened health risks.

How can we adapt?

Health systems are able to better protect vulnerable populations if they know about what threats they may be facing, such as high summer temperatures in the Mediterranean, flooding or the early onset of the pollen season. Steps should be taken to ensure relevant social and health protection, for example, by providing timely warnings, information and ensuring access to necessary services. Knowledge of which groups or geographical areas are most vulnerable to the various health effects of different climate-related threats allows health systems to target their interventions appropriately.

Health systems can act specially to protect vulnerable populations. An example is provided by active surveillance of particular frail populations in Italy (Box 6). Actions are also needed to protect children. This includes active involvement of paediatricians in alerting mothers and fathers on how to protect their children from diarrhoeal diseases, providing eventual additional vaccinations, and reducing exposure to allergens and air pollution.

Box 6. Health systems role in identifying susceptible populations: An example of active surveillance in Rome, Italy *(47)*

The Italian Department of Civil Protection produces heat warning bulletins. The local health coordination centres receive these bulletins and activate the local information network. The issuance of a heat warning activates local prevention programmes and intervention strategies. Each year, general practitioners, review the lists of susceptible people selected by current surveillance systems, including individual characteristics such as age, gender, family status, health conditions and socioeconomic conditions. In response they actively monitor the patients most at risk through specific interventions: advice on pharmacological treatment, active telephone calls, house calls, home-based visits and treatment and facilitated access to nursing and residential homes.

REDUCING HEALTH INEQUALITIES IN RELATION TO CLIMATE CHANGE

What is the problem?

Climate change has the potential to worsen health inequities within and among countries, put additional stress on already poorer groups in populations and on financing health care.

What do we know?

Economic growth and equitable distribution are necessary to reduce poverty and pursue many health and environmental goals. Many countries face increasing poverty and widening inequality after implementing free-market policies. In the former Soviet Union, more than 60 million people (12% of the population) are living in absolute poverty, which the World Bank defines as living on less than US$ 2.15 a day. Even in rich countries, disadvantaged groups such as immigrants can experience high poverty levels *(48)*.

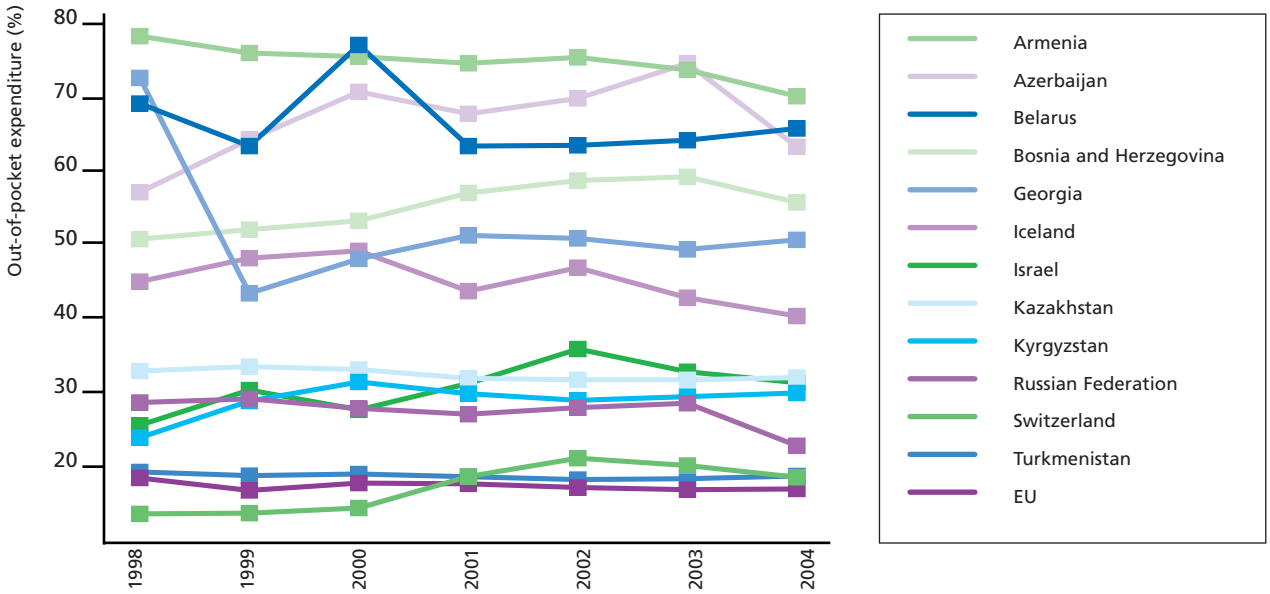
Climate change will have adverse effects on economic growth. The net economic costs of damages from climate change for 2005 have been estimated to be of an average value of US$ 12 per tonne of CO_2 *(49)*. Several estimates are available on global mean losses of GDP: "It is estimated that 1 to 5% of GDP for 4 °C of warming, could be lost with substantial regional differences" *(1)*. Stern anticipated, that in the United Kingdom, annual flood losses alone could increase from 0.1% of GDP today to 0.2–0.4% of GDP once the increase in global average temperatures reaches 3–4 °C *(50)*. Heat waves like that experienced in 2003 in Europe, caused agricultural losses of US$ 15 billion, will be commonplace by the middle of the century.

Climate change will pose challenges to many economic sectors in the Region, and is expected to alter the distribution of economic activities such as agriculture and tourism. In many countries in the eastern part of the Region, the poor are concentrated in rural areas and rely on agriculture as a source of employment and income. Tourism along the Mediterranean is likely to decrease in summer and winter tourism in mountain regions is likely to face reduced snow cover. Winter heating demands are expected to decrease and summer cooling demands to increase around the Mediterranean. Peak electricity demand is likely to shift in some locations from winter to summer *(4)*.

Climate change will reduce countries' ability to achieve sustainable development, as measured for example by long-term progress towards the Millennium Development Goals. From reducing poverty and hunger, to reducing child mortality, ensuring environmental sustainability and developing a global partnership for development, progress towards each of the Goals makes an important contribution to protecting the health of the most vulnerable.

In some places the need in health care services will increase, because of extreme weather events or potential climate change related infectious disease outbreaks. Out-of-pocket costs for health services are already high in some countries and present additional barriers to care, especially for the poor *(51)* (Fig. 8). The additional risks from climate change will present additional burden to household out of pocket financing.

Fig. 8. Private households out-of-pocket expenditure on health as a percentage of total health expenditure, 1998–2004



Source: European Health for All database (HFA-DB) [online database] *(51)*.

How can we adapt?

Even as economic growth is pursued, progress towards health, education, training and access to safe water and sanitation, and other indicators of social and environmental progress remains a significant challenge. The IPCC suggests that poverty strategies consider climate-change risks.

The question is how to protect the strata of populations that are poorer, have limited access to health care or risk increased out-of-pocket health expenditure. While more knowledge is required on what needs to be strengthened to avoid increasing inequalities, some general observations can be made on health systems.

In emergencies, universal access to health services is needed. In addition, new structures will be required, such as emergency medical services, in some cases.

To avoid population exposure to climate-related conditions, personal and population health services will need to be strengthened to anticipate potential health effects (e.g. infectious disease spread), to recognize them early (e.g. heat-wave conditions), to prevent hazardous conditions that could be further aggravated through climate change (unsafe water and food). Additional needs could include interventions in case of need (e.g. vaccination, treatment) or development of new technology.

Initiatives to help countries fight the negative health consequences of climate change should aim to strengthen country health systems, not to set up new structures.

WHAT HEALTH SYSTEMS CAN DO TO PREPARE FOR CLIMATE CHANGE

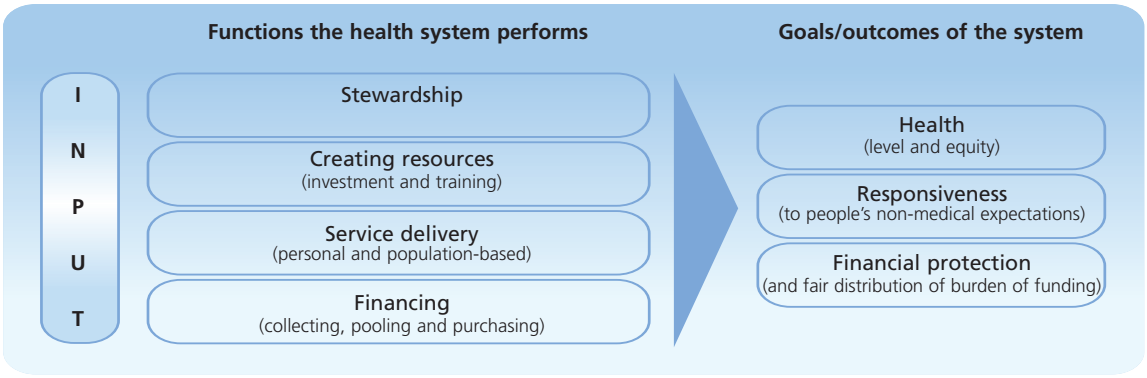
What is the problem?

As a result of climate change, health systems will need to prepare for gradual changes in health outcomes, sudden extreme events (e.g. heat-waves, infectious disease outbreaks), an extra burden of disease and potential new conditions. In addition, adaptation to climate change and action to reduce GHG emissions require the active engagement and support of different sectors of government, the economy and civil society. Health systems' capacity effectively to advocate health with these different actors and stakeholders varies across the Region.

What do we know?

Health systems comprise "all the organizations, institutions and resources that are devoted to producing actions principally aimed at improving, maintaining or restoring health" *(52)*. They strive to improve health (through the attainment of both the best attainable average level and of the smallest feasible differences among individuals and groups), and to ensure responsiveness to the expectations of the population, social and financial risk protection, a fair distribution of the burden of funding and improved efficiency *(52)*. Fig. 9 summarizes the vision of health systems' functions and goals articulated by the WHO Regional Office for Europe *(52)*.

Fig. 9. Functions and goals of health systems



Source: *Assessing health systems performance (52)*.

Health-system stewardship is important for effective advocacy of health with different actors and stakeholders. Population and personal health service delivery – for disease monitoring and surveillance, controlling water quality and sanitation, ensuring a safe and adequate food supply and providing safe, effective disease vector control, as well as ensuring immunization – and disaster preparedness are fundamental in preparing for climate change. The health workforce is at the forefront of preventing, anticipating, detecting and responding to the health effects of climate change. In addition, families will be likely to see an increase in their health expenditure, as their vulnerability to some climate-related diseases increases.

The capacity of health systems in the Region to respond to climate change varies greatly. This variation reflects historical processes, as well as current economic and human-resource constraints. In some countries, concerns persist about the ability of publicly funded institutions to provide even basic services to most of the population. Their health systems will require substantial strengthening to address the added burden posed by climate-related threats. Such strengthening can lead to broad health benefits in the climates of both today and tomorrow.

Assessing potential effects and response capacities can inform development strategies for resource and service delivery, as well as identify needs for investment (e.g. in vaccines, medicines, laboratory diagnostics), training (undergraduate and postgraduate) and service delivery, including ways to reach the most vulnerable populations. Systematic, interdisciplinary applied research can help health systems to gather intelligence and to monitor and evaluate the efficacy of their approaches.

What can health systems do?

While specific needs and initiatives will vary among countries, all countries can take a number of common actions to strengthen their preparedness to respond. These actions are further highlighted in the following pages, and can be summarized as follows.

Strengthen health security. This includes maximizing synergy with already existing instruments, such as the IHR, preparing the health workforce to respond to health-related consequences of climate change and strengthening of health services to address climate-related events in a timely manner.

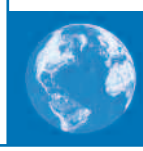
Advocate health with other sectors. A key component of health-system stewardship is the capacity to advocate health in other sectors' policies and actions. For example, normative action has been strengthened and informed by the availability of evidence-based knowledge of the relation between health and different environmental exposures, as well as the capacity to express the expected results of policy interventions in terms of potential gains to health, and related economic benefits. Such health advocacy is particularly important in sectors where GHG emissions can be reduced to produce collateral health benefits, such as energy, transport, housing, land use and water management.

Share good practice in intersectoral action. Local communities are often at the forefront of action and solving problems. Many interesting lessons have been learned in recent decades on how communities and cities can improve population health and reduce climate change.

Build capacity in the health workforce. Health professionals, who will be on the front lines in protecting health from the effects of climate change, will need to be prepared.

Provide intelligence. Information systems and communication strategies are important elements of health and climate change. This comprises the development of both a robust information infrastructure, capable of providing reliable and timely information (for example, for early warning), surveillance, and communication strategies that are transparent, build trust, reduce the distance between risk assessment and public perceptions and result in better support to the management of events.

Set the example by "greening" the health services. As one of the pillars of government and economy, health systems can set the example: i.e. strengthen their advocacy role and credibility by taking action to reduce GHG emissions from health-care-related activities and facilities, thereby contributing to reduce their own carbon footprint.



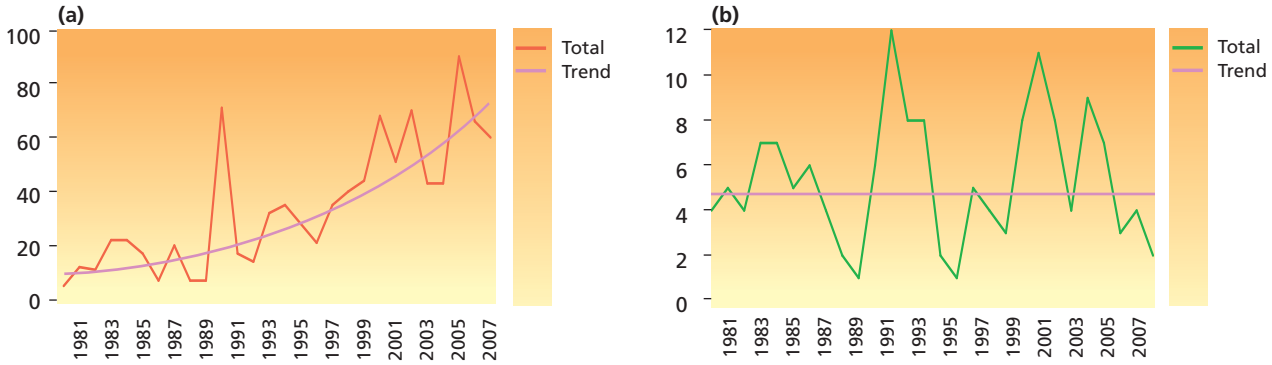
What is the problem?

Climate-related health threats such as extreme weather events and infectious disease outbreaks make sudden and large demands on health systems. These events are projected to increase in frequency and intensity. Health systems' capacities to respond to them vary across the European Region, and health systems will need strengthening to address these new challenges.

What do we know?

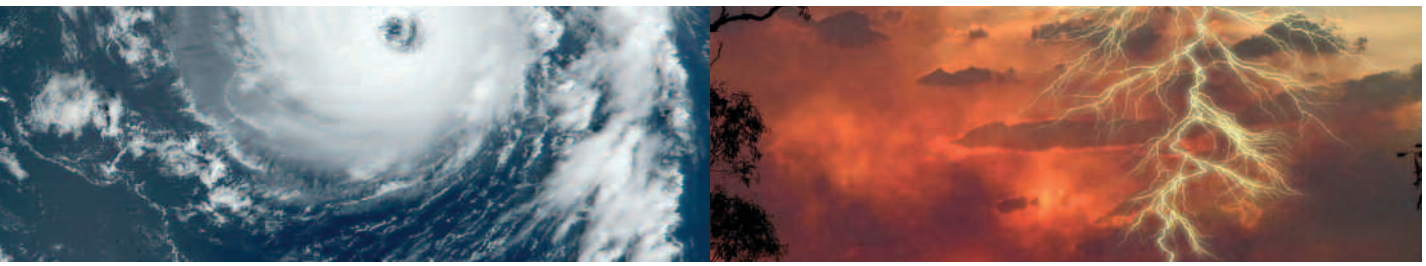
In the European Region, 1097 climate-related events occurred between 1980 and 2007. In contrast to earthquakes and volcanic eruptions, these climate-related extreme weather events are increasing exponentially, which arouses concern (Fig. 10) *(19)*.

Fig. 10. Trends in extreme weather events (a) and geological events (b)



Source: EM-DAT. Emergency Events Database [online database] *(19)*.

The human cost of these climatic events directly depends on the vulnerability of the people exposed. Social and environmental determinants of health, such as poverty, support systems, concurrent environmental stresses (including polluted water, unprotected waste disposal or polluted air) and displacement, all contribute to population vulnerability.



How can health systems respond?

Many of the adverse health effects of climatic crises, especially those that can result from heat-waves and floods, can be reduced through proper health-system action. Global, regional and national experience point to the need to take the following actions.

Strengthen mechanisms for early warning and action. Early-warning systems can reduce the impact of events, particularly when vulnerable groups are identified and carefully targeted. Effective links between the health sector and relevant national, regional and global systems, such as meteorological forecasting, need to be established.

Implement the 2005 IHR *(33).* The revised IHR provide a globally agreed platform for early detection of climate-related public health events and strengthening capacities for public health surveillance and response. Such global cooperation – among governments, United Nations agencies, the private sector, professional associations, academe, the mass media and civil society – is needed to create an infrastructure for comprehensive and effective surveillance and outbreak alert and response.

Adopt a long-term approach. Responding to an emergency is not enough. Long-term planning, to prevent as well as prepare for crises, is important. This approach is particularly relevant in addressing the underlying social and environmental determinants that increase vulnerability. In addition, the infrastructure of most health care facilities needs to be made disaster proof.

Use existing systems and link to general emergency response systems. Many of the approaches to planning for and responding to climate crises draw on generic emergency-planning models. In crises, tried and tested command and control mechanisms work best. Existing local, regional and national emergency response systems should be used in planning and responding to the health aspects of any climatic emergency.

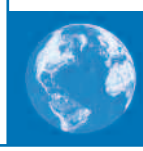
Be broad. Nearly all emergency plans require a multi-agency, intersectoral approach; so do climate-related health emergency plans. While many of the component actions will fall to the health system, active involvement of other sectors is also essential.

Build the national emergency services' capacity to prevent, mitigate, prepare for and respond to crises. These capacities need to be institutionalized and appropriately funded.

Communicate effectively. The effectiveness of any action depends on policy-makers' ability to deliver useful, timely, accessible, consistent, trustworthy information to target audiences, especially high-risk populations. Unfortunately, examples abound of communication failures that delayed action and undermined public trust and compliance, resulting in unnecessary harm.

Strengthen national recovery/post-disaster mechanisms to serve the needs of affected populations.

Responses to climate-related disasters should not exacerbate the problem of climate change if possible. For example, immediate cooling is important in heat-waves, and it is easy to assume that the solution is widespread use of air conditioning. Yet air conditioning is energy intensive and adds to GHG emissions, and many ways of addressing the situation are more environmentally friendly (e.g. green roofs, tree shadings, building codes, behavioural measures, etc.).



ADVOCATING HEALTH WITH OTHER SECTORS

What is the problem?

Adaptation to climate change and actions to reduce emissions of GHGs require the active engagement and support of different sectors of government, the economy and civil society. Health systems' capacity for effective advocacy of health with these different actors and stakeholders varies across the Region.

What do we know?

Many health arguments can orient decision-making on policy options in directions that maximize health benefits while allowing the achievement of sectoral goals. The selected examples given here contribute either to reducing the direct or indirect health effects of climate change or to improving health while tackling GHG emissions.

Health ministries, in their role as health-system stewards, can advocate the development and strengthening of climate-change-related policies on, for example, the management of air and water quality by providing evidence-based information, such as the burden of disease attributable to these risk factors. The current environment and health burden of disease – accounting for 34% of deaths and 25% of disability-adjusted life-years in people younger than 19 in the European Region – is caused primarily by outdoor and indoor air pollution, unsafe water, lead and injuries *(37)*. Improving water and air quality will not only increase populations' resilience to climate change but also have broader benefits for health and health-system capacity today and in the years to come.

Health systems can provide evidence-based information for the establishment of norms and standards and legislative enforcement. For example, implementation of the WHO air quality guidelines *(44)* in all countries would help lower levels of air pollutants, and thus reduce the risks of climate-change-related effects, in addition to those related to air quality.

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Health systems can also provide evidence-based information on the health effects of policies developed by other sectors, to maximize the possible gains for health. For example, the assessment of the health effects associated with policies that reduce GHG emissions in the transport and urban planning sectors. Some of these policies can have important benefits for health, particularly those that promote physical activity through cycling and walking and those to reduce emissions of air pollutants.

WHO *(53)* recommends at least 30 minutes of regular, moderate-intensity physical activity on most days to reduce the risk of cardiovascular diseases and diabetes, and colon and breast cancer. This recommended physical activity could be achieved by using walking or cycling to replace the car in taking some trips. This shift has potential, as 50% of all car trips taken in the EU are shorter than 5 km and 30% are shorter than 3 km. About 50% of these trips could be made on foot or by bicycle. For this to happen, however, a portfolio of measures is needed to, for example, reduce the need to travel long distances between different destinations, increase public transport, cycling and walking, promote safe infrastructures for cyclists and pedestrians and provide incentives for changing one's travel choices.

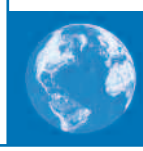
All in all, the implementation of these policies can contribute to reducing emissions of GHGs from the transport sector, while providing additional health benefits through physical activity. Several of these policies are advocated and/or documented by the WHO/UNECE transport health and environment pan-European programme *(54)*, CEHAPE *(39)* or other initiatives *(55,56)*.

Health systems can also contribute to adapting to climate change by providing information on the health effects of future technological choices, as promoted under the various portfolios proposed for the reduction of GHGs from electric-power generation. For example, in monetary terms, the external costs from electricity generation in the 15 EU countries in 1998 were equivalent to 1% of the total GDP of the EU. Of this total, about 90% was caused by health effects. The biggest health effects arise from coal, oil and gas power cycles. By comparison, renewable sources, such as wind and solar energy have limited adverse health effects. The production of electricity from nuclear sources remains a concern for health, because of the risks from nuclear accidents, including those potentially caused by security accidents, and nuclear waste disposal. Health-system stewardship is also needed, in those policy debates where simultaneous policies could reinforce health gains. The interaction of policies to reduce stratospheric ozone depletion and those to reduce GHG emissions gives an example (Box 7). To provide information to other sectors more proactively, health systems will need to strengthen their capacity to recognize and take such opportunities for advocacy, using such instruments as economic valuations and health impact assessments of other sectors' policies.

BOX 7. Ultraviolet radiation, its health effects and climate change

Solar ultraviolet (UV) radiation caused 60 000 premature deaths globally in 2000. The greatest burdens result from UV-induced cortical cataracts, cutaneous malignant melanoma and sunburn (although the latter estimates are highly uncertain due to the paucity of data). UV exposure may weaken the immune response to certain vaccinations, which would reduce their effectiveness. Climate change will alter human exposure to UV radiation in several ways. GHG-induced cooling of the stratosphere is expected to prolong the effect of ozone-depleting gases, which will increase levels of UV radiation reaching some parts of the earth's surface. Higher ambient temperatures will influence clothing choices and time spent outdoors, potentially increasing UV exposure in some regions and decreasing it in others *(2)*.

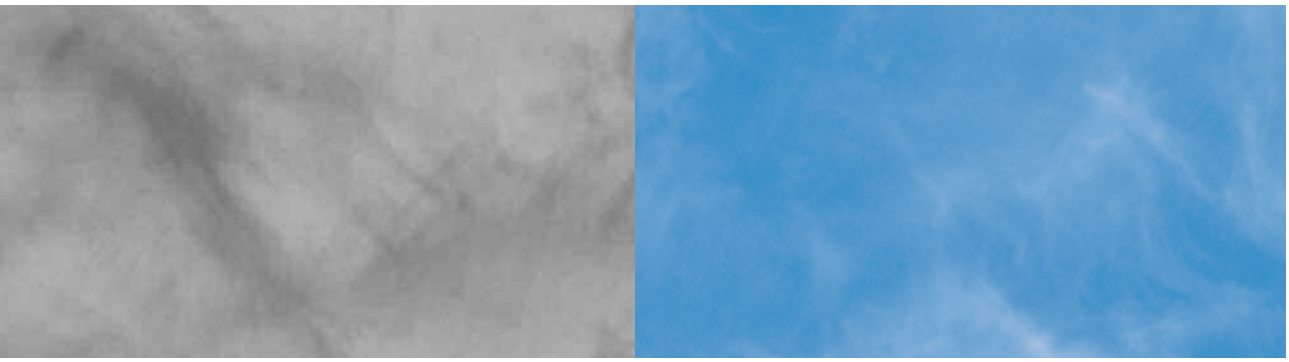
Protecting people's health from climate change through informed government action is also at the core of governments' accountability to citizens. This means not only ensuring that each individual can realize his or her potential to live in good health but also accounting for the effectiveness of measures taken.



AN EXAMPLE OF INTERSECTORAL ACTION: healthier communities in a changing climate

More than 70% of Europeans live in cities. Cities are major consumers of non-renewable resources and contributors to GHG emissions. In a single day, a European city of 1 million inhabitants uses an estimated 320 000 tonnes of water, 11 500 tonnes of fossil fuels and 2000 tonnes of food. It also produces 300 000 tonnes of wastewater, 25 000 tonnes of CO_2 and 1600 tonnes of solid waste *(57)*. Some of the first negative effects of heat-waves associated with climate change appeared in cities, including the deaths of more than 70 000 extra people in European cities in summer 2003 *(12)*. The heat-island effect may contribute to the greater vulnerability of city dwellers.

Consequently, cities have become areas of primary concern when it comes to the health effects of global warming, as well as centres for adaptation and mitigation efforts. Many cities in the eastern part of the Region are still recovering from the devastating effects of economic transitions on their budgets. They have had to deal with a complex array of linked economic, social, environmental and health problems. Their difficult situations have forced them to choose between immediate action, unsustainable repair measures and long-term exertions. Some huge residential buildings, for example, remain in poor condition due to a lack of maintenance and to inadequate construction standards.



Develop city- or community-based plans for adapting to climate change. Policy options include early warning systems, health-system preparedness and response, urban and community planning, and housing improvements. A comprehensive adaptation plan should involve multiple public entities, such as city management, the public health department, social services agencies, emergency medical services (or their rural equivalents) and civil society. Communications should be developed to advise people of appropriate behaviours. Measures to reduce air pollution are important throughout the year. Traffic-reducing measures, such as congestion charges, bicycle lanes and park-and-ride arrangements, not only limit CO_2 emissions but also facilitate adaptation. The development and maintenance of green spaces is also of fundamental importance.

Long-term planning. Long-term climate forecasts should be taken into account in constructing new buildings and planning new neighbourhoods, to provide as much thermal comfort and protection from extreme weather events as possible. An important component of new construction should be utilizing the best possible methods and materials for space cooling. Relying on energy-intensive technologies such as air conditioning is not sustainable and can be considered maladaptive. Finally, it is important to monitor progress and report results, for example by installing roadside pollution meters and announcing the readings to the public on a daily basis.

Local communities and cities are in an optimal position of **establishing links across sectors** and departments. Addressing the health impacts of climate change provides an opportunity for the integration of public health and climate change knowledge. Integration requires reciprocal understanding of terminology, goals and methods. Beyond this, it requires working together to achieve the goal of reducing deaths, disease and disabilities.

City and local community leaders can use the respect and **authority** they have as policy-makers, and institutionalize the changes discussed above. For example, one can insist that all new housing meets minimum environmental standards and that all transport meets certain standards that protect health and the environment. One could also introduce traffic-reducing measures such as congestion charges (toll fees for entering central city areas), bicycle lanes and park-and-ride to limit CO_2 emissions.

Today there are already a number of leading examples of cities and local community action in reducing GHG emissions while improving health. Distributing the lessons learned from this experience could contribute to collective action worldwide.

BUILDING CAPACITY IN THE HEALTH WORKFORCE

What is the problem?

Health professionals, who will be on the front lines in protecting health from the effects of climate change, are not consistently or adequately prepared to do so.

What do we know?

To prepare health professionals to deal with climate change and health issues, it is important to inform, train and build capacity in these areas, including information about:

- increased burden on health systems;
- new and emerging patterns of infectious diseases;
- higher potential for increases in inequalities;
- heat-related symptoms and treatment;
- early-warning mechanisms, sources and responses, and how health workers can contribute;
- effective interventions, and how they can be improved;
- how health personnel can help minimize relevant health risks; and
- how to best reduce personal CO_2 emissions.

How can health professionals help?

Health professionals have the expertise, opportunity and often – through advocacy and direct participation – the political leverage that can help ensure that adaptive and preventive action is taken *(58)*. Health professionals can promote strategies for adaptation and mitigation efforts through:

- public education, especially in settings such as doctors' waiting rooms and hospital clinics;
- prevention programmes, e.g. vaccination, mosquito control, food and personal hygiene initiatives and nutrition advice;
- health care (especially mental health and primary care) for communities affected by environmental adversity;
- surveillance of disease (especially infectious disease) and key risk factors, and early detection and identification of effects;
- publicizing the possible health risks of anticipated climate change; and
- promoting the benefits of mitigation and adaptation strategies.

Box 8 summarizes advice for general practitioners (GPs) relating to heat-waves *(59)*.

Box 8. A proactive approach – what GPs should know and do before and during a heat-wave *(59)*

- Understand the thermoregulatory and haemodynamic responses to excessive heat exposure.
- Understand the mechanisms, clinical manifestations, diagnosis and treatment of heat illnesses.
- Be aware of the risk and protective factors in illnesses associated with heat-waves.
- Identify patients at risk for heat illness and educate them on heat illnesses and their prevention, as well as educating caregivers of the elderly, the infirm and the very young.
- For people with chronic disease, incorporate into routine care pre-summer medical assessment and counselling for preventing heat problems (reducing heat exposure, ensuring fluid intake, adjusting medication doses).
- Recognize early signs of heat stroke, which is a medical emergency.
- Be prepared to initiate proper cooling and resuscitative measures.
- Be aware of the potential side-effects of all medicines prescribed and adjust dosages as needed during hot weather and heat-waves. Make decisions on an individual basis, since there are currently no standards or formal advice for altering medication regimes during hot weather.
- Be aware that high temperatures can adversely affect the efficacy of drugs, as most manufactured drugs are licensed for storage at temperatures of only 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 elderly, the infirm and those with advanced cardiac disease.
- Educate and counsel patients, stressing the importance of adhering to recommendations.
- Provide patients and caregivers with the contact details of social and medical services, help lines and emergency services.

STRENGTHENING HEALTH-SYSTEM INTELLIGENCE

What is the problem?

Too often, risk assessment and communications are not in line with public perceptions, which can lead to a loss of trust in policy-makers and negatively affect health-response capacities. Accurate, timely communication of information is required to ensure the proper prioritization, choice, targeting, monitoring and evaluation of actions to protect health from climate change. In turn, this requires the availability of reliable information, for example on diseases outbreaks, surveillance, environmental monitoring, or groups at risk.

What do we know?

Information collection, delivery and communication are essential to provide timely information.

First, a well-functioning health information system ensures the production, analysis and dissemination of reliable and timely information and its use by decision-makers and other key health-system stakeholders, on a regular basis and in emergencies.

There are four types of information for trends, events and response related to climate change.

1. The weather and climate community can provide the health decision-makers with timely and relevant **early warnings** of heat-waves, cold waves, floods, windstorms and fires. In the case of heat-waves, some European countries have developed heat health warning systems to trigger action in the health community.
2. Several systems are in place that allow the rapid **early detection** of events that could threaten health security. This is one of the requirements of the IHR *(33)*.
3. **Surveillance** systems can provide timely information about the occurrence of disease outbreaks and the groups at risk, while monitoring of water, food and air quality can provide information on potential risks to health and enables a prompt reaction to limit the occurrence of negative health effects (e.g. by alerting people to the need to provide safe drinking-water in case of failure in water networks).
4. **Information for response** includes the provision of information on effective response measures to citizens, health professionals, public health authorities and others. This is important to communicate and contain events that threaten public health security, where and when they occur, and to be able to synthesize information and promote the availability and application of this knowledge.

In the dissemination of information, experience with early-warning information and communication on climate change points to the importance of:

1. packaging information in customized ways for different target audiences;
2. involving end-users in developing and testing the appropriateness and comprehensibility of materials and messages (formative research);
3. choosing appropriate channels for the distribution of information based on knowledge of target audiences' preferences;
4. reframing discussions of climate change around health (as opposed to ecosystem or security concerns); and
5. monitoring the impact of communications on behaviour, choices and perceptions.

Communication strategies need to take into account the importance of dialogue with the public as a way to bring risk assessment and risk perception closer together. Transparent, timely information is crucial: it will foster people's resilience and encourage them to support an appropriate response, thus enabling better management of events. Particularly in crises, public demand for information (and action) is so great that, if official sources provide no information, others will fill the gap. The authorities need to say something even when there is uncertainty: it is more credible than being overly reassuring.

Finally, if health communications are to incorporate information about climate-change risks, they need to be grounded in knowledge of the subject. Such integration requires an understanding of the terminology, goals and methods of both health systems and climate change. It also requires cooperation to achieve the goal of reducing deaths, disease and disability. Several lessons can be drawn on from experiences with crisis communication in the European Region and elsewhere (Box 9).

Box 9. Principles of crisis communication *(60)*

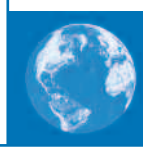
The overriding goal is to communicate with the public in ways that build, maintain or restore trust. Abundant evidence in the literature shows that, the less people trust those who are supposed to protect them, the more afraid they will be. Conversely, the greater the trust, the more resilient the public becomes.

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

Maintaining the public's trust throughout an event requires **transparency**: being candid, easily understandable, complete and factually accurate. Transparency allows the public to follow and understand the logic and process of gathering information, assessing risks and making decisions in responding to extreme events.

Informing and involving the public help build trust, which strongly encourages the acceptance of official guidance. People's judgments are influenced by the communication of many elements beyond mere data: values, emotions, socioeconomic status, institutional credibility and a sense of control. Changing existing beliefs is usually difficult unless those beliefs are explicitly addressed. Designing successful messages (those that bridge the gap between expert and public) is nearly impossible if the communicator does not know what the public thinks. The communicator's job is to understand the public's beliefs, opinions and knowledge on specific risks. This task is sometimes called communications surveillance. The public's concerns must be appreciated, even if they seem unfounded. Failing to consider them can lead to poor communication outcomes.

In the heat of a crisis, effective media communication is crucial, as it can directly affect events. If crises are difficult to predict, a media communication strategy can and should be planned beforehand. When a crisis occurs, this strategy can then be adapted to the current emergency.



SETTING THE EXAMPLE BY "GREENING" HEALTH SERVICES

The challenge and opportunity of mitigation

The health sector has a challenge – and an opportunity – to demonstrate its leadership and responsibility in dealing with climate change by acting to reduce its own carbon footprint.

What do we know?

In addition to providing health care, health systems are often major employers, land owners, purchasers and transport centres. By working to reduce GHG emissions in their own institutions and facilities through careful planning and spending, health systems can create virtuous cycles that are good for the environment, reduce health risks and save money. Additional financial savings can also result from spending less on energy, waste disposal and the treatment of avoidable diseases; from improved staff morale and productivity; from a healthier local population (active, well-fed and gainfully employed); and from faster patient recovery rates (thanks to good food and a healthy environment) *(61)* (see Box 10).

Box 10. Sustainable development in the National Health Service (NHS), United Kingdom *(61)*

The NHS is one of the Region's biggest employers (1.2 million staff) and represents 10% of the United Kingdom's GDP, equivalent to £90 billion. If the NHS were a country, its economy would rank thirtieth in the world. The NHS has a Good Corporate Citizenship policy and is currently setting up a sustainable development unit.

As part of this policy, the country's Sustainable Development Commission helps the different NHS organizations:

- to assess themselves;
- to manage energy (a recurring theme being the virtuous cycle of mitigation, saving money and reducing health risks);
- to manage food (changing procurement patterns by considering the benefits for local jobs and health instead of cost alone);
- to manage buildings (overseeing water, waste and materials used);
- to manage transport (with green travel plans reducing the need for private vehicles); and
- to promote natural environments (patients with a view of trees after gall bladder surgery recovering faster, leaving hospital earlier and needing fewer painkillers than those with a view of a wall).

This particular sustainable-development model is eminently transferable, although it has not yet been promoted in other EU countries. While the approach was designed for a centrally controlled health system, an alternative may be to work through health insurers.

How can health services mitigate their own contributions to climate change and improve health?

A health system can demonstrate good corporate practice and citizenship while utilizing its size and financial power to find and demonstrate innovative ways to reduce its environmental footprint, improve health and save money. Several areas have been identified for actions that can benefit the social, environmental and economic conditions within which the health system functions: energy, transport, procurement (of food, etc.), buildings and landscape, employment and skills, and community engagement.

- Combined heat and power generate electricity on site utilizing the heat that is a by-product of the generation process. In an appropriate application, combined heat and power can reduce **energy** bills by up to 20–30% and reduce carbon emissions accordingly. In addition, approximately a quarter of a building's heat can escape via an uninsulated roof. Insulating roof spaces and unfilled external cavity walls is an effective, inexpensive way of reducing heat loss.
- Green travel plans can promote healthy methods of **transport** and help change the travel patterns of patients, staff members and visitors.
- The right **procurement** choices can reduce harmful environmental effects by producing less waste, minimizing transport needs and reducing carbon emissions and other pollution. Local sourcing of food and other supplies can bring economic, environmental and health benefits.
- Investing in large-scale **capital improvements** that are also sustainable can pay dividends in terms of financial and carbon savings.
- Employees need to be on board to help deliver carbon savings. Incentives can help persuade them to choose low-carbon options, e.g. a more generous travel allowance for cycling and the provision of changing and showering facilities.
- Community engagement can help to inform and influence action and communities can lead examples of good practice.

PARTNERSHIP TO PROTECT HEALTH FROM CLIMATE CHANGE

One of WHO's greatest strengths in international health work is its ability to consolidate and share the best knowledge, experience and capacity of experts, institutions and countries around the world and to bring their expertise to bear on health development issues. In the European Region, WHO's particular strength lies in its ability to serve as a bridge between countries, especially between the eastern and western parts of the Region, and between diverse societal sectors. In the past decade, WHO has carried out a major shift towards country-based operations by channeling increased resources to countries forming a reliable WHO network.

Importance of partnerships. WHO participates in more than 80 global health partnerships and many global, regional and national health networks, and works with various United Nations bodies, such as the United Nations Environment Programme, the World Meteorological Organization, the United Nations Economic Commission for Europe and the UNFCCC. The European Commission, including the European Environment Agency (EEA) and European Centre for Disease Prevention and Control (ECDC), is a key partner in work for a better understanding and monitoring of trends over time and evidence-based solutions for problems such as heat-waves.

Strong regional mechanisms: European environment and health ministerial process. The environment and health process was launched in 1989 to reduce the most significant environmental threats to health as rapidly as possible, taking the approach that prevention is better than cure. It is a unique platform that brings together ministries of health and the environment, as well as intergovernmental and nongovernmental organizations, to define joint regional priorities for health and the environment and promote joint action. Climate change featured on the agendas of the third and fourth ministerial conferences on environment and health (in 1999 and 2004, respectively). The third recommended the establishment of a Europe-wide interagency network for monitoring, researching and reviewing the early human health effects of climate change and the fourth demanded a proactive and multidisciplinary approach by governments, agencies and international organizations and improved interaction on all levels, from local to international. Climate change is also expected to be one of the main themes to be addressed by the fifth conference in the series, which is expected to take place in Italy in 2009.

Strengthening institutional capacity. Promoting a coordinated, cross-cutting health-system response has increasingly become a core orientation for the Regional Office. The activities developed over the last 10 years on climate change and health – in partnership with Member States, many research institutions and the European Commission – will help to shape a better health-system response to climate change, by:

1. providing tools and expertise;
2. shaping the research agenda;
3. articulating ethical and evidence-based policy options;
4. sharing experiences and lessons learned; and
5. monitoring the health situation and assessing health trends.

First, WHO has developed a number of **tools** that can help countries study the health effects of climate change and plan adaptation measures, particularly for extreme weather events. This includes methods to assess the health effects of climate change; to make plans for multihazard emergency preparedness, heat health warning and action, and disaster preparedness and response; and to provide emergency medical services and practical advice.

Second, many **research** initiatives have involved the WHO Regional Office for Europe as a coordinator or as a partner, such as those on climate change and adaptation strategies for human health, the effects of summer climates on human health, allergic disorders, etc. Further research is needed:

- to improve the understanding of the health effects of climate change, trends, the costs of the projected health effects and the effectiveness of adaptation in decades to come; and
- to evaluate policy options for their benefits or harm to health.

The Regional Office has tried to engage partners from eastern Europe in these research initiatives.

Third, national assessments of climate change and health impact of adaptation and mitigation measures are important in framing **evidence-based policy options** at the national and subnational levels. Here, the Regional Office assists countries in developing capacity and reviewing findings, and contributes technical expertise and know-how. Health impact assessments of climate change in the eastern part of the European Region are needed.

Fourth, recent experience with the evaluation of action to prevent the health effects of transport and heat-waves has clearly demonstrated the importance of extracting and documenting **lessons learned** to improve future preparedness and fashion appropriate responses.

Fifth, the identification, development, standardization, evaluation and broad use of **systems for monitoring and assessing changes** in environmental and health indicators have started through the Regional Office's cooperation with EEA, and are planned to be extended through the development of an information system on climate, environment and health. Further work, however, is needed on key indicators of climate change's impact and how to assess trends over time.

CONCLUSIONS

Health needs protection from climate change. There is now growing scientific consensus that global warming is already adversely affecting health, and that these effects will be unevenly distributed in the WHO European Region. Some populations, such as children and the elderly, will be more at risk. Health security is also threatened. Failure to respond now can be very costly in terms of disease, health-care expenditure and lost productivity.

A number of current measures, policies and strategies need to be revised or strengthened under the present levels of risks from climate change. Current threats have already led to the introduction of new measures and policies, such as heat health action plans. As long as the increase in global warming is less than 2 ^{o}C from preindustrial levels (and not too rapid), many of the projected effects on health are likely to be controllable by strengthening well-known, well-tested public health interventions, such as public education, disease surveillance, disaster preparedness, food hygiene and inspection, nutritional supplementation, primary care, and training. Nevertheless, the effectiveness of these actions will need to be further evaluated.

Existing actions, policies and measures might become insufficient at higher levels of risks or in the face of more frequent and intense events, or more rapid climate change. Even if CO_2 emissions are stabilized during the next decades, the inertia in the climate system will require that available policies, strategies and measures be reviewed and adjusted over time.

Where capacities are weak, health systems will need strengthening. The capacities of health systems to respond vary greatly in the European Region. Health systems will need to assess potential climate-related health impacts, review existing capacities for addressing them, strengthen their functions where needed and consider the need to review some legislation, in order rapidly to detect and take action against current and future climate-related risks.

Implementing international and European instruments will be essential in mitigating and adapting to climate change. The major instruments include the IHR *(33)*, the Protocol on Water and Health *(38)* and the Convention on Long-range Transboundary Air Pollution *(43)*, as well as non-binding instruments such as the CEHAPE *(39)*.

Health must be at the centre of all climate change action. Health-system leaders can use their knowledge and authority to inform and influence action in key national and international processes that guide policy and allocate resources for work on climate change, for instance in preparing national communications, national action programmes on adaptation and international agreements.

Reducing GHG emissions (mitigation) can have direct and immediate health, environmental and economic benefits. Employing cleaner fuels and shifting to more active transport (walking and cycling), for example, will lower carbon emissions, increase physical activity, reduce traffic-related casualties and result in less air pollution and noise. For example, money saved from not having to cover the health-care costs of air pollution and lost productivity will often match or exceed the costs of climate mitigation measures.

Health systems can lead by example. Protecting health from climate change will require not only good science and effective adaptive actions but also moral authority and commitment. Health systems and their employees must demonstrate that they truly understand what is at stake and are changing their behaviour and choices as they advocate local, national and global solutions to climate change.

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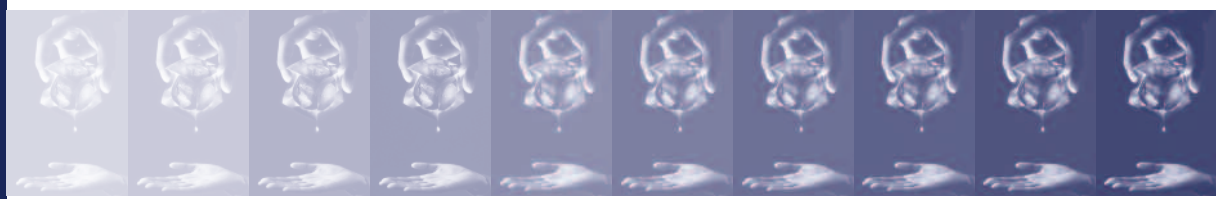

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