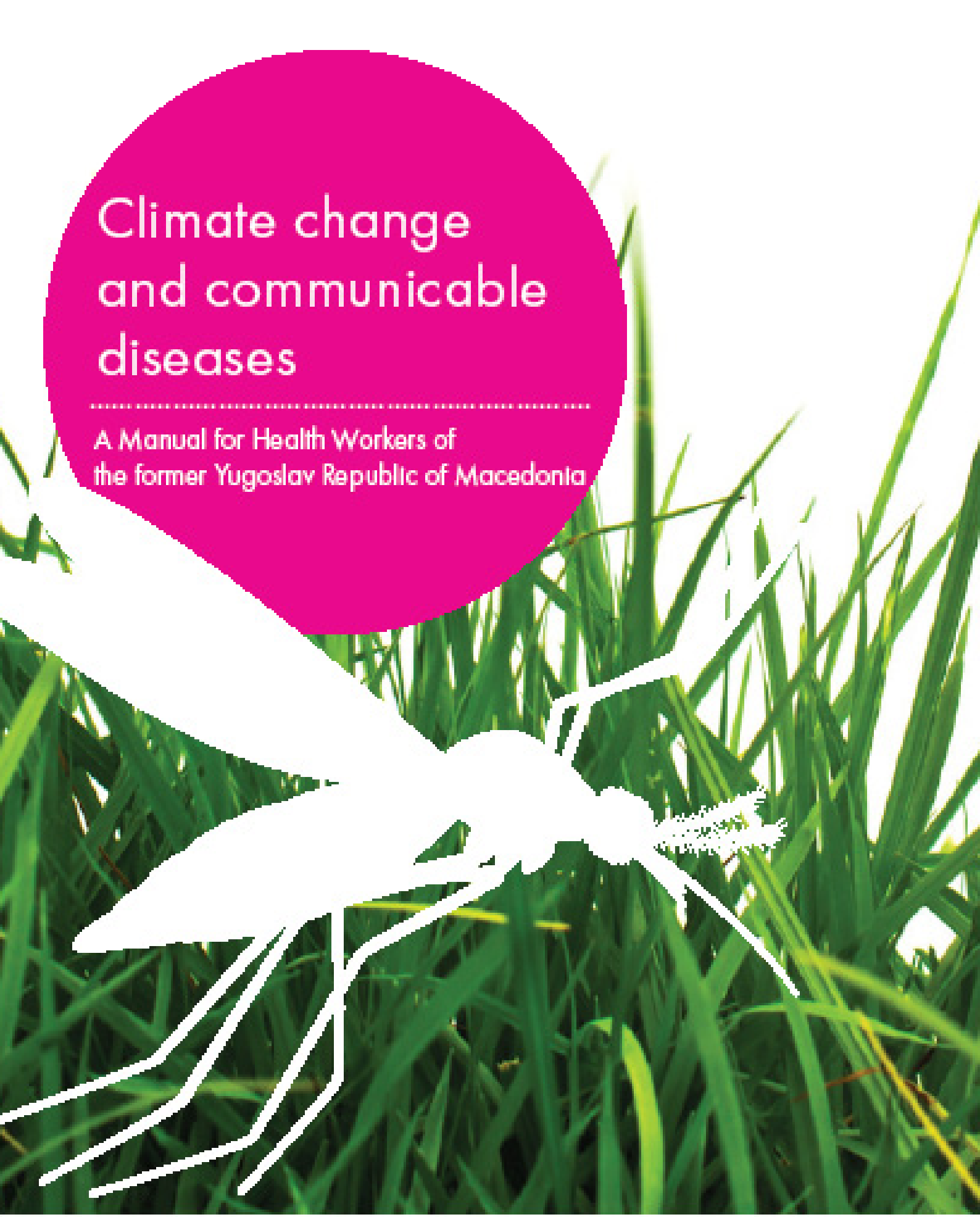
Climate change and communicable diseases

A Manual for Health Workers of the former Yugoslav Republic of Macedonia



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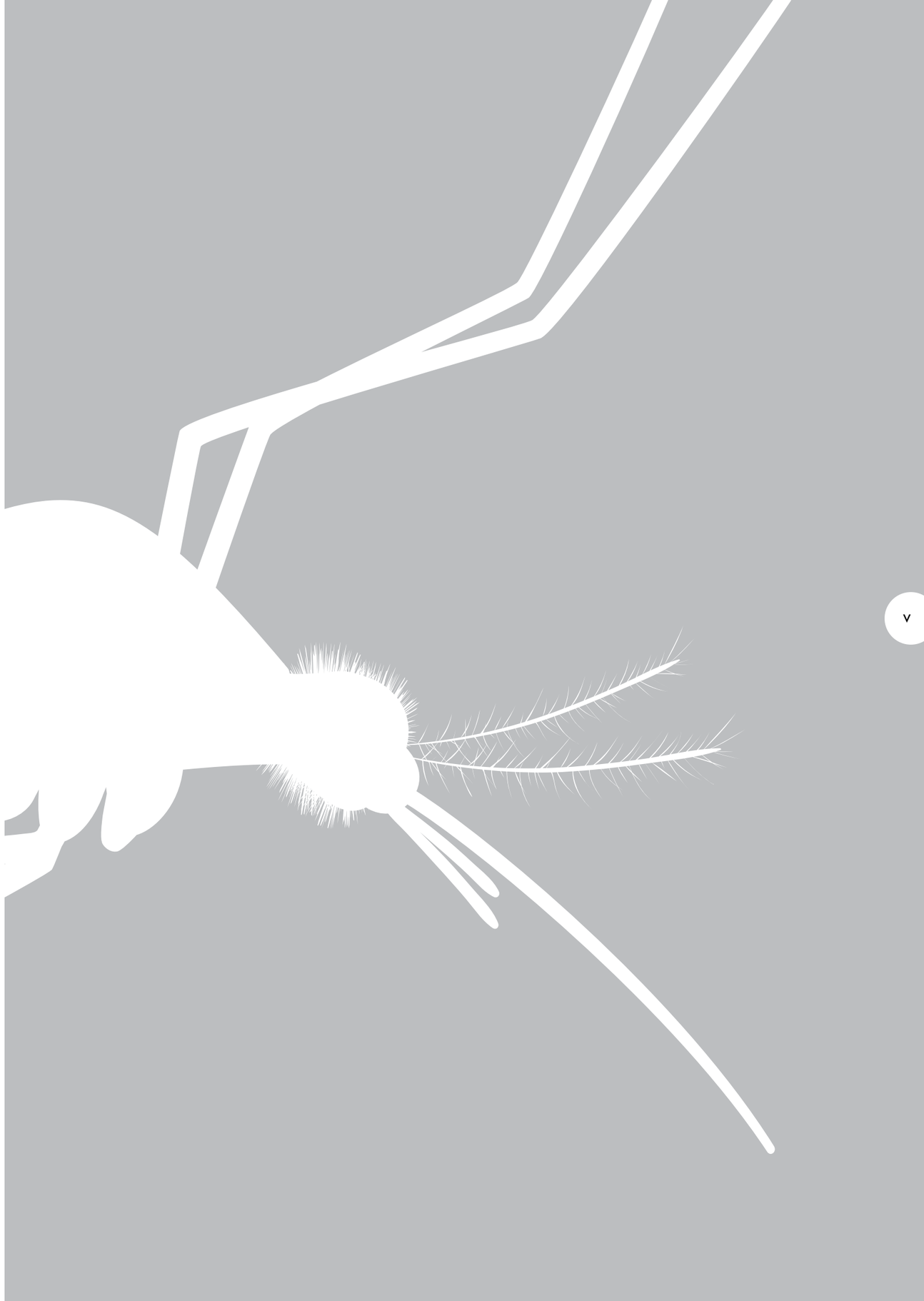

List of abreviations

AIDS	Acquired immune deficiency syndrome
ATI	Alimentary toxic infections
BMU	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
CCHF	Crimean-Congo haemorrhagic fever
CHKV	Chikungunya virus
DHF	Dengue and dengue haemorrhagic fever
EHEC	Enterohaemorrhagic Escherichia coli
ELISA	Enzyme-linked immunosorbent assay
EWARN	Early Warning System for Communicable Diseases Surveillance
HIV	Human immunodeficiency virus
HFRS	Haemorrhagic fever with renal syndrome
IFA	Immunofluorescence assay
LB	Lyme borreliosis
LD	Lyme disease
MAT	Microscopic agglutination test
MSF	Mediterranean cerebro-spinal meningitis
MSF	Mediterranean spotted fever
RT-PCR	Reverse transcriptase-polymerase chain reaction
VL	Visceral leishmaniasis
TBE	Tick-borne encephalitis
UNEP	United Nations Environment Programme
WNF	West Nile fever
WMO	World Meteorological Organization
WHO	World Health Organization

EXECUTIVE SUMMARY

There is a broad consensus nowadays that the Earth is warming up as a result of greenhouse gas emissions caused by anthropogenic activities. It is also clear that current trends in the fields of energy, development and population growth will lead to continuous and ever more dramatic climate change. This is bound to affect the fundamental prerequisites for maintaining good health: clean air and water, sufficient food and adequate housing. The planet will warm up gradually, but the consequences of the extreme weather conditions such as frequent storms, floods, droughts and heat-waves will have sudden onset and acute repercussions. It is widely accepted that climate change will have an impact on the spread of infectious diseases in Europe, which is likely to bring about new public health risks in the majority of cases. Transmission of infectious diseases depends on a number of factors, including climate and environmental elements. Foodborne and waterborne diseases, for instance, are associated with high temperatures. Disease-transmitting vectors (e.g. mosquitoes, sandflies and ticks) are highly sensitive to climate conditions, including temperature and humidity; their geographical distribution will widen as climate conditions change, potentially allowing them to spread into regions where they are not currently able to live.

The primary purpose of this manual on climate change and infectious diseases is to raise the awareness and the level of knowledge of health workers at national, regional and local levels in the former Yugoslav Republic of Macedonia on the health risks associated with climate change and infectious diseases. This manual was developed as part of the WHO Regional Office for Europe project, Protecting health from climate change: a seven–country initiative, implemented with financial support from the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

Section 1 of the manual features general information about climate change and its impact on human health, including a specific section on its impact on infectious diseases and special focus on the situation in the former Yugoslav Republic of Macedonia. There is information about the epidemiological characteristics, clinical profile, and prevention and surveillance of selected infectious diseases (salmonellosis, leishmaniasis, leptospirosis, Lyme borreliosis) for which epidemiological data is available and which have been registered in the former Yugoslav Republic of Macedonia, both in individual and epidemic forms. Section 1 also features a few other infectious diseases which may become relevant for the former Yugoslav Republic of Macedonia in the future, although for the time being there is no epidemiological data about any recorded cases in the country, nor is there the required etiological diagnostic capacity (chikungunya, cryptosporidiosis, West Nile fever, Crimean–Congo haemorrhagic fever, rickettsiosis, etc.). Finally, this section deals with measures for adaptation, as well as basic preventive measures that need to be applied in order to mitigate the risks associated with climate change and infectious diseases.

Section 2 of the manual includes an alphabetical overview of the infectious diseases for which there is a possibility of their being recorded in the former Yugoslav Republic of Macedonia, and which at this point in time are considered to be associated with climate change. Information is set out on their definition, transmission mode, clinical profile, diagnosis, treatment and prevention.

The Appendices feature additional information relating to the prevention of foodborne and vector-borne diseases.

This manual is expected to contribute to making health workers in primary health care (GPs), public health professionals (epidemiologists, hygiene specialists) and infectious disease specialists capable of giving advice aimed at awareness raising and preventing health risks associated with climate change and infectious diseases among the general public, to minimize the incidence thereof.

PREFACE

The primary goal in the development of these manuals is to raise the awareness of health care practitioners, at national, regional and local level, regarding the health risks related to climate change and communicable diseases.

Reducing the effects of communicable diseases related to climate change requires continuous epidemiological surveillance, as well as preparedness to take immediate epidemiological measures to respond to the threats. Furthermore, consideration should be given to investigating the routes of transmission and improving the safety of drinking water and food, controlling the insects and vectors that transmit disease, as well as providing a rapid response by the public health sector in the event of outbreaks.

Health effects related to communicable diseases in the context of climate change are generally preventable, provided that the health care system is prepared and the population informed. The health care system should strengthen its functions as a leading sector that needs to have the capacity to protect the population and to work together with other government sectors, to establish a proactive, multisectoral and multidisciplinary approach. The activities encompassed by the health care sector should include strengthening the capacities of health care practitioners and strengthening the laboratory diagnostic system for identification and diagnosis; obtaining knowledge; adaptation; and health promotion.

The manuals aim to:

- Raise awareness of health care practitioners in primary health care (family doctors) and public health pro fessionals (including epidemiologists, hygiene specialists and infectious disease specialists) of the health risks related to communicable diseases associated with climate change in the former Yugoslav Republic of Macedonia;

- Enable health practitioners in primary health care (family doctors) and public health professionals (including epidemiologists, hygiene specialists and infectologists) to provide advice to the population and raise awareness on prevention of communicable diseases related to climate change in order to minimize the associated risks; and

- Build capacity at all levels within the health care sector to rapidly recognize risks associated with climate change and communicable diseases and provide an adequate response to all negative impacts of climate change on human health, by offering timely intervention and appropriate health protection.

PART ONE

GENERAL INFORMATION CLIMATE CHANGE AND COMMUNICABLE DISEASES

1. CURRENT KNOWLEDGE ABOUT CLIMATE CHANGE

The natural generation of gases that cause the greenhouse effect (water vapour, carbon dioxide, methane, nitrous oxide and ground-level ozone) allows the solar energy to reach the surface of the Earth in the form of visible light, warming the planet and emitting infrared heat back into the cosmos, some of which is reflected back by the greenhouse gases in the atmosphere. This process maintains the warmth of our planet, providing for normal operation of the physiological functions of all living organisms. The absence of greenhouse gases would reduce the temperature of our planet by about 33 °C, rendering the Earth just another lifeless planet. Currently, the quantity of accumulated emissions of CO2 in the atmosphere is higher than at any time in the last 400 000 years, when compared with samples of air trapped in the ice in the Antarctic. If the accumulated emissions of CO2 in the atmosphere continue to increase, the temperature of the surface of the Earth will rise accordingly (IPCC 2005).

Due to industrialization and population growth, emissions of greenhouse gases as a result of combustion of fossil fuels, deforestation and clearing land for agricultural use are increasing. During the past 150 years, greenhouse gases have been released into the atmosphere faster than the natural processes' capacity to remove them. In addition, new synthetic gases have begun emerging in the atmosphere, which it has been found also support the greenhouse effect. The concentration of such gases has been constantly increasing over recent times and it is assumed that such growth will persist in parallel to the growth of the global economy. These emissions have begun to disturb the delicate natural balance, significantly increasing the quantity of greenhouse gases in the atmosphere and their insulating effect.

The mean temperature on the surface of the Earth has increased by 0.74 °C over the past 100 years. An increase of 2.3-6 °C may reasonably be expected within the next 100 years, depending on the scenario in place (Bates et al. 2008).

There is a global, firm and scientific consensus that climate is changing and that the current trends of global warming, increases in temperature and sea levels, as well as increasingly common extreme weather events (heatwaves, fire, tropical storms, floods, drought, landslides, etc.) may lead to a shortage of food and drinking water, loss of habitats and extinction of some species of plants and animals.

Climate change refers to changing climate conditions that are directly or indirectly attributable to human activities that cause variations in the composition of the global atmosphere and which, alongside natural climate variation, are being monitored over comparable time spans.

Vulnerability in the context of climate change refers to the extent to which human and natural systems are predisposed to, or cannot adjust to, the negative impacts of climate change, including climate variability and extremes (IPCC 2001).3

1. Intergovernmental Panel on Climate Change (IPCC) (2005). Contribution of Working Group I to the Fourth Assessment Report of the IPCC. Draft. Cambridge: Cambridge University Press.
2. Bates BC, Kundzewicz ZW, Wu S and Palutikof JP (eds.) (2008). Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva.
3. Intergovernmental Panel on Climate Change (IPCC) (2001). Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton JT, Ding Y, Griggs DJ, Noguer M, van der Linden PJ, Dai X, Maskell K and Johnson CA (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Negative impact of climate change refers to variations in the physical environment or in the biota, occurring as a result of climate changes and having significant detrimental effects on the composition, flexibility or productivity of natural or managed ecosystems, or on the functionality of socio-economic systems, or on human health and welfare in general. Such a level of warming will have an impact on many aspects of our lives, since it will cause temperature and precipitation variations, increased sea levels and variations in fresh water distribution. This will have greatest impact on (i) human health, (ii) vitality of forests and other natural areas and (iii) agricultural productivity. An increasingly warming planet Earth will affect the global water cycle, i.e. the exchange of water between the oceans, the atmosphere and the soil. Higher temperatures will cause increased evaporation and more rapid dessication of the soil. The increased quantity of water in the atmosphere will mean more precipitation. These changes may cause floods, land erosion and even loss of certain species of living organisms. In other areas, increased evaporation will lead to droughts, as abundant rainfall migrates to other locations (IPCC 2001; WHO, UNEP, WMO 2003).[3,4]

Climate change in the former Yugoslav Republic of Macedonia will have an impact in terms of higher air temperatures and reduced rainfall during the summer period. The scenarios show that the total available amounts of water (the river basin of the Vardar river) for the year 2100 will most probably be 18% less than today (estimates vary between 13% and 23%). In addition, more frequent flash flood and floods may be expected. Various parts of the country will suffer different impacts (MEPP 2003, 2008).[5,6]

The regions of the former Yugoslav Republic of Macedonia with a Mediterranean climate are likely to experience reduced availability of water, increased number of dry periods and increased health-related impacts resulting from heat-waves. Those regions with a continental climate are likely to suffer an increased number of floods and impacts resulting from extreme weather conditions (MEPP 2008). [6]

3. Intergovernmental Panel on Climate Change (IPCC) (2001). Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton JT, Ding Y, Griggs DJ, Noguer M, van der Linden PJ, Dai X, Maskell K and Johnson CA (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
4. WHO, UNEP, WMO (2003). Climate change and human health - risks and responses, Geneva
5. Ministry of Environment and Physical Planning (2003. First National Report to the UN Framework Convention on Climate Change Ministry of Environment and Physical Planning, Skopje
6. Ministry of Environment and Physical Planning (2008). Second National Report to the UN Framework Convention on Climate Change Ministry of Environment and Physi cal Planning, Skopje

2. CLIMATE CHANGE AND HUMAN HEALTH

Climate-change-associated diseases are estimated already to comprise 4.6% of all environmental risks. It has been estimated that climate change in the year 2000 contributed to about 2.4% of all diarrhoea outbreaks in the world, 6% of malaria outbreaks in certain developing countries and 7% of the episodes of dengue fever in some industrial countries. In total, the estimates show that mortality due to climate change has been 0.3%, whereas the related burden of disease has been 0.4% (WHO 2002).[7]

Climate change is linked to human health in a complex manner. There are direct impacts, such as diseases and conditions that may result in morbidity or mortality related to extreme temperatures, and other, more indirect health effects such as diseases related to consumption of contaminated drinking water, foodborne or vector-borne diseases and zoonoses, or health conditions related to lack of food and water.

There are projections regarding the expansion of diseases from the southern to the northern latitudes, especially re-emerging diseases that had already been eradicated, such as malaria, yellow fever, etc. Changes have also been detected in the distribution of rodent-borne diseases, such as the hantavirus disease and leptospirosis. Geographical, weather and environmental changes are likely to affect the vectors of disease and to have a corresponding impact on the distribution of diseases such as leishmaniasis, Lyme disease, tick-borne encephalitis, malaria (in endemic regions), dengue, etc. An increased burden of disease related to drinking water and food may be expected due to inadequate distribution at a global level and the projections for decreased availability of drinking water and food production (cholera and food poisoning). Exposure to extremely high temperatures may lead to cardiovascular or respiratory diseases, whereas extreme disturbances in climate conditions (floods, warm winds) may lead to injuries, choking, respiratory disorders, diarrhoea, etc. Increased temperature and floods are the cause of an increase in water contamination and resulting food- and waterborne diseases. Climate change is also likely to have an impact on the distribution of aeroallergens, especially pollen, and thereby cause changes in the distribution of allergic diseases. On the positive side, health conditions related to extreme low temperatures will decrease (WHO, UNEP, WMO 2003; Patz et al. 2000; Wilson 2001).[4,8,9]

Weather effects, especially related to temperature, act in an indirect manner as regards transmission of infectious diseases. Temperature may affect both the causes of infectious diseases and their carriers (vectors) or water supplies. Higher temperatures speed up the metabolism of the vectors and accelerate their need to feed; human contacts with carriers become more frequent and the probability of infection for humans increases accordingly. Variation in the minimum temperature may affect the survival of the vectors; for instance, warmer winters – which may reasonably be expected in the future – are likely to increase the vector population.

Generally, it is expected (with some presumption of uncertainty) that the effect of rapid climate change on human health will be negative. This will be especially the case in some low-income countries and countries in transition, notwithstanding the fact that their contribution to gas emissions that exacerbate the greenhouse effect is negligible (except some countries in rapid transition, e.g. India and China). Adverse effects are expected to include:

- The variations in rainfall will most probably compromise the supply of fresh drinking water, thereby increasing the risk of waterborne diseases;

7. WHO.(2002). World Health Report. Geneva
8. Patz, J.A., et al.,(2000). Effects of environmental change on emerging parasitic diseases. Int J Parasitol, 30 (12-13).
9. Wilson, M.L. (2001). Ecology and infectious disease, in Ecosystem Change and Public Health: A Global Perspective, J.L. Aron and J.A. Patz, Editors, Johns Hopkins University Press: Baltimore. p. 283-324.

- The higher temperatures and the variability of rainfall will most probably reduce food production in the least developed regions, thereby increasing the risk of malnutrition; and

- Climate change will most probably prolong the season of transmission of certain significant vector-borne diseases and will tend to change their geographical distribution, potentially allowing them to spread into regions characterized by lack of immunity among the population and/or lack of well-organized health care infrastructure (Confalonieri et al. 2007). [10]

The link between weather impacts and infectious diseases has led to the development of scenario models to predict the expansion of infectious diseases due to climate change.

Changed lifestyles, food production, modern urban planning, climate change and variations in the quality of the environment increase the danger of expansion of zoonoses.

3. COMMUNICABLE DISEASES RELATED TO CLIMATE CHANGE IN THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA

Epidemiological characteristics, clinical presentation and measures for prevention and monitoring of a few selected infectious diseases are given below. Some of them have been reported in the former Yugoslav Republic of Macedonia, both in their individual and epidemic forms (salmonellosis, leishmaniasis, leptospirosis, Lyme borreliosis) and there is epidemiological data available for them.

Some of the infectious diseases described below may become of concern in the future (chikungunya, cryptosporidium, West Nile fever, Crimean-Congo haemorrhagic fever, rickettsia, leptospirosis, etc.). Currently, there is neither epidemiological data nor the requisite etiological diagnostics available for them.

However, there are clinical parameters for the majority of these diseases, which is indicative of their presence, but in the absence of any causal diagnosis, they remain unconfirmed for the time being. Many of these infectious diseases are present in neighbouring countries, so it is probably just a matter of time before they are reported in the former Yugoslav Republic of Macedonia.

However, due to their importance for public health in the former Yugoslav Republic of Macedonia, they need to be included in programmes for the monitoring and prevention of infectious diseases associated with climate change and diagnosed, reported and monitored accordingly.

Reporting of all infectious diseases which are of concern for the former Yugoslav Republic of Macedonia is mandatory, in accordance with the current legislation published in the Official Gazette no. 66/2004.

10. Confalonieri and al. (2007). Human health. Climate Change Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK.

3.1. FOODBORNE COMMUNICABLE DISEASES

New challenges associated with the emergence of large epidemics related to food consumption are arising as a result of globalization, increased trade in food products, increased consumption of fast food, international travel, environmental contamination by human faecal matter in areas with poor sanitation, the increased frequency of natural disasters related to climate change, the introduction of new technologies in food production processes, etc.

There are different ways in which weather conditions can affect the incidence of foodborne diseases. Firstly, the prevalence of specific pathogenic organisms in animals may increase with higher temperatures. Secondly, the food cooling chain is harder to maintain in higher temperatures and prolonged warm weather increases the risk of mistakes in food handling. Thirdly, higher air temperatures may speed up the replication cycles of foodborne pathogenic organisms, which leads to a higher degree of contamination. Higher temperatures, in interaction with inadequate hygienic conditions, improper food handling and lack of hand-washing, may lead to an increased number of epidemics resulting from consumption of unsafe food.

In the former Yugoslav Republic of Macedonia, foodborne and climate-sensitive pathogenic organisms causing the greatest concern in the context of climate change include the following:

Alimentary toxic infections (ATI) – These diseases were reported throughout the period 1991–2008, with fairly uniform prevalence each year. During the period there were a total of 26 092 cases of ATI, an average of 1450 cases a year. Total morbidity for the entire period was 1304.6 per 100 000, a yearly average of 72.4 per 100 000, with a clear tendency to maintenance.

During the period, ATI continually ranked between fourth and sixth among the ten most frequently reported infectious diseases in the former Yugoslav Republic of Macedonia, depending on whether ATI epidemics had been more common in any specific year.

Syndromes related to ATI tend to be seasonal (with an increase during the summer months), with a few very large outbreaks reported in 2008, connected to specific closed communities and having one common source. As they are a normal feature of the general pathology, ATI will not be elaborated on further within this paper.

Salmonellosis – Recent studies on foodborne diseases show that disease episodes caused by Salmonella bacteria increase by 5-10% per each degree Celsius rise in temperature. During 1991–2008, 6969 cases of salmonellosis were reported in the former Yugoslav Republic of Macedonia, with total morbidity of 340.3 per 100 000, or an average of 387 cases a year, with an increasing trend in recent years.

Shigellosis – In the former Yugoslav Republic of Macedonia during 1991–2008, a total number of 2652 cases of shigellosis were reported, or 147 cases a year, with a total morbidity of 132.6 per 100 000 inhabitants for the entire period. The trend has significantly decreased over the last eight years, with the average being 35 reported cases each year. This is most likely due to improved access to safe food and drinking water as well as other provisions, proper and hygienic disposal of liquid and solid waste substances, and increased levels of health education and information among the general population regarding hygiene, safe food preparation, etc.

Campylobacter – The risk of infections caused by Campylobacter is directly proportional to the increase in temperature. Recent studies show increased incidence of campylobacteriosis at 2-5% per each degree Celsius rise of temperature, based on weekly temperature data. Notwithstanding that it is mandatory to report cases of campylobacteriosis in the former Yugoslav Republic of Macedonia, there is currently no reliable information on its distribution, although estimates indicate that its incidence exceeds 18 000 cases annually.

Other foodborne pathogenic organisms causing concern in the context of climate change – These include Brucella, Hepatitis A, E. coli O157 H7 (EHEC) and bacteria causing bacterial food poisoning (e.g. Clostridium perfringens). As far as these pathogenic organisms are concerned, the effect of climate change remains within the area of speculation. However, due to their possible sensitivity to climate conditions and their importance for public health in the former Yugoslav Republic of Macedonia, they have been included in the programmes for monitoring and prevention of climate-change-related infectious diseases. Such diseases are subject to mandatory reporting under the current legislation.

From an epidemiological point of view, significant diseases in the region are brucellosis and viral hepatitis A. Brucellosis has been present for 30 years now in the former Yugoslav Republic of Macedonia. Over the last three years there were 287 reported cases in 2009, 490 reported cases in 2008 and 381 reported cases in 2007.

Hepatitis A is constantly present in the former Yugoslav Republic of Macedonia and there were 290 reported cases in 2009, 243 reported cases in 2008 and 257 reported cases in 2007.

3.2. WATERBORNE COMMUNICABLE DISEASES

Climate change will most probably have an impact on the incidence of waterborne infections, not only as a result of changing average meteorological parameters (e.g. rainfall), but also as a result of the increased frequency of extreme weather events, such as heavy rainfall, flash floods and droughts. Such extreme weather events will have an impact on the available quantity of water, on the quality of the water or on the availability of clean and safe water.

Waterborne pathogens include viral (Hepatitis A), bacterial (Cryptosporidiae, E.coli) and protozoan (Giardia lamblia) agents, which cause gastroenteritis.

Waterborne diseases may even occur following adequate treatment of water. An example of this is the epidemic of cryptosporidiosis associated with the urban drinking water supply of Milwaukee, Wisconsin, USA in 1989, which resulted in 400 000 cases. Heavy rainfall may contaminate watercourses by bringing human and animal faecal products and other waste substances into surface waters. There is evidence of contamination of the water during heavy rainfall by Cryptosporidium, Giardia and E. coli.

Floods and low water levels may both lead to contamination of water and higher disease incidence and mortality due to diarrhoea. Warming and the higher variability of rainfall increase the risk of greater burden of these diseases.

Pathogenic organisms identified as relevant for the former Yugoslav Republic of Macedonia in this context include:

Cryptosporidium – This has only recently been added to the list of infections that are mandatory to report; therefore, no details on incidence are available yet. No cases have been registered in the former Yugoslav Republic of Macedonia so far.

Giardia lamblia – This has recently been added to the list of infections that are mandatory to report. At the moment no incidence data is available, other than information on laboratory isolates.

Leptospirosis – There is firm evidence showing that leptospirosis is affected by climate conditions. In the former Yugoslav Republic of Macedonia, eight cases were reported in the period 1991–2008. Due to the lack of diagnostic facilities, it is assumed that a large number of cases have not been reported. Regions at high risk might include the rice fields in the region of Kocani, in addition to urban areas, river banks and lakes.

3.3. VECTOR-BORNE COMMUNICABLE DISEASES

Vector-borne infections are passed onto humans from arthropods or mammals, including rodents. Arthropod vectors, such as mosquitoes and ticks, are cold-blooded and thus especially sensitive to climatic factors.

Climate change might have an impact on the distribution and the activity of arthropods. In addition, rodents are reservoirs of a large number of human diseases and the population of rodents is subject to the impact of weather conditions. Warm winters and warm springs may increase the population of rodents, a phenomenon that has been reported over the last few years. Climate is an important factor for the distribution of vectors, in addition to other factors such as the destruction of their habitats, pest control and the density of hosts.

Some vector-borne diseases sensitive to climate change have already been reported in the former Yugoslav Republic of Macedonia (e.g. Lyme disease) and there are some infections that might occur in the future (e.g. West Nile fever).

The vector-borne diseases listed below have been identified as a possible threat of primary significance for the former Yugoslav Republic of Macedonia in relation to climate change:

Crimean-Congo haemorrhagic fever (CCHF) – During the period 2000–2008, cases of CCHF were reported from Bulgaria, Albania, Kosovo, Turkey and Greece (ECDC 2009). The expansion of the disease is ascribed to mild winters as well as to the cessation of agricultural activities, which has led to an increased population of ticks. Infections are also to be expected in the former Yugoslav Republic of Macedonia. It is believed that potent vectors (such as H. marginatum rufipes) are already present in the former Yugoslav Republic of Macedonia. CCHF was reported in the former Yugoslav Republic of Macedonia in the 1970s, when it caused thirteen infections and a few fatalities in the village of Ciflik, near Tetovo.

West Nile fever (WNF) – This disease is caused by a virus that has emerged a few times already, causing some epidemics within the Mediterranean region and Eastern Europe. The disease is usually transmitted through the bites of mosquitoes which have been infected by feeding on infected birds. The infection causes encephalitis in animals (horses) and humans. The spread of West Nile fever in Europe is likely to result from a combination of factors, including weather conditions, abundance of mosquito vectors and infected migratory birds. No cases have been reported in the former Yugoslav Republic of Macedonia so far, although it is likely that cases may have occurred but not yet been diagnosed.

Haemorrhagic fever caused by hantavirus – Hantavirus is transmitted from rodents to humans through excretions (urine). In rare cases, the virus causes haemorrhagic fever with renal syndrome (HFRS). Hantaviruses are endemic on the Balkan Peninsula. An outbreak of haemorrhagic fever with renal syndrome occurred in 2002 in Serbia and Montenegro. No reported cases have been reported in the former Yugoslav Republic of Macedonia so far.

Chikungunya – Chikungunya is transmitted through mosquitoes of the species Aedes, primarily by the so-called 'tiger mosquito' (Aedes albopictus), which has already become endemic in Albania. It is believed that the former Yugoslav Republic of Macedonia is likely to be colonized by Aedes albopictus and therefore prone to the emergence of chikungunya, though no cases have been reported in the former Yugoslav Republic of Macedonia so far. The latest research on the presence of Aedes albopictus in the former Yugoslav Republic of Macedonia, performed in the summer of 2010, showed this vector is not yet present.

Lyme borreliosis (LB) and tick-borne encephalitis (TBE) – Lyme borreliosis (LB) is the most prevalent tick-borne disease in Europe and is endemic in the former Yugoslav Republic of Macedonia. Mild winters may increase the abundance of ticks and increase the risk of infections. Tick-borne encephalitis is a viral disease that can be prevented by the use of vaccine; it is considered endemic in the Balkan region. Like LB, TBE is transmitted through the Ixodes ricinus ticks, which are commonly found in all regions of Europe. A very limited number of cases with specific clinical presentation have been treated in the Clinic for Infectious Diseases.

Leishmaniasis (visceral (VL), cutaneous) – In Europe, Leishmaniasis is a disease transmitted by sandflies. Dogs are the main carriers of the pathogen. Visceral leishmaniasis (VL) is a severe clinical disease, which is endemic in Southern Europe, including the former Yugoslav Republic of Macedonia. During the period 1991–2008, there were 91 cases of the more severe visceral leishmaniasis in the former Yugoslav Republic of Macedonia, with an incidence of 4.6 per 100 000, or an average of five cases a year. Studies indicate a significant potential for climate conditions to influence the distribution of leishmaniasis in the future.

Malaria – Despite a few models that anticipated potential expansion of the malaria vector in Europe, a consensus has been reached that the risk of further spread is very low, taking into account the current socio-economic conditions. The former Yugoslav Republic of Macedonia has been certified malaria-free by WHO since 1973. During the period 1974–2010, there were 1–2 reported cases of malaria annually, all of which were imported.

Dengue – At the moment, the risk of local transmission of dengue in Europe is low. The reappearance of the disease is subject to a possible repeated import of the principal vector in Europe, the mosquito Aedes aegypti. However, Aedes albopictus, which is already present in Albania, Italy and some other European countries, is also capable of transmitting dengue and caused the first indigenous cases of dengue in France in September 2010. There have been no reported cases of dengue in the former Yugoslav Republic of Macedonia so far.

Rickettsia conorii – In a study conducted in 2003, this pathogenic organism causing Mediterranean cerebro-spinal meningitis (MSF) was found in Albania and Turkey in certain species of ticks that do not belong to the family Ixodes. The results of that study indicated that Rickettsia conorii could be endemic in the Balkan region.

4. CLIMATE CHANGE ADAPTATION, HEALTH PROMOTION, AND PREVENTION

The health care system has an important role in establishing adaptation, health promotion, prevention and response measures against the health risks related to climate change and communicable diseases, such as:

- Strengthening existing public health capacities for early detection and adequate response to communicable disease outbreaks;
- Anticipating the consequences of emerging communicable diseases possibly related to climate change; and
- Raising awareness among the general population about the possible links between climate change and communicable diseases.

4.1 CLIMATE CHANGE ADAPTATION

Measures for adaptation to climate-change-related health risks are aimed at reducing the effects of climate change on human health and they can be categorized as follows:

Primary adaptation measures: Measures aimed at preventing the initiation of disease occuring as a consequence of certain environmental conditions among the exposed population;

Secondary adaptation measures: Preventive measures aimed at providing a response to the early evidence of impacts on health (e.g. strengthening disease control and providing an adequate response to the disease); and

Tertiary adaptation measures: Health care measures aimed at reducing the mortality or morbidity caused by disease (e.g. improved diagnostics and treatment of certain infectious diseases).

Adaptation to potential consequences of climate change on communicable diseases at local and regional levels encompasses public health measures in the following fields:

- Establishing early warning systems;
- Systematic control and surveillance of foodborne, waterborne and vector-borne diseases;
- Upgrading existing facilities for laboratory diagnosis and expertise; and
- Promoting and improving the health education of the general population, promoting hygiene measures among the population and enforcing environmental protection measures.

Adaptation measures form part of the National Climate Change Health Adaptation Strategy.

As regards the surveillance of communicable diseases, the former Yugoslav Republic of Macedonia has in place a syndrome-based early warning system (EWARN system that includes reporting upon eight syndromic diseases, such as diarrhoea outbreaks, acute haemorrhagic fevers, etc.) and a system for mandatory reporting of diseases under the Infectious Diseases Protection Law.

In respect of laboratory capacity, it should be noted that an external assessment in November 2009 identified that the country is lacking capacity for laboratory confirmation of chikungunya, dengue haemorrhagic fever, leptospirosis, hantavirus disease, Crimean-Congo haemorrhagic fever (CCHF), West Nile fever (WNF) and tick-borne encephalitis (TBE). Taking into account the epidemiological situation of CCHF in neighbouring countries, especially in Albania, it may be assumed that CCHF is also endemic in the former Yugoslav Republic of Macedonia. Additional emerging pathogens might include West Nile fever and hantavirus disease. Although there have been no laboratory-confirmed cases so far, this is largely due to the lack of laboratory capacity, which underlines the need for establishing adequate laboratory facilities.

In addition, it is necessary to provide for continuous education of medical staff regarding the health risks associated with climate change. Part 2 of this document contains some guidance for employees in the public health sector, both at local and national levels, with a view to raising awareness about the health risks of infectious diseases associated with climate change.

4.2. HEALTH PROMOTION

About 10% of the population in the former Yugoslav Republic of Macedonia still lacks access to clean and safe water, be it for drinking or for meeting their basic needs. In addition, there are year-on-year growing trends for certain groups of communicable diseases, especially those associated with contaminated food and water (salmonellas, alimentary toxic infections, shigelloses).

In this regard, the key activity for the health sector must be health promotion and improvement of health education for the general population, as well as the promotion of good hygiene practices. Health education campaigns should promote good hygiene and include guidance on the safe preparation of food, education about avoiding certain foods in specific climate conditions, and sanitary-hygienic knowledge for individuals with their own water supply and food production facilities. Education and information of the public should especially be targeted to those parts of the country that are at higher risk due to shortage or lack of water.

Key activities for health sector institutions should include health education and information for the public; preparation of health advocacy materials, such as posters and leaflets providing information about infectious diseases, and distribution thereof; and media campaigns for health promotion.

Information leaflets and health promotion materials should provide:

- Information on the transmission routes of the most common diseases associated with the consumption of contaminated food and water, on practical measures for prevention, and information on the need for boiling water, especially for population groups without access to safe drinking water;
- Information on transmission by specific vectors and associated preventive measures, such as wearing ap propriate clothing or applying insect repellents. (Further information can be found in Part 2.)

4.3 PREVENTION

4.3.1 GENERAL PREVENTIVE MEASURES

General measures to maintain personal and collective hygiene and protect from communicable diseases include:

- Avoiding food and water that might be contaminated;
- Avoiding contact with animal faeces;
- Provision of safe food and drinking water;
- Proper storage and safe transport and cleaning of equipment prior to use for food preparation;
- Proper disposal of human excretions;
- Extermination of mice, flies, cockroaches and other pests;
- Avoiding close contact with stray animals (cats, dogs, etc.);
- Education of the general public, employees and patients in health care institutions and day centres on how to improve personal hygiene and on the importance of washing hands prior to handling food and taking meals and after using the toilet;
- Installation of filters in water supply facilities which process drinking water and at places exposed to risk of faecal contamination from humans and animals;
- Protection of public water supply facilities from faecal contamination, by providing several protection zones;
- Appropriate and regular disposal of faecal and other liquid substances, following rigorous sanitary procedures; and
- If necessary, in cases of uncertain hygienic conditions, provide for boiling of water and for chlorination or iodination of the water.

4.3.2 PREVENTION OF FOODBORNE COMMUNICABLE DISEASES

Higher temperatures and climate change are the reason for the increased incidence of foodborne diseases.

Living organisms constitute biological risks for food contamination, including pathogenic microorganisms – bacteria, moulds, viruses, parasites and pests (birds, flies, rodents, cockroaches, etc.). The most common microorganisms include Salmonella, Staphylococcus aureus, Clostridium perfringens, Clostridium botulinum, Shigella, Listeria, and all types of Bacillus, Proteus, Staphylococcus, Enteroccocus faecalis.

Food poisoning episodes caused by viruses are unlikely, as viruses do not grow in food. However, viruses are present inside living organisms – in animals, in faeces, in water, etc. – and can be transmitted to humans.

There have been large epidemics of food-poisoning due to consumption of contaminated food (such as fresh milk and meat, fruit juices produced on a farm, fermented milk, unpasteurized milk, salads and young vegetables, raw food, homemade mayonnaise, creams, ice-cream, etc.).

The most common causes of food poisoning include:

- Storing food at room temperature;
- Preparation of food much earlier than required for consumption;
- Insufficient cooking and inappropriate reheating of food;
- Food contaminated during processing;
- Consumption of raw food (eggs, meat, etc.);
- Contamination of canned food;
- Inadequately thawed food;
- Cross-contamination;
- Contamination of food from unwashed hands;
- Irrigation using contaminated water; and
- Using unsafe water in food preparation.

Preventive measures should be enforced at all levels of society. WHO guidance on essential preventive activities to inform the public about foodborne diseases is included at Annex 1. It covers maintaining of cleanliness and hygiene, keeping raw and cooked food separate, hygienic preparation and safe handling of food and ensuring safe drinking water supply.

4.3.3. PREVENTION OF WATERBORNE COMMUNICABLE DISEASES

The most important waterborne pathogens include E.coli, Hepatitis A, Legionellae, Leptospirae and Cryptosporidiae. Public health and preventive strategies relating to water are summarized at 4.3.1 above (General prevention measures). Additionally, the following measures are especially important for reducing infections caused by Cryptosporidia:

- Standard filtration of the water is often insufficient to eliminate the cryptosporidia; therefore, water should preferably be treated by boiling it for at least one minute (three minutes above 2000 meters above sea level). Boiling drinking water is actually the most efficient way to treat water infected with Cryptosporidi um. This is especially important given the fact that Cryptosporidia are highly resistant to chlorinated disinfection agents, though chlorine dioxide and ozone may still inactivate them if sufficiently high con centrations are used. However, the chlorine concentrations required for this purpose are generally so high that the application of chlorine disinfection is excluded from the list of appropriate methods to control Cryptosporidia in drinking water. Giardia intestinalis is also resistant to chlorine preparations.

- Efficient inactivation of the Cryptosporidia may be achieved by treating the water with relatively low doses of ultraviolet rays.

- Additionally, filtration through filters with a pore size not greater than 1 micrometer, or filters specifically intended for removal of the cysts of Cryptosporidium, will also be effective in making the water safe.

- Bottled drinking water is less likely to contain Cryptosporidium, especially if it originates from under ground springs.

- Persons suffering from cryptosporidiosis should avoid bathing in public swimming pools, baths, etc., as Cryptosporidia may inhabit the anal and genital regions and could be washed out into the water, creating a risk for other swimmers. Infected persons should refrain from using public water sources for at least two weeks after cessation of the diarrhoea to avoid the risk that the oocysts are still able to detach and disseminate during this period.

- In addition, infected persons should keep away from immunocompromised persons.

- Persons with compromised immune systems should take precautions to protect themselves from the water in lakes and watercourses.

- Immunocompromised persons should keep away from animal faeces and keep their contact with animals to a minimum and, if such contact is unavoidable, should wash their hands thoroughly after each contact. For safety reasons, they should boil drinking water and filter it appropriately.

- They should also wash and cook vegetables thoroughly.

The general and overriding message in the prevention of food- and waterborne infectious diseases can be summarized in one sentence: Protect food and drinking water from faecal contamination.

For treatment of patients with foodborne diseases, early detection and diagnosis of the infection is necessary, followed by hospitalizing the patient and providing information to the general public on how to prevent its spreading. Suitable diagnostic procedures and capacities exist for most of the foodborne diseases, but more sophisticated equipment, tests and diagnostics are necessary.

4.3.4. PREVENTION OF VECTOR-BORNE COMMUNICABLE DISEASES

A. PROTECTION AGAINST MOSQUITO BITES

Mosquito-borne diseases identified as a possible risk for transmission to humans in Macedonia are chikungunya, West Nile fever and dengue. Cutaneous leishmaniasis is usually imported in the Balkans: only the visceral leishmaniasis, which can be transmitted by sandflies, has been recorded up to now.

The following recommendations for avoiding and minimizing the risk of mosquito and sandfly bites are made:

- Wear long garments, with long sleeves and trousers to cover the limbs.

- Use insect repellents; however, great care should be taken when using these preparations in the presence of infants and elderly persons.

These measures should be undertaken especially after sunset or in the early morning hours, when the mosquitoes are most active.

- Use anti-mosquito coils, repellents and electrical vaporizers during daylight hours.

In the event that there is an outbreak of a potentially dangerous disease that is transmitted through vectors (e.g. West Nile fever, malaria), the following additional measures should be taken:

- Use bednets to protect babies and young children, the elderly and other people who need to rest during the day. The efficiency of the nets may be improved if treated with insecticides.

- Curtains (made out of textile or bamboo) protecting windows or doors may also be treated with insecticides in order to deter or kill mosquitoes.

It is very important to protect the community against further spread of the infection through already infected persons. In this regard, it should be remembered that mosquitoes become infected upon biting infected persons.

B. VECTOR CONTROL MEASURES

The public should be informed about vector control measures as set out in Annex 2. There are some registered and officially approved insecticidal substances available in the former Yugoslav Republic of Macedonia for vector control measures.

C. PROTECTION AGAINST TICK BITES

Tick-borne diseases that are known to be or are possibly present in the former Yugoslav Republic of Macedonia are Lyme borreliosis, tick-borne encephalitis, Crimean-Congo haemorrhagic fever and Mediterranean spotted fever.

Public education should include the following:

- Persons at specific risk are those who are exposed in nature and in green areas (game wardens, forest workers, hunters, picnickers, etc.): ticks are found in nature, yards, green areas, parks, meadows and forests.

- A tick bite is usually painless. Ticks may remain for several days in the site of the bite on the skin, until they have sucked enough blood. Over the course of the year, ticks remain active between early spring and late autumn, being most active in June.

- Tick-borne encephalitis (TBE) may also be transmitted through unpasteurized milk and cheese.

The following information about protection measures and removal of ticks is useful:

How to protect yourself from ticks

- Light-coloured clothes highlight ticks and make them more visible.

- Long sleeves and tucking the shirt into trousers give protection.

- Walking through tall grass should be avoided; the same goes for forest and wet areas covered with leaves – this is where ticks like to hide.

- Use roll-ons or sprays to protect your skin from insects or ticks.

- Always check your clothes and skin carefully after spending time in nature.

- Ticks like to hide in warm, wet parts of the human body such as armpits, groin, behind the elbows or knees, in the wrinkles of the back of the neck, the umbilicus and the ears.

- Keeping grass mown short or modifying the environment may protect people from exposure to ticks.

Recommendations for removing ticks

- If you have been bitten, removal of the tick within 24 hours markedly lowers the risk of becoming infected with Lyme borreliosis and tick-borne encephalitis.

- In the event of a bite, remove the tick from the skin carefully, without squeezing or breaking it.

- Do not apply any chemical agents (ether, alcohol, petrol, oil, etc.) before removing the tick.
- Remove the tick using tweezers by gripping the proboscis of the tick (the mouth parts) closest to the skin. Once the tick has been removed, disinfect the affected spot.

- If you fail to remove the tick completely (e.g. a portion of the proboscis remains embedded in the skin), consult your doctor immediately.

- The site of the tick bite should be monitored for at least one month. Signs of reddening (erythema migrans) may be evidence of infection with Lyme disease, which will need treatment.

PART TWO

SPECIFIC INFORMATION COMMUNICABLE DISEASES RELATED TO CLIMATE CHANGE

Part two gives an overview of communicable diseases that are potentially linked to climate change and could be reported in the former Yugoslav Republic of Macedonia, in alphabetical order.

They have been identified as significant due to the possibility of an outbreak occurring which would make huge demands on the health budget, require highly sophisticated equipment, tests and methods for their laboratory confirmation, and could possibly affect a large percentage of the population. For each of the diseases listed below, information about the pathogen, epidemiology, clinical presentation, diagnosis, treatment and prevention is given.

Communicable diseases for which the most common mode of transmission is the faecal-oral route, through consumption of contaminated food and water – salmonellosis, shigellosis, alimentary toxic infections (food poisoning), campylobacteriosis, viral hepatitis A, listeriosis, brucellosis (alimentary mode of transmission) and E. coli infection (O157/H7) – are very common and normally present in the former Yugoslav Republic of Macedonia. They are regularly reported and a sufficient number of tests for their laboratory confirmation have been carried out, with standardized procedures as well as highly experienced personnel, and data on trends is available. Therefore, they are only covered in Part 1 of the manuals and are not included below.

CHIKUNGUNYA

Pathogen

Chikungunya is an 'arbovirus' (arthropod-borne) belonging to the genus Alphavirus in the Togaviridae family. In terms of its clinical presentation, chikungunya fever is very similar to dengue.

Humans become infected with the chikungunya virus (CHKV) after being bitten by an infected mosquito from the genus Aedes (Ae. aegypti or Ae. albopictus), which has become infected with CHKV by sucking blood from infected individuals. Infected mosquitoes then spread the virus to other individuals by biting them. Monkeys and some other animals can also serve as a reservoir of the virus.

Photo 1: Tiger mosquito (Aedes albopictus)

Given that humans are a very efficient reservoir of the virus, chikungunya is mostly found in urban areas. In fact, the epidemics represent a sustainable human–mosquito–human transmission cycle.

Epidemiology

The vector Aedes albopictus is known to be endemic in Albania. The former Yugoslav Republic of Macedonia is considered to be at risk for the establishment of Aedes albopictus and for subsequent chikungunya disease.

Photo 2: Geographical distribution of chikungunya

Clinical profile

Incubation lasts 1–12 days, but the most common period is 3–7 days. Inapparent, asymptomatic forms of CHKV are possible, but their frequency is unknown. CHKV infection (whether clinically manifested or not) creates lifelong immunity and is rarely fatal.

Symptoms include raised temperature up to 400C, petechial or maculopapular rash on the trunk and occasionally on the limbs, and arthralgia or arthritis affecting several joints (especially on the limbs, e.g. ankles, wrists, fingers) with pain that can be severe. About 50% of cases develop maculopapular rash. Children usually develop a bullous rash, but they can also develop localized petechiae and gingivorrhagia. Sudden onset of flu-like symptoms is also possible, including severe headaches, fever, malaise, nausea, vomiting, muscle and joint pain.

Other, non-specific symptoms include headaches, conjunctival infection and mild photophobia. In typical cases, a raised temperature lasts for two days and then falls suddenly. However, the other symptoms such as joint pain, intensive headache, insomnia and ultimate degree of prostration last longer, usually around 5–7 days. Joint pain can last longer, depending on a patient's age. Young patients recover within 5–15 days, middle-aged patients in 1–2½ months, and the elderly take longer than that. The clinical profile is milder and shorter in young patients and pregnant women.

Possible complications include gastrointestinal problems, cardiovascular decompensation and meningoencephalitis. Deaths from chikungunya fever have been reported only among elderly patients or those with reduced immunity in the first place.

Diagnosis

Diagnosis is confirmed with RT-PCR, virus isolation and serological tests. A biological safety level 3 laboratory is required for isolating the virus. Serological diagnosis requires a large amount of blood and employs ELISA for the purpose of determining the concentration of the chikungunya-specific IgM antibodies. The recommended protocol includes RT-PCR in serum from the first until the fifth day from the onset of the disease, and serological investigations with detection of IgM as of the sixth day onwards.

Treatment

There is no specific treatment for the disease itself. Treatment consists of rest and fluid intake with medicines to alleviate the symptoms (temperature and pain, especially for patients with arthritis). Ibuprofen, naproxen, acetaminophen or paracetamol are acceptable but aspirin should be avoided, due to the risk of haemorrhage and also the possibility of Reye's syndrome. There are high hopes for chloroquine as a possible treatment for the symptoms associated with chikungunya, including as an anti-inflammatory drug for the associated arthritis. Infected individuals should be protected against any further exposure to mosquitoes (they should stay at home, protected with mosquito nets), especially during the first couple of days of the disease, in order to prevent them from contributing to the transmission cycle and to reduce the risk of further spread of the disease.

Prevention

There is no vaccine against chikungunya viruses. For prevention measures, see 4.3.4.

CRIMEAN-CONGO HAEMORRHAGIC FEVER

Pathogen

The genus Nairovirus family Buniaviridae (RNA virus) comprises 32 different species that are transmitted via argasid or ixodid ticks, but only three are capable of causing disease in humans: the virus of the Crimean-Congo haemorrhagic fever (CCHF) is the most important human pathogenic virus among them, the other two being Dugbe and Nairobi sheep disease viruses.

Epidemiology

Crimean-Congo haemorrhagic fever is transmitted via ticks of the genus Hyalomma (mainly H. marginatum marginatum, H. Marginatum rufipes). Livestock (cows, sheep, goats and camels) are a primary reservoir (normally without symptoms). Rabbits and hedgehogs usually serve as amplifying hosts for the immature life stages of ticks, whereas domestic animals are the usual hosts for the adult ticks (humans are not the preferred host for the ticks of the genus Hyalomma, which rarely bite people). Infected ticks transmit the virus for life.

Transmission is also possible through direct contact with the blood of infected animals or humans. Nosocomial infections may also occur.

The CCHF virus may infect a large number of domestic and wild animals. Many bird species are resistant to infection, but ostriches are vulnerable and exhibit a high prevalence of infections in endemic areas. Both animals and humans become infected after being bitten by an infected tick.

Groups at risk include farmers, slaughterhouse workers, veterinarians and health workers (nosocomial transmission). Meat cannot be a source of infection for two reasons: firstly, the virus is deactivated by tissue acidifcation after the slaughtering of the animal, and secondly, it cannot survive the cooking process (boiling, roasting, etc.). Health workers who do not adequately follow the procedures and measures for personal protection while providing care to patients with profuse bleeding/haemorrhages in a hospital setting may also be infected (nosocomial infection).

Crimean-Congo haemorrhagic fever (with clinical manifestation) is present in northern Greece, Albania, Kosovo, Turkey and Bulgaria. Serological evidence in humans has been reported in Portugal, France and Hungary. The mild winters were followed by outbreaks of CCHF in Kosovo in 2001 and in Turkey in 2004. In the northern hemisphere, the tick Hyalomma marginatum marginatum normally becomes active with the rise in temperature in spring (starting in April), and the immature forms are active in the summer months (between May and September).

Clinical profile

Duration of the incubation period depends on a number of factors, including the the viral load and the manner of becoming infected. Following a tick bite, the incubation period is normally 1–3 days (up to a maximum of 9 days), and after contact with infected blood or tissues 5–6 days (documented maximum, 13 days). In general, the incubation period is longer following nosocomial infection. The symptoms of Crimean-Congo haemorrhagic fever are a sudden-onset fever, headaches, severe myalgia, arthralgia and neck pain.

Patients are often confused or aggressive. After 2–4 days, agitation can be replaced by dizziness, depression or tiredness. Nausea, abdominal pain and diarrhoea are often present. The following symptoms can occur between the third and fifth days: haemorrhages (petechiae, ecchymoses, melaena, upper intestinal bleeding), haematuria, epistaxis, etc. Signs of hepatitis are often present, with icterus. In severe cases, usually after the fifth day from the onset of the disease, the patient may develop signs of hepatorenal syndrome and respiratory failure. The death rate is 2–50%.

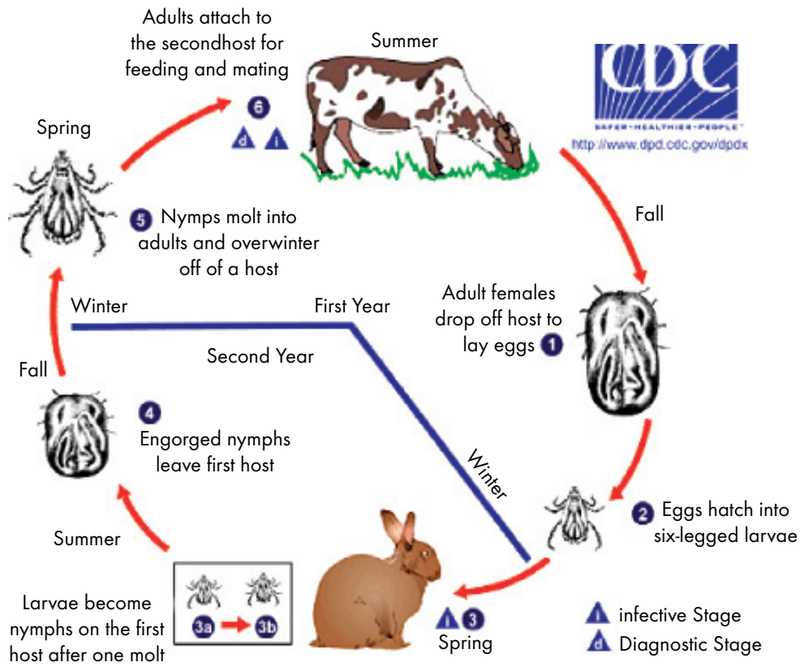

Photo 3: Two host life cycle of CCHF virus

Diagnosis

Diagnosis must be done in laboratories with a high level of biological safety. IgG and IgM antibodies can be detected in serum through enzyme-linked immunoassay starting as of day six of the disease. RT-PCR detects the virus genome of CCHF until 10–15 days after the onset of the disease. Given that the CCHF virus is considered a high-risk pathogenic organism, specific protocol is required for its investigation.

Treatment

Treatment mainly consists of supportive therapy for the symptoms and careful monitoring of replacement of fluids and blood products. Treatment with the antiviral drug ribavirin, administered as oral and intravenous formulation, can be effective. There has been no evidence yet of the efficacy of specific immunoglobulins (or plasma from patients who have recovered from CCHF) for therapeutic purposes, which have hitherto been used several times.

Prevention

See C. Protection against tick bites in section .4.3.4, Prevention of vector-borne communicable diseases.

CRYPTOSPORIDIUM

Pathogen

Cryptosporidium is an intestinal parasite found in different animals. It belongs to the Coccidia, similar to Isospora. The genus Cryptosporidium can cause an intestinal infection in immunocompromised persons (e.g. those with AIDS) and lead to a severe diarrhoeal episode.

This agent is known from the past as a parasite found in rodents, monkeys, cattle, sheep, cats, dogs, birds and lizards. However, it was not recognized as the cause of mild gastroenteritis and severe diarrhoea, which would heal spontaneously among the majority of the population. It can also cause pneumonia.

Cryptosporidia are relatively small parasites, 2–5 milimicrons in size. They are intracellular, sphere-shaped microorganisms, localized in the mucous membrane of the stomach or the lower parts of the intestines. Cryptosporidium forms oocysts, which can survive for months in humid soil or water as well as in harsh environments (drought, ice, etc.).

There are several Cryptosporidium genotypes, the most common in humans being C. hominis and C. parvum (also found in other mammals). Other genotypes are found less often: C. meleagridis (in turkeys), C. muris (in mice), C. anderson (in cattle), C. felis (in cats), C. baileyi (in chickens), C. canis (in dogs), C. galli (in birds), C. serpentis (in snakes) and C. saurophilum (in lizards).

Epidemiology

Cryptosporidium has been selected as a subject of study and risk assessment because of its persistence and ubiquity in nature, as well as its resistance to chemical disinfectants, which makes it one of the most serious pathogenic organisms found in drinking water. Several studies have shown that infections by Cryptosporidium are associated with extreme weather events, for example heavy rainfall. The parasite is excreted in faeces of infected animals and humans.

Since its detection in 1984, there have been many epidemics due to omissions and shortcomings in water treatment and distribution. There have been large epidemics as a result of the inadequate treatment and filtration of the water supplying large cities, such as the epidemic in Milwaukee in 1993, with 370 000 cases.

This infection has also been found in hospitals, outpatient clinics, kindergartens and swimming pools. This agent can survive the majority of disinfection procedures such as chlorination.

Transmission of the disease from person to person or from animal to person usually happens through contaminated water and food. Cryptosporidium has also been found in oyster shells and in fresh vegetables, which suggests the infectious agent can be transmitted by eating these foods. Cryptosporidiosis occurs after contact with animal or human faeces containing the causative agent, or through the use of food and water contaminated by faeces.

The prevalence of Cryptosporidium in faeces ranges from 1–4% in Europe and North America to 3–20% in Asia, Africa, Australia and South and Central America. In industrialized countries, the highest prevalence is registered in children under five and in young people. In developing countries, Cryptosporidium is very common in infants under one year and is usually found in late summer.

Asymptomatic carrier rates range below 1%, although in day nurseries it is above 1%. High asymptomatic carrier rates (10–30%) are very common in developing countries. Seroprevalence there is generally higher and ranges from 25% to 35%, and in South America as high as 80%.

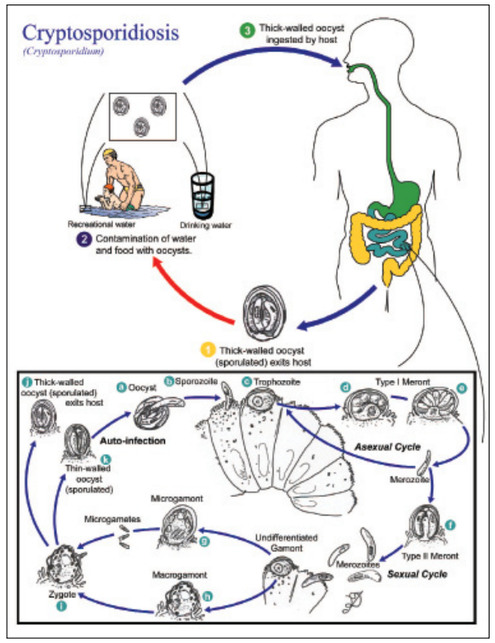

Photo 4: Life cycle of Cryptosporidium

Clinical profile

The incubation period of cryptosporidiosis is approximately one week and the basic clinical symptom is diarrhoea, which is normally mild and can heal spontaneously in a period of 1–2 weeks. The disease can be severe and long lasting in very young or old people, as well as in immunocompromised persons. The latter can develop profuse, life-threatening, watery diarrhoea that is difficult to cure. Extra intestinal cryptosporidiosis (pneumonia and disseminated) mainly occurs in immunocompromised persons (e.g. those with HIV and AIDS).

Asymptomatic infection is quite common in humans.

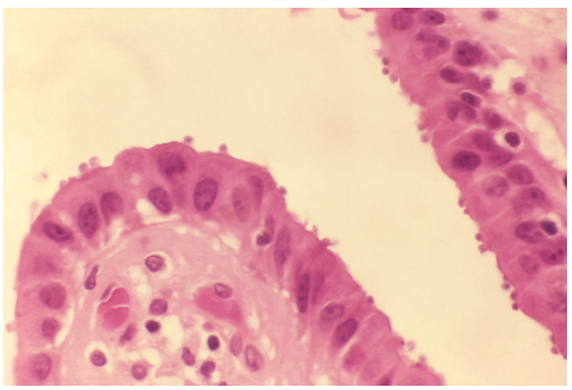

Photo 5: Histopathology image of Cryptosporidium organisms along luminal surfaces of epithelial cells.

Diagnosis

Diagnosis is established by finding oocyst in fresh stool specimens, using the Kinyoun method of concentration and modified staining for acidoresistant bacteria. Immunofluorescence (IF) assay with monoclonal antibodies for oocysts detection and ELISA for antigen detection in faeces and PCR can also be used

Treatment

Individuals with a normal immune system should not receive any treatment. Individuals receiving immunosuppressive therapy and those with AIDS or congenital immunodeficiency are given additional therapy.

Prevention

For prevention measures, see section 4.3.3, Prevention of waterborne communicable diseases.

DENGUE AND DENGUE HAEMORRHAGIC FEVER (DHF)

Pathogen

The species is Dengue virus from the genus Flavivirus in the family Flaviviridae. There are four closely related viruses or virus serotypes (Dengue virus 1-4). Vectors are Aedes aegypti and Aedes albopictus mosquitoes. Mosquitoes remain infectious throughout all their life, which in tropical regions can be several days to several weeks, but for overwintering females in temperate zones may be up to a year.

It should be noted that infected persons are able to infect the mosquitoes even if they do not have significant symptoms. There is an incubation period of about 8–12 days before the virus can be transmitted to another person.

Epidemiology

Dengue and dengue haemorrhagic fever (DHF) are acute febrile diseases, which can be life threatening, occurring mainly in subtropical areas. The disease is endemic in over 100 countries around the world and is common in urban environments.

Infection with one of the serotypes does not protect against the others and sequential infections pose a greater risk for the occurrence of dengue haemorrhagic fever (DHF) and dengue shock syndrome (DSS).

Clinical profile

Following an incubation period of 3–15 days (average 5–8), the disease starts with fever, headaches, pain behind the eyes when moving the eyes and pain in the lower back. Severe leg and joint pains occur during the first hours of the disease. Temperature quickly reaches 400C, accompanied by relative bradycardia and hypotension. The eyes go red and the face develops a reddish or pale pink rash that quickly disappears. Neck and inguinal lymph nodes are often enlarged. High temperature and other symptoms last for 2–4 days, followed by rapid fall to normal temperature and profuse sweating. There follows a short period with normal temperature when the patient feels better (lasting only one day), followed by a second, rapid increase in temperature. In addition, a characteristic rash occurs which spreads from the limbs to the whole body, except the face. Palms and feet can be bright red and swollen.

From a practical point of view, the three clinical forms of dengue can be observed as a progressive evolutionary model.The classic picture is characterized by high fever with no localized source of infection, a petechial rash with thrombocytopenia and relative leukopenia.

Dengue haemorrhagic fever (DHT) is manifested by:

Fever, constant headaches, eye pain, severe dizziness and loss of appetite; Haemorrhagic tendency (spontaneous bruising, bleeding from mucosa, gingiva, injection sites, etc.; vomiting blood or bloody diarrhoea) Thrombocytopenia (<100 000 platelets per mm^3 or estimated as less than three platelets per high power field) Evidence of plasma leakage (haematocrit more than 20% higher than expected, or drop in haematocrit of 20% or more from baseline following IV fluid, pleural effusion, ascites, hypoproteinaemia)

- Encephalitic episodes

Dengue shock syndrome is defined as dengue haemorrhagic fever plus:

- Weak, rapid pulse
- Narrow pulse pressure (less than 20 mm Hg)
- Cold, clammy skin and restlessness

Diagnosis

The diagnosis of dengue is usually made clinically. It is confirmed by isolating the virus from serum or material obtained from autopsy; a fourfold or greater change in HAI titre to one or more dengue serotypes in specimens; documenting a dengue virus antigen in autopsy material – tissue, serum or fluid – with immunohistochemical, immunofluorescent or ELISA techniques; or detection of dengue virus genome sequence with PCR.

Treatment
There is no specific treatment for dengue. Paracetamol is recommended to reduce temperature. The infected person should be isolated from the other family members until full recovery in order to prevent any further spread of the infection.

Prevention
There is no effective vaccine for Dengue viruses. For prevention measures, see 4.3.4. A. Protection against mosquito bites.

GIARDIASIS

Pathogen

Giardiasis (giardia) is an infection of the intestines caused by the parasite Giardia, a flagellated protozoan parasite that colonizes the small intestine of humans and animals. Giardia (Giardia intestinalis and Giardia duodenalis) causes the production of cysts and can cause disease in both humans and animals such as dogs, cats, cows and sheep. Giardiasis is widespread worldwide, especially in hot countries where there is inadequate hygiene and substandard hygiene-related infrastructure (inappropriate water supply system, lack of sewerage).

Giardia lamblia (also known by its old name of Lamblia intestinalis) is a pear-like flagellate (height 10–20 micrometers, width 5–15 micrometers) appearing in both vegetative and cystic form. The front part is wider and convex and the rear is concave and resembles a short mandolin or a short spoon. The infectious form is hardy and is called a cyst, which enters the intestines and starts to colonize before mutating to the active form (trophozoite).

Worldwide, 5–30% of the population is assumed to carry Giardia lamblia in their digestive tract. It is estimated that in countries with moderately hot climate, 2–10% of the adult population and about 25% of children are infected.

The disease usually affects children, travellers, men who have sex with men, mentally disabled persons, people who have had a gastrectomy or have reduced secretion of stomach acid, people with chronic pancreatitis and people with reduced or deficient immunity. Cases of this disease have also been reported among hikers and campers, where spread of the infection through drinking water is common because of inappropriate treatment of the water. The cyst can survive quite a long time in an external environment (up to three weeks) and water chlorination alone cannot destroy it.

The infection has a faecal-oral transmission route, usually through contaminated hands, food or water. The reservoir of infection includes sick people who transmit the infection from person to person through indirect contact. It can also be transmitted through direct contact among children and through food and water contaminated by faeces. There is also a possibility of transmission of the disease from domestic animals (dog, cat) or wild animals (beaver, monkey) to humans as a zoonosis. Flies and cockroaches may have a role in transmission.

The infection is highly endemic in some countries in Africa, Southeast Asia, South America and Eastern Europe.

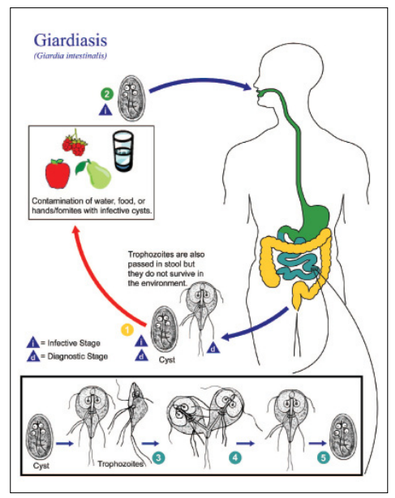

Photo 6: Life cycle of Giardia lamblia

Clinical profile

Giardias are usually apathogenic, commensal parasites in the duodenum and intestines. Clinical symptoms may include dyspepsia, acute or chronic diarrhoea and signs of malabsorption.

Symptoms of acute giardiasis begin after the incubation period of 1–3 weeks, with epigastric pain and spasms. Stools may vary from watery to thicker ones, may be profuse, foul-smelling and sometimes pale. They can be foamy and explosive, usually in the morning, or 3–5 times during the day. There are sometimes voluminous, greasy stools. There is no blood in the faeces. Tenesmus stools occur especially in the morning and after meals. Other symptoms include loss of appetite, fatigue, bloating sensation, belching, flatulence, anorexia, loss of weight. The symptoms of chronic giardiasis are similar to the acute form, but milder and periodic.

Diagnosis

Diagnosis is based on detection of the cysts or trophozoites of the protozoan. Trophozoites can be detected in the duodenal mucosa or in the fluid from intestinal lavage. A minimum of three stool specimens are tested for presence of the parasite.

If the three subsequent stools are negative, the more sensitive method of antigen detection may be employed (ELISA or immunofluorescent investigation) for confirming giardia.

Photo 7: Electron micrograph of Giardia lamblia in a late stage of cell division

Treatment

The treatment of symptom-free individuals is indicated in order to eliminate the source of transmission and prevent any further occurrence.

The most effective drug is metronidazole as a 5-day course (usual dose is 250 mg x 3 for adults; for children it is 15 mg/kg/day, in three doses). Tinidazole (single dose of 1.5–2 g) is also available – this drug is effective for over 90% of patients. In recent years albendazole has also been used for treatment.

Prevention

For prevention measures see 4.3, Prevention, including general prevention measures as well as specific measures for the prevention of waterborne and foodborne diseases.

LEISHMANIOSIS

Pathogen

Leishmaniasis is a parasitic infection which may manifest as a visceral or a cutaneous form. The protozoa Leishmania is part of the Trypanosomidae family. At least 20 species are able to infect humans. Leishmania donovani and Leishmania infantum cause an acute visceral disease and they have different geographical distribution worldwide. For the European region, the Mediterranean type of visceral leishmaniasis is characteristic, while the cutaneous form is reported rarely as imported from endemic countries. The disease is transmitted through sandflies of the Phlebotomus species.

Leishmania major and L. tropica cause the worst chronic cutaneous form of Leishmaniasis in Europe, Asia and Africa. Chronic cutaneous and visceral leishmaniasis are caused by L. amazoniensis, L. mexicana, L. brasiliana, L. guinea, and L. peruana in South America.

Leishmaniasis is a disease that mainly affects mammals. The zoonotic reservoir can be found in rodents (L. major, L. amazonensis, L. mexicana, L. braziliensis), marsupials (L. amazonensis, L. mexicana, L. braziliensis), monkeys (L. braziliensis) and carnivores (L. infantum). In Europe, dogs are the main reservoir animal of concern. Infection in animals is most often asymptomatic but it can also be fatal.

Sources of infection can be found in natural hot spots: wild animals, dogs and, less often, domestic animals and humans.

Photo 8: Phlebotomus papatasi sandfly

The main mode of transmission is through the bite of infected female phlebotomine sandflies (in Europe, Asia and Africa) and sandflies of the Lutzomyia species (America). Female sandflies become infected with leishmaniasis while sucking blood from an infected person. The infection can also be spread through sharing of needles and syringes when taking drugs intravenously, or from mother to child.

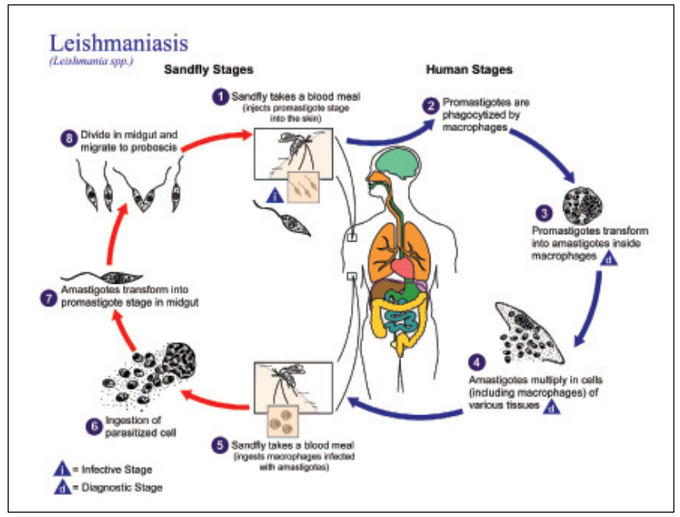

Photo 9: Life cycle of Leishmania spp.

Epidemiology

The highest number of infections with Mediterranean type VL is amongst children aged 5–10. The characteristic season is the hot months of the year because of the increased activity of vectors and rodents.

Leishmaniasis is recorded all over the world, including the whole Mediterranean region. This disease is due for the most part to changing climate conditions, including increased temperatures, rainfall and humidity. The largest endemic hot spots for visceral leishmaniasis include India, Bangladesh, Nepal, Sudan, Ethiopia and Kenya, where it is known as kala-azar and is caused by L. donovani.

Both the Mediterranean basin and the border areas of the Middle East are still affected by the visceral leishmaniasis epidemic caused by L. infantum. Over the last ten or so years, many asymptomatic carriers of HIV with leishmaniasis as co-infection have been reported in southern Europe. If co-infection with the visceral form of leishmaniasis and HIV occurs, the mean survival of the patient is only 13 months. Over recent years, there has been a high risk of cutaneous leishmaniasis caused by L. tropica in southern Europe as a result of abundance of vectors.

Clinical profile

The incubation period is 10–30 days but can sometimes be several months (3–18 months). However, the parasite may remain dormant and not present itself until a person's immune system becomes compromised.

Cutaneous leishmaniasis causes skin sores (which usually heal spontaneously and disappear in a few months, but can leave an unpleasant scar), depigmentation, erythema or haemorrhagic nodules. It is characterized by ulcers developing around the site of the bite. The type of leishmaniasis prevalent in the United States of America can affect the mucous membranes of the mouth, nose and throat in addition to the skin of the face.

Visceral leishmaniasis is a systemic disease characterized by fever, raised temperature, exhaustion, loss of weight, loss of appetite, anaemia, diarrhoea, enlargement of the spleen, liver and lymph glands, pancytopenia (normochromic/normocytic anaemia, leukopenia and thrombocytopenia), hypergammaglobulinaemia and low albumin. The visceral disease can be very severe and, if untreated, may even be fatal.

Some agents cause cutano-visceral forms (L. braziliensis and L. americana).

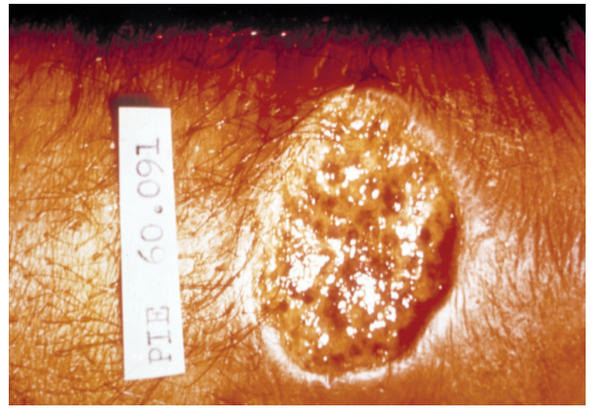

Photo 10: Crater lesion of leishmaniasis, skin

Diagnosis

Diagnosis of leishmaniasis is based on clinical parameters as well as microbiological and parasitological diagnosis. Microscopic identification of the parasite can be done from skin sores, blood, bone marrow, spleen biopsy, lymph nodes with Giemsa's stain to check for amastigotes.

RVK immunofluorescence and ELISA test are used for conducting serological investigation. Direct agglutination tests (DAT) for blood testing are available for visceral leishmaniasis and can be used under field conditions. A quick test can be done from urine of suspected visceral leishmaniasis cases. PCR diagnostic has also been used recently. In the former Yugoslav Republic of Macedonia diagnostic procedures are available for diagnosis of visceral leishmaniasis in several institutions.

Treatment

Pentavalent antimony preparations have been the primary drug for leishmaniasis for a long time, and they are still being used in many countries in tropical climates where the disease is endemic. They are given in the form of 5–20% solution over 7–10 days (20 mg/kg/daily, im, 28 days). Amphotericin B is also effective (1mg/kg, every other day, in 5% glucose, iv).

In addition, symptomatic and polyvitamin therapies are given. Antibiotics are prescribed in the case of secondary infection, based on the results of an antibiogram.

The treatment recommendations provided here are current as at 2010. Every suspected case should be consulted by an infectious disease specialist and treatment should be provided accordingly.

Prevention

At the moment, there is no vaccine for leishmaniasis in humans. For prevention measures, see 4.3.4 A., Protection against mosquito bites.

LEPTOSPIROSIS

Pathogen

Leptospirosis is a zoonotic infectious disease, endemic all around the world. It is caused by spirochaetes of the genus Leptospira. There are over 300 serotypes of strains of Leptospira interrogans that are pathogenic for humans, classified in 25 serogroups.

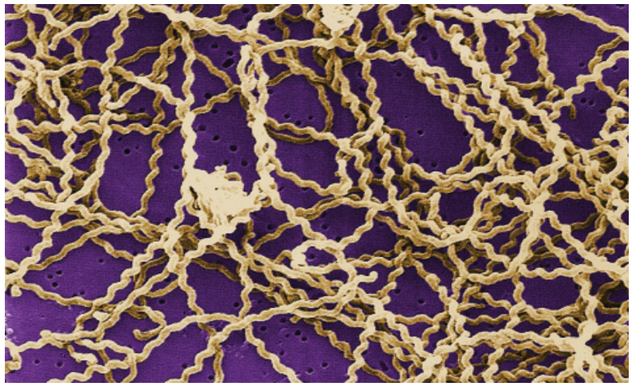

Photo 11: Scanning electron micrograph of Leptospira sp.

Epidemiology

Leptospirosis is the most widespread zoonosis in the world. Over the past decade, this disease has appeared globally and a number of epidemics have occurred all around the world. Pathogenic Leptospira organisms survive longer in a hot and humid environment. Consequently, the disease is especially prevalent in the humid tropical and subtropical areas. There is clear seasonality of the disease, with the highest number of cases in the period June–September.

In the last decade, leptospirosis has been recorded in persons who are frequent travellers and the number of leptospirosis cases is increasing in the countries of Western Europe. In Europe, leptospirosis is mainly found in the Mediterranean region and in Eastern Europe.

This disease usually affects domestic animals such as cattle, horses, pigs, sheep, goats and dogs and Leptospira organisms are excreted with the urine. The disease is transmitted to humans when they ingest food or water contaminated with the urine and other excretions from infected animals. Humans can also become infected through direct contact with the urine of infected animals, or through contact with contaminated objects and water or soil containing urine from infected animals. Other modes of transmission include contamination of broken skin and skin contact, especially with mucosal surfaces, such as the eyes, mouth or nose, and through sexual contact or through breast milk.

Professional exposure to infection occurs amongst slaughterhouse and sewerage workers, farmers, veterinarians, stockbreeders and military personnel. Other persons at risk include sugar cane pickers and rice growers, as well as individuals participating in water sports outdoors (swimming, kayaking and fishing).

Severe cases of leptospirosis are found in persons with reduced immunity and among elderly people.

Clinical profile

Leptospirosis is an acute infectious disease for which the incubation period is 2–30 days (average around 10 days). Clinical presentation is variable but is dominated by fever, muscle aches and icterus. The disease is usually mild or occasionally severe, but it can also be fatal.

The disease can occur in two phases: the first phase (4–9 days) is characterized by sudden onset of influenza-like symptoms, fever, severe headache, chills, muscle aches and vomiting; in the second phase the patient may develop fever, jaundice, abdominal pain, diarrhoea and eye infection. A more severe clinical course is also possible, characterized by haemorrhage often affecting liver, kidneys, lungs and heart and, less frequently, the brain. Depending on the organ affected, the disease can lead to liver damage, renal failure, cardiovascular problems, lung failure and meningitis.

Leptospirosis known as Weil's disease is the most well known and the most severe form, characterized by jaundice, oliguria, circulatory collapse and haemorrhage. Petechial haemorrhage occurs in parallel to the icterus.

Organ failure may occur in severe cases. If not treated, recovery can take up to several months. Mortality rate is low, but it is higher among elderly persons and can reach 20% or more in complicated cases.

Diagnosis

Confirmation of clinically suspected cases of leptospirosis is usually performed by isolating Leptospirae from blood, fluids and urine.

Photo 12: Photomicrograph of leptospiral microscopic agglutination test using darkfield microscopy technique.

Agglutination tests (i.e. the Microscopic Agglutination Test (MAT)) can be performed, which requires a well-equipped laboratory with experienced staff. ELISA test is used in serology, with epidemiological investigations playing an important role in confirming the diagnosis. Several rapid diagnostic tests are currently available and are mainly intended for monitoring purposes.

Treatment

Timely antibiotic treatment is effective. In severe cases, high doses of intravenous penicillin are recommended. In less severe cases, oral antibiotics such as amoxicillin and ampicillin are used. Doxicillin or erythromycin may also be used. Third generation cephalosporins and quinolone antibiotics are also effective treatments.

The treatment recommendations provided here are current as at 2010. Every suspected case should be consulted by an infectious disease specialist and treatment should be provided accordingly.

Prevention

- Wear protective clothes whenever exposure is suspected (boots, gloves, glasses, aprons, masks).
- Wash or shower after exposure to urine or contaminated soil or water.
- Wash and clean wounds.
- Wear gloves when handling urine of dogs or other animals and then wash hands thoroughly. Be aware of the possibility of infection while caring for sick dogs or other animals.
- Apply all hygiene measures strictly when handling animals and avoid contact with their urine or other bodily fluids.
- Wherever possible, disinfect contaminated areas (scrub the floor in barns, butchers' shops, slaughterhouses, etc.).
- Prevent access to, or put adequate warning signs near, bodies of water that are known to be or suspected of being polluted (swimming pools, ponds, rivers).
- Prophylaxis with doxicillin can provide some protection for persons who are at higher risk of exposure.

Vaccines providing short-term protection are available for domestic animals (cattle, dogs and pigs) and people with a high professional risk of infection in a limited number of countries (Italy, Cuba, France, Spain), but currently it is not considered a generally acceptable option. The risk of infection through domestic animals can be reduced with vaccination or carrier treatment. Both approaches should be combined under a joint management exercise.

LYME BORRELIOSIS – LYME DISEASE

Pathogen

Lyme disease is an acute infectious disease caused by the spirochaete bacteria Borrelia burgdorferi. The main vector in Europe is the Ixodes ricinus tick and I. persulcatus in Euroasia and Asia.

Photo 13: Ixodes scapularis – transmitter of Lyme disease

Epidemiology

In the United States of America, where the disease was first recognized, about 30-35% of ticks are infected. However, the European Lyme disease differs from that in North America in that there are several different pathogen strains in Europe but only one in America. There are several reservoir animals (rodents, hares, birds, etc.) involved in the transmission cycle in Europe, where larger animals like deer are important blood hosts for the tick vector.

All adults are considered equally susceptible to the infection. However, highest morbidity rates are recorded in children aged 2–15, people aged 30–55 and elderly people.

The most significant risk factor for catching the infection in endemic areas includes spending time in suburban or rural forest or shrubby areas infested by infected ticks. It is assumed that the highest number of cases are due to periresidential exposure to infected ticks by people involved in recreational activities in their spare time, or in property maintenance activities.

An increased risk for catching Lyme disease (LD) has been registered in persons involved in recreational activities outside of the home (e.g. picnic, camping) and in persons who carry out their profession in the open air (landscape painters, foresters).

Clinical profile

Like the other spirochaetal diseases, LD goes through several stages with various clinical symptoms in each stage. The first stage comprises cutaneous symptoms and lasts for weeks; the second stage displays neurological and cardiological disorders and lasts for months; the third stage is characterized by joint problems and lasts for years.

Infected persons cannot pass the disease to other people. Lyme disease is curable, provided it is detected early. The first stage starts after the incubation period of 3–32 days. A macule occurs at the site of the tick bite, which immediately transforms into a papule and spreads outwards, creating a ring-like lesion with pallor inside. The centre of the lesion sometimes displays intense erythema and can be indurated, vesicular or necrotic. This is called erythema chronicum migrans and is most often localized in the area of thighs, loins and axillae.

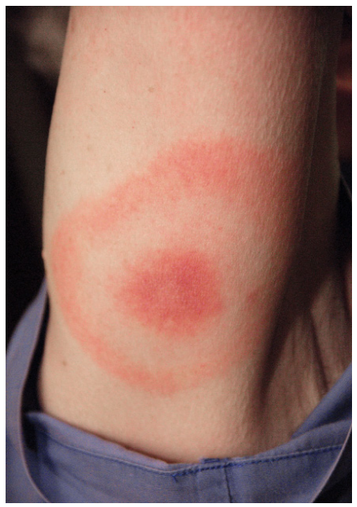

Photo 14: Skin manifestation – erythema migrans

The local lymph nodes may be enlarged. Secondary annular skin lesions, similar to those described, occur in the later course of the disease and they spread all over the body. The rash, however, may be different (diffuse erythema, urticaria, etc.).

In the second stage, about 15% of patients develop neurological disorders, such as meningitis, encephalitis, or other forms of nervous inflammation. Examination of fluid will show lymphocytic pleocytosis, which will return to normal after a couple of months. Around 8% of cases develop cardiological disorders in the form of atrioventricular block (first degree, Wenckebach or complete heart block) and possible pancarditis. This stage lasts for several weeks, but it can also recur. There may also be migratory musculoskeletal pain.

In the third stage, around 60% of patients develop arthritis characterized by typical intermittent episodes of oligoarticular arthritis affecting the large joints, especially knees. In some cases both the large and the small joints can be affected and there may even be symmetrical polyarthritis. Characteristically, there will be recurrent attacks over a period of a few years, each attack lasting for several weeks or months.

Diagnosis

The erythema migrans rash, which does not occur in all cases, is considered sufficient to establish a diagnosis of Lyme disease even when serological blood tests are negative. Serological testing can be used to support a clinically suspected case but is not diagnostic by itself. The serological laboratory tests most widely available and employed are the Western blot and ELISA. The diagnostic protocol includes essential ELISA test for patients with symptoms of the disease and sensitive Western blot test for those with positive ELISA test or undetermined ELISA. However, ELISA testing is typically done against region-specific epitopes and may report a false negative if the patient has been infected with Borrelia from a region other than that in which they are tested.

Treatment

Different therapeutic approaches are applied in different stages of the disease. In the second and third stages of the disease, medicines for treatment will depend upon the specific symptoms. In the early phase (erythema migrans, without specific neurological manifestations), adults can be treated with a 14-day course of doxicillin, amoxicillin or cefuroxime. Doxicillin is generally contraindicated during pregnancy and lactation, as well as for children under eight.

For children, amoxicillin and cefuroxime are recommended, or doxicillin for children over eight. Patients with meningitis and other neurological disorders are treated with ceftriaxone or penicillin G. Patients with atrioventricular heart block and/or myopericarditis associated with the early phase of Lyme disease can be treated with oral or parenteral antibiotic therapy, and patients with Lyme arthritis with antimicrobial therapy administered orally (doxicillin over 28 days).

Patients with suspected Lyme borreliosis should always be seen by an infectious disease specialist.

Prevention

See 4.3.4 C. Protection against tick bites.

MALARIA

Pathogen

Malaria is caused by a parasite belonging to the genus Plasmodium. There are four types of human malaria: Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale and Plasmodium malariae. Almost all deaths from malaria are caused by P. falciparum. P. vivax, P. malariae and P. ovale can be found in all tropical regions in the world and are less dangerous for humans.

Transmission of malaria can also occur with blood transfusion, organ transplantation, or use of shared needles and syringes for intravenous injections. Malaria can also be transmitted from mother to child.

Photo 15: Transmitter of malaria - Anopheles mosquito

Epidemiology

Although several models predicted a potential increase of malaria in Europe, there is agreement that the risk is very low under the current socioeconomic conditions. However, cases may be imported from endemic countries into the former Yugoslav Republic of Macedonia.

Groups at higher risk include children under five, those older than 65, pregnant women, people on steroids long term, people with AIDS, people who have had their spleen removed, as well as people with porphyria, epilepsy and chronic diseases.

WHO certified the former Yugoslav Republic of Macedonia malaria-free on 19 December 1973. Since then, only imported cases have been reported.

Clinical profile

The incubation period is different for each agent. For Plasmodium falciparum, it takes 7–14 days for the symptoms to develop; for Plasmodium vivax and Plasmodium ovale it takes 8–14 days (in some cases longer, up to several months); and for Plasmodium malariae it takes 7–30 days.

If onset of the infection is very sudden, symptoms may be dramatic as a result of the rapid increase in the amount of the agent in the human circulation. In the onset stage, the symptoms can be very similar to influenza symptoms: fever, headache, malaise, fatigue, sweating, muscle pain, abdominal pain, diarrhoea, loss of appetite, orthostatic hypotension, nausea, yellowish skin, coughing, enlarged liver and spleen and vomiting. Serious complications of malaria caused by Plasmodium falciparum affect the kidneys and brain, leading to delirium, coma and death.

Epidemiological investigation can indicate and even confirm whether a case of fever occurring in the first week of travel to an area considered high-risk is likely to be malaria.

Diagnosis

Recognition of malaria parasites in a blood preparation by using Giemsa's stain still remains the 'gold standard' for laboratory confirmation of malaria.

Alternative methods to laboratory-based diagnosis include:

- Antigen detection by means of Rapid Diagnostic Tests, which are a useful alternative where a accurate microscopic diagnosis is not available;
- Molecular diagnosis, which is more precise than microscopic diagnosis but is also more expensive and requires a specialized laboratory; and
- Serology, by using indirect immunofluorescence (IFA) test or ELISA test. This does not detect current infection but reflects cumulative exposure.

Diagnosis provides for rapid detection of infection and also checks for resistance of the parasite to available drugs as well as of the vector to available insecticides.

Treatment

Early malaria treatment reduces the duration of the disease, prevents complications and avoids the majority of fatalities. The best available treatment, especially for Plasmodium falciparum, is artemisinin-based combination therapy (ACT).

There are various drugs used both for prevention and treatment purposes. Different therapeutic regimes are available for the various types of malaria, based on WHO recommendations. Historically, the most well known and used drug was quinine. Today the most effective and well known are chloroquine, mefloquine, doxycycline, and primaquine, as well as malarone, which is usually used in prevention.

Primaquine should be used to prevent recurrence of the same disease, as it prevents the parasites from re-developing, especially those of P. ovale and P. vivax.

The treatment recommendations provided here are current as at 2010. Every suspected case of malaria should always be seen by an infectious disease specialist and therapy should be provided by an infectologist.

Prevention

Malaria prevention is based on two complementary measures: chemoprophylaxis and protection against mosquito bites. In Europe, chemoprophylaxis against malaria is provided only to travellers to endemic regions. The drug used depends on the travel destination, duration of the potential exposure to mosquitoes, resistance of the parasite, age group and pregnancy status. In endemic countries, chemoprophylaxis can also be recommended for young children and pregnant women.

For information on the protection against mosquito bites, see 4.3.4 A.

MARSEILLES FEVER (Mediterranian spotted fever) (MSF)

Pathogen

The tick-borne disease is caused by Rickettsia conorii, which is transmitted to humans by the vector Rhipicephalus sanguineus. Other possible vectors are Haemaphysalis leachi, Amblyomma hebraeum and R. appendiculatus.

Photo 16: Transmitter of Marseilles fever (Mediterranian spotted fever) - Rhipicephalus sanguineus

Epidemiology

Ticks become infected with R. conorii through sucking the blood of infected wild rodents and then transmitting the disease to larger mammals. MSF has been found in Albania, Italy and other European countries and is likely to be endemic in the former Yugoslav Republic of Macedonia, too.

The source of the disease includes wild rodents (Citellus citellus) and dogs, and the vector is the tick Rhipicephalus sanguineus. The causative agents of the disease are transmitted from one generation of ticks to the next by transovarial transmission, which provides for their survival in nature. Small rodents are the main reservoir of the disease.

Clinical profile

The incubation period is around seven days. Onset is sudden, with fever, high temperature, myalgia and severe headache. A maculopapular rash affecting the whole body occurs between the third and fifth days; it is most severe on the face, palms and feet and least severe on the abdomen. The rash is sometimes haemorrhagic. Nervous and mental symptoms are less severe than in spotted typhus. The primary characteristics of the disease are a small, black wound or ulceration with necrotic bottom and red areola (eschar) 2–5 mm in diameter on the site of the tick bite and a regional lymphadenitis. Fairly swift recovery occurs after 7–10 days.

Diagnosis

Diagnosis is established on the basis of the clinical presentation and is confirmed with Weil-Felix reaction, in which the titre for the antigen of Proteus OX2 is higher than for the antigen of Proteus OX19. More sensitive and more specific are the reaction to complement fixation and the reaction to agglutination with purified R.conorii as antigen.

Treatment

Doxycycline or chloramphenicol over seven days or, in children under eight, azithromycin or clarithromycin over three days.

Prevention

See 4.3.4 C. Protection against tick bites.

RICKETTSIOSES - Murine typhus (rickettsiosis murina)

Pathogen

The disease is caused by Rickettsia mooseri which is transmitted to humans by fleas. Rats are the natural reservoir.

Photo 17: Transmitter of Rickettsioses - Amblyomma aureolatum

Epidemiology

Murine typhus is found all over the world. Primarily, this is an infection of rats and mice among which the rickettsia is transmitted via fleas (Xenopsylla cheopis) or lice (Polypax spinulosus). Transmission to humans occurs via faeces from rat fleas, either by introduction of faeces into damaged skin (through scratching) or through inhalation of the dust of dried faeces.

Clinical profile

This is a relatively mild acute febrile disease, which lasts 9–15 days and is characterized by headaches and macular rash. The clinical presentation resembles influenza or a severe form of the classic spotted typhus. Incubation lasts 6–14 days. The disease starts with a sudden or gradual increase in temperature, severe headaches, back pain and other general symptoms, followed by a redness on the face and mild conjunctivitis, as well as other symptoms resembling spotted typhus. On about the fifth or sixth day, patients develop a macular or maculopapular rash, which is not as dense as in the case of spotted typhus. Brain, myocardium and kidneys are less often affected. Temperature is mildly raised (remittent or continuous fever) and goes back to normal after 9–13 days, which is shorter than in the classic spotted typhus. Complications rarely occur and mortality is low.

Diagnosis

Diagnosis is established on the basis of the clinical presentation (acute febrile disease, severe headaches and rash) and is confirmed with serological tests. The Weil-Felix reaction to the antigen of Proteus OX19 and Proteus OX2 is positive as with classic spotted typhus and this reaction cannot distinguish between the two types of typhus. Therefore, specific serological tests are performed, with antigens from both Rickettsia.

Treatment

Doxycycline or chloramphenicol over seven days.

Prevention

Prophylaxis consists of:

- Control of fleas and other vectors with contact insecticides that have a residual effect constitutes the primary prevention measure.
- Destruction or eradication of rodents, which serve as a reservoir of the virus. However, this poses some practical difficulties and in general is less efficient compared with the previous one, which targets their ectoparasites.The new rodenticides, such as sodium fluoroacetate or ANTU, are very effective but are toxic to humans (there is no antidote yet available). Therefore, there is a very high risk of mortality if used inappropriately, without taking proper precautions.
- Protecting foods against contamination with rat excreta is also recommended.

SALMONELLOSIS

Pathogen

Salmonellosis is an acute infectious zoonotic disease, which is normally found in a large number of domestic and wild animals and birds. The causative agent of this disease belongs to the family of Enterobacteriaceae, genus Salmonella, of which more than 2200 serotypes have been discovered so far. The most commonly isolated causative agents for this disease (both nationally and internationally) are S. enteritidis, S. typhimurium, S. java, S. abony, S. wien, S. dublin, S. abortus bovis, S. newport, S. infantis, S. virchow, S. gallinarum, S. saint paul, etc. Humans become infected with salmonellosis if they consume infected food (milk, eggs, meat and dairy products), or if they come into direct contact with infected animals or their excretions. Salmonellosis caused by the consumption of contaminated food is the main cause of increased mortality around the world and the most significant cause of increased morbidity in developing countries.

This bacterium can usually be found in the gastrointestinal tract of poultry and other animals, which may show no symptoms of disease.

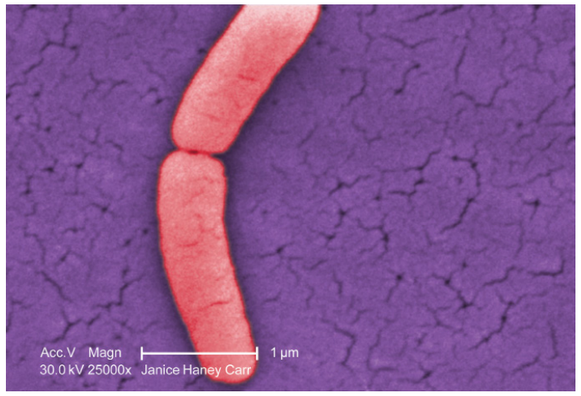

Photo 18: Salmonella enteritidis

Epidemiology

Salmonellosis has been one of the most common and most described infectious diseases in the world for the last 20 years, because there have been both sporadic cases and epidemics all over the world.

Because of its global nature, with increasing morbidity and mortality, it can be considered a disease of the modern, developed world. Because of the potential for epidemics, this disease is a widespread public health problem throughout Europe. Incidence of this foodborne disease is expected to increase over the coming decades as a result of climate change. Diarrhoea caused by food contaminated with Salmonella is a very significant cause of increased morbidity in the eastern countries of the European region, especially among young children aged 0–6. Salmonellosis from consuming contaminated food is often due to poor hygiene during food preparation, transport and storage and inappropriate and incompetent food handling, or to the lack of adequate systems for risk prevention and hygiene control.

Salmonella on fingers can survive for a couple of hours and still be capable of contaminating food.

During outbreaks, epidemiological surveillance usually highlights a number of shortcomings, such as poor sanitary conditions and inadequate cooking of food. In developed countries, up to as much as 30% of the population become infected with Salmonella through contaminated food and there are 20 deaths per million as a consequence of salmonellosis each year.

Monthly distribution of salmonellosis shows that it is found throughout the year, both as individual cases and less often as epidemics, with the peak in the summer and early autumn. Hospital infections caused by Salmonella do not have a distinct seasonal nature.

This microorganism is a constant problem in raw meat, poultry and eggs, and has been found in as many as 70% of broiler carcasses.

Clinical profile

The majority of patients infected with Salmonella develop fever, diarrhoea, raised temperature (38–39oC), abdominal pain, cramps, malaise, fatigue or dehydration over a period of 12–72 hours after infection. In order for the characteristic symptoms to appear, the number of Salmonellae needs to be around one million. Diarrhoea occurs as a result of irritation of the intestinal wall by endotoxin. A diarrhoeal episode can be very severe and patients have to be hospitalized. The disease usually lasts for 4–7 days and the majority of patients recover without treatment. There is also a pyemic form of the disease, where pus collects in various organs.

In some patients, infection with Salmonella can spread from the gastrointestinal tract to the blood and from there to other tissues and organs, which can be fatal. Immediate antibiotic treatment is required in such cases.

Mortality for this disease is mainly low. The majority of the recorded deaths are babies, elderly or those whose health was already compromised by some other immunological disease. Salmonellosis can be especially dangerous for patients with HIV/AIDS.

The increasing resistance to antibiotics reported for some types of Salmonella increases the risk for humans, who can develop severe forms of the disease that can be fatal.

Diagnosis

A confirmed diagnosis requires isolation and identification of the Salmonella species from stool samples. The diagnosis of Salmonella typhi (salmonella fever) and septicaemia is performed on blood samples (metastatic focus) with a Widal test.

Treatment

Oral or parenteral rehydration of patients with gastrointestinal infections is important. Some researchers believe antibiotics prolong the carrier state, or can cause further problems by causing imbalance in the intestinal flora.

Typhoid fever (salmonella fever) and septicaemia are most commonly treated with ciprofloxacin, azithromycin, ceftriaxone and cefotaxime. Resistance to trimethoprim-sulfamethoxazole and chloramphenicol is increasing. Resistence has also been reported to ceftriaxone (Taiwan 2003) and fluoroquinolones (Japan 2003).

Prevention

For prevention measures, see section 4.3.2., Prevention of foodborne communicable diseases.

WEST NILE FEVER

Pathogen

West Nile virus is an arbovirus from the genus Flavivirus and is primarily transmitted through mosquitoes. Especially efficient vectors include Culex species. Birds are the main reservoir of West Nile virus among vertebrates.

Humans become infected through mosquito bites but there have also been cases where the infection occurred after contact with infected birds or tissues of infected alligators. An epidemic among workers on a turkey farm was recorded, as a result of exposure of damaged skin or mucous membranes to the virus, or exposure to aerosols of the virus. Human beings do not spread the virus in secretions or excretions, but it can be transmitted through blood transfusion and organ transplantation. Rare cases of transplacental transmission and of probable transmission through breastfeeding have also been reported. Transmission from person to person is not possible through normal day-to-day contact.

Photo 19: Aedes Albopictus – Tiger mosquito transmitter of West Nile Fever

Epidemiology

Persons older than 50 and those with compromised immune systems have a greater risk of neuroinvasive disease. Patients developing encephalitis are generally older than those developing meningitis or flaccid paralysis. Recipients of transplanted organs are especially vulnerable to developing neuroinvasive disease; after infection, their chances of developing this form of the disease are estimated at 40%.

Primary diseases like diabetes and autoimmune diseases are associated with the severe clinical form of this disease.

Clinical profile

Incubation lasts 2–14 days. In the majority of cases, infection is usually asymptomatic. In humans, there are two clinical forms of the disease: West Nile fever, which is relatively mild and influenza-like, and neuroinvasive disease, which includes all cases with neurological problems.

West Nile fever is the most common form of the disease, characterized by raised temperature, tiredness, malaise, headaches and pains all over the body. Anorexia, lymphadenopathy, nausea, diarrhoea, vomiting, stiffness of the neck and conjunctivitis can also occur.

Occasionally, erythematous, non-pruritic, macular, papular or morbilliform rashes can appear on the neck, trunk, arms or legs. For the majority of uncomplicated infections, recovery occurs in 2–6 days, whereas more severe cases may include prolonged exhaustion that can last for more than a month.

A small number of patients with West Nile fever develop a neurological disease. This form can be severe and in some cases even life-threatening. It can be manifested with three different clinical syndromes: encephalitis, meningitis or acute flaccid paralysis. In some cases, there may be combinations of symptoms that are characteristic of the different syndromes.

West Nile meningitis is characterized by fever, headaches, stiff neck and photophobia. Patients with encephalitis usually have disturbed consciousness, including disorientation and/or neurological symptoms like ataxia, lack of coordination, tremor, uncontrolled movements and symptoms resembling Parkinson's disease (rigidity, instability and bradykinesia). Permanent neurological sequelae remain in some patients.

Some patients may develop acute flaccid paralysis (sometimes called West Nile poliomyelitis). The paralysis, which is similar to that of polio, occurs suddenly and progresses rapidly, reaching its peak in only a couple of hours. In typical cases it is asymmetric and can affect one or more limbs, usually legs.

Diagnosis

In humans, infections with West Nile virus are confirmed serologically. The most commonly used tests include ELISA, reaction to neutralization, indirect immunofluorescence and inhibition of haemagglutination, but RT-PCR is also used. Rapid tests have recently been made available.

Level 3 biological protection is required for virus isolation, which is rarely performed. Virus isolation from fluids and brain tissue is often unsuccessful.

Treatment

There is no specific treatment for the disease. Treatment is usually supportive. Intensive treatment and mechanical ventilation may be necessary in some cases.

Prevention

For information on the protection against mosquito bites, see 4.3.4 A.

LIST OF ANNEXES

ANNEX 1

WHO five keys to safer food

1. Keep clean!

- Wash your hands before you handle food and often during food preparation
- Wash your hands after going to the toilet
- Wash and sanitize all surfaces and equipment used for food preparation
- Protect kitchen areas and food from insects, pests and other animals

While most microorganisms do not cause disease, dangerous microorganisms are widely found in soil, water, animals and people. These microorganisms are carried on hands, wiping cloths and utensils, especially cutting boards, and the slightest contact can transfer them to food and cause foodborne diseases.

2. Separate raw and cooked food!

- Separate meat, poultry and seafood from other foods
- Use separate equipment and utensils such as knives and cutting boards for handling raw foods
- Store food in containers to avoid contact between raw and prepared foods

Raw food, especially meat, poultry and seafood, and their juices, can contain dangerous microorganisms which may be transferred onto foods during preparation or storage.

3. Cook thoroughly!

- Cook food thoroughly, especially meat, poultry, eggs and seafood
- Bring foods like soups and stews to boiling to make sure that they have reached 70°C. For meat and poultry, make sure that juices are clear, not pink. Ideally, use a thermometer
- Reheat cooked food thoroughly

Proper cooking kills almost all dangerous microorganisms. Studies have shown that cooking food to a temperature of 70°C can help ensure it is safe for consumption. Foods that require special attention include minced meats, rolled roasts, large joints of meat and whole poultry.

4. Keep food at safe temperatures!

- Do not leave cooked food at room temperature for more than 2 hours
- Refrigerate promptly all cooked and perishable food (preferably below 5°C)
- Keep cooked food piping hot (more than 60°C) prior to serving
- Do not store food too long even in the refrigerator
- Do not thaw frozen food at room temperature

Microorganisms can multiply very quickly if food is stored at room temperature. By holding at temperatures below 5°C or above 60°C, the growth of microorganisms is slowed down or even stopped. Some dangerous microorganisms still grow below 5°C.

5. Use safe water and raw materials!

- Use safe water or treat it to make it safe
- Select fresh and wholesome foods
- Choose foods processed for safety, such as pasteurized milk
- Wash fruits and vegetables, especially if eaten raw
- Do not use food beyond its expiry date

Raw materials, including water and ice, may be contaminated with dangerous microorganisms and chemicals. Toxic chemicals may be formed in damaged and mouldy food. Care in selection of raw materials and simple measures such as washing and peeling may reduce the risk.

ANNEX 2

Information for the general public on vector control for mosquito-borne diseases

When there is an outbreak of a potentially dangerous disease that is transmitted through vectors (e.g. West Nile fever, malaria), the following specific measures should be introduced:

Once a week:

Inspect the interior or the exterior parts of the house and the surrounding area, to:

- Discharge any water remaining in tanks, barrels, old tyres, ponds for animal use, water storage containers, plastic food storage containers, etc., prior to refill.
- Empty cooling devices when they have been set to stand-by.
- Scrub the internal surfaces of vases, to remove any mosquito eggs, before renewing the water.
- Remove water from saucers and dishes used for plants and scrub them to remove any mosquito eggs.
- Clean fallen leaves and stagnant water in drainage channels and gardens. The leaves might collect water.

Once a month:

- Sprinkle the prescribed quantities of granulated insecticide (temephos, in ratio one part per million) over containers, vases, roof channels and gutters, even if they are dry. (Warning: Do NOT dilute the chemicals in drinking water. Keep the chemicals away from children).
- Remove the leaves from gutters and drainage channels, whenever possible.

Continuously:

- Keep barrels and cans for water under shelter away from the house. Containers for storing water should always be kept under shelter.
- Do not drop litter. Paper cups and water bottles dropped in drainage channels or onto grass verges, spare ground and other public places may collect rainwater, which harbours mosquitoes.

Practical advice for protection against mosquito bites:

- Use bednets if you sleep in rooms that are not completely air-conditioned or protected against mosquitoes.
- When going outdoors during the period when the mosquitoes are active and bite, wear long sleeved shirts/blouses and long trousers.
- Apply repellents to the skin and clothing.
- Use tested and approved repellents that are safe and effective.
- Skin should preferably be protected with a product containing 20–50% DEET (N,N-Diethyl-meta-tolua mide; also known as N,N-Diethyl-3-methylbenzamide or NNDB). Higher concentrations of DEET are no more effective.
- DEET should be used with caution in children: apply in smaller quantities and avoid application on hands, as children often put their hands into their mouth.
- Apply DEET to the exposed parts of the skin. Avoid contact with eyes, lips and damaged or irritated skin.
- For facial application, pour a small quantity of DEET on the hands, and then apply a thin layer to the face.
- When the danger of exposure to mosquitoes is over, wash away all traces of the DEET.
- If DEET is used in addition to sun protection, apply the sun protection first and leave for 30 minutes to one hour before applying DEET. This will allow sufficient time for the sun protective factor to penetrate and bind with the skin, which will not interfere with the effectiveness of DEET.
- Spray clothing with repellent to protect against bites through the clothes.
- Use products containing permethrin for preference.
- Permethrin is commercially available as a 0.5% spray.
- Do not inhale the aerosol formulations.
- When sleeping outside, protect the bed with a bednet impregnated with permethrin.

Photo credits

No	Title	Content Provider/ Photographer	Source
1	Tiger mosquito (Aedes albopictus)	CDC/James Gathany, PhD/ Michael L. Levin	http://phil.cdc.gov/phil/home.asp
2	Geographical distribution of chikungunya	WHO	http://gamapserver.who.int/mapLibrary/Files/Maps/Global_Chikungunya_ITHRiskMap.png
3	Two host life cycle of CCHF virus	CDC	http://www.dpd.cdc.gov/dpdx/html/imagelibrary/S-Z/Ticks/body_Ticks_il8.htm
4	Life cycle of Cryptosporidium	CDC/Alexander J. da Silva, PhD/Melanie Moser	http://phil.cdc.gov/phil/home.asp
5	Histopathology image of Cryptosporidium organisms along luminal surfaces of epithelial cells	CDC/ Dr. Edwin P. Ewing, Jr.	http://phil.cdc.gov/phil/home.asp
6	Life cycle of Giardia lamblia	CDC/Alexander J. da Silva, PhD/Melanie Moser	http://phil.cdc.gov/phil/home.asp
7	Electron micrograph of Giardia lamblia in a late stage of cell division	CDC/ Dr. Stan Erlandsen	http://phil.cdc.gov/phil/home.asp
8	Phlebotomus papatasi sandfly	CDC/ Frank Collins, James Gathany	http://phil.cdc.gov/phil/home.asp
9	Life cycle of Leishmania spp.	CDC/Alexander J. da Silva, PhD/Blaine Mathison	http://phil.cdc.gov/phil/home.asp
10	Crater lesion of leishmaniasis - skin	CDC	http://phil.cdc.gov/phil/home.asp
11	Scanning electron micrograph of Leptospira sp.	CDC/ Rob Weyant, Janice Haney Carr	http://phil.cdc.gov/phil/home.asp
12	Photomicrograph of leptospiral microscopic agglutination test using darkfield microscopy technique	CDC/Mrs. M Gatton	http://phil.cdc.gov/phil/home.asp
13	Ixodes scapularis – transmitter of Lyme disease	CDC/ PhD Michael L. Levin, Jim Gathany	http://phil.cdc.gov/phil/home.asp
14	Кожна манифестација – erythema migrans	CDC/ James Gathany	http://phil.cdc.gov/phil/home.asp
15	Transmitter of malaria - Anopheles mosquito	CDC/ James Gathany	http://phil.cdc.gov/phil/home.asp
16	Transmitter of Marseilles fever (Mediterranian spotted fever) - Rhipicephalus sanguineus	CDC/ James Gathany, William Nicholson	http://phil.cdc.gov/phil/home.asp
17	Transmitter of Rickettsioses - Amblyomma aureolatum	CDC/ Dr. Christopher Paddock, James Gathany	http://phil.cdc.gov/phil/home.asp
18	Salmonella enteritidis	CDC/ Bette Jensen, Janice Haney Carr	http://phil.cdc.gov/phil/home.asp
19	Aedes Albopictus - Tiger mosquito transmitter of West Nile Fever	CDC/ James Gathany	http://phil.cdc.gov/phil/home.asp

References

Benenson AS (1995). Control of communicable diseases Manual, sixteenth edition, Giardiasis, 202–203.

Braga ALF, Zanobetti A, Schwartz J (2001). The time course of weather related deaths: a tridimensional estimate in 12 US cities. Epidemiology, 12:662–667.

Borivoje S and Blaze N (1999). Zoonoses – diseases transmitted from animals to people. Skopje.

Christova I, van de Pol J, Yazar S, Velo E, Schouls L (2003). Identification of Borrelia burgdorferi sensu lato, Anaplasma and Ehrlichia species, and spotted fever group Rickettsiae in ticks from Southeastern Europe. Eur J Clin Microbiol Infect Dis. 22(9):535–542.

Codex Alimentarius (2006). FAO/WHO guidance to governments on the application of HACCP in small and/or less-developed food businesses. FAO Food and Nutrition Report No. 86.

Confalonieri U et al. (2007). Human health. In Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Parry ML, Canziani OF, Palutikof JP, van der Linden PJ & Hanson CE (eds.). Cambridge, UK: Cambridge University Press, 391–431.

Curriero FC, Patz JA, Rose JB, Lele S (2001). The association between extreme precipitation and waterborne disease outbreaks in the United States, 1948–1994. Am J Public Health. 91(8):1194–9.

Desai S et al. (2009). Re-emergence of the field fever in countries with temperate climate: Epidemic of leptospirosis in seasonal strawberry pickers in Germany 2007. Clinical infectious diseases.,48(6):691–697.

Dimic E, Jovanovic J (1995). Acute infectious diseases. Medical School, Novi Sad University.

Dorland (2007). Dorland's Illustrated Medical Dictionary with CD-ROM, 31st Edition. Saunders.

Dzavec E et al. (1998). Medical microbiology, Savremena administracija. A Lange medical book, Simon Schuster & Co.

ECDC (2009). Annual epidemiological report on communicable diseases in Europe, Surveillance report. Stockholm.
Epstein PR, Diaz HF, Elias S et al. (1998). Biological and physical signs of climate change: focus on mosquito-borne disease. Bull Am Meteorological Soc. 78:409–417.
European Commission (2003). Enviroment 2010: Our future, our choice. The 6th Environment Action Programme of the European Community 2001–2010. Brussels.

Government of the former Yugoslav Republic of Macedonia. Law on Protection of the Population against Infectious Diseases. Official Gazette of the former Yugoslav Republic of Macedonia No. 66/04, 139/08 and 99/09.

Intergovernmental Panel on Climate Change (2001). Climate Change 2001 Synthesis Report. Geneva.

Intergovernmental Panel on Climate Change (2001). Impacts, Adaptation and Vulnerability. Working Group II of the IPCC. Geneva.

Intergovernmental panel on Climate Change (2001). Synthesis Report, the Scientific Basis. Working Group I of the IPCC, Contribution to the 3rd assessment Report. Geneva.

Intergovernmental Panel on Climate Change (IPCC) (2001). Human Health: Climate Change 2001: Impacts, Adaptation and Vulnerability. Cambridge University Press.

Josseran L, Caillère N et al. (2009). Syndromic surevaillance and heat wave morbidity: pilot study based on the EMS departments in France. BMC Med Inform Decis Mak. 9:14.

Kendrovski V (2006). Vulnerability assessment and adaptation measures for the health sector. Second National Report on Climate Change by the former Yugoslav Republic of Macedonia.

Kendrovski V (2008). Health sector vulnerability in the Second National Report to the UN Framework Convention on Climate Change. Ministry of Environment and Physical Planning, Skopje.

Kovats RS, Edwards S, Hajat S et al. (2004). Effect of temperature on food poisoning: time series analysis in 10 European countries. Epidemiology and infection. 132 (3):443.

McMichael A et al. (2003). Climate change and human health, Risks and Responses. WHO, Geneva.

McMichael A et al. (eds.) (1996). Climate change and human health. World Health Organization, Geneva. Available at http://whqlibdoc.who.int/hq/2000/WHO_SDE_OEH_00.4.pdf.

Milenkovic Z, Petrov S (2003). Antimicrobial therapy – clinical aspects. Monograph. Makavej. Skopje.

Military publishing centre (1989). Salmonellosis in Military epidemiology. 237–242. Belgrade.

Ministry of Environment and Physical Planning (2002). Kyoto Protocol to the United Nations Framework Convention on Climate Change.

Ministry of Environment and Physical Planning (2003). First National Report of the former Yugoslav Republic of Macedonia to the UN Framework Convention on Climate Change.

Ministry of Environment and Physical Planning (2006). Second National Environmental Action Plan. Skopje

Ministry of Environment and Physical Planning (2008). Second National Plan on Climate Change. Skopje.

Ministry of Environment, Physical Planning and Construction (2006). Second, Third and Fourth National Communication of the Republic of Croatia under the United Nations Framework Convention on Climate Change.

Nichols G, Lane C, Asgari N, Verlander NQ, Charlett A. (2009). Rainfall and outbreaks of drinking water related diseases in England and Wales. J Water Health. 7(1):1–8.

M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Contribution by the working group II towards the fourth assessment report by the Intergovernmental Panel on Climate Change., Eds. Cambridge University Press, and Cambridge, UK.

Patz JA, Epstein PR, Burke TA, Balbus JM (1996). Global climate change and emerging infectious diseases. JAMA. 275:217–223.

Polozani, Kendrovski, Danev (2009). HACCP, System for analyzing dangers and critical control points, Theory and Practice. Skopje.

Public Health Institute (2009). Tabular annual reports on the acute infectious diseases trends in the Former Yugoslav Republic of Macedonia for the period 1991–2008. Skopje.

Rudel E, Matzarakis A, Koch E (2005). Potential increase of heat load on humans in a changing climate. World Resource Review. 17: 32–44.

WHO (2001). Global surveillance of foodborne disease: developing a strategy and its interaction with risk analysis. Report of a WHO consultation, Geneva, Switzerland 26–29 November 2001.
Ref: WHO/CDS/CSR/ EPH/2002.21. Available at http://whqlibdoc.who.int/hq/2002/WHO_CDS_CSR_EPH_2002.21.pdf.

WHO (2002). Global Strategy for Food Safety. Geneva. Available at
http://www.who.int/foodsafety/publications/general/en/strategy_en.pdf.

WHO (2003). Climate change and human health – risks and responses. Summary. Available at http://www.who.int/globalchange/environment/en/ccSCREEN.pdf.

WHO (2004). Risk Assessment of Cryptosporidium in Drinking Water. Geneva. Available at http://whqlibdoc.who.int/hq/2009/WHO_HSE_WSH_09.04_eng.pdf.

WHO (2006). Lyme borreliosis in Europe: impacts from climate and climate change, epidemiology, ecology and adaptation measures. http://www.euro.who.int/__data/assets/pdf_file/0006/96819/E89522.pdf.

WHO (2008). Protection of health in Europe against climate change. http://www.euro.who.int/__data/assets/pdf_file/0016/74401/E91865.pdf.

WHO (2009). Improving the public health responses to extreme weather conditions /heat waves–EuroHEAT. Technical summary. http://ccsl.iccip.net/e92474.pdf.

WMO (1999). Weather, Climate and Health No. 892. http://www.meteo.go.ke/pws/wmd98.html.

Zafirovska K et al. (2006). Manuals on practising evidence-based medicine, Volume I–V. Ministry of Health, former Yugoslav Republic of Macedonia. Skopje.

Zaninovic K (2003). The influence of meteorological parameters on acute neurovegetative disability. European Conference on Applications of Meterology,.15–19 September 2003, Rome.

Zaninovic K, Gajic-Sapka M (2008). Climate change and its impact on health. Croatian Journal of Infection. 28:1,5–15.

The transmission patterns of communicable diseases are influenced by many factors, including climatic and ecological elements. It is widely anticipated that climate change will impact the spread of communicable diseases in Europe, which in many cases will pose new threats to public health. Food- and waterborne disease incidence, for example, have been correlated to warmer temperatures. Disease vectors (e.g., mosquitoes, sand flies and ticks) are highly sensitive to climatic conditions, including temperature and humidity, and will tend to change their geographical distribution, potentially spreading into regions that have not previously encountered them. The primary goal in the development of this Manual is to increase the knowledge and raise the awareness of the healthcare practitioners, at a national, regional and local level in the former Yugoslav Republic of Macedonia, regarding the health risks related to climate change and communicable diseases.

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