STRATEGY FOR ADAPTATION TO CLIMATE CHANGE IMPACTS ON THE POPULATION’S HEALTH IN THE ARKHANGELSK REGION AND NENETS AUTONOMOUS DISTRICT OF THE RUSSIAN FEDERATION

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Уважаемые коллеги!

Сотрудниками Северного государственного медицинского университета совместно с Представительством ВОЗ в России проведено исследование влияния температурных волн и изменения климата на здоровье населения Архангельской области. Анализ полученных данных показывает убедительную связь влияния климатических изменений на обращаемость населения за медицинской помощью, смертность, распространенность клещевого энцефалита, сальмонеллеза и других инфекций.

Министерством здравоохранения и социального развития Архангельской области и СГМУ разработана «Стратегия адаптации к воздействию изменений климата на здоровье населения Архангельской области и ПАО Российской Федерации», включающая программу мероприятий по снижению отрицательного воздействия климатических факторов.

В целях снижения неблагоприятного воздействия изменений климата на население министерство здравоохранения и социального развития Архангельской области рекомендует ознакомить сотрудников с мероприятиями программы и руководствоваться «Стратегией» в деятельности учреждений здравоохранения.

Министр

Л.И. Меньшикова
План адаптации к воздействию изменений климата на здоровье населения для Архангельской области и НАО Российской Федерации
Управление Роспотребнадзора по Архангельской области согласовывает «Стратегию адаптации к воздействию изменения климата на здоровье населения для Архангельской области и НАО Российской Федерации».

С уважением,
Руководитель
Р.В. Бузинов
Администрация Ненецкого автономного округа согласовывает «Стратегию адаптации к воздействию изменения климата на здоровье населения для Архангельской области и Ненецкого автономного округа Российской Федерации».

Заместитель главы Администрации Ненецкого автономного округа по социальным вопросам

О.В. Барташова
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<tr>
<td>AD</td>
<td>Autonomous Districts</td>
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<tr>
<td>AOGCM</td>
<td>Atmosphere and Ocean General Circulation Model</td>
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<tr>
<td>CDH</td>
<td>Central district hospital</td>
</tr>
<tr>
<td>CJSC</td>
<td>Closed Joint Stock Company</td>
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<tr>
<td>CI</td>
<td>Confidence Interval</td>
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<tr>
<td>CVD</td>
<td>Cerebrovascular Disease</td>
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<tr>
<td>DAT and ORS</td>
<td>Department of Advanced Training and Occupational Retraining of the Specialists</td>
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<tr>
<td>DAT NSMU</td>
<td>Department of Advanced Training at the Northern State Medical University</td>
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<tr>
<td>DIA</td>
<td>Department of Internal Affairs</td>
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<td>EMERCOM</td>
<td>Emergency Control Ministry</td>
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<tr>
<td>FOU</td>
<td>Felsher-obstetrics unit</td>
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<td>FSSE</td>
<td>Federal Service for Sentence Execution</td>
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<tr>
<td>HCF</td>
<td>Healthcare Facility</td>
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<td>IHD</td>
<td>Ischemic Heart Disease</td>
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<td>IHR</td>
<td>International Health Regulations</td>
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<tr>
<td>MGO</td>
<td>Main geophysical observatory</td>
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<tr>
<td>MIAC</td>
<td>Medical Information-analytical Center</td>
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<tr>
<td>MM</td>
<td>Mass media</td>
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<tr>
<td>MMT</td>
<td>Mobile Medical Teams</td>
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<tr>
<td>MPC</td>
<td>Maximum permissible concentration</td>
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<tr>
<td>NAD</td>
<td>The Nenets Autonomous District</td>
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<tr>
<td>NGO</td>
<td>Non-governmental organization</td>
</tr>
<tr>
<td>NSMU</td>
<td>The Northern State Medical University</td>
</tr>
<tr>
<td>OJSC</td>
<td>Open joint-stock company</td>
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<tr>
<td>PHC</td>
<td>Primary Healthcare</td>
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<tr>
<td>RPI</td>
<td>Regional public institution</td>
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<td>RR</td>
<td>Russian Railroads</td>
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<tr>
<td>SIZO</td>
<td>Detention center</td>
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<tr>
<td>TBE</td>
<td>Tick-born Encephalitis</td>
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<tr>
<td>WHO</td>
<td>World Health Organization</td>
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<tr>
<td>WWF</td>
<td>World Wildlife Foundation</td>
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The strategy presented in this book was developed in order to gain a better understanding of how, and to what extent, the variation in climate conditions can affect people, and whether it represents a threat to human health. This is important for both present and future generations in order to develop healthcare programs with effective measures to prevent or minimize such impacts. The results are unique because of differences in our local, socio-economic, cultural, and legally regulated conditions, which influence the process of decision-making when choosing alternative ways and approaches for achieving goals - protection of the population’s health.

A previously conducted retrospective study of the nature of weather fluctuations for more than a century, as well as an evaluation of medical issues arising due to such fluctuations, allowed agencies to develop a plan of priority actions to ensure short- and medium-term preparedness of medical and social services in partnership with other agencies to respond more adequately and to mitigate the expected abnormal changes of weather on the population’s health in the Arkhangelsk Region and Nenets Autonomous District.

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Minister of Health and Social Development
Arkhangelsk Region, Prof., MD
Strategy for Adaptation to Climate Change Impacts on the Population’s Health in the Arkhangelsk Region and Nenets Autonomous District of the Russian Federation

Global climate change, along with threats to international security such as thermonuclear war, terrorism, cyber crime, environmental and financial crises present new challenges to humanity at the turn of the 20th - 21st centuries. Of particular concern to all social institutions of society, and of the health system in particular, are the problems that are a result of temperature fluctuations and global warming in the northern regions of the Russian Federation and the Arctic regions in particular. These changes impact the biocenotic sphere, public health and healthcare organizations that operate within these territories.

The natural environment in northern Russia has its own emblematic distinctions, characterized by unfavorable climate, geographical conditions, heliocosmic impact, low ecological capacity, and unique features of the flora and fauna, just to name a few. According to the World Wildlife Fund (WWF), global warming in the Arctic could affect a quarter of the world’s population. The increase in air temperature in the circumpolar area almost twice exceeded the global average indicator in recent decades. A combination of melting Arctic sea ice and the West Antarctica and Greenland ice sheets is likely to lead to an increase in the sea level by approximately 1.2 meters by 2100, which exceeds previous estimates.

The most pronounced negative effect on humans and the surrounding environment is frequently repeated episodes of heat waves (an abnormally high temperature of 30 °C and above). In addition to the deterioration of health in vulnerable populations with disorders of respiratory and cardiovascular systems, there are problems with the safety of food and risks of intestinal infectious diseases. We should also not exclude the risk of changing local ecosystem in terms of migration of new infectious disease vectors. In this regard, the rural settlements with unstable means of communication are subject to higher risk factors.

The Arkhangelsk Region is a northern territory of Russia, which has accumulated various risk factors - climatic, natural, geographic, ethnic, environmental, social, organizational and healthcare. The proposed strategy provides for involvement of various interagency services in an effort to mitigate climate change impacts on humans. The healthcare system has a leading role, but without interaction with local authorities (the Arkhangelsk Centre for Hydrometeorology and Environmental Monitoring, Regional Emergency Center, NSMU, media, etc.) it will be quite difficult to achieve positive results.
GOALS OF THE STRATEGY
The goal of the strategy is to ensure protection of public health from the changes in weather and climate through the optimization of basic organizational structures of society, in particular, adaptation of the healthcare system in the Arkhangelsk Region and Nenets Autonomous District.

STRATEGY OBJECTIVES
• Adapt the healthcare system of the Arkhangelsk Region and Nenets Autonomous District to address possible health deteriorations related to the climate change/extreme temperature fluctuations.
• Promote interagency cooperation within the healthcare system with different sectors and social institutions to develop and strengthen prevention efforts, including the mitigation of the influence of heat and cold waves.
• Implement educational and informational activities aimed at improving the skills of healthcare professionals in the field of preventive medicine. These activities should include the prevention or mitigation of the health impacts of extreme weather events, better training for paramedics and emergency responders, raising public awareness of climate change impacts on health and the need for well-known preventive measures to reduce adverse effects, and to provide first aid.
• Target the healthcare system, the staff of the social and other assistance services, as well as the population in general.
Geographical area: the Arkhangelsk Region, the Nenets Autonomous District.
Timeframe: 2011 – preparation and coordination of plans, methodological and financial base; From 2012 – implementation of the strategy.

PRIORITY OF ACTIVITIES IN THE FRAMEWORK
OF THE STRATEGY
1. Improvement of accessibility and quality of medical care in the AR and NAD by strengthening healthcare services, including primary healthcare in order to reduce incidence and mortality among the population
2. Optimization of the system for developing a healthy lifestyle. Activities aimed at decreasing the population’s mortality
5. Health education of the population related to climate change (social advertisement, booklets, mass media, internet). Development of emergency alert systems to inform the population and various services in case of a heat wave.
6. Improvement of the material resources of healthcare institutions, starting with rural areas (felsher’s units, outpatient clinics and district hospitals). Supplies for first-aid kits, diagnostic equipment etc.
7. Methodical resource assistance to social isolation units (pre-trial detention centers, colonies, boarding schools, nursing homes) and to organized groups of children and adolescents.
8. Epidemiological and ecological safety. Improvement in the system for collection, recording and automatic timely processing of information on the population’s health
9. Coordination of activities of EMERCOM (The RF Ministry of Civil Defense, Emergency Management and Natural Disasters Response), the Emergency Medical Center, emergency ambulances and fire departments.
CLIMATE CHANGE IN THE ARKHANGELSK REGION AND NAD

According to studies performed between 1907–2006 in Russia, average warming was 1.29 °C, with its peak of 1.33 °C, registered from 1976 to 2006. In the Arkhangelsk Region during that same time period the temperature increased from 0.72 °C to 0.96 °C and from 0.1 to 1.88 °C respectively.

In the northern regions, increases in temperature by 7 times were observed. In the southern regions, increases of 8–9 times were observed. The coldest year during this period was 1998. In the north, temperatures were 2–3 °C below the norm, while temperatures in the south were 0.5–1 °C below the norm. The warmest year was 2005. In the north, temperatures were 2–3 °C above the norm, while temperatures in the south were 1–2 °C above the norm. Since the mid-1990s there has been a tendency toward cooling, but warmer periods persisted. Between 1997–2008, warming was reported 10–11 times in the southern and central regions. In the northern regions, cooler summer temperatures were noted 3–4 times more frequently than the southern regions. Since the late ’90s, a sharp increase in the number of warm days was reported, and its amplitude exceeded that of the 20’s and 30’s.

Climate change is also accompanied by a change in the dynamics and frequency of natural disasters.

In the Arkhangelsk Region and Nenets Autonomous District (NAD), extreme weather events and conditions that directly and indirectly affect human health include severe frosts, heavy rainfall, high winds, and snowmelt floods.

Long periods of frost (defined as more than 3 days with minimum temperatures below –35 °C), as well as extremely low temperatures (below –45 °C) are most typical for the eastern part of the Arkhangelsk Region and coastal regions of the NAD. Every year there are 6 to 10 consecutive days on average with frosts below –35 °C. Extremely low temperatures are repeated on average once every 2 years and are most common in January and February.

Strong winds associated with the release of deep cyclones are most frequently observed on the coasts and seas in the NAD, where the recurrence rate of this dangerous phenomenon can reach up to 3.5 days per year. Among strong winds, squalls and tornadoes are especially dangerous because they can be sudden and carry destructive force. They can also cause significant damage to the economies of the affected regions and their populations. They are more typical for the southeastern part of the Arkhangelsk Region, and the peak of their recurrence is in July.

In July and August the main hazard is caused by heavy rains, resulting in elevated river water levels, risk of flooding, as well as direct economic losses. Heavy rains (usually in the form of thunderstorms) most frequently occur in the southern part of the Arkhangelsk Region. The frequency of this dangerous phenomenon is significantly variable, but does not exceed 0.5 days per year.

In addition to heat and cold waves, the risks to human life in the region are related to climatic influences such as floods, water saturation, fires, agricultural and forestry droughts associated with fumes. These floods occur every 7–9 years on average and are most frequent in the Kotlas, Kholmogorsky and Vynogradovskiy districts (in the southeastern and central regions), as well as at the delta of the River Pechora near Naryan-Mar. However, over the past 20 years, the frequency of flooding has increased, on average, to once every 2 years. Flooding in the area presents a danger due to washing out of the cattle burials, and the risk of transmission of anthrax infection in the population. Intensification of seasonal permafrost thawing (especially at the southern border) poses a threat to the infrastructure of the Nenets population. The geographic areas for game and fish may vary due to changes in the coastal zone, thickness of water surface ice, additional injuries in the fishing industry, etc. Heat waves during the summer have led to numerous fires in the Arkhangelsk Region; they affect the development of traditional wood industries of the North and can create an immediate threat to the population’s life and health.

Throughout the 21st century all climate models, without exception, have predicted warming across northern Russia. The greatest warming is expected occur during the winter, and it will spread to the north, reaching maximum levels in the Arctic. For all scenarios surface air temperature rises across the Arkhangelsk Region. However, spatial and quantitative distribution are somewhat different in various scenarios. Thus, the greatest warming in all scenarios is shown over the Arctic seas. In the experiment A1B, the average annual warming reached 4.5 degrees. In the experiments A2 and B1 it is about 3.5 degrees. Apart from the Novaya Zemlya, over the large territory of Arkhangelsk Region an average annual warming of 2.5–3.5 degrees was observed according to scenario A1 and 1–2 degrees lower than in the other experiments.
ADDITIONAL FACTORS THAT DETERMINE THE IMPACT OF CLIMATE CHANGE ON HUMAN HEALTH IN THE ARKHANGELSK REGION AND THE NENETS AUTONOMOUS DISTRICT

Population specifics
The Arkhangelsk Region has a low population density – 2.1 persons / km² (in the RF it is 8.4). In some areas (Leshukonskiy, Mezenskiy) the population density is only 0.3 people / km². Half of the population lives in metropolitan areas: Arkhangelsk, Severodvinsk, Novodvinsk. In the region, there are about 1,300 settlements, with an average of only 4–5 people per settlement.

Socioeconomic problems
The economy of the Arkhangelsk Region is characterized by relatively low productivity and wages. The region has a poor prognosis for the number of economically active people of working age. In terms of income per capita, the region places 29th among all Russian regions. It place behind the national average in GRP, which is 24%. The share of old and dilapidated housing in the Arkhangelsk Region is more than 2 times higher than the Russian average. Living conditions in the Arkhangelsk Region are worse than average for Russia. The region also lags behind the Russian average in a number of basic living condition indicators, such as availability of hot water, plumbing, drainage, gas supply and heating.

Demography and Health Status
The demographic processes in the region are characterized by sustained population loss. This is associated with unfavorable birth rates and a negative migration balance (people leaving the region). There are also high levels of divorces and illegitimate births. A high proportion of external causes of death include, homicide, poisoning with alcohol and its surrogates and an especially high suicide rate. The male mortality rate in this group is 1.2 times higher than the female mortality rate with an increased mortality rate in men of working age, compared to Russia overall, where the male mortality rate is 1.1 time higher than the female mortality rate. This has led to the predominance of women over 40 years old in the population. Overall, there are 91,000 more women than men. Life expectancy is 67.6 years: 61.3 in men, 74.4 in women, both worse than the Russian national average.

Cardiovascular disease is the leading causes of death in the region. Though total deaths from cardiovascular disease have fallen slightly over the past three decades it still contributes to 50% of male deaths and 65–70% of female deaths in the region. Overall, the Northwest Federal District has presently shown some reduction in mortality. Mortality from circulatory diseases in the Arkhangelsk Region is 1.5 times higher than that in NAD, 1.4 times higher than in the Komи Republic and 1.3 times higher than in the Murmansk region. Mortality from respiratory diseases in the Arkhangelsk Region is 1.4 times higher than the Murmansk region and 3.2 times higher than in NAD. In recent years the Arkhangelsk Region has marked reduction in mortality of eleven classes, with a growth rate of such classes as neoplasms, respiratory diseases, diseases of the digestive and genitourinary systems. There was a clear downward trend in mortality from circulatory system diseases (by 13.5% compared to 2005). This decrease is mainly due to the cerebrovascular diseases. Yet cardiovascular diseases are the leading cause of death in the Arkhangelsk Region. It is important to note that every fifth person who died from diseases of the circulatory system belonged to the working age class. On average the mortality in men of working age with chronic coronary heart disease is 11 times higher than that of the women, while mortality from all forms of acute coronary heart disease (myocardial infarction, acute coronary insufficiency) is 7 times higher and from cerebrovascular diseases by 4.2.

Transport and Communications
Low population density and the lack of developed transport infrastructure, which limits the opportunities for growth in major sectors of the region’s economy: forest industry, tourism, trade, construction, mining, etc., are major contributors to regional economic problems. A similar situation is typical for railway communications (low density and a lack of development). In combination with a low population density, this leads to less access to healthcare.
Environmental safety

Air quality in the urban areas of Arkhangelsk, Severodvinsk, Novodvinsk, Korjazhma is determined by a concentration of the main impurities common to all the sources of emission: particulate matter, sulfur dioxide, carbon monoxide, nitrogen oxides, banspyrene and specific emissions (formaldehyde, hydrogen sulfide, carbon disulfide, methyl mercaptan). This leads to a significant deterioration in air quality when combined with forest fires.

Risk factors in industrial work environments

Work conditions in industrial workplaces remains unsatisfactory. In 2010, the proportion of workplaces not meeting hygienic norms for noise level was 41.4%; vibration level – 28.4%; light level – 28.7%; microclimate parameters – 11.4%. The level of air pollution in work zones with dust, aerosols, vapors and gases including substances of class 1 and 2 hazards in the Arkhangelsk Region remains high. The proportion of samples exceeding maximum allowable concentrations is 15.5%. The ratio of workplaces in educational institutions not meeting the hygienic norm for light level in 2010 was 13.8%, for microclimate – 18.1% and electromagnet fields – 3.0%.

Water safety

The proportion of surface water sources not meeting sanitary requirements in 2010 amounted to 71.0%, if you include the lack of sanitary protection zones – 65.2%. The proportion of decentralized water supply sources not meeting sanitary requirements amounts to 36.5%. One of the main reasons for unsatisfactory conditions of water sources is the discharge of untreated (or inadequately treated) polluted industrial wastewaters. The prevailing amount of surface water pollution comes from the pulp and paper industry. The proportion of central water supply samples not meeting the norms of sanitary-chemical indicators is 56.8%, of microbiological indicators – 17.8%. The proportion of drinking water samples in the distribution network of water pipes in the Arkhangelsk Region not meeting sanitary-chemical indicators is 39.9%, exceeding the microbiological indicators – 9.6%. More than 745 000 people, which accounts for 61% of the total population of the Arkhangelsk Region, are not provided with quality drinking water. With climate change and related impacting factors (i.e., floods, water logging, “winter floods”), further deterioration of water quality may be expected.

In the north there is an elevated vulnerability to water resources designed for maintaining operational stability during floods and dry spells. The increase in surface water temperatures causes growth of harmful cyanobacteria in phytoplankton communities with an eventually growing risk to the ecological state of the lake and human health. Heavy rainfall in summer or soil freezing in cold spells in towns of the Arkhangelsk Region negatively affects the functionality of regional sewerage systems; uncontrolled run-off may contaminate water bodies with microbiological and chemical pollutants, which are difficult to process using the conventional drinking water treatment processes.

Fires and Floods

The Arkhangelsk Region is known for natural disasters, which include wildfires, wind events, flooding, etc., all of which are inextricably linked to climate change. These are characterized by unstable weather conditions like sharp temperature drops, strong daily winds, hurricane winds and powerful river floods during flood season. During the spring (flood season) rivers in the north can overflow and flood vast areas, including major population centres. During the spring and autumn periods, storm and hurricane winds cause large surges and also lead to flooding. Given that water reservoirs in the region are far from satisfactory sanitary conditions, due to the dumping of industrial and sewage waste without prior waste neutralization, this leads to a more complicated epidemiological situation and an increase in the incidence of intestinal and viral infections and even the possibility of massive outbreaks. Every year another potential threat to the Arkhangelsk Region becomes more and more dangerous - fires. The most problematic year for fires in the area was 2010. In the beginning of the 2010 fire season there were 352 forest fires recorded, spreading to the total area of 14210 hectares and the average area per fire was 40.3 hectares. Compared to the 2009 fire season, the number of fires has increased by 4.9 times and their area by 78.9 times.

Ethnic security

In addition to the “habitual” problems of the indigenous NAD population (lack of readily available medical care, nomadic way of life, ethnic polymorphism and a special sensitivity to alcohol (enzyme deficiency),
low resistance to the socioeconomic changes and disruptions, etc.), some new problems have become apparent as a result of climate change. Specifically, modification of hunting and fishing areas, new reindeer migratory paths, the emergence of various infections in the northern latitudes, flooding of cattle cemeteries, and “ice storages,” to name a few. The Nenets people also have traditional peculiarities of nutritional behavior that affects their health, which include eating reindeer meat; they have an increased internal exposure to natural and artificial radionuclides through the food chain “reindeer lichen-reindeer-man”, which is a concentrator of contaminants.

Problems of the healthcare sector in the region
Overall, medical worker staffing in the region is low (89.8 %), 44.1% in the Verkhnetoemskiy district, and just .1% in Leshukonskiy. There are about 685 job openings for doctor, including more than 220 of them in primary healthcare. The proportion of retired doctors still working has varied from 32 to 69% recently. In regional facilities there is a deficiency of modern diagnostic and laboratory equipment used for resuscitation and intensive care. Twelve facilities are in critical condition and 100 buildings require major repair. Throughout the facilities the level of physical deterioration has reached 57.3%.

Only 88.5% of healthcare facilities have running water, 59.7% have a hot water supply, and 83.3% of them have sewerage. The level of equipping the outpatient-polyclinic facilities with computers is 79%, including that of the district medical service - about 80%, and the specialized medical service – about 70%.

EFFECT OF THE TEMPERATURE FLUCTUATIONS ON THE POPULATION'S HEALTH IN THE ARKHANGELSK REGION
Temperature dependencies are defined as causes of death from ischemic heart disease (IHD), cerebrovascular diseases (CVD), respiratory tract diseases and external causes in two age groups (30–64 and above 64 years), except for CVD in the 30-64 age group during high temperatures. It was identified that the temperature dependencies of almost all causes (CVD, IHD, all natural, all external causes) have a classic U-shape or V-shape with a minimum between +16 ºС and +18 ºС (for external causes +20 ºС and +22 ºС). Thus, there is a reliable association between the above-mentioned causes of death and the average daily temperature in Arkhangelsk. Therefore, it is important to mention that the temperature fluctuations’ impact on the death rate from all external causes is much stronger than the one from all natural causes. Contribution of a short-term displacement of the death rate to the total additional death rate caused by temperature stress was quantitatively evaluated for all defined temperature dependencies. During heat waves there was an increase in the death rate from CVD in people 65 years of age and older. During cold waves there was an observed increase in the death rate from IHD and from all natural causes in both age groups, CVD in the age group of 65 years of age and older, along with natural causes in people from 30–64 years old. Additional mortality due to temperature fluctuations in Arkhangelsk was observed between 1999–2008. Damage from heat waves amounted to 110 additional deaths, while 179 additional deaths can be attributed to cold waves. Thus, the total number of additional deaths for the study period on average was about 300.

During summers an increase in the effective mean daily temperature (taking into account the humidity above the 90th percentile), i.e. above 15.5 ºС, caused emergency medical aid requests to increase by one degree. With regard to the external climate causes, the male population between 18–50 years old increased by 1.81%, and the cumulative male population – by 1.60%. With regard to ARVI in: males between 18–59 years old and 60 years of age and over – by 3.03% and 6.52% respectively; females within between 18–59 years old and 60 years of age and over – by 4.05% and 4.97% respectively. With regard to cerebrovascular diseases: in males older than 60 years – by 3.84%; in females older than 60 years – by 3.90%.

An increase in the effective mean daily temperature was accompanied by an increase in medical aid requests at polyclinics in Novodvinsk due to diseases caused by external factors in males by 1.4% on average per every degree exceeding a threshold value of 15.4 ºС.

For the majority of the investigated diseases it was identified that the number of medical care requests at the polyclinics were lower on the hottest and coldest days (except for diseases caused by the external reasons). In combination with the identified increase in mortality as a result of the impact of high and low temperatures, and with the increased number of emergency calls related to the several investigated diseases
on hot days, it may suggest a need for preliminarily informing the population about the influence of high and low temperatures on health.

A significant increase in the incidences related to of tick-born encephalitis (almost 60-fold) were registered in the Arkhangelsk Region from 2000–2009 compared to 1980–1989 is due to a number of factors, with the most important of them being climate change. The elevation of mean annual temperatures led to the spread of ticks and carriers of tick-born encephalitis to the north. Thus, since 2002 ixodic ticks have been reported in the central part of the Arkhangelsk Region previously free from this arthropod. Eventually they started to appear annually with their numbers significantly increasing. Expansion of ixodic ticks to the north is confirmed not only by the results of their collection with a flag, but also by the data on spatial-temporal distribution of tick attacks on the residents of the region. Thus, the number of people attacked by ticks increased from 1980 to 2009 almost 40-fold, and the population within this time period decreased by almost more than 20%, whereas the incidence of ticks attacks is gradually expanding to the north. In the 1980’s complaints about tick attacks were typical for the population of the southern districts of the region. On the opposite, in 2000’s a significant number of people living not only in the central but also in the northern parts of the region reported a large number of arthropod attacks. There is a defined correlation between the air temperature, elevation, the number of people experiencing the tick attacks, and the incidence of tick-born encephalitis in the southern, central, and northern parts of the region. Increases in the incidence are to a great extent associated with the movement of taiga ticks to the northern districts. The most significant temperature increase was reported in the central districts where a drastic increase in the incidence was registered; a mathematic analysis showed that there is a strong correlation between increasing temperatures and strongest and the number of tick attacks and incidence increase. This confirms the belief that climate change is a major factor of TBE incidence growth.

In Arkhangelsk, the elevation in temperature by 1 °C was associated with the increase in the number of salmonellosis cases during the following month on average by 1.9%. In the Velskiy district, an increase in the relative humidity by 1% was associated with a decrease in the number of salmonellosis cases in two months by 4.5%. In the neighboring Konoshskiy district, an elevation of the relative air humidity by 1% was associated with an increase in the number of salmonellosis cases in two months by 4.6% on average. All those associations were of the linear type without any threshold values. A directly proportional association was observed between the number of reported cases of salmonellosis and the air temperature in the previous month in Arkhangelsk.

Tularemia is endemic to the Arkhangelsk Region. Since 2006 there has been a registered increase in incidence of this nosological entity in the population of the region. Climatic and landscape conditions of the Arkhangelsk Region facilitate the spread of certain types of rodents – carriers in this territory, which in its term contributes to the existence of focal-sources not only of tularemia but also of leptospirosis, hemorrhagic fever with renal syndrome and pseudotuberculosis.

Other than heat and cold waves, risks factors of climate related emergencies include floods, fires, fumes and drought. Floods repeat on average once every 7–9 years and most often occur in the Kotlas, Kholmogorsky and Vynohradiv districts (in the southeastern and central regions), as well as at the mouth of the Pechora River and near Naryan-Mar. Over the past 20 years the frequency of flooding has increased on average to once every 2 years.

Major rivers including the Northern Dvina, Pechora, Vychegda and Onega can overflow during the spring flood season and flood flat land areas on which settlements are located. The most vulnerable to flood events are the Kotlas, Onega, Pinega, Maritime and Kholmogory districts. As a result of the weather conditions in the region, characterized by thawing with rain of abnormal intensity, the rivers formed a powerful flood wave, which was the reason for the opening of the rivers Onega, North Dvina, Pinega and other small rivers of the region. In connection to the flooding and the damage created by the flood to roads, bridges and overpasses; communications were interrupted between 67 settlements in the region with a population of over 16,500 people. Transportation services for passengers, food and medicine were discontinued. The increasing number of forest fires in 2010 caused abnormally hot and dry weather over a long period. During the last fire season there were 16 large fires in the region. In the zone of forest conservation, there were 12 fires with a total area of 940.21 hectares and 4 fires in the aviation zone with a total area of 10 203 hectares (Vynohradiv, Belsky, Lenski, Vilegodsky municipal districts).
PRIORITY HEALTH DETERMINANTS AND CLIMATE CHANGE IMPACT ON HEALTH OF THE POPULATION IN GENERAL

1. Chronic non-communicable diseases, especially pathology of the cardiovascular system.
2. Tick-borne encephalitis, hepatitis A, salmonellosis and other enteric infections.
3. Vulnerable groups include: elderly people, children, people with chronic diseases, socially vulnerable groups, the Nenets people.
4. Climate change impacts on health related to heat and cold waves.
5. Environmental safety: floods and fires.

OPTIMIZATION OF THE HEALTHCARE SYSTEM UNDER THE CONDITION OF CLIMATE CHANGES

Vectors, which define the priorities of modernization and approaches to the interventions, are the following: systemic nature and multi-sectoral approach in addressing the complex problem of maintaining health and reducing mortality. Promotion of multidisciplinary principles, which provide a rational balance of medical and preventive measures, their availability, continuity, resource provision and therefore quality of the healthcare system will be based on the principles of primary healthcare. Increasing access to healthcare in the Arkhangelsk region and Nenets Autonomous District can be improved by strengthening primary healthcare (staffing, disaggregation of the medical sites, prioritizing preventive work under the conditions of heat waves (especially in the vulnerable populations), improving clinical examinations, developing and implementing programs of patronage for the elderly who suffer from chronic diseases during temperature fluctuations (without prejudice to the public), lengthening the work schedule of healthcare facilities, and postponing elective surgeries and examinations. In addition, it is recommended that mobile types of the medical care and telemedicine stations in the NAD be established.

Optimization of healthy lifestyles in the population should be conducted with more active involvement of the paramedics.

It is necessary to improve the health and hygiene education of the population, especially of children and adolescents through mass media, as well as through educational institutions by compulsory introduction of appropriate educational programs for preschool, primary school, secondary school and higher education. There should be a promotion of healthy nutrition, a prevention of addictions; the work of the “Health Promoting Schools”, the Center for Preventive Medicine. Centers for Healthy Lifestyle should be improved; a special microclimate should be created to persuade its members to lead healthy lifestyles. Medical facilities, social workers and psychologists should be involved in working with the population. In this regard, postgraduate education should be provided to healthcare workers. It is necessary to train paramedics (medical consultants, households, police officers, teachers, veterinary services, postal workers) in the basics of diagnostics of conditions directly threatening human life, providing them with the means to administer first aid, to establish the mobile medical teams, “cooling centers” and to conduct public information and awareness campaigns.

It is also necessary to develop training materials / guidelines for the healthcare workers and paramedics. These recommendations should be based on the existing educational, methodical and information materials, including the recommendations of the WHO and NGO “Doctors of the World.”

Health education of the population using public service announcements, brochures, media, Internet, personalized advice on health issues related to the climate change and health in general should be utilized as well.

Development of the notification system alerting the public and various services about heat waves:

To reduce and prevent excess mortality due to the impact of air temperatures, it is important to develop a system of timely public warnings of heat and cold waves, to allocate special broadcasting time on TV and radio, and to use the information screens in the region. It is necessary to repeat public warnings about the seriousness of threats posed by high concentrations of carbon monoxide and fine particles (soot) in the air during fires.
In this respect, the following factors are principally important:

• Since it will take time to implement the plan, timely operational information provided to the population and relevant services about the occurrence of heat is of fundamental importance. According to the data provided by WHO experts, the forecast should be given at least 2 days prior to the onset of heat. People today no longer have the skills to continuously perceive complex information. So the advocacy “chord” has to be very clear for accurate understanding: on the advertisement boards, posters, in booklets, etc. Emergency phone lines, online web sites for advising have to work around-the-clock. Social workers and psychologists should be involved in counseling as well.

• Improvement of material and methodological resources of health facilities, primarily in rural areas (district hospitals, dispensaries, feldsher-obstetric-units, households), development and distribution of first aid kits, diagnostic equipment, educational materials/standards. Concentration of resources (material, teaching, organizational and coordination in the inter-district centers (Kotlas, Velsk, Karpogory, Severodvinsk, Nyandoma).

• Increasing the number of healthcare facilities equipped in accordance with the approved procedures of medical care.

• Methodological and resource assistance to the “social isolation units” (detention centers, prisons, assisted living centers for disabled, nursing homes and organized children’s and adolescent groups). Conducting educational workshops in targeted organizations. Provision of first aid kits, diagnostic equipment, and guidelines. Involvement of social workers and psychologists in practicing the interdisciplinary approach to addressing problems.

• Epidemiological and environmental safety. Improving the system for collecting and recording information related to the population’s health, including the major risk factors associated with climate change (monitoring the situation of tick-borne encephalitis, salmonellosis, other infections, improving laboratory diagnosis of tick-borne encephalitis, acaricidal treatment of crowded places, and expansion of the TBE vaccination).

• Interdisciplinary coordination within the healthcare system, medical emergency services, the Center for Emergency Medicine, Emergency Medical Care, the Center for Hydrometeorology and Environmental Monitoring, and the Fire Department.

MANAGEMENT STRUCTURE

Four levels can be distinguished in the managerial structure and strategy implementation: 1 – Leader of the strategy, 2 – Interagency Working Group, 3 – People in charge of the sectors 4 – frontline workers. Strategy implementation will be negotiated with the Administration of the Arkhangelsk Region in order to assign a person in charge of project coordination on behalf of the Deputy Governor on social issues (Level 1 – Head of the Strategy), who establishes a Working Group at the regional level (Level 2) to indirectly control the implementation of activities in accordance with the abovementioned plan of action - according to the stated priorities. This (the highest) level of leadership for the region should provide the legal framework, take responsibility for decisions, and ensure diligence and legal support for strategy and supervision.

The Working Group should include: the Minister of Health and Social Development of the Arkhangelsk Region, the Head of the Department of Health and Social Development of the NAD, the Head of the Arkhangelsk Region Rospotrebnadzor, the Dean of the Northern State Medical University, the Head of the Department for Internal Affairs in the Arkhangelsk Region, the Minister of Education, Science and Culture of the Arkhangelsk Region, the Minister of Agriculture and Trade in the Arkhangelsk Region, the managing director of the Arkhangelsk branch of Sberbank of Russia, the director of the PMU of the Arkhangelsk Region “Pharmacy”, the director of the Information Policy Department at the Arkhangelsk Region administration, the Head of FSSE in the Arkhangelsk Region, the head of EMERCOM in the Arkhangelsk Region, the chief meteorologist of SI “Arkhangelsk Center for Hydrometeorology and Environmental Monitoring with Regional Functions”, the head of the Department of the Federal Postal Service of the Arkhangelsk Region - a branch of the Federal State Unitary Enterprise “Russian Post”, Directors of CJSC “Nord-Avia”, and the Northern Branch of the JSC “Russian Railways”. The members of the Working Group provide horizontal and vertical coordination of the strategy. They are responsible for its performance in their sectors and appoint frontline workers for specific interventions (level 3).
Given that in its essence this strategy is of a healthcare nature, we believe that there are some fundamental differences in the structural organization of activities to be performed. In services with their own healthcare providers (ATM, FPS, Railways, etc.) the heads of the relevant medical institutions are responsible for these sectors. Where such services are not available, the heads of healthcare services and certain fields of medicine (leading experts in the certain fields of medicine, heads of the municipal hospitals etc.) are in charge of those sectors. Depending on sector priorities, the direct frontline workers (Level 4) will be doctors, nurses, staff members of the NSMU, media workers, social workers, psychologists, trained paramedics, medical instructors, homemakers, policemen, teachers, postal workers, librarians, bank officers, etc.

STRATEGY FINANCING
The region has developed and approved a “Program of Modernization of Healthcare in the Arkhangelsk Region For 2011–2012.” There is a correlation between a number of key provisions of the program. About 4.5 billion rubles will be allocated to strengthen primary healthcare for a given time period (more than 3 billion rubles) to increase access to healthcare. Equipment costs incurred by the WHO within the framework of this project and will amount to 140 000 USD. The costs of training and information materials amount to 181 447 USD. It is necessary to provide funding for informing the population through the media, Internet, and public service announcements in order to provide methodological and resource assistance to the “social isolation units.”

PLAN TO RAISE PUBLIC AWARENESS OF HEAT IMPACT ON HEALTH
Awareness of the risks associated with hot weather and heat waves, and providing public with some advice on behavior in these circumstances should be included into the strategy of preventive measures to protect the population’s health from abnormal summer heat. But even before the onset of the summer season, it is recommended to establish a well-structured and proven communication strategy, aimed at specific target groups.

For this purpose the following items are defined:

- Target audiences-population in general, vulnerable groups (children, elderly, people with chronic diseases, those located in the “social isolation units”).
- Means of communication: for the population in general- mass media channels, Internet resources; for the vulnerable groups – individual and group discussions, brochures.
- The content of information that is to be conveyed to the audience are the rules of behavior that must be followed to prevent the negative impacts of temperature fluctuations on health.
- First aid measures.
- Time when it needs to be done – 10 days prior (with a confirmation – 2 days in advance) the forecasted heat or cold waves within the period of abnormal temperatures.

RECOMMENDATIONS FOR PRACTICAL PUBLIC HEALTH
Vectors that define modernization priorities of the healthcare system and approaches to it, include: the systematic and multi-sectoral approach in addressing high mortality rates, promoting the principles of multidisciplinarity, availability, and continuity. The quality of the healthcare system will be based on the principles of primary healthcare and increase access to health care in the Arkhangelsk Oblast and the Nenets Autonomous District by strengthening primary health care (staffing, downsizing medical sites, prioritize prevention in situations for diseases linked to heat waves, particularly in vulnerable groups, the improvement of clinical examination, development and implementation of programs patronage of older people with chronic respiratory and cardiovascular systems during thermal waves).

For a period of abnormal fluctuations in temperature, it is important to consider changing (without prejudice to the public) the schedules of health facilities, the temporary failure of planned operations, surveys, conducting mobile health services, creating a telemedicine station in the NAD, etc. During the implementation period, the National Project “Health” has taken steps to strengthen primary care, including equipment for
primary care establishments in rural areas and training of personnel to operate the equipment to complete the process necessary to retrofit some equipment for the diagnosis of cardiovascular and respiratory diseases – spirometers, reflectometers, etc. In the NAD, given the remoteness of the area and the nomadic lifestyle of the indigenous population, it is necessary to apply the fullest exit methods, develop telemedicine, etc. Optimization of a healthy lifestyle of the population should be conducted in partnership with the more active involvement of nursing staff.

It is extremely necessary to improve the health and hygiene education of the population, especially children, adolescents and youth through the media, as well as by the compulsory introduction of appropriate educational programs for preschool, school, secondary and higher education. Medical and social institutions should play a larger role in advocating for better nutrition and healthier lifestyles of the population. Impacts on the population should be conducted with the involvement of health care providers and specialists in social work and psychology.

Solving this problem will include certain educational provisions like postgraduate education of health workers to train paramedics (chum-workers, sanitary instructors, police officers, teachers, veterinarians, employees, postal workers, households, etc.), the basics of diagnostic conditions that directly threaten human life, first aid training, and measures to create mobile health clinics, “soft centres”, information and awareness.

In addition, the need to develop teaching materials / guidelines for medical personnel and paramedics is seen as critical. These recommendations should be based on existing teaching and informational materials, including the recommendations of WHO and “Doctors of the World.” Health education of the population is possible to carry out with the help of social advertising, leaflets, media, the Internet, personalized advice on health issues related to climate change and health in general.

**Fundamental importance:**

Priorities that were identified by the MoH of the Arkhangelsk Region and Advisory committee for advancing the following areas:

- **timely operational information to the public and relevant services about the onset of heat**, because it takes time to implement the plan. According to experts at WHO, the forecast must be given not less than 2 days before the onset of heat. And based on the fact that modern man has no skills relating to the long-term perception of complex information, propaganda, “chord” should be placed in an accessible form, on billboards, posters, leaflets, etc. Telephones “hot line”, the sites for online advice should work around the clock. Participation of advising professionals in social work and psychology.

- **improving the material and methodological basis of health**, especially in rural areas (district hospitals, dispensaries, FAPs, households), the development and provision of first aid kits, diagnostic equipment, and educational materials / standards.

- **the highest concentration of resources (material, teaching, organizational and coordination)** is needed in inter-centre - Kotlas, Velsk, Karpogory, Severodvinsk, Nyandoma.

- **increasing the number of health facilities equipped in accordance with the approved procedures of medical care.**

- **methodical and resource support “social isolates”** (jail, prison, boarding schools, nursing homes), and organized children’s and adolescent teams. An interdisciplinary approach to problem solving with experts in social work and psychology. Holding educational seminars in the target organizations, providing them with first aid kits, diagnostic equipment, and guidelines.

- **epidemiological and environmental safety.** Improvement in the collection and recording of information on health, including basic information and risks arising from climate change.

- **monitoring the situation of tick-borne encephalitis, salmonellosis, other infections, improved laboratory diagnosis of tick-borne encephalitis, acaricidal treatment in crowded places, and expansion of tick-borne encephalitis vaccine.** Improvement in the collection, recording and timely processing of information on health

- **interdisciplinary coordination of the health care system, medical Service Emergency Ministry, Centre for Emergency Medicine, emergency medical services, the Centre for Hydrometeorology and Environmental Monitoring, and the Fire Department.**
Global warming is an obvious fact now ("Climate Change and Health" WHO 61/14 Materials of the 61st Session of the World Health Assembly, 2008), based on data that shows a global increase in surface temperature and ocean waters, accompanied by a widespread melting of glaciers and a rise in sea level (Climate change 2007, Synthesis Report. (Summary for Policymakers (formally agreed statement of the IPCC) Plenary XXYII, Valencia, Spain, 12–17 Nov. 2007).

Until recently, the attention of researchers was attracted mainly to the ecological and environmental consequences of climate change. Empirical evidence has confirmed sustained changes in the nature of precipitation, storms and imbalance of the natural ecosystem. Environmental Researchers have studied general manifestations to identify the causes of this phenomenon at the global level. One of the most important conclusions drawn at the time of the famous publication in 2005 “Arctic Climate Impact Assessment” (ACIA) was the one made by the Intergovernmental Panel on Climate Change in its Fourth Assessment Report (the 4th Assessment Report of the Intergovernmental Panel on Climate change (IPCC) 2007), which stated that climate change is most likely to be the product of human activity. Most of the observed increase in the global average temperatures since the mid-20th century is very likely due to an increase in anthropogenic greenhouse gas concentrations (4th Assessment Report on the IPCC website www.ihcc-wg1.unibe.ch/presentations).

Another report, ACIA 2008, provided conclusive evidence that supported the idea that natural changes in the arctic affect physical and biological systems, including humanity (Arctic climate impact science, An update since ACIA April 2008 by WWF International Arctic Programme, Oslo, Norway). It was shown that either through direct or indirect influence, climate change may pose a threat to human health.

Increases in the frequency and severity of extreme weather events such as hurricanes, heat waves, droughts and floods will contribute increasingly to the most important risk factors and health determinants of the spread of the global burden of diseases. This is closely associated with food production, provision of water supply and spread of vectors and pathogens among the population, which, above all, include malnutrition, diarrhea and malaria.

Bad air quality increases prevalence of asthma and respiratory infections. Increased frequency and intensity of heat waves will increase mortality rates from heat stress and exacerbation of cardiovascular diseases. Evidence indicates that this is already happening ("Climate Change and Health" WHO 61/14 Materials of the 61st session of the World Health Assembly, 2008), and that the negative effect may increase disproportionately in vulnerable groups (people in areas with low income and poor infrastructure, geographically remote and rural areas with low population density). In this respect, healthcare and social services, which are also important determinants of health, are often not well developed or equipped to adequately respond to the needs of the rural population. It is therefore imperative that this issue is central in the debate on climate change in order to support the development of proper responses to protect the population’s health.

In recent years WHO has taken steps to clarify the nature and the extent of possible harm, and to increase knowledge about the mechanisms underlying these processes for their use in determining the measures necessary to prevent or alleviate the effects of climate change on health (Climate change and health. A61/14 Report of the Secretariat, WHO 61, May 2008). At the 62nd session of the World Health Assembly in 2009 a resolution proposed by the Board (EV124.R5) to support the action plan, including the technical sup-
port to countries in order to assess and mitigate the effects of climate change on human health was adop-
ted. The following activities were recommended:

• Public awareness campaign and an increase in the level of information provided;
• Establishment of partnerships with other UN agencies and public institutions (with the exception of the
  health facilities) at the national, regional and international levels;
• Promotion and support of scientific data;
• Strengthening healthcare systems to address threats to human health associated with climate change,
  including emergencies related to the extreme weather events. It is worth noting that six weeks of heat
  waves in the summer of 2010 in the regions of Russia took over 50,000 lives.

It is expected that the implementation of international projects involving interagency support for gene-
ral development based on standard protocol will help to clarify a number of issues related to the risk of di-
seases or their complications in various climatic conditions. It will also help to promote the development
of adaptive strategies in order to minimize the impacts of climate change on the health of the population.

The Arkhangelsk Region is a northern territory of Russia with a combination of various risk factors: climate,
natural, geographical, ethnic, environmental, social and healthcare related. In the interdisciplinary aspect
of the proposed strategy, the participation of various harm reduction services is intended to reduce the im-
pacts of climate change on humanity. The healthcare system has a leading role but without its interaction
with the local authorities, the Arkhangelsk Centre for Hydrometeorology and Environmental Monitoring,
the Regional Emergency Center, NSMU, media, etc., it will be quite difficult to achieve any positive results.

Thus, the dual purpose of this project is to conduct research to enhance our knowledge and understanding
of direct effects, as well as the complex indirect effects of changes in weather and climate on human health.
Equally important will be the analysis and assessment of the healthcare system’s capacity to adapt using a
multi-sectoral approach, raising the necessary level of knowledge and activity of the population to provide
timely and effective responses to threats posed by extreme weather and climate change.
Global weather upheavals of the last decade leave no doubt that there is a need to pay special attention to the conclusions made by the Intergovernmental Panel on Climate Change which takes place in most parts of the world. The manifestations of global warming are most evident in the Arctic and it is accompanied by melting and permafrost retreat. There are scenarios with extreme consequences such as loss of ground stability and risk of destruction of large multi-storey buildings. However, the epidemiological vigilance is necessary even with the consequences of a lower severity because of possible deformation / damage of engineered structures, water supply and sewerage systems.

Impacts of climate warming are already evident in subarctic zones and are important for the small ethnic groups of the North and their traditional way of life and socio-economic organization. They are extremely dependent on the balance of the environment, which, as it is now apparent, very fragile. Early spring warming and shifting of vegetation and wildlife areas disrupt traditional ways of nature management, and the unique ways of life typical for the northern ethnic groups, which were the result of centuries-old adaptation and have become an integral part of their culture.

The most pronounced negative effect on humans and the surrounding environment appears to be repeating episodes of heat waves (an abnormally high temperature (30 °C and above). In addition to deterioration of health in vulnerable populations with disorders of the respiratory and cardiovascular systems, there are problems with food safety and the risk of intestinal infectious diseases. We should not exclude the risk of changing local ecosystems in terms of migration of new vectors, including malaria and encephalitis. Rural settlements with unstable means of communication are subject to even higher risks. There are some expected shortcomings in achieving the Millennium Development Goals related to health. Especially considering a stronger warming effect in the entire Arctic region as projected by global climate models. The international community and the World Health Organization, with the direct global mandate in the area of healthcare all over the world, continue to work with member states in their effort to collect additional information to establish the evidence base for development of the recommendations in accordance with the updated principles of healthcare development (Tallinn Declaration). The pilot project in the Arkhangelsk Region is intended to contribute to the development of a clear response system in order to protect human health.

Optimization of the healthcare system in the Arkhangelsk Region in regard to climate change will involve more interaction of the healthcare field with various relevant institutions.

The analysis of the causes and other factors associated with the deterioration of health due to the influence of thermal waves will be performed. It will include the current structure of healthcare, modern economic opportunities, and the most vulnerable population groups. On this basis the priorities and mechanisms for the implementation of this strategy will be formulated. The main methodological tool should be a strategy on Impacts of Climate Change on Human Health proposed by the WHO, BMU.
Many years of experience, which the WHO (and the UN in general) has in the implementation of the vertical, “donor supported” programs at the country level, demonstrated a frequently observed short lifespan of original achievements. Usually this was due to exclusively targeted allocation of donor resources, without considering the need for investment in the basic infrastructure of healthcare services. Fortunately, recent trends are changing, and today the donors are interested in using its resources effectively. Germany is one of the donor countries that has taken into account lessons from the past; moreover, it is one of the leaders in innovative solution to problems concerning public health. This is a comprehensive, systematic approach, which takes into account multiple factors relating to the health care process. In regards to the problem of climate change and health, this position appears to be just as distinct: “Adaptation measures do not replace activities related to protection of the climate, since there is an inextricable link between these two processes. They represent the two pillars on which the “Climate Policy” of Germany stands.

Risks associated with climate change give the health sector an opportunity to demonstrate its leadership in adapting to and mitigating the effects on health through the efficient involvement of other sectors for a common benefit.

It is very important in this case that the priority is given to the basic components of the healthcare system in order – to the development of infrastructure and adequately staff medical facilities with the qualified personnel to ensure service quality.

The following is a list of the ten main priorities identified by the strategy. The necessity to strengthen basic elements of the public healthcare system and an emphasis on the inter-sectoral partnership aimed at protection of the environment is omnipresent throughout these recommendations:

- Increasing access to healthcare in the Arkhangelsk Region and Nenets Autonomous District by strengthening primary healthcare.
- Optimization of the system for establishing a healthy lifestyle in the population to be achieved in partnership with other sectors and through a more active involvement of the nursing staff (empowering district and family nurses). Activities aimed at mortality reduction.
- Improve and extend the postgraduate education of healthcare workers for disease prevention and the promotion of a healthy lifestyle with a focus on strengthening primary healthcare in general, with joint medical and nursing programs for undergrads.
- Training of paramedics (homemakers, sanitary instructors for households, police officers, teachers, veterinary services staff and postal workers). It is necessary to pay more attention to training of sanitary instructors and homemakers, who may, in turn, act as a more active and useful link between medical service and the community; the civil society.
- Development of teaching materials/guidelines for healthcare workers and paramedics.
- Health education of the population using public service announcements, reminders, media, internet, personalized advice on health issues related to climate change and health in general. Development of a system alerting the public and its various services on heat wave occurrence.
- Improvement of the material and methodological basis of healthcare facilities, most importantly, those in rural areas (district hospitals, dispensaries, feldsher-obstetric units, households). Also to include the
distribution of first aid kits, diagnostic equipment, educational materials / standards. Concentration of resources (material, teaching, organizational and coordination in inter-district centers (Kotlas, Velsk, Karpogory, Severodvinsk, Nyandoma).

• Methodological and resource assistance to “social isolation units,” detention centers, prisons, nursing homes, and organized children’s and adolescent groups.

• Epidemiological and environmental safety. Improving system of data collection and recording related to the state of public health, including major and new risk factors due to climate change.

• Interdisciplinary coordination of the Emergency Medical Service, Center for Disaster Medicine, ambulance and fire departments.
The concerned international community, it’s intergovernmental organizations, particularly WHO, have undertaken efforts to clarify the nature and extent of possible harm to increase the knowledge of the mechanisms underlying these processes so that they could be used to identify the measures necessary steps to prevent or alleviate the effects of climate changes on health (Climate change and health. A61/14 Report of the Secretariat, WHO 61, May 2008).

This strategy takes into account a project aimed at improving measures to protect public health in terms of extreme weather / heat waves (Euro HEAT), initiated in 2005 in the framework of the Action Plan for 2004 - 2010, adopted at the Fourth Ministerial Conference on Environment and Health (European Commission). The regional programs within UN Program on staff training on climate change were drafted to help developing countries. Such activities include:

- Prompt implementation of adaptation activities in cases where there is enough information for justification for such actions, including those in the field of rational use and water resources control, land use, agriculture, infrastructure development, vulnerable ecosystems, comprehensive use and protection of the coastal zone;
- Monitoring the improvement of diseases and infection proliferation, which is affected by climate change and associated with the systems for forecasting and early notification, and improvement of the work on disease control and prevention;
- Support the development and strengthen the capacity, including managerial capacity, in the field of prevention, planning, preparedness and organization of activities in case of disasters caused by climate change, which include planning emergency actions (in particular dry spells and floods in districts that are prone to extreme weather conditions);
- Strengthening the existing, and if necessary establishing new, national and regional centers and informational networks for methodological support and prompt response to extreme weather conditions with maximum use of information technologies.

The current strategy is based on the experience of WHO activities related to “Health and global environmental change,” where, in particular, a group of experts developed methodological guidelines: “Methods for evaluation of human health sensitivity and public healthcare adaptation to climate change, 2005” and “Periods of extreme heat: threat response measures, 2005,” Resolution 62 Session of the World Health Assembly (May 2009), Resolution of International Seminar “Global Climate Change Impact on Russian Arctic Health, 2008,” experience of public healthcare programs on mitigation of climate change, and the influence on human health in the USA, Canada, France, Italy.”

Finland, for example, Russia’s closest neighbor, in 2005 prepared and published “Climate strategy” on the bases of available scientific findings and expert evaluations. It covered activities of many sectors starting with agriculture and ending with tourism and emergency insurance. The healthcare sector should coordinate its activities with activities of other sectors. Finland planned to allocate resources based on this scientific research.

In the United Kingdom, the structure development and the distribution of roles is being performed in accordance with the adopted adaptation policy (Adaptation policy framework). It is important that this acti-
vity highlights coordination of sectors to promote efficiency and to prevent unproductive duplication. In addition to the importance of the leading role of the Government, it is stressed that local authorities play an important role in the implementation of the adaptation process on the basis of local partnerships resulting from the local specifics of climate changes. Various scenarios of climate manifestations are developed (4 options) and funds are allocated for the inter-sectoral studies on the prediction of interventions’ outcomes (indications for hospitalization and mortality from temperature fluctuations, frequency of food poisonings, and spread of infection due to the change and intensity of the vector’s multiplication. In particular, in England, the work of the Health Department in developing recommendations on adequate protection of the population may be taken as an example. Based on risk-benefit ratio studies, some measures were suggested to reduce the actual risks that are more frequent and have the most hazardous impacts. Developed guidelines provide people with the knowledge and skills for effective protection. Recommendations on prevention of dehydration are vital; as without any premonitory signs, it may result in “heat shock” with irreversible health outcomes.
This strategy is aimed at optimization of the healthcare system in the Arkhangelsk Region and Nenets Autonomous District, and increasing its preparedness for an adequate and timely response to mitigate the potential public health impacts of critical weather fluctuations and climate change through a comprehensive, systematic and dynamic interaction of various services.

This vision of the strategy is based on a forthcoming development and introduction of additional inter-agency activities on mitigation of climate change impact on human health within the current regional healthcare system, social services, emergency institutions, and hydrometeo service. Optimization of the healthcare system is considered to be the improvement of human resource capacity in this field, particularly in primary healthcare by improving the proficiency level of medical workers specializing in preventive activities, and by strengthening the material and technical base which ensures the operation of primary healthcare facilities at the current level. It is important to further expend use of expeditionary forms of medical care and telemedicine.

The training of paramedics, that is, specialist that work directly with people in various circumstances, pertaining mainly to emergency situations, plays a central role in our strategy.

The improvement of educational and informational activities among the population in addition to more traditional forms of education like lectures, and group and individual counseling, will be supported by modern media technologies. A set of procedures will be developed for the prompt notification of appropriate services based on predetermined expected changes in temperature for the introduction of rapid comprehensive activities focused on prevention and control of the harmful impacts of temperature change on human health. This work will be focused on the entire population, especially the most vulnerable risk groups as defined by this strategy. Interagency cooperation is important in addressing relevant issues and personal responsibility of the heads of service departments involved in working with vulnerable groups (healthcare, education, social welfare system and penitentiary service) for the implementation of management decisions.

The system in place for monitoring the impacts of environmental change on human health (climate change) will be enhanced/improved. Prior to recommending this intervention for further replication, an evaluation of its effectiveness will be performed in the pilot region.
1. Promote adaptation of the healthcare system in the Arkhangelsk Region and NAD in accordance with the expected deterioration of the population’s health due to climate changes/extreme temperature fluctuations.

2. Promote interagency cooperation of the healthcare system with various sectors and social institutions in the development and strengthening of preventive activities that include mitigation of impacts of heat and cold waves.

3. Expand educational and informational activities aimed at increasing the proficiency level of medical workers in the field of preventive medicine and to control or mitigate the effects of extreme weather conditions on health. Paramedic training should also consist of methods for informing the population about the effects of climate change on health and the need to take proven preventive measures to minimize this impact and provide first medical aid.

4. The targets of this strategy are the following: healthcare systems, staff of the social and other service systems, and the population in general.

5. Geographic territory: the Arkhangelsk Region, NAD. The implementation timeline: 2011 – development and approval of the plans, methodological, resource and financial base; 2012 – implementation of the strategy.
7.1. CURRENT AND HISTORICAL TRENDS OF CLIMATE CHANGE

The air temperature in the northern part of the Arkhangelsk Region has not been consistent in the 19th–21st centuries; this high variability also remains after 10-year averaging.

Fluctuations analysis of the mean annual air temperature for more than a 100 year period shows that the end of the 19th and beginning of the 20th centuries were characterized by the lowest values. After the first decade of the 20th century a major warming process known as “Arctic warming” began. This process, from 1920–1940, took a significant amount of time in a majority of Russia, and was shorter yet more pronounced in the South. The warmest decades were: 1930–1939 and 1931–1940. The years with the highest temperatures were 1930–1940. It was identified that that warm era was mainly due to a high transparency of atmosphere and, to a small extent, by a relatively small increase of CO2 concentration reported at that time. At the end of 1940 there was a decrease in air temperature. The coldest decade was the period from 1962–1972. Since the mid-1960’s a change towards warming occurred, which increased in 1980, and continued to do so through 1990 and is still present today.

According to studies performed in from 1907–2006, the average warming in Russia was 1.29 °C. From 1976–2006 it was 1.33 °C (Assessment Report 2008). The analysis of air temperature has shown that warming in the Arkhangelsk Region from 1907-2008 was 0.72–0.96 °C/100 years. From 1976–2006 the range was between 1.01 and 1.88 °C/31 years.

The global observations of temperature show that the 11 years from 1995 to 2006 were the warmest within the entire period of instrumental observation of the global temperature since 1850. The Arkhangelsk Region has a different pattern of temperature fluctuations. The increases in temperature (positive abnormalities) reported in the northern districts were recorded 7 times. In the south these were recorded 8–9 times. The coldest year during this time period was 1998. In the north, temperatures were 2–3 °C below the norm. In the south, temperatures were 0.5–1 °C below the norm.

The warmest year was 2005, when in the north, temperatures were 2–3 °C above the norm. In the south, temperatures were 1–2 °C above the norm. New data available for the period of 2007 and 2008 suggests the situation has changed slightly; to the north of northern latitude 64°, the warmest year was 2007, to the south – 2005 (eastern areas) and 2008 (western areas). The increase in winter temperatures could be traced consistently from the 1980s to the mid-1990s. Its duration and intensity reached and even exceeded the warming of the 1930s. Since the mid 1990’s there has been a cooling trend, but warm abnormalities persist. In the north, summer temperatures in the late 1980’s and early 1990’s approached the same levels as the 1930’s and 1940’s, followed by a slight decline in temperatures. However, in recent years, the temperature has risen again.

Warming has been recorded since the mid 1990s in the central and southern parts of the territory. From 1997–2008, positive abnormality of summer temperatures was observed for 10–11 years in the southern and central regions. Closer to the north, cooler summer temperatures (negative abnormalities) were noted more frequently by 3 or 4 times. It should be noted that in the summer of 2008, there were cooler temperatures throughout the entire territory. Summer temperatures were warmer only in the extreme north.
Figure 1 shows long-term change in the number of warm days with the average daily air temperature at 20 °C and higher. Compared to 1961–1990, the increase in the number of warm days in the 1920’s and 1930’s is obvious; the 1940–1950s are noted by their significant decrease in temperature. The number of warm days was around the norm with some small positive and negative abnormalities from the late 1950s to the late 1990s. A sharp increase in the number of warm days has been noted since the late 1990s, with its amplitude exceeding that of the 1920–1930s.

Number of cold days with the average daily air temperature of 0 °C and below is shown in Figure 2. In the extreme northern areas, long-term changes are expressed clearly. Until the mid-1960s the number of cold days was below normal by 2–16 days, then there was a modest recovery with amplitude of 3–10 days. Since the late 1970’s there has been a steady decrease in the number of cold days with amplitude of 3–13 days. The trend in the number of cold days remains the same toward the south, but the amplitude compared to the northern region is reduced to 2–8 days.

Climate change is also accompanied by a change in the dynamics and frequency of natural disasters. In the Arkhangelsk Region and Nenets Autonomous District (NAD), extreme weather events and conditions directly and indirectly affecting human health include: severe frosts, heavy rainfall, high winds, overflowing during snowmelt floods.

Long periods of frost (defined as more than 3 days with temperature lows below –35 °C), as well as extremely low temperatures (below –45 °C) are most typical for the eastern part of the Arkhangelsk Region and coastal regions of the NAD. Every year there are, on average, 6 to 10 consecutive days with frosts below –35 °C. Extremely low temperatures occur, on average, once every 2 years and are most common in January and February.

During the abnormally hot summer of 2010, the mean monthly temperature in Velsk was 23 °C, in Kargopol 22.6 °С, Arkhangelsk 20 °С, which was significantly above the climate norm. As on July 21, 2010 in Arkhangelsk, the temperature was 8° above the norm and it was a new absolute temperature maximum for that day. Strong winds associated with the release of deep cyclones are most frequently observed on the coasts.

Figure 1. Long-term variation in the number of warm days
Figure 2. Long-term variation in the number of cold days

and seas in the NAD. This dangerous phenomenon occurs 3.5 days per year. Squalls and tornadoes are especially dangerous types of strong winds, as they can occur suddenly and have a great destructive force. They can also cause significant damage to the economies of the affected districts and their populations. Squalls and tornadoes appear mainly in the southeastern part of the Arkhangelsk Region with the peak of their recurrence in July.

In July and August the main hazards are heavy rains, which cause an increase in water levels in the rivers, risk of flooding, as well as direct economic losses. Usually in the form of thunderstorms, heavy rains occur most frequently in the southern part of the Arkhangelsk Region. The reoccurrence of this dangerous phenomenon is significantly variable, but is less than 0.5 days per year.

Thus, in this section we have reviewed the signs of the population’s health deterioration due to climate changes, the causes of which will be discussed below.

7.2. AIR QUALITY

Ambient air is a vital and integral part of the human environment. Air quality is compromised by intensity of emissions pollution from both stationary (industrial plants) and mobile (transportation) sources. Ambient air pollution poses a serious threat to the environment and human health. Emissions of enterprises are dangerous and harmful substances when combined with atmospheric precipitation. These emissions get into soil and surface water, join the biosphere cycle and accumulate in various environments of the human and natural biogeocenosis.

The leading industries in the Arkhangelsk Region are: forestry, woodworking, pulp and paper, mechanical engineering - shipbuilding, thermal - electric power, construction and food processing.

The Northern Inter-Regional Territorial Administration carries out a systematic observation of the air pollution level in the Arkhangelsk Region for Hydrometeorology and Environmental Monitoring (North AHEM) at 9 different sites in 4 cities (Severodvinsk, Novodvinsk, Koryazhma, Arkhangelsk). The industrial laboratories in Koryazhma carry out additional observations. Concentrations of major impurities common to all sources
of emissions were identified in the air (particulate matter, sulfur dioxide, carbon monoxide, nitrogen oxides, benzene, pyrene) and specific sources (formaldehyde, hydrogen sulfide, carbon disulfide, methyl mercaptan). In 2008, according to the monitoring data provided by the North AHMS, the level of air pollution in the cities of Arkhangelsk and Novodvinsk was estimated to be elevated due to a high content of formaldehyde and benzene. The mean annual concentrations of formaldehyde and benzene in Arkhangelsk and Novodvinsk exceeded MAC by two times, in Severodvinsk – 3.0 and 2.5 times respectively. Sulfur containing combinations were recorded in the air of Arkhangelsk, Novodvinsk and Koryazhma (sulfurated hydrogen, methyl mercaptan), exceeding MAC by 1.3 to 4 times. From 2004 to 2008 there was an elevated level of air pollution comprised of carbon monoxide in Arkhangelsk, suspended matter in Novodvinsk, and nitrogen dioxide in Koryazhma.

As per data of the mobile laboratory of OSI (State Ecological Inspectorate for the Arkhangelsk Region), the main air pollutant on highways of Arkhangelsk is carbon monoxide. More than 25% of the atmospheric air samples tested for carbon monoxide did not meet sanitary norms. On some highways in the center of Arkhangelsk, carbon monoxide concentration was 6.5 times higher than the maximum allowable concentration (MAC).

7.3. FUTURE PROJECTIONS OF CLIMATE CHANGE TRENDS

Climate changes are more evident in the Arctic because its climate strongly depends on heat and humidity that comes from warmer parts of the planet, which is increasing due to global warming. The Assessment Report, produced by the State Hydrometeo Service, presents the results of the model’s dynamic trend calculations (by a set of model) for the key meteorological characteristics of the middle of the 21st century (2040–2060) in Russia, including the Arctic zone. The calculated estimates reflect the general trend. An increase in the mean annual surface air temperature will continue into the middle of the 21st century in the Arctic regions of Russia. The most notable increase in temperature will be during winter. It is expected to see a decrease in the number of months with stable snow cover, more precipitation, water runoff and an increase in the temperature of water bodies.

By mid-century a freeze-up period will decline, and the rate of permafrost retreat will increase. Reduction in thickness of ice cover of the Arctic seas will take place, mainly due to the reduction of size and thickness of multiyear ice. Sea level rises and the increased frequency and intensity of severe weather events are projected. At the same time, a fairly high level of uncertainty in the estimates due to insufficiently dense network of observations and relatively short series of instrumental observations and limits in the spatial resolution of climate models should be taken into consideration.

Projected climate change will have both negative and positive consequences for the environment, economy and population of the Arctic region. Negative manifestations of climate change include negative consequences for ecosystems, environment, infrastructure of coastal areas, overall human health and the traditional local way of life. Positive consequences of climate change include reduced heating costs, increased opportunities for agriculture and forestry, the development of shipping along the Northern Sea Route, as well as improved access to and increased production of mineral and marine resources.

A forecast of the mortality change due to the climate change between the forecasted period (2041–2060) and basic period (1980–1999) in Arkhangelsk was made. It was based on the climate forecast made by MGO by regionalization of the set of climate models of the general atmosphere and ocean circulation (MGCAO). The most pessimistic scenario, A2, was chosen for the calculation of the increase in greenhouse gas emissions. Impact of climate warming has two opposite effects, a reduction in winter mortality and an increase in summer mortality. Studies showed that winter temperatures grew almost twice as fast as summer temperatures. In this regard, the reduction of winter mortality prevails over the growth of summer mortality, and general climate warming effects are favorable; climate warming should result in the reduction of mean annual mortality. But, herein of great importance is the fact that summer mortality is persistently increasing despite the reduction of the winter mortality.

Based on these forecasts, the following conclusion can be made: natural mortality should decline by about 1%, and mortality from external causes by about 2%, and some climate-related causes the decline will be greater, for example, for cerebrovascular diseases by up to 4%.
This forecast confirms the finding that major changes are expected in the oldest age group, as those people are more susceptible to the changing environmental factors. There are more statistically significant results available for this age group, and the decline in mortality due to all natural causes was 1.4% compared to 0.4% in the middle age group.

Both negative and positive climate change manifestations require thorough investigation. It is very important to facilitate studies of climate risk and identify possible benefits to various sectors of the economy in the Arctic region, so they may be taken into account when drafting development programs that aim to reduce the damage from some risk factors and to make the best use of others.
Certain threats to the health of the population in the Arkhangelsk Region and NAD are posed by flooding caused by the spring snowmelt. This is mainly related to natural flooding in the spring. These floods occur on average once every 7–9 years and are most often in Kotlas, Kholmogorsky and Vynohradiv areas (in the southeastern and central regions), as well as at the delta of the River Pechora and the area of Naryan-Mar. However, over the past 20 years the frequency of flooding has increased once every 2 years on average. Critical flooding events with large scale adverse effect were observed in November-December of 2006; they were associated with abnormally high temperatures. That autumn-winter flooding of the river caused damage to farm roads, meadows, winter storage of hay, wooden bridges, communication infrastructure between settlements, and telephone lines. It also disrupted the supply of food and delivery of medical care to the population.

A difficult situation could have resulted with the spring flooding of 2011. This was reported at a meeting on 2/21/11 at CHC, dedicated to the preparation for spring floods. Long-term, abnormally warm weather in autumn of 2010 delayed the formation of ice cover on the rivers (later than mean time by 5–15 days) at levels below the long-term averages, with the exception of the lower stretches of the Northern Dvina, Pinya and Malaya Severnaya Dvina, where the levels of freeze-up were 0.6–1.6 m above normal. Such a long period of freezing led to the formation of a series of ice jams in the lower and middle reaches of the Pinega and the Northern Dvina. Conditions of ice formation, caused by very low air temperatures, as predicted by the Northern AHEM, gave reason to expect that the openings in the rivers of the Arkhangelsk Region would be accompanied by the formation of long ice jams and waters rising to unfavorable levels. At present, the thickness of ice has continued to increase on the Sukhona, Northern Dvina, Pinega and Vyatschegda Rivers. Over the first half of February there was a significant increase in the thickness of river ice, which was caused by very low air temperatures.

Thickness of ice on the Northern Dvina River at the end of the first week of February was 55–70 cm, which is above the norm by 5–15 cm. In contrast with the neighboring southern regions, in the major part of the Arkhangelsk Region since the onset of snow accumulation there was a deficit of water accumulation in snow: in November-December –35–50%, in January – 15%, and by the end of the first week of February the deficit increased due to the persisting low air temperatures, low density of snow and lack of precipitations. Depth of snow in the forests reaches on average 50–60 cm, which is close to the norm, in the river-basins of the Vaga and the Onega rivers the depth of snow exceeds the norm by 5–10 cm. In the basins of the rivers Pinega and Mezen the snow depth is below the norm for this period by 10 cm.

Flooding in the area is dangerous because of the washing out of cattle cemeteries, and the risk of anthrax transmission. Transmission of certain human diseases to the north is expected, as well as the transmission vector-borne (tick-borne encephalitis) diseases.

Strengthening of seasonal melting of permafrost (especially on its southern border) poses a threat to the infrastructure of the Nenets population. Game and fish geographic regions may be transformed due to the changes of the coastline and ice depth in water bodies, there may be some additional injuries while fishing, etc. In addition, for the indigenous nomadic population of NAD ice storage of food is traditional, and in case of flooding this ice may pose a potential risk of an outburst of infectious intestinal diseases.
Taking into account of the elevated humidity, poorly developed infrastructure, periods of heat in the region have a particularly negative impact on the life quality in people with chronic diseases, which is reflected in the “additional deaths”, mainly - of cardio-vascular diseases. Abnormal heat in the summer season results in numerous fires in the Arkhangelsk Region, it negatively affects the development of industry branches traditional for the north – timber procurement and wood processing- and may cause a direct threat to the life and health of the population. In addition, due to a high temperature in the summer season and the consequences of wood fires, people lose the opportunity to replenish stocks of berries and mushrooms, which are a sources of vitamins. This, in its turn, should be considered as impoverishment of essential structural elements of nourishment. From the food security point of view, this factor reveals a vulnerability of the area that is directly related to climate change.

Changes in the quality of the environment during the thermal (heat and cold) waves, given the extremely high anthropogenic and human impacts in the region and low ecological capacity (ability of self-purification of air, water, soil) in the north, lead to a high level of attributable and relative risks of various pathology.
9.1. SPECIFICS OF THE POPULATION SETTLEMENT
The Arkhangelsk Region is characterized by an unfavorable climate and geographic parameters for life activities. A low population density is typical for the region – 2.1 people per km² (for the Russian Federation in general – 8.4 people per km²). In some districts of the Arkhangelsk Region (Leshukonskiy, Mezenskiy) the population density is only 0.3 people per km². Half of the population resides in the metropolitan area of Arkhangelsk-Novodvinsk. In the region there are about 1,300 populated areas, with only 4–5 people on average living in each settlement. By the level of development of transportation-logistic infrastructure the Arkhangelsk Region is considerably inferior to the majority of the Russian regions.

9.2. SOCIO-ECONOMIC PROBLEMS
The economy of the Archangelsk region is characterized by the relatively low level of productivity and wages. In the region there is an unfavorable prognosis for the number of economically active people of working age. The region takes the 29th place among all Russian regions in per capita income, and 40th in GRP, which is 24% below the country’s average level. The proportion of dilapidated housing in the Arkhangelsk Region is more than 2 times higher than the Russian average. Living conditions in the Arkhangelsk Region are worse than average for Russia: the region is below average for Russia by such indicators as the level of hot water supply, running water, water disposal, gas supply and heating. According to the UNDP report, in 2008 by Human Development Index, the Arkhangelsk Region was ranked 21st among the entities of the Russian Federation, making it inferior to the majority of regions of the North West Federal District according to these parameters.

9.3. DEMOGRAPHIC SAFETY
Demographic processes are characterized by a persistent population loss, associated with the excess mortality over birth and negative balance of migration, high divorce levels and illegitimate births. For causes of death, there is a high proportion of external causes, especially suicides, homicides, and alcohol and its surrogates poisoning. Excessive mortality in males of the working age (the death rate in males of this group is 1.2 times higher than in females and 1.1 times higher than the Russian average) resulted in age-gender disproportion expressed in the preponderance of women in the population age group above 40 years old. Overall, the number of women is 91,000 greater than the number of men in the region. This region can also be characterised by a slightly pronounced demographic aging of the population – 15.5%, in Russia this rate is at the level of 17.4% (60 years and older). Life expectancy was 67.6 years, in males – 61.3, in females – 74.4, lower than in the Russian Federation in general.
Cardiovascular disease is among the leading causes of death in the region. The probability of dying from it over the past three decades has diminished, but its defining role has always been persistent: about half of the male population and 65.0–70.0% of the female population die from this cause. In general the Northwest Federal District has shown some reduction in mortality during the present period. Mortality from circulatory diseases in the Arkhangelsk Region is 1.5 times higher than that of the NAD, 1.4 times higher than in the Komi Republic and 1.3 times higher than in the Murmansk region. Mortality from respiratory disea-
ses in the Arkhangelsk Region is 1.4 times higher compared to the Murmansk region and 3.2 times higher than in the NAD. In recent years the Arkhangelsk Region has experienced a reduction in mortality by eleven classes, with a growth rate in such classes as neoplasms, respiratory diseases, and diseases of the digestive and genitourinary systems. There was also a clear downward trend in mortality from circulatory system diseases (by 13.5% compared to 2005). This decrease is mainly due to cerebrovascular diseases. Yet cardiovascular diseases are the leading cause of death in the Arkhangelsk Region. There is a high loss of people of working age. Every fifth person who died from circulatory diseases belonged to this age group. On average the mortality of men of working age with chronic coronary heart disease is 11 times higher than that of women; while mortality from all forms of acute coronary heart disease (myocardial infarction, acute coronary insufficiency) is 7 times higher and from cerebrovascular diseases by 4.2 times.

9.4. TRANSPORT AND COMMUNICATIONS
The problems in this area are determined by a low population density and a lack of development of the transport infrastructure which limits the opportunities for growth of the major sectors of the region’s economy: forest industry, tourism, trade, construction, mining, etc., a similar situation is typical for the railway communications (low density and lack of development). There is a need for a major renovation effort and construction of a number of transport infrastructures (bridges, ferries, etc.) to ensure a year round automobile connection in some of the districts of the region and to establish modern logistical complexes.

9.5. ENVIRONMENTAL SAFETY
The quality of air in the urban areas of Arkhangelsk, Severodvinsk, Novodvinsk, Korjazhma is determined by the concentration of the main impurities common to all emission sources. These include: PPM (particulate matter), sulfur dioxide, carbon monoxide, nitrogen oxides, benzapiren, as well as specific ones (formaldehyde, hydrogen sulfide, carbon disulfide, methyl mercaptan).

A proportion of air samples which exceeded the recommended level was 2.0%. The average annual radiation dose from all sources of ionizing irradiation per resident of the region amounted to 2.7 mSv (millisievert (symbol Sv) — SI unit of measurement of effective and equivalent doses of ionizing radiation (used since 1979). 1 Sievert is the amount of energy, absorbed by a kg of the biological tissue with an effect equivalent to the absorbed dose of gamma radiation of 1 Gy.

9.6. INDUSTRIAL OCCUPATIONAL RISK FACTORS
The condition of industrial workplaces in the region remains unsatisfactory. In 2010, the proportion of workplaces not meeting hygienic norms for noise level was 41.4%; on vibration level – 28.4%; on light level – 28.7%; on microclimate parameters – 11.4%. The level of air pollution in working zone with dust, aerosols, vapors and gases including substances of hazard classes 1 and 2 at industrial objects in the Arkhangelsk Region remains high. The proportion of samples exceeding the maximum allowable concentrations is 15.5%. The proportion of workplaces in educational institutions not meeting the hygienic norm on lighting in Y2010 was 13.8%, on microclimate – 18.1%, on electromagnet fields – 3.0%.

9.7. WATER QUALITY AND SAFETY
According to the performed studies and measurements, the proportion of surface water sources not meeting the sanitary requirements in 2010 was 71.0%, including those due to the lack of the sanitary protection zones – 65.2%. The proportion of decentralized water supply sources not meeting sanitary requirements is 36.5%. One of the main reasons for the unsatisfactory condition of water bodies was a discharge of untreated (or inadequately treated) polluted industrial wastewaters. Most of the pollution comes to the surface water from the pulp and paper industry. The proportion of samples from the central water supply not meeting the hygienic norms on sanitary-chemical indicators is 56.8%, on microbiological indicators – 17.8%. The proportion of drinking water samples in distribution network of water pipes in the Arkhangelsk Region not meeting the hygienic norms on sanitary-chemical indicators is 39.9%, on microbiological indi-
cators – 9.6%. More than 745 thousand people, what accounts to 61% of the total population of the Arkhangelsk Region, are not provided with quality drinking water.

9.8. FIRES AND FLOODS
The Arkhangelsk Region is known for natural disasters, including wildfires, wind events, flooding, etc., all of which are directly related to climate change. These are characterized by an unstable state of regional weather conditions, for example, sharp temperature drops, strong daily winds, hurricane winds and powerful river floods during the spring flood season. During the spring flood season rivers of the North can overflow and flood vast population centres. During spring and autumn, storm and hurricane winds cause large surges and also lead to flooding. Given that the water reservoirs in the region are far from satisfactory sanitary conditions, caused by the dumping of industrial and sewage waste without prior waste neutralization, a more complicated epidemiological situation and an increase in the incidence of intestinal and viral infections and even the possibility of massive outbreaks are the result. Most problematic for the area in 2010 were fires. In 2010 alone, 352 forest fires were recorded, spreading over a total area of 14210 hectares with an average area of 40.3 hectares per fire. Compared to the fire season of 2009 the number of fires has increased by 4.9 times in number and 78.9 times in area.

9.9. ETHNIC SAFETY
In addition to typical problems of the indigenous population of NAD (low availability of medical care, nomadic mode of life, ethnic polymorphism and a special sensitivity to alcohol (enzyme deficiency) associated with it, low tolerance to socioeconomic changes and disasters, etc), some new ones appear due to the global climate change – changing of the geographic areas for game and fish, a necessity to look for new deer - migration paths, occurrence of various infections in the northern latitudes, flooding of cattle burials and “ice food storages”, etc. The Nenets have their traditional specifics of nutrient behavior, which have an effect on their health – eating reindeer meat, they are exposed to higher internal irradiation by the natural and artificial radionuclides, as food chain “reindeer lichen-reindeer-man” being the path of the radionuclides getting into the human body is a concentrator of pollutants.

9.10. PROBLEMS IN THE HEALTHCARE SECTOR IN THE REGION
Medical care in the Arkhangelsk Region is being provided by 96 healthcare facilities, 95 polyclinics and 496 feldsher-obstetric units. The staffing rate for doctors and nurses per 10,000 people is 43.9 and 110.1 respectively. The ratio of doctors and nurses is 12.6 (the WHO recommended ratio is 1 doctor per 4–5 nurses). The level of medical staff overall in the region is 89.8 %. The lowest doctors staffing levels are reported in Verkhnnetomskiy (44.1%) and Leshukonskiy (67.1%) districts. There are 685 jobs openings for physicians including more than 220 in the primary healthcare. Recently, the proportion of physicians at the retirement age that have continued working is between 32 – 69%.

Facilities in the region have a deficiency of diagnostic, anaesthesia-respiratory, laboratory, resuscitation and ultrasonic equipment. Twelve facilities are in critical conditions and 100 buildings require major repairs. The level of physical deterioration in all facilities is 57.3%. Therefore within the next two years of the “transition period,” with the financial support announced by the Federal Minister T.A. Golikova, it will be necessary to define and carry-out priority planning of targeted support for healthcare facilities. This is to ensure equal opportunities for the Archangelsk region and NAD to achieve maximum coverage of high quality healthcare and healthcare support. In the region, 88.5% of the health facilities have running water, 59.7% have hot water, and 83.3% have a sewerage system, and 97.4% have telephone service. The level of facilities equipped with proper computer equipment is also low (regional outpatient clinics are 79% equipped, those of the district service - about 80% equipped, and the offices of the subspecialty physicians - about 70% equipped.

The amount of ambulatory-polyclinical care is 10,339.5 visits, or 8.2 visits per 1 citizen/year. The level of hospitalization was 226 per 1000 people. The following figures represent inpatient bed use in the region: bed turnover – 25.6 days, average duration of hospitalization – 12.7 days, with bed occupancy 331 days per year. The proportion of the hospitalized patients from rural areas was 28.0%.
First and foremost, climate change has an impact on mortality, which further aggravates demographic problems in the region, also taking into account the prolonged depopulation of the region. The impact of air temperature on the mortality rate in the Arkhangelsk Region is demonstrated in the analysis of event dependencies between the daily death rate and air temperature for the period of 1999–2008 in Arkhangelsk and in the study of time-series of the daily mortality for the analysis of short (discrete) weather episodes—heat and cold waves. Statistically significant (at a level of 95%) temperature dependencies were defined for all the studied causes of death (CVD, IHD, respiratory diseases, all natural and external causes) in two age groups (30–64 and above 64 years), with the exception of strokes in the age group of 30–64. It was identified that the temperature dependence of mortality for almost every cause of death (CVD, IHD, all natural and all external causes) had classic U-shaped or V-shaped form with a minimum between +16 °C and +18 °C (for all external causes – between +20 °C and +22 °C). Thus, there is a reliable interdependence of the abovementioned causes of death and the mean daily air temperature in Arkhangelsk within the study period. It is important to note that the effect of seasonal air temperature fluctuations on mortality caused by all the external causes is stronger than that of mortality from all the natural causes. For all quantitatively defined temperature dependencies input of the short-term mortality shifting to the total additional mortality caused by temperature stress was evaluated (the total mortality increase is registered for both short-term and long-term periods – by the 50th day). A study of the time series of daily mortality for analysis of cold and heat waves impact identified ten waves of heat and eight waves of cold. The temperature threshold for heat waves was +21.0 °C, and –21.5 °C for cold waves. The temperature waves were divided into two groups: “short,” with duration from 5 to 7 days, and “long,” with duration from 8 days and more. Thus, there was a separate study of mortality characteristics for short heat, long heat, long cold and short cold waves. The impact of short waves on mortality could not be considered reliable. In this respect, only long waves were taken into consideration. There were however, statistically reliable results of the evaluation of additional mortality during the temperature waves. An increase in mortality due to CVD was recorded in the age group of 65 and older, though all natural causes in the same age group and external causes in both groups were registered during the heat waves. During cold waves the study registered mortality increases due to IHD and all natural causes in the age group of 65 and older and external causes in the age group of 30–64. It is interesting to note that the highest relative risks of mortality increases were identified for mortality due to all external causes, with this finding relevant for both heat and cold waves. The integral assessment of additional mortality due to the identified temperature waves in Arkhangelsk within the study period of 1999–2008 was performed. The damage caused by heat waves amounted to 110 additional deaths, and by cold waves – 179 additional deaths. Thus, if we sum up all additional deaths for the study period, there will be about 30 deaths. The results suggest that these deaths are avoidable and therefore it becomes obvious that the decline of climate related mortality in Arkhangelsk should become one of the top priorities for local authorities.

The impact of temperature fluctuations on the mortality rate was supplemented by the analysis of relevant effects (mean daily temperature, wind velocity, atmosphere pressure change) on frequency of the emergency calls for males and females by some of the nosological forms. The study of the meteorological effects on the requests for emergency care in Arkhangelsk was performed separately for two seasons: summer and winter.
This analysis was not performed for the pediatric population due to a small number of requests.

It was proven that an increase in the mean daily effective temperature by every degree above the 15.5 ºС threshold is associated with an increase in the number of medical calls for traumas, poisonings and external causes in males (all ages) by 1.6%, due to respiratory diseases in children by 2.5% and in the general population in the age group of 60 years and older – by 3.0%.

An increase in the mean daily temperature by every degree above the 16.1 ºС threshold is associated with an increase in the number of medical calls due to respiratory diseases by 3.7% in the age group of 60 years and older.

A decrease in the mean daily temperature by every degree below –12.8 ºС is associated with an increase in the number of calls due to the external causes in the age group of 60 years and older by 1.6%; a decrease in the number of calls due to respiratory diseases in the age group of 18–59 years (both genders) by 1.7%; a decrease in the number of calls for respiratory diseases among females (all ages) by 1.5%; a decrease in the number of calls on the following day due to diseases of blood circulation to organs – by 0.9%, and a reduction in the total number of calls among patients aged 0–17 by –1.2%.

An increase in the effective maximum temperature by every degree above the 23.9 ºС thresholds is associated with an increase in the number of medical calls on the following day due to the diseases of blood circulation to organs by 0.7% in the female population.

An analysis of an association between the mean daily effective temperature and requests for medical care due to all studied diseases in Novodvinsk for 2008, revealed that an increase in the current temperature by 1 ºС above the 15.4 ºС threshold was associated with an increase in the number of referrals to the policlinics of Novodvinsk city due to diseases caused by external causes in males on average by 1.4%.

For the majority of the diseases under study, a low number of referrals to the policlinics were reported on the hottest and coldest days (with the exception of diseases caused by external causes). In combination with the identified increase in mortality due to the effect of both high and low temperatures, and with an increase in emergency calls due to the diseases under study, it may suggest a necessity to inform the population in advance on the impact of low and high temperatures on health that are associated with the risks and measures for their mitigation.

An analysis of an association between the mean daily effective temperature and requests for medical care due to to all studied diseases in Novodvinsk for 2008, revealed that an increase in the current temperature by 1 ºС above the 15.4 ºС threshold was associated with a reduction in the number of visits: among the population in general (both genders, all ages) and in the population above 60 years old on average by 0.7% and 1.0% respectively; among the female population (all ages) and in groups of 18–59 years old, 60 years old and older – on average of 0.8%, 0.8% and 0.7% respectively; and among the female population over 60 years old – on average of 1.8%.

Every 1 ºС drop in the mean daily effective temperature below the –11.8 ºС threshold value was associated with a reduction in the number of calls for the general population (both genders, all ages); in the age group of 0–17 and above 60 years old on average of 2.2%, 2.6% and 3.4% respectively; for women (all ages) and in the age group of 60 years old and older on average by 2.1% and 3.6% respectively; for males (all ages) and in the age group of 0–17 year old – on average of 2.2% and 3.2% respectively.

A relation between the mean daily effective temperature and requests for medical care due to external causes (S00-T98) was identified: an increase in temperature by 1 ºС above the threshold value was associated with an increase in the number of requests for medical care for men of 1.4% on average A drop by one degree below the threshold value was associated with a reduction in the number of requests for medical care for girls aged 0–17 of 5.4% on average.

A relation between the mean daily effective temperature and the number of requests for medical care due to respiratory diseases (J00-J99): an increase in temperature of 1ºС above threshold value was associated with a reduction in the number of medical calls for: general population in the age group of 18-year old on average by 1.5%; males (all ages) and in the group of 18–59 year old– on average of 1.7% and 1.8% respectively.
A reduction in the mean daily effective temperature of 1ºС below the threshold value was associated with a reduction in the number of requests for medical care: for the general population (both genders) in the age group of 60 years and older – on average by 2.8%; female population aged 60 years and older – on average by 4.1%.

There is a relation between the mean daily effective temperature and the number of requests for medical care due to bronchial asthma (J00-J99): an increase in air temperature of 1 ºС above the threshold value was associated with a reduction in the number of calls in the general population (all ages, both genders) on average of 2.5%. A temperature drop of 1ºС below the threshold value was associated with a reduction in the number of requests for medical care in the population above 60 years old and female population above 60 years old on average of 6.8% and 13.2% respectively.

There is a relation between the mean daily effective temperature and the number of requests for medical care due to diseases of blood circulation organs (I00-I99): a temperature rise of 1 ºС above the threshold value was associated with a reduction in the number of requests for medical care in the general population (both genders, all ages) and in the general population (both genders) in the age group of 60 years and older – on average of 1.0% and 1.3% respectively; in males (all ages) and in group of 60 years and older – on average of 1.2% and 2.8% respectively; in females (all ages) and in the group of 18–59 year old – on average of 0.91% and 1.57% respectively.

A relation between the mean daily effective temperature and the number of requests for medical care due to diseases characterized by elevated blood pressure (I10-I15): an increase in the mean daily effective temperature of 1 ºС above the threshold value was associated with a reduction in the number of requests for medical care: in the female population (all ages) and in the group of 18–59 year old – on average by 1.2% and 2.4% respectively; in the male population in the age group of 60 years and older – on average of 2.5%. A reduction in the mean daily effective temperature of 1 ºС below the threshold value was associated with a reduction in the number of requests for medical care: in the general population (both genders, all ages) and in the group of 60 years and older – on average of 2.5% and 3.4% respectively; in the female population (all ages) and in age groups of 18–59, 60 years and older – on average of 2.9%, 2.6% and 2.9% respectively.

A relation between the mean daily effective temperature and the number of requests for medical care due to ischemic heart disease (I20-I25): a reduction in the mean daily effective temperature of 1 ºС below the threshold value was associated with a reduction in the number of requests for medical care: in the general population (both genders, all ages) and in the age group of 60 years and older – on average of 2.6% and 2.8% respectively; in the male population (all ages) and in the group of 60 years and older – on average of 3.8% and 4.0% respectively.

A relation was identified between the mean daily effective temperature and the number of requests for medical care due to cardiac conduction and cardiac rhythm disorders (I44-I49): an increase in the mean daily effective temperature of 1 ºС above the threshold value was associated with a reduction in the number of applications for medical care in the entire male population – on average of 8.9% and in the male group of 60 years and older – 14.0%.

A modifying effect of air pollutants was found between the temperature and the number of requests for medical care: for temperatures above the threshold value (15.4 С), no modifying effect of any of the pollutants was identified in relation to temperature and the number of requests for medical care due to the major groups of the diseases in this study. With temperatures below the threshold value (−11.8 ºС) a statistically significant modifying effect was identified for suspended matter and its impact on the number of requests for medical care due to diseases caused by external causes with a trend towards exacerbation; concentrations of sulfur dioxide on the number of requests for medical care due to respiratory diseases and blood circulation disorders without evident direction of the modifying effect.
A reduction in the number of requests for medical care due to the majority of diseases under study with the temperature increase above the threshold value in a warm season, and a reduction in applications for medical care with the temperature decrease below the threshold value in a cold season, may not indicate the lack of reliable relations between temperatures and incidence of diseases, but rather reflects the behavioral habits of the population of Novodvinsk and the need for medical care in periods of extreme cold and hot temperatures.

The main manifestation and impact of climate change on the population’s health are the extreme fluctuations of air and ocean water temperatures. In this respect, 2010 was typical for many territories of the Russian Federation. However, the remaining concern of the population and authorities may quickly vanish completely if such conditions do not reoccur in the near future. This is very likely given the predictions of meteorologists that such heat and cold waves may occur less than 3 times in a decade. That is why the problem of preserving the motivation to maintain preparedness for timely response of appropriate social and medical services, including awareness of population, should remain the focus of attention.

Climate change also raises a problem of food safety, that is to say heat facilitated growth of bacterial flora in the food products. With the temperature of ambient air above 5°C, every one degree increase of the mean weekly temperature causes an increase in the incidence of salmonellosis of 5–10%. Hot weather also contributes to more frequent failures of refrigerating equipment, multiplication of flies and other pests.

Climate warming effects the frequency of transmission of zoonotic diseases due to changes in the habitat for vectors’ populations and conditions for development of infectious agents in vectors, resulting in modification of the ways of transmission of many human and animal diseases spread by arthropods and dipteran vectors.

The analysis of a long-term ecological-epidemiologic monitoring of tick-born encephalitis (TBE), conducted in the European Subarctic region, near the northern border of the taiga tick’s (ixodes persulcatus) habitat, demonstrates that a significant increase in the incidence (almost 60-fold) registered in the Arkhangelsk Region (in 2000–2009 versus 1980–1989) is associated with a number of factors. The most important of which is climate change. This statement is based on the following facts:

- First, as a result of an increase in mean annual temperatures there was a transmission of ticks - vectors of tick-born encephalitis infection to the north. Thus, since 2002 these arthropods have been reported in the previously free of ixodic ticks central part of the Arkhangelsk Region. Consequently, they started to appear annually, with their number increasing.

- Second, expansion of ixodic ticks to the north is confirmed by the results of their collection on flag and by data on the spatial-temporal distribution of cases of ticks attacking the population of the region. So, the number of people who experienced tick attacks from 1980 to 2009 increased almost 40-fold, and the population of the region within this time period decreased by more than 20%. Reports of tick attacks are expanding to the north. In the 1980’s, reports about the tick attacks were typical for the southern districts of the region. On the contrary, in the 2000’s, a significant number of tick attacks were reported not only in the central but also in the northern parts of the region. A similar situation is being observed in the neighboring Komi Republic. It was identified that the duration of the attack period in the Arkhangelsk Region has significantly increased.

- Third, a statistically significant correlation between the increase in air temperature, the number of people attacked by ticks and the incidence of TE in the southern, central, northern parts of the region.

- Fourth, an increase in incidence is largely associated with movement of taiga ticks farther to the north. The most significant temperature increase was registered in the central districts of the region where the most dramatic increase in incidence has been reported. A mathematical analysis demonstrated that the central districts of the region experienced the strongest and synchronic changes in air temperature and had the most people who had been attacked by ticks. This supports the idea that climate changes are the key factor for the increase in incidence.

- Fifth, the social-occupational status of infected people confirms the role of climate change in the increase of TE incidence to a certain degree. Thus, recently the rate of incidence among the rural population of the region has been higher than among the urban population. A conclusion: the rural population has a more traditional way of life; they do not need to go beyond their settlements to experience nature. During seasons of heavy tick activity, people are busy with the routine agricultural work like decades ago.
Since within the analyzed time period the TE incidence has increased more significantly among the rural population rather than in the urban population, we may suggest that ixodic ticks have occupied new territories in the vicinity of rural settlements.

A comprehensive review of potential causes of the increase in TE incidence in the Arkhangelsk Region suggests that they include not only climate changes, but also a number of social factors. For example, improved opportunities of the population in the region, availability of personal vehicles (mainly among the urban population), allow them to spend more time in their summer homes, gardens and in forests “exploring nature” which leads to an increased number of contacts with ixodic ticks. However, the role of these factors is relatively minor, as within the last decade the TBE incidence in the urban population has been significantly lower than in the rural population.

There are some other factors that have the potential to influence the increase in TBE incidence, such as insufficient vaccination among the population and acaricidal treatment performed in areas where TBE is prevalent. It should be noted, that the amount of activities spent on TBE prevention does not meet the requirements of the present situation on TBE in the Arkhangelsk Region. An increase in the number of vaccinated individuals and treated territories has been reported recently. There are also subjective factors affecting the increase in incidence, which can’t be quantitatively assessed. Thus, due to the improved awareness of TBE among the population, people seek medical care much more often than in the past (which might have an effect on the increase in reported tick attacks and incidence). The significance of these factors is quite limited as they are reported in other territories of the Russian Federation where incidence are declining. In addition, the subjective factors cannot have a selective effect on the central districts of the Arkhangelsk Region, where the highest correlation ratio between the climatic and epidemiologic indicators exists.

For the last 10 years, a significant reduction in salmonellosis incidence has been reported in the region (from 115.7 per 100 000 of the cumulative population in 1992 to 36.6 in 2009). The analysis of the long-term epidemiologic monitoring of salmonellosis shows that the reduction in salmonellosis incidence in the Arkhangelsk Region (more than 3-fold) is associated with a number of factors, with the most important of them being the improvement of laboratory capacity and the stabilization of the socioeconomic situation in the region, though the number of incidence within the entire time period exceed those for the Russian Federation.

Dependencies between the number of registered cases of salmonellosis and the mean monthly air temperatures, relative humidity and the amount of precipitation for the time period from 1990 to 2009 in Velskiy, Konoshskiy, Leshukonskiy, Mesenskiy and Pinezhskiy districts and in Arkhangelsk were analyzed using various multivariate regression models using baseline data. The most adequate models were selected according to information criteria of Akaike and Bayesian, and the analysis of residuals. Uncorrected and corrected rates were calculated with 95% confidence intervals (CI). The study of the correlation between the temperature raise in the Arkhangelsk Region and salmonellosis incidence showed that an increase in the mean monthly temperature by 1°C in Arkhangelsk was statistically associated with an increase in the number of cases of salmonellosis in the following month on average by 1.9% (95% CI: 0.1 – 3.7). That correlation was identified with various models, demonstrating its reliability. The study results show a linear dependence between a monthly number of reported cases of salmonellosis and an increase in the average temperature during the previous month for the entire range of temperatures without any threshold values. In addition, the impact of temperature on the number of salmonellosis cases in Arkhangelsk was constant throughout the entire period of the study. A relation between the number of reported cases of salmonellosis and the amount of precipitation in Arkhangelsk was less robust and was identified only in one of the models according to which an increase in the amount of precipitation by 1 mm was associated with an increase in the number of cases by approximately 0.24%. In the districts of the region a relation between the temperature and the number of reported cases was not identified and a relation with the relative air humidity was the opposite, even in the neighboring districts. Taking into account the monthly arrangement of data, low case numbers in the districts of the region and relatively short time spans, the results of data analysis by districts should be very carefully interpreted. Considering the pros and cons of the available data, despite the identified statistically significant association between the temperature within the previous month and the incidence, it may be stated that the socioeconomic factors, along with age and other data not taken into consideration, remain the key risk factors for salmonellosis in the Arkhangelsk Region.
The climate and landscape conditions in the region contribute to the spread of certain types of rodents – diseases carriers, which in its turn create some preconditions for maintaining the sources of such diseases as tularemia, leptospirosis, hemorrhagic fever with renal syndrome, pseudotuberculosis.

According to the available data, in the Arkhangelsk Region there were 68 populated areas in 17 administrative territories, including Arkhangelsk, with an unfavorable anthrax situation. Based on the data of the veterinarian service in the region, there are 32 anthrax animal burials. Of them, only 24 animal burials have a defined location and geographic coordinates.

Other than heat waves and significant cold, risk factors of climate related emergencies may include floods, flooding, fires, fumes and drought. Floods repeat on average once every 7–9 years and most often occur in Kotlas, Kholmogorsky and Vynohradiv districts (in the southeastern and central regions), as well as at the mouth of the Pechora River and near Naryan-Mar. Over the past 20 years the frequency of flooding has increased on average to once every 2 years.

Major rivers including the Northern Dvina, Pechora, Vychegda and Onega can overflow and flood flat land areas on which settlements are located during the spring flood season. The most vulnerable to flood events are the Kotlas, Onega, Pinega, Maritime and Kholmogory districts. Early and more severe thawing, along with increase levels of rain during flood season led to a powerful flood wave and was the reason for the opening of the Onega, North Dvina, Pinega Rivers, as well as other small rivers in the region. In connection to flooding the region experienced damage to roads, bridges, and overpasses, which caused communication to be interrupted between 67 settlements with a population of over 16,500 people. Transportation services for passengers, food and medicine were discontinued.

The increasing number of forest fires in the region in 2010 was caused by abnormally hot and dry weather over a long period. During the past season there were 16 large fires in the region. In forest conservation zones there were 12 fires with an area of 940.21 hectares and 4 fires in the aviation zone, an area of 10,203 hectares (Vynohradiv, Belsky, Lenski, Vilegodsky municipal districts).
VULNERABLE POPULATION GROUPS

The consequences of temperature (heat and cold waves) on health are the result of a number of factors that manifests themselves in all age groups. However, a higher risk of morbidity and mortality caused by heat is more common for certain categories of the population; this has a regional specificity in the Arkhangelsk Region.

11.1. ELDERLY PEOPLE

Surveys show that in periods of abnormal heat, the largest population group that is prone to the risk of disease exacerbation and death is senior citizens of 60 years and older, with greater risks to the population aged 75 and older. Those who suffer from age-related dementia are exposed to the highest risk, which requires additional interventions of primary healthcare services, including nursing care and preventive actions of workers in nursery-homes.

With aging, the human body's resistance to the effects of heat waves is reduced: sensation of thirst is delayed, reaction of sweating is slow, the general metabolism slows down and the number of sweat glands is reduced.

For older people it is typical to have a polymorbidity pathology, physical and cognitive impairments and polypragmasy. In the Arkhangelsk Region there are about 200,000 people older than 60 years old (15.5%: the criterion of “demographic aging” of the population is 12%), this rate is especially well expressed in females (20.1%) versus males (11%). In rural areas, where aging is more critical, low accessibility and low recourse capacity of medical care is a typical problem.

According to the projection, the proportion of the population older than working age in the region by 2030 will be 26%.

11.2. CHILDREN AND INFANTS

The metabolism of infants and children is different from the metabolism of adults. They are extremely sensitive to the effects of low and high temperatures. The temperature of the environment around them and the amount of consumed liquid depends on those who take care of them. In this regard, it should be noted that in the Arkhangelsk Region, in comparison with the Russian Federation in general, high levels of illegitimate births (40%) are recorded, as a result these children are either sent to boarding schools or being raised in single-parent families with low levels of social protection and insufficient support.

11.3. INDIVIDUALS WITH CHRONIC DISEASES

People with various chronic diseases have a high risk of recurrence, exacerbation or death at abnormally high temperatures. Proper functioning of cardiovascular, genitourinary, endocrine and nervous systems is vital for proper thermal regulation of the body during periods of heat stress.

In the Arkhangelsk Region high levels of morbidity, disability and mortality from cardiovascular disease have been recorded. Since with angiopathy, which typically develops in patients with diabetes mellitus or
atherosclerosis, blood circulation in skin is insufficient, which increases the risk for development of severe conditions caused by body overheating.

From 2000 to 2009, the incidence of diseases of endocrine system and sensory organs increased by 1.8 times. Urgency of the issue in the Arkhangelsk Region is supported by the fact that within eight years the level of diseases specified by the elevated blood pressure increased by 10% and in 2009 it was 9431.7 per 100,000 population.

Fluid loss and dehydration from diarrhea or fever, especially in children, may increase the risk of morbidity and mortality, as well as metabolic diseases.

Any disease or condition requiring a bed-ridden regimen, which limits the patient’s chances for going out or the ability to take care of oneself, also increases this risk. This is explained by the inability of a person to react properly to heat in such situations. A number of drugs prescribed for some chronic conditions may increase the risk of temperature-associated diseases. Many drugs may directly affect the central and peripheral mechanisms of thermal regulation, namely the thermoregulatory center or afferent and efferent pathways, perspiration, cutaneous vasodilatation and/or cardiac output increase and thereby the emission of heat.

Urolithiasis and diffuse goiter are endemic in the region. The pathogenesis and development of these diseases are directly dependent on temperature (heat and cold) fluctuations and water resources safety. Other problematic types of pathologies may include psychiatric diseases, alcohol abuse and one of their manifestations – high level of alcohol – associated psychosis, suicidal behavior and committed suicides (at a level 35–45% higher than the average for Russia). Chronic nonspecific pulmonary diseases like chronic pneumonia, bronchitis, bronchial asthma, and COPD are characterized by a high prevalence in the Arkhangelsk Region under conditions of high air pollution levels during forest fires along with unfavorable ecologic situation, which have a tendency to exacerbate.

11.4. SOCIAL RISK GROUPS

This category consists of people, who due to their social-destructive status or professional activities become vulnerable to climate change. This group includes detainees at detention centers and incarcerated individuals. The level of convicted persons (per 100,000 population) in the Arkhangelsk Region is twice as high as in the rest of Russia. In 26 penitentiary facilities there are about 15,000 detainees or convicts. In those institutions there are a number of negative factors that have the maximum effect in summer time during heat waves. The most important of them are the lack of ventilation, unsanitary conditions, isolation stress, and criminal subculture. Thus, for example, SIZO #1 (a preliminary detection center of the Administration of the Federal Service for Execution of Sentences in the Arkhangelsk Region) was built in the early 19th century. It has an extremely high density of detainees, unsanitary conditions, “miasmic gases”, “thermos effect”; a special microclimate which significantly increases the risk of TB infection and psychiatric disorders. It is very important to pay attention to the problems of this “social isolation” and health, not only from the point of view of the departmental (penitentiary) medical service, but also from the point of view of civil healthcare and welfare, since many released persons are the potential sources of TB infection. It should be noted, that in Russia there are about 40 million people with a history of imprisonment.

There are some other problems which are not as pronounced but are still present and exacerbate during periods of abnormal temperatures in other social isolation units – nurseries homes for the elderly and disabled, facilities for psychoneurologic patients (there are 25 of them in the region), orphanages, etc.

Increased risk to health threatens all those who have to work in hot weather without proper protection. Especially if the work involves heavy physical labor - these are workers of wood industry, builders, workers in “hot shops”, etc.

In addition to these, socially vulnerable populations includes the homeless, unemployed, and people living with incomes below the subsistence minimum.

11.5. THE INDIGENOUS POPULATION OF NAD

The Nenets is one of the minority ethnic populations of the European North. In the context of climate warming, indigenous populations in the far north belong to one of the most vulnerable population groups. In
addition to “traditional” problems (low availability of medical care, ethnic polymorphism and low tolerance of socioeconomic changes) some new ones appear in connection with global climate changes—changing areas of vegetation, fish and game, a need to search for new reindeer migration paths, infections that are new to the northern latitudes, flooding of animal burials, “ice-storages” and an elevated risk of epidemics associated with it. There is an increased possibility of contamination of marine animals, fish, birds and deer, which are traditionally used for food (usually raw or fresh-frozen) or of those in contact with humans. A deviation in migratory bird paths to the north due to climate warming could promote the spread of tropical infections to the north.
1. Chronic non-communicable diseases, especially pathology of the cardiovascular system.
2. Tick-borne encephalitis, hepatitis A, salmonellosis and other enteric infections.
3. Vulnerable groups: elderly people, children, and people with chronic diseases. Also socially vulnerable groups like the Nenets people.
4. Climate change impact on health related to heat and cold waves.
5. Environmental safety: floods and fires.

In addition to high incidence, disability and mortality, all of which cause significant economic losses, the priority of inclusion into the project with limited resources is also defined by the availability of effective interventions and cheap diagnostic and treatment methods. That is why, so far, the selection principle of strategy development is unfortunately considered to be a justifiable alternative approach. The effects of heat waves and abnormal heat on human health depends on the level of exposure (frequency, intensity, duration) on the number of groups exposed, and the sensitivity of the groups to the effects of hot weather and heat waves.

Each particular region has a specific relation between temperature deviations from the optimal range in any direction and the population’s health. It is associated with climate specifics, ecological situation, social and transport infrastructure, population structure and location as well as development of the social sphere (including healthcare).

The strongest impact of abnormal heat was on the elderly, and the greatest increase in mortality was registered in the elderly population. Excessive heat effect is a serious stress for the human body, but even more so for the cardiovascular system. The lethality due to heat shock is 10–50.0% of all the cases; due to heat shock neurologic disorders may develop in 20–30.0% of patients. It is worth mentioning that these numbers are below the actual figure, as in the majority of cases cardiovascular diseases and respiratory diseases are indicated as the cause of death. Evaluation of the situation, verification of the diagnosis associated with the impact of temperature fluctuations in the Arkhangelsk Region is difficult, as autopsies are not being performed in more than 60% of death cases, and in some districts – in 90% of cases.

A study of heat waves impact on mortality showed that there is a relation between daily death rates and air temperature. The relation was identified for such causes of death as IHD, CVD, respiratory diseases and external causes in people older than 30 years, with the exception of CVD in people between 30–64 years in areas of high temperatures. The number of deaths due to respiratory diseases has decreased for the entire range of temperatures, and the relation of temperature and death rate for the rest of the causes (CVD, IHD, all natural causes, all external causes) has a classic U or V-shape with a minimum between +16°C and +18 °C (for external causes +20 °C and +22 °C). Thus, there is a reliable association between the abovementioned causes of death and the mean daily air temperature in Arkhangelsk for the studied time period. The cumulative increase in mortality is reported for both short-term and long-term periods – by the 50th day. Ten heat waves and eight cold waves were identified during the study. The temperature threshold for heat waves was +21.0 °C, and for cold –21.5 °C. During heat waves there was an increase in mortality due to CVD in people 65 and older, and due to all external and natural causes in both age groups. During cold waves there was increase in mortality due to CHD and all natural causes in both age groups, due to CVD in people 65 years and older, and due to external causes in people 30–64. The highest relative risks of mortality in-
creases were identified for external causes, and this conclusion relates to both cold and heat waves. Within the period of the study, between 1999 and 2008, heat waves caused 110 additional deaths, and cold waves caused 179 additional deaths (about 30 deaths per year).

The incidence of tick-borne encephalitis (TBE) in the Arkhangelsk Region has increased in recent years, while it has decreased in the Russian Federation as a whole. Climate change, namely an increase in the average annual air temperature is regarded as one of the main reasons for a sharp rise in the incidence of TBE. The study used epidemiological and climatic data for the Arkhangelsk Region. The analysis of the long-term ecologic-epidemiologic monitoring of TBE suggests that the increase in the TBE incidence registered between 1980 and 2009 in the Arkhangelsk Region (almost 60 – fold) is caused by a number of factors with climate change being the most important. As a result of the increase in the mean annual air temperatures there was a spread of ticks that carry the TBE virus to the north. Expansion of ixodic ticks to the north is confirmed not only by the results of tick collection with a flag, but also by the spatial-temporal data on the distribution of tick attacks in the region. There was a statistically reliable correlation between the increases in air temperature, the number of tick bite victims and morbidity of TBE in southern, central and northern parts of the region.

Socio-occupational status of the people attacked, to a certain extent, confirms the role of climate change in the increase in TBE morbidity.
In addition to the direct impact, climate change has an indirect impact on human health through changes in various aspects of human activities. Rigorous data collection and analysis of changes in the profile and severity of diseases (clinical and laboratory data), using mortality as the most objective indicator in the study of causes, will allow a greater degree of confidence in the development of preventive measures. Temperature (heat and cold waves), air pollution, flooding and lack of flooding are the factors of attributive and relative risks for various diseases in the Arkhangelsk Region. In particular, this relates to cardiovascular diseases, infectious diseases and their occurrence in various problematic population groups.

From the perspective of the bio-socio-ecosystem in the Arkhangelsk Region there are a number of specifics that have a multi-factorial and cumulative effect on the population’s health under climate change conditions. Geographic, climate, and communication aspects, along with inadequate resource capacity of the healthcare sector all contribute to the abovementioned problems in regard to low availability of medical care, particularly emergency aid and medical care in cases of accidents.

At present, in the Arkhangelsk Region there is no centralized, coordinated policy of response to the challenges of climate change. The Emergency Service along with the social protection service and the healthcare system work in the model of a “fire team” and to a certain extent can promptly react to multiple challenges associated with temperature fluctuations and their impact on the population’s health.

Positive aspects in the current healthcare sector of the Arkhangelsk Region include public medical care with powerful material and human resource potential in the metropolitan area of Arkhangelsk-Severodvinsk-Novodvinsk; quite efficient historically developed system of the centralized anti-epidemiologic surveillance and the presence of the Medical University.

Healthcare problems of the indigenous population of NAD are closely associated with the nomadic way of life, ethnic (physiologic, biochemical, behavioral) and occupational factors. Among the problems affecting deer farms, in addition to quality deterioration and reduction in the area of pasture-land, there are social factors, such as inefficient managing, a loss of prestige of deer breeding, a loss of traditional knowledge, a sharp transformation of values in the Nenets society, social apathy, unemployment and the spread of alcohol addiction associated with it. Unsatisfactory sanitary and hygienic living conditions in the northern villages, insufficient living space availability, crowded dwelling conditions, lack of centralized water supply systems and sewerage in the majority of populated areas (causing the spread of various intestinal infections), hepatitis, and helminth infestations all characterize the region’s living conditions.

The indigenous population of the North is one of the population groups in Russia that lacks the developed mechanisms of biosocial adaptation to the factors of modern civilization, which has resulted in deterioration of physical and emotional health. In addition, high incidence and mortality rates are associated with the poor living conditions, poverty, deteriorating ecology and imperfect medical-social support, which is mainly due to high mobility of the population. Thus, when speaking about the health of indigenous population in the north, we deal with the full “set” of determinants that negatively affect health – cultural, so-
cioeconomic, drawbacks of public healthcare organization, behavioral, and certain anthropologic-biological specifics typical to the northern populations.

Health problems are especially critical in indigenous population that is scattered over vast territories and virtually devoid of basic healthcare. The rapid retreat of the indigenous population from a traditional lifestyle led to a change in the nature of employment, nutrition and consequently to the occurrence of many previously rare forms of diseases such as heart attack, hypertension, diabetes, coronary heart disease, and short-sightedness. These diseases are progressing rapidly among the indigenous population, leading to premature death and reduced life expectancy.

Resulting from climate change, professional and industrial difficulties of fishing and hunting, changes of reindeer migration paths and their nutritional base, and a reduction in livestock and marine animals may result in a reduction of traditional industries. This tendency is already visible, and in time will lead to the disruption of traditional nutrition. Moreover, a periodic local depletion of food supply has been observed in certain time periods during the spring and fall when traditional movement is impossible, and flight connections between small villages are irregular, people get isolated for long periods of time with irregular food supplies and shortages of other products.

Access to safe water remains a critical issue to ensure the population’s health, as in many locations, pathogens are still being found in drinking water. The lack of quality water especially affects the population with low per capita income. Not one region in the Arctic territory is included (by Rospotrebnadzor) on the list of regions with good, quality drinking water.

The population of the north is most vulnerable and most in need of political, legal, social and psychological support as well as medical care. In the past, the situation was complicated by a countywide crisis resulting from political and economic reforms. In the northern areas, a previously existing healthcare system collapsed, which resulted in a decrease in the number of medical facilities in the northern territories. In the areas inhabited by the indigenous population, the number of doctors and nurses is declining. A significant number of healthcare facilities require major restoration, provision with the required amount of medications, and modern medical equipment. Small arctic settlements lack adequate medical care due to the limited availability of transportation. One of the priorities for the healthcare authorities should be ensuring access to quality primary medical care for all residents of the district regardless of their place of residence and lifestyle.

In cases when reindeer herders need more specialized care, they may contact the rural authorities by radio and ask for an emergency medical flight. However, there are some problems related to compliance with the vaccination calendar, follow-up treatment, prenatal patronage, follow-up appointments with children during their first year of life, and births outside the hospital. However, a systematic study is necessary to evaluate the quality of health and disease prevention in reindeer herders and their families. In this respect, well-trained paramedics may be of great help as well. Medical examination of the tundra population should not be a one-time activity, but rather a smoothly running system of follow-up appointments and health education aimed at the reduction of a gradient of determinants and risk factors (climate-geographic-behavioral-social). At present, the main and only way to bring the nomadic population together for medical examinations, laboratory tests, X-rays and other types of screenings, be it dental sanitation, or primary and secondary prophylaxis is at the Herder’s Day celebration, when the tundra population gathers in one place. The distinct lifestyles typical for the ethnic minorities living in the Russian north are a product of extreme weather conditions and geography that make further expansion and development of mobile forms of treatment, diagnostic and consulting services as well as planned medical preventive care in NAD such a necessity.

Expeditionary medical services, which were introduced to NAD in the form of mobile medical teams, were a successful in dealing with multiple medical and social problems experienced by the families of nomadic herders. An 8-year project, named Kaninskiy Red Tent, allowed authorities to bring medical care closer to the nomadic camps of the north to assess the population’s health and to evaluate their social and domestic problems. In the framework of this medical-social project, all families of the nomadic reindeer herders of the Kanin Peninsula were evaluated (350–360 people annually). It is one of the most successful and comprehensive multidisciplinary approaches to solving the problem of limited access to qualified and specialized medical care for the indigenous population of the region. The project also included a detailed data collec-
The project activities strengthened medical care, taking into account regional specifics and local pathologies; the organizational form of the periodic health examination among the nomadic indigenous population.

The problem with delivering care to the population of the remote northern territories or the indigenous groups and small ethnic minorities of the north, who tend to lead a nomadic life, requires major managerial and financial decisions, as it is part of the general problem for preserving a unique ethnosc. The cost of healthcare delivery in the remote northern territories should meet the scale and importance of socially oriented activities. The Ministry of Health and Social Development of the Arkhangelsk Region developed a “Concept of Healthcare Development in the Arkhangelsk Region by 2020” that is based on the analysis of the population’s health and medical services activities. The Concept defines “goals, objectives and main directions” of the modernization project over the next few years. In case of effective implementation, a number of items in “the Concept” would facilitate the implementation of the present strategy of the WHO.

13.2. ADAPTATION CAPACITY IN THE NON-HEALTH SECTORS

Water resources in the Arkhangelsk Region do not meet the requirements according to a majority of chemical and microbiological indicators. Typical pollutants include: compounds of iron, copper, zink, organic matter and lignosulphonates; in some areas they are supplemented by phenols and petroleum derivatives. More than 745,000 people, or 61% of the total population of the Arkhangelsk Region, are not provided with quality drinking water. With climate change, and impacts associated with climate change (floods, water-logging, “winter flooding”), further deterioration of the water quality can be expected. Water safety is characterized by flooding and water-loggings, but in case of abnormal heat, it is characterized by the lack of good quality water and increasing demand for water in regional households. In the north, there is an increased vulnerability of the water reservoirs, which are designed to maintain operational stability. An increase in surface water temperatures causes growth of harmful cyanobacteria in the phytoplankton communities that jeopardize the ecology of regional lakes and pose risks to human health. A high level of precipitation in summer or freezing of the soil during the cold season in the cities of the Arkhangelsk Region causes disorders in the operation of the sewerage system. Uncontrolled wastewaters may contaminate water bodies with microbiological and chemical pollutants, which are difficult to treat with conventional processes of water treatment.

Climate warming effects the frequency of zoonotic diseases, changing the habitat of the vectors’ population and conditions for the agents’ development in vectors, which results in changing the roots of transmission for many human and animal diseases transmitted by arthropods and dipteran carriers.

Tularemia is endemic to the Arkhangelsk Region. Since 2006 there has been an increase in the incidence of this nosological infection.

The climate and landscape conditions of the Arkhangelsk Region contribute to the spread of certain type of rodents - infection carriers, which create the preconditions for development of the sources of infection to leptospirosis, hemorrhagic fever with renal syndrome and pseudotuberculosis.

The area of the European north is characterized by low agricultural capacity (deficiency of resources, short vegetation period and insufficient availability of land) with limited opportunities for local food production and a need to import food products in big volumes; this is why the northern districts are notable for a high level of food dependence. Remoteness of the northern districts from the main suppliers of food products complicates transportation schemes of their delivery. Short navigation periods on the northern rivers cause the need to establish seasonal stocks of various food products for a long-term (almost one year) period. This is also a risk factor for transmission of vector-born infectious diseases.

Traditional specializations of agriculture include: potato farming, vegetable growing, livestock farming, i.e. the production of available and stable components for a well-balanced diet. However, as a result of unfavorable agricultural-meteorological conditions there has been a reduction in potato yields aggravated by the migration of the Colorado potato beetle to the north and poor preparedness of some farms to use crop protecting agents and ensure food safety.

About half of the Arkhangelsk Region is covered in forests, with the total area of about 29147.0 thousand ha. In August of 2007 within the framework of the joint Finnish-Russian project “Northern Boreal Forests” in the Verkhnevaengskiy forestry of the Bereznikovskiy forest farm, forest pathology studies were perfor-
med jointly with the members of the Northern SRI of Forestry. Results of the study show that fir trees are dying. On average, by the end of the current season the percentage of dying-decaying trees in the area of the study was about 40%. For a number of years the following was observed: windthrows, dry seasons (1997 and 2005), and massive snowbreak (2001-2002). Development and recovery of the dying forests area has been a major problem for the last decade. The Arkhangelsk Region, with almost half of the territory covered by forests, is extremely vulnerable to fire: condemned housing, almost half (40%) of the houses with stove heating, and a developed woodworking industry, are the preconditions for forest fires. There are no long-term statistics for forest fires, but in 2010, 2134 fires were recorded in the region (ranked second in the northwestern region after the Leningradskiy region) with 142 people died and 201 people injured. Fir tree deaths remain a serious problem. The main reasons for high fir tree deaths include disturbances to soil nutrition and water supply caused by a complex of external forces and old age.

A number of various preventive measures on fire protection have been continuously performed in the area. Fire prevention barriers are being built, mineralized belts and fire breaks are being maintained, and firefighting roads are being repaired in order to prevent the outbreak of forest fires. OSU “North base of aviation protection of the forests” and the local municipal authorities, together with EMERCOM of Russia in the Arkhangelsk Region, held selective command and staff training on forecasting fire situations, coordinating the interaction of forces, and means for fighting the forest fires. The performance of joint checkups on preparedness for fire season, the execution of the operative mobilization plans for the allocation of forces, and the means of the institutions to fight forest fires in the districts of the region was introduced into practice and accepted for execution. The “Flood Commission” is being established to forecast natural disasters and to draft an action plan in the Arkhangelsk Region. During the spring season, the icebreaking and ice-cutting work is performed, and a necessary supply of explosives is provided and used. With the deficiency of resources, the reserve fund of the Governor is being used.

The living conditions in the Arkhangelsk Region are worse than in Russia in general: the region is behind the Russian average level of indicators like supply and availability of hot water, plumbing, drainage, gas supply and heating. The heating system of residential and nonresidential buildings in the region is in poor condition. For example, in February of 2011, on frosty days where the temperature was –30 °C, more than 7 000 people in Nyandoma had no heat for a week. Emergencies such as this happen every year in various municipalities in the region including the regional center. In the Arkhangelsk Region there is a poorly developed energy sector of small power plants, peat plants, and sawdust plants, of which are many in the region. Sawdust is an excellent raw material for the production of gas, biogas and for burning. At the same time 40% of residential houses in the region have stove heating. On the one hand, people protect themselves from the cold and are independent from the poor performance of the local authorities, but on the other hand, there are problems of costly wood supplies. From the point of view of energy security, positive changes to natural gas in Arkhangelsk and Severodvinsk CHP took place in 2011.

13.3. ADAPTATION CAPACITY IN HEALTH SECTOR
Currently there are no planning systems in place for inter-sectoral activities (early warning of natural/weather emergencies) or programs for comprehensive training of medical staff and educational campaigns to increase knowledge and alertness of the population. It can be assumed that it is quite feasible to start this work from scratch.

With regard to the capacity of system adaptation, it will depend on the success of negotiations with partners and building trust among decision makers in terms of transferring this issue from a predominantly healthcare field to the level of regional development, which will provide higher level of significance to this issue and make it an integral part of planned inter-sectoral projects, including regular allocation of funding for their implementation.

At present, healthcare plans for intervention methods in cases of flood or heat waves, as well as monitoring and identification of climate change impacts on health do not exist. Staff does not receive the knowledge and skills associated with combating the effects of climate change on health. Special healthcare resources for treatment of people affected by climate change and for risk assessment of the infrastructure damage due to climate change, for example, due to heat and floods, are also lacking.
For the next two years of project implementation, a favorable environment for synergism of this strategy and the state policy on a broad-scale assistance (in the amount of 630 billion rubles) to the RF entities announced by the Minister of Health and Social Development, Tatyana Golikova must be established. The money will be allocated for the reconstruction of infrastructure of healthcare facilities and training of medical staff. The immediate aim of this work is to align the technical capacity of health facilities to ensure the constitutional right of free medical care.

Therefore, a prioritization process is required to ensure careful planning and coordination of the future use of the project’s resources (on behalf of WHO) and to identify the elements of healthcare services in the greatest need for support. Such analysis should not be very difficult, as the vertical program of climate change study is mainly focused on improving primary healthcare in its broad interpretation, revived by the WHO in «Report on the World Health (2008), “Report On Primary Healthcare” (2008) as the basis for development of health system in general, (WHO European ministerial conference on Health System / www.euro.who.int/healthsystems, 2008), where the principles of the strategy “Health for All,” important for the implementation of this project, are re-established. This is a partnership and an inter-sectoral activity with the active involvement of the population that gives maximum accessibility to medical services and information for each member of society, especially for the most vulnerable groups.

Based on the analysis of the population’s health in NAD and the level of development of healthcare services, it appears necessary to perform the following activities:

- Strengthen measures to ensure health and expand access to primary healthcare
- Promote health with active participation of other sectors;
- Exchange best practices programs for multi-disciplinary and cross-sectoral workers;
- Build capacity of human resources in the healthcare system;
- Provide information to ensure prompt responses to effects of temperature fluctuation

1. Increasing access to medical care in the Arkhangelsk Region and Nenets Autonomous District. Strengthening of primary healthcare sector

Primary healthcare (district physicians, pediatricians, emergency care physicians, nurses, midwives and feldshers working on their own) plays a key role in combating climate change and adverse health effects (80% of the population receives medical care in this health sector).

Medical care provided by the primary healthcare sector should be readily accessible, prompt and qualified. Its quality and accessibility are provided by the organizational component of the system, which provides for:

- Provision for equally high quality of care for the population regardless of the remoteness of the place of residence;
- Fast transportation of patients to a healthcare facility equipped with medical and diagnostic equipment, staffed by trained medical personnel, and stocked with the necessary medicines and medical products in accordance with relevant standards;
• If necessary, continuation of treatment in other medical facilities (continuity of follow-up and rehabilitation, secondary prevention, i.e. early detection of asymptomatic cases or cases with early symptoms, often using special techniques (markers, mammography, etc.), sanatorium rehabilitation treatment) or at home, in accordance with the procedures of management of specific diseases or conditions to achieve the best outcomes (cure, functional rehabilitation).

To create such system it is necessary to:

• Develop primary healthcare, starting with the district polyclinics and units of general practitioners for the purpose of development/revision of a range of responsibilities and performance indicators, which include a reduction in a number of the adult population in the catchment areas to 1,200–1,500, the child population to 600–800 children, and adolescents per 1 medical district with a reduction of workload of the local doctors and medical teams;

• Give priority status to preventive activities with the development of clear mechanisms for its coverage throughout the system of mandatory medical insurance;

• Strengthen the links with relevant centers for prevention;

• Develop and introduce into practice a wider range of responsibilities in the preventive activities of nurses (registration of patients with risk factors for development of socially relevant chronic diseases and preparation of a health profile of a district so that work can be transferred to a district doctor);

• Strengthen patronage and rehabilitation: introduction of the system for “home-based treatment” supported by specifically equipped mobile teams;

• Improve and expand community based methods;

• Equip inter-district centers, district hospitals and feldsher’s units;

• Improve emergency medical services, including optimization of routes for patient delivery to the hospitals, depending on the type of pathology, and the severity of the patient’s condition;

• Introduce ambulance performance indicators (arrival time to the place of a call, time for transporting a patient to a hospital, pre-hospital lethality);

• Introduce the order for care delivery during pre-hospital management of patients with different types of pathology;

• Optimize in-patient facilities in terms of setting target operational indicators, reflecting not only the types and scope of medical services provided, but also its quality;

• Introduce phased care and develop routes for transportation of patients on the basis of a rational distribution of responsibilities between inpatient clinics.

It is necessary to increase the number of specially trained medical staff (in relation to the impact of climate change on health) and capacity of the medical institutions to provide efficient care to the population, which is especially needed during heat waves, due to association with cardiovascular and respiratory diseases, and during waves of cold, which cause frostbite, hypothermia, and colds. It is also necessary to develop and implement programs of patronage for elderly people with chronic cardiac and respiratory diseases. During periods of abnormal temperature fluctuations it is advisable to modify, without any inconvenience to the public, the working schedules of medical facilities, postpone planned surgeries, medical examinations, etc. In the regions of the far north it is advisable to introduce the work of mobile medical teams (MMT), using the experience of the Municipal Institution “Central district polyclinic of the NAD Polar region, Head Doctor – T.N. Zueva” (MI CDP PL NAD) since 2007.

The main goal and mission of the MI CDP PL NAD is to ensure access to the specialized medical care for the rural population of the polar region and provide educational activities in the community.

To work in MMT, experts have to meet the following requirements: good health, high level of expertise and such personality traits as kindness, sociability, optimism, modesty, conscientiousness, efficiency, responsibility and dedication to work and to people. Alcohol addiction was an exclusion criterion for inclusion in the team. It took 2.5 years to staff and to equip the team.

At first, specialists from the Arkhangelsk medical facilities were contracted to work on the mobile medical teams for 1–2 months. Full-time employees were hired later. At present, the specialists are involved in the work of MMT: an otolaryngologist, an ophthalmologist, a neurologist, a gynecologist, an endocrinologist and a feldsher-lab technician. Additionally, the following specialists from Arkhangelsk are being hi-
red: a urologist, a pediatric cardiologist and a gynecologist with the skills to perform ultrasound examinations, an orthopedic surgeon, a pediatric surgeon, etc. The neurologist has a certificate in manual therapy and, if necessary, uses this method of treatment free of charge during visits. The endocrinologist is highly qualified. He also examines the patients as a therapist. During the examination they can also perform electromammography.

Within 3 years 338 visits were made. The team visited all settlements, with the exception of Vaigach Island. Big settlements were visited several times. In total, there were 46,444 visits to the doctors, of them, 9,569 visits were pediatric, of which 2301 were due to diseases and 7,268 for prophylactic examinations.

The trial period showed that the team’s activities should not be limited to treatment and diagnostics; they should include organizational, methodological and educational activities. The action plan includes testing of:

- Preparedness of the medical facilities to provide emergency care (including specialized care) i.e. availability of the quality equipment, a variety of medicines and an appropriate level of knowledge and staff skill. If problems are identified, equipment should be improved and the staff trained further;
- Compliance with the requirements for disinfection, aseptics and antiseptics;
- Proper storage of drugs and vaccines;
- Nutrition of children and pregnant women;
- Equipping healthcare facilities, maintenance of the equipment;

Responsibilities of the specialists include treatment monitoring and performing workshops to train the staff, which includes records reviews, and analysis of errors in management of individual patients.

At the end of each visit, lectures to local health workers were given regardless of the staff number. The selection of the topics is based on:

- the results of patient examinations and review of medical documentation, identification of errors in diagnosis and treatment;
- new techniques, medications, case studies, etc.;
- the requests of healthcare workers.

Suggestions to adapt the healthcare system of the NAD regarding medical care delivery to the indigenous population with traditional a lifestyle:

- Express diagnostics and laboratory equipment in rural healthcare facilities;
- Prepare medical kits for the reindeer herders.
- Teach first aid training to homemakers, thus enhancing their social status in general and providing them with a system for control and prevention of risk factors for chronic diseases, promotion of healthy lifestyle in the groups of people they communicate with. Use questionnaires / perform surveys to identify cultural feasibility of such innovations.
- Plan the schedules and routes of mobile medical teams to improve organization of medical follow-up for the nomadic indigenous population;
- Improve medical care for the nomadic population in HCF close to winter nomadic camps;
- Develop and introduce the training modules for medical assistants in reindeer teams, including the introduction of a practical guide on first aid delivery ("A Practical Guide for care assistants," 2007, "Doctors of the World").

2. Optimization of a healthy lifestyle promotion related to climate change and interventions to reduce mortality

To promote a healthy lifestyle, reduce incidence, disability, and mortality, including temperature-associated diseases, it is necessary to implement federal, public, and social health measures, such as:

- Improvement of health and hygiene education of the population, especially children, adolescents, and young adults through mass media, as well as in educational institutions through the introduction of appropriate educational programs for preschools, secondary schools and institution of higher education;
- Introduction and dissemination of effective measures to combat alcohol, tobacco, and drug dependencies, and to prevent non-communicable diseases (hypertension, unhealthy diet, physical inactivity)
• Improvement of medical-hygienic education of the population, particularly, children, adolescents, and youth through mass media, and by compulsory introduction of appropriate educational programs in pre-school, primary school and secondary school;

• Rationalization and introduction of the system for medical service delivery to healthy and practically healthy citizens during regular screenings / examinations (the frequency of screening depends on gender, age and other determinants, including the epidemiological profile of the area of residence or work). The nursing staff should be consulted about regular medical screenings, the importance of hygiene, nutrition of the population. These actions can be supported by doctor recommendations if necessary.

In order to establish a healthy lifestyle, it is necessary to:

• Organize and develop medical and preventive care by introducing modern medical technologies;

• Ensure interagency cooperation and functioning of the coordination mechanism for promotion of healthy lifestyles;

• Establish the vertical of interaction between centers of preventive medicine and units of prevention in primary healthcare facilities, organizational and methodological support of the Medical Prevention Centers and Health Centers.

• Expand the network of health schools focused on major risk factors (overweight, codependency), and chronic diseases (“School of hypertension,” “Asthma School”, “School of diabetes mellitus”);

• Create a microclimate in the community to promote, development and support a healthy lifestyle.

3. Undergraduate and postgraduate education of health workers in the context of climate change

Based on the Department of Postgraduate Training of the Northern State Medical University, training and developing responses of health services to heat and cold waves will be provided to the managers and medical workers and the cycles of thematic advanced training for medical staff from primary healthcare will be performed. In addition, the inclusion of thematic lectures as refresher courses for primary care physicians of different clinical specialization and healthcare managers should be coordinated by the Ministry of Health and Social Development. In the short term, given the requirements of modernization and optimization of the health system, education on the prevention and promotion of a healthy lifestyle should be modernized at the undergraduate level. For the specific content of such programs, it is advisable to enhance medical and nursing inclusive education. This approach is aimed at establishing a common understanding and approach to health improvement of the nation.

4. Training of paramedics

Homemakers, hygiene instructors, police officers, teachers, veterinary service staff, pharmacy staff, bank employees, transport and postal workers, etc.) in situations when temperature fluctuations have health effects is critical for effective treatment of such effects. Given that this issue involves the entire population of the region, it is necessary to carry out educational activities among service professionals much in advance as to assure immediate implementation. Training paramedics (in the U.S. – Emergency Medical Technicians – EMT) in specific areas of medical care will be organized in academic medical institutions and hospitals, particularly at the Central District Hospitals. The program will include the basic necessary for accurate diagnosis of conditions directly threatening human life and the performance of first aid. In addition, paramedics can perform certain organizational activities: the establishment of the mobile medical teams, “cooling centers” where people can get some relief from heat in the air-conditioned rooms, the distribution of potable water, provision of socio-medical care for older and disabled people, health education of the public (individual and group discussions), etc.

5. Development of guidelines for health workers and paramedics

These recommendations should be based on existing educational, methodological and informational materials, including the recommendations of WHO, and “Doctors of the World.”
6. Health education of the population for protection against climate change

Social advertising, leaflets, mass media and Internet resources on health issues related to climate change should be used (See Annex 2). A system responsible for timely warning of the population and various other services regarding the occurrence of heat waves should be developed.

In order to reduce and prevent additional mortality due to abnormal air temperature, it is important to develop a system for timely public warnings about heat and cold waves (health information activities) to allocate special time on television and radio channels, as well as to use TV broadcasting in the region. It is necessary to repeatedly warn the public about major threats posed by high concentrations of carbon monoxide and fine particles (ashes) in the air during fires. Informing the population and relevant offices about the occurrence of heat in a timely manner is extremely important, because it takes time to implement the plan. According to WHO experts, this forecast should be given no later than 2 days prior the heat wave. People nowadays do not have any skills of continuous perception of complex information. So the advocacy “chord” has to be made in an accessible form, such as billboards, posters, booklets, etc. Phone emergency lines, and online sites are to work around the clock.

The experience of preventive activities implemented in the United States is very interesting [Kalkstein, 2001], it promotes the system of “good offices”. The mass media publish reports on weather conditions, as well as provide information on how to avoid heat-related illnesses.

7. Improvement of material and resource base of healthcare facilities,

development and distribution of first aid kits is necessary, especially in rural areas (inter-district centers, FOUs, feldsher-obstetric units, outpatient clinics, district hospitals).

It is necessary to provide primary healthcare facilities with appropriate diagnostic and medical equipment.

In the framework of activities, which have been implemented in 2011 by the Moscow office of the WHO, it is planned to purchase 28 sets of equipment for the central district hospitals in the Arkhangelsk Region and NAD which include reflectometers and spirometers, and for some central district hospitals, 6 gynecology examination chairs, since the assessment of the population’s vulnerability in those regions showed a need to improve the diagnostics of the cardiovascular and respiratory diseases, as well as the necessity to optimize medical care provided to the female population. Healthcare facilities in remote rural hospitals need this equipment at the primary healthcare stage. In addition, due to an increase in incidence of tick-borne encephalitis in the Arkhangelsk Region, there is a need to equip regional laboratories in order to improve the quality of the laboratory diagnostics of this disease. It is planned to purchase a PCR with auxiliary equipment, test systems and consumables. The region also needs additional supplies of 20,000 doses of vaccines against tick-borne encephalitis for prevention of this disease among children and adults and for better coverage of the risk groups by the vaccination.

Protection of patients from exposure to heat waves requires more effective protection of the microclimate in medical institutions from the weather conditions. Important factors that require special attention include energy efficiency and insulation quality in the buildings, as well as individual behavior. In addition, due to climate change the healthcare sector should provide an optimal arrangement of the structural elements of the facilities and thermal protection measures when designing the buildings.

It is advisable to arrange air conditioning in hospitals, operation rooms, intensive care units and post-surgery units.

It is recommended to establish a comfort temperature in all rooms at the municipal polyclinics. Since during heat waves the age group of 65 years and older is the most vulnerable, it requires special attention. Suggested measures include equipping rooms with air conditioners, supplies of clean drinking water, the necessary items in first aid kit and a tonometer. During the period of cold temperatures it is necessary to provide additional heating in the rooms and to maintain temperature balance providing hot drinks (tea, rose hips drinks, etc.). During periods of cold temperatures the vulnerable age group with an increased risk of death in the Arkhangelsk Region is the group of 30–64 years, so in case of extreme temperature fluctuations, attention should be given to all individuals over 30 years.
Expert medical statisticians should analyze the work “of the temperature comfort rooms” (requests, assistance provided, etc.). This aspect of the analysis is quite important for annual monitoring. In the long-term it is recommended to repeat the time series analysis in the study of temperature impact on mortality five years after the introduction of the “anti-temperature wave” measures. Then it is necessary to compare the results with the data for the period prior to the introduction of these measures.

8. Methodological and resource assistance to social isolation units (detention centers, prisons and nursing homes), and organized children and adolescents’ teams

The most unprotected and vulnerable individuals to climate change are those belonging to social isolation units. These institutions belong to different sectors, and with regard to the problem under study, we advise they pay more attention to the application of the generally accepted principles of medical and social work when trying to manage these institutions:

- Ecosystem approach (recording of the entire system of human relations and the surrounding environment, a systematic analysis of the situation and a definition of a set of socio-functional positions and actions)
- Polymodality (a combination of different approaches, modes of action, functionally focused on a specific target)
- Solidarity (cooperation of agencies working in this field)
- Constructive enabling (rejection of paternalistic forms of assistance and care, encouraging personal responsibility and activity of clients, maximum utilization and development of their resources)
- Succession (continuity, integrity, functional dynamics).

9. Epidemiological and environmental safety

Preparedness of the healthcare systems is a key factor in the identification of potential outbreaks of diseases and rapid response measures. In high-risk areas, healthcare systems cooperate with the veterinary services to strengthen prevention activities such as vaccination, surveillance and early detection of disease outbreaks, vector control, supply safe drinking water, emergency diagnosis and raising the awareness of the measures necessary for personal protection.

Reduction of risk for the population’s health will be based on prevention and elimination of harmful effects of factors within the human environment (biological, chemical, physical and social). One of the most important factors of health protection is ensuring sanitary and epidemiological wellbeing of the population, which includes:

- Improvement of measures aimed at the reduction of risk of adverse environmental factors that may have an impact on the population;
- Control of communicable and parasitic diseases.

WHO and the other UN agencies, which established a coalition to assist member states in achieving the Millennium Development Goals (MDGs), are concerned that additional challenges posed by climate change, tangibly deprive the country of the possibility to implement the MDGs strategy. Recurrence of old and new communicable diseases due to viral mutations take up limited project resources. Under the conditions of globalization, the WHO initiative on revision and updates in 2005 of the International Health Regulations (IHR) is very timely. The IHR established principles of sanitary-epidemiological surveillance, diagnosis of the most dangerous communicable diseases, registration and subsequent notification of the international community and WHO so the necessary steps can be taken to combat these diseases, and in some extreme cases, emergency measures to prevent their transmission outside the source areas. Russia, with its unique system of sanitary surveillance (Rospotrebnadzor) and its extensive network of offices and laboratories is an active participant in this international agreement. Among the seven major areas of work activities, in the fields there is a clause “strengthening the management of specific risks,” which de facto is already considered in the implementation of the multidisciplinary monitoring of potential outbreaks of dangerous communicable
diseases in the AR in regards to their epidemic transmission (anthrax, tick-borne encephalitis, tularemia, the area of food safety). Therefore, it is necessary to further plan and prepare the application of the anti-epidemic activities to interrupt the transmission of agents and their vectors. There is a need to further improve the system for collection, registration and processing of data related to the population’s health (See Annex 1).

Providing healthy and safe foods for the population of all age groups is an important aspect of the formation of a healthy lifestyle among the population of the Russian Federation, which promotes the optimization of the appropriate diet, as well as training of various groups on healthy nutrition.

Rospotrebnadzor will continue to monitor the local and central authorities to provide coordination of activities:
• To ensure adequate water quality, food safety and the implementation of appropriate sanitation and hygiene standards;
• To follow precautions when carrying out clearance operations;
• Vaccination activities, when needed;
• Protective measures against potential vector-borne diseases and chemical hazards;

When developing the plan for prevention of tick-borne encephalitis (TBE) and other “tick” infections, it is necessary to consider specific zoological and the entomological and epidemiological situation, including specifics of distribution, nature and loymopotential of natural and anthropurgic centers, as well as the extent of exposure among the population of the Arkhangelsk Region. Therefore, a systematic environmental surveillance of TBE and other “tick” infections is an extremely important condition for effective prevention. It includes the following sections:
• Study of monthly (during period of activity) indicators of the number of ticks, collected from plants in the areas of the region, and differentiation in the species composition of ticks;
• Study in areas where ticks are collected, the number and species composition of wild small mammals which are the sources of food for ticks;
• Analysis of the information on number and species composition of the dominating wild large mammals which are the sources of food for ticks;
• Annual examination of ticks collected from the vegetation for TBE virus and other “tick” infections
• Increase the number of laboratories (including those in the central districts of the region) capable of detecting TBE virus in ticks taken from attacked people;
• Landscape geographical zoning of the area in order to identify and isolate active foci of TBE;
• Forecasting the number of mites and their feeders;
• Annual serological testing for TBE and other “tick” infections of various professional and social groups living in different zones of the region, with special attention to the residents of Vilegodsk, Vinogradov areas which differ from the neighboring areas by a low incidence;
• Analysis of immunity of the population of different regions, comparison of the results with the incidence rates;
• Data of serology examination performed during the seasonal activity of ixodid ticks reported in all patients who developed fever of unclear etiology for the presence of antibodies to tick infections, including the EC;
• Control over timely identification of patients with TBE paying particular attention to the patients of the Kotlas district where in August - October of 2007, ninety percent of them were diagnosed with TBE;
• A retrospective and operational analysis of incidence of TBE and other tick-borne infections and of the number of people attacked by ticks;
• Implementation of the state sanitary and epidemiological surveillance of the allocation of land for gardening and construction in the areas of ixodic ticks habitat;
• Listing of institutions, the employees who perform professional activities associated with exposure to tick infections;
• Prediction of the TBE source areas and TBE incidence among the population of the Arkhangelsk Region.
• Implementation of effective surveillance will help to specify preventive measures and adapt them to the conditions of the Arkhangelsk Region. Changing of the situation related to the expansion of habi-
tat of ixodic ticks, vectors of various pathogens would increase the importance of non-specific prophylactic measures for prevention of tick attacks.

Therefore it is needed:

- To significantly increase the acaricidal treatment of congregated settings with the following monitoring of its efficiency;
- To provide regular improvement of these territories and the extermination of rodents;
- To strengthen health education that gives people more information about tick-borne infections and measures for prevention and personal protection from tick attacks;
- To publish brochures for family reading.

Along with the measures of nonspecific prevention of tick-borne infections for reduction of TBE incidence, some additional specific protection measures should be applied. TBE vaccination should be scaled up including in those areas of the Arkhangelsk Region where cases of TBE have been registered only in recent years. For emergency prevention of TBE (when medically indicated) the use of human immunoglobulin should be expanded.

In order to improve the quality of prevention and anti-epidemic measures and to improve laboratory diagnostics of tick-borne encephalitis in the Arkhangelsk Region the following activities will be initiated:

1. Diagnostics of TBE will be performed at the existing laboratories in branches of the Center for Hygiene and Epidemiology in the Arkhangelsk Region. Immunological studies of clinical samples (serum and CSF samples) will be performed, and studies of ticks collected from people will be conducted to address the issue of immunoglobulin injections. To solve this problem it will be necessary to purchase equipment for the rapid diagnostics of tick-borne encephalitis virus (enzyme immunoassay analyzers), diagnostic test kits, as well as other supplies and to train the laboratory staff. In particular, the WHO will provide the equipment and supplies for identification of TBE markers for express diagnostics infectiousness of vectors and differential express diagnostics of viral TBE. It is planned to equip the laboratory of highly infectious diseases and the virology laboratory at the Center for Hygiene and Epidemiology in the Arkhangelsk Region.

2. Mass vaccination of the population in the Arkhangelsk Region. Funds will be allocated for the purchase of vaccines; instead of less efficient means of emergency prevention (human immunoglobulin), as from the point of view of TBE prevention effectiveness it cannot be compared to immunization.

3. Volumes of acaricidal treatments will be increased by involving stakeholders including the heads of municipalities through signing of agreements to conduct acaricidal treatments in their territories.

The most important aspect of the prevention of salmonellosis is veterinary-sanitary measures aimed at disease prevention among livestock, especially in livestock and poultry farms, as well as the provision of appropriate sanitation and technological conditions in slaughterhouses, meat processing plants, and meat and dairy enterprises. Special measures will be taken to ensure continuous laboratory quality control of bone and fish flour used for animal feeding; at the meat processing plants, food warehouses and cold storages disinfection - deratization activities will be carried out. Sewage from livestock farms and meat processing plants are subject to proper treatment and decontamination prior to discharge into water bodies.

Preventive measures of sanitary and epidemiological services consist of organizational and methodological work and monitoring activities aimed at ensuring proper hygienic and technological conditions of processing, storage, transportation and sale of food products to the food industry. Particular attention should be given to meat products - shredded and minced meat, which is favorable nutrient medium for the growth of salmonella. For decontamination of meat it is necessary to maintain the meat at a minimum temperature of 80°C with exposure time of 10–15 minutes. It should be noted that under favorable temperature conditions, salmonella multiply more rapidly in cooked food products rather than in raw ones, so cooked meat or fish should not be cut on the tables or cutting boards used for raw food processing. To prevent contamination of milk with salmonella it should be filtered immediately after milking, cooled and sent to milk processing factories. Individuals who are the carriers of salmonella bacilli should not be allowed to work in childcare institutions, catering or related businesses.

The analysis of incidence of acute intestinal infections in the Arkhangelsk Region showed that during outbreaks of salmonellosis, children attending daycare centers, and those residing in nursing homes were the
most at risk. One should not forget about the possibility of salmonellosis transmission in medical facilities. Prevention of nosocomial outbreaks of salmonella consists of prevention of salmonella importation and spread of the infection in the hospital settings.

To prevent the importation of salmonellosis into a hospital, medical staff referring children to an in-patient department for hospitalization should indicate the presence (absence) of clinical symptoms suggestive of salmonellosis, as well as the registration of salmonellosis cases in the community or daycare centers for the last 7 days. In the admission ward, regardless of the diagnosis specified in the request for hospitalization, patients should be checked for the presence of clinical manifestations of salmonellosis. If there is any clinical or epidemiological evidence suggestive of salmonellosis, bacteriological examination of children referred for hospitalization should be performed in the admission ward. These children should be placed in diagnostic rooms for a period of time necessary to exclude the diagnosis of salmonellosis. Discharge from the hospital and clearance for work (return to the childcare facilities) will be made after clinical recovery and repeated negative result of the bacteriological examination of feces.

Prevention of the salmonellosis infection in the households, hospitals, educational institutions, and work places is being achieved by means of a set of measures for prevention of the nosocomial infections - architectural design, sanitation, hygiene, institutional, disinfection, sterilization, etc.

According to reports, in the Arkhangelsk Region there are 68 settlements in 17 administrative areas, including the city of Arkhangelsk, that are areas of concern due to reported cases of anthrax. According to the data of the regional veterinary service, there are 32 anthrax cattle burials. The location and geographic coordinates are known only for 24 of them.

Therefore, under the current conditions it is necessary to perform the following actions:

1. Develop and introduce standards and approaches to the assessment of anti-epidemic and prevention activities performed in the areas of feral herd infections. At the same time, the incidence level of the feral herd infections cannot be accepted as a quality indicator of the performed activities, as it often leads to a significant underestimation of the official number of reported cases or to a complete concealment of those cases.

2. Implement annual control of the anthrax cattle burials with filing a report on their sanitary condition.

3. Strict prohibition of the use of territories within the sanitary-protected zone of the anthrax cattle burials for any economic activities: for pastures, fields, gardening, livestock watering places, any work related to excavation and earth moving, construction of the residential, public, industrial or agricultural buildings.

4. When there are substantiated facts that existing anthrax cattle burials were destroyed by melting snow or rainwater, it is necessary to check the environment (soil, water) for the presence of anthrax bacteria and identify the boundaries of the contaminated areas.

5. Monitoring of the population size, species composition and infestation by agents of the natural focal infections among small mammals and by agents of the natural focal infections among the bloodsucking dipteran in natural habitats. It appears to be appropriate for the Reference-Center to develop a five-year plan of references for the Center for Hygiene and Epidemiology in the Arkhangelsk Region in agreement with the Department of Rospotrebnadzor in the Arkhangelsk Region.

6. Monitoring of the population size, species composition and feral herd infection in small mammals in the Arkhangelsk Region. Addressing this issue is closely related to the fact that the existing legislation does not allow experts from the Center for Hygiene and Epidemiology to freely visit the objects of interest in the city. In addition to the Center, rodent control in Arkhangelsk is being performed by two private companies that consider visits by experts from the Center to the facilities they service to be intrigues by their competitors. Therefore, at present the monitoring system is feasible only in the part of the city where experts of the Center perform deracination.

7. Re-establishment of the departments of high-risk and feral herd infections at the Center consisting of biologists and entomologists, and with available vehicles. The number of staff members should be adequate to the area of the serviced territory.

8. Equipping the FGUZ laboratory to work with the agents of groups 1 and 2.

9. Coordination of activities among the local authorities, healthcare sector, EMERCOM medical services, emergency, Emergency Medicine Center, fire emergency service, etc.
It is necessary to develop an Agreement on Cooperation between the Northern Interregional Territory Administration of the Federal Service for Hydrometeorology and Environmental Monitoring and the Ministry of Health and Social Development of the Arkhangelsk Region in the framework of coordination of interagency cooperation. In particular, priority should be given to informing the Ministry early about the occurrence of cold and of heat waves for proper management of the emergency response. At the same time, according to the results of the analysis performed in the Arkhangelsk Region, the temperature threshold for heat waves was +21,0 ° C, and for cold waves –21,5 ° C, and the duration of the exceeded threshold was 8 days or more. According to the guideline documents, it is the responsibility of the department of monitoring and forecasting at the EMERCOM of the Arkhangelsk Region, which is a part of the Crisis Management Center of the EMERCOM in the Arkhangelsk Region, to monitor and forecast the situation.

The monitoring information is being processed by specialists at the Center and is to be provided as daily forecasts of possible occurrence of disasters (adverse weather events, dangerous phenomena, hydrologic situation, fires, emergencies in housing and communal services, etc.) to the dispatching services of the municipalities and other agencies.

In addition, EMERCOM gives the recommendation to perform preventive activities (some guidance including the involvement of mass media, updates on the availability of material and financial reserves, transportation, evacuation locations, etc.) This system of activities was successfully tested and is now functioning in the region. Regarding strategy implementation, it is suggested that dispatching services of the municipalities should deliver information about future waves of heat and cold (10 days in advance, followed by a confirmation 2 days in advance) to all services in the region which were specified in the Strategy. In the framework of strategy implementation, it is suggested to use the following communication algorithm for interactions schemes between the Arkhangelsk Center for Hydrometeorology and Environmental Monitoring, the Regional EMERCOM Center and other participants.

Figure 3. Algorithm for Reporting on Temperature Waves for Members of the Strategy on the Example of Municipal Education
At the local legislation level it is advisable to approve:

• To recognize climatic equipment as socially relevant and to secure food safety and other goods in the risk group;
• To prevent the unprecedented growth of prices for air conditioners and fans, as in 2010;
• To make mandatory the air conditioning of grocery stores and pharmacies, since the maximum temperature for storing medication and other pharmaceutical products should not exceed 23–25 degrees;
• To use watering equipment ("washing" of air is a well-known and effective method of pollution reduction in the surface layer of the atmosphere);
• To close companies with particularly harmful technology, so as not to aggravate the ecology,
• To limit for use of private vehicles to reduce harmful emissions.

Recommend to the administration of the City of Arkhangelsk to allocate financial support for air-conditioning of public transportation (buses, minibuses). The control over the implementation should be the responsibility of the Regional Ministry of Transport and Communication.

In the NAD, the development and implementation of the program for the far north "Healthy life – Healthy Living – the Nation’s Health" should be initiated. Therefore it is necessary to identify the sources and amounts of funding, and the implementation timeline. The Program, technology and operational criteria of its effectiveness should be interdisciplinary supported by the collaboration of psychologists and social workers.

The program should provide for:

• The establishment of public baths with laundry in each village (washing, drying, ironing);
• The establishment of cafeterias in each village with an option to order lunches for home delivery with a discount, social meals and subsidies;
• The improvement of intra-village roads, road maintenance, responsibility for the damage (fines, public works);
• Central heating for the budgetary agencies;
• Centralized water supply to each house;
• Centralized garbage removal from each house;
• Centralized garbage disposal. Addressing the issue of waste disposal.
• Minor mechanization for individual heating of houses;
• Communication: local radio, media, Internet, satellite communication.

Within this program it is necessary to consider a sub-program or a separate section – “Struggle for Healthy Life” with the participation of the local administration, institutions of education, culture and healthcare, local radio and public catering. In every village, a group should be formed and assigned a leader, who is not necessarily a medical worker;

• Measures to regulate tariffs and welfare policy are urgently needed for protection of the poorest population groups of the society.
In regards to the activities, which have been implemented since 2011 by the Russian office of the WHO, it is planned to purchase 24 sets of equipment for the Central district hospitals of the Arkhangelsk Region and the Nenets Autonomous District. The equipment includes reflectometers, spirometers and for some hospitals, 6 gynecology examination chairs, as the vulnerability assessment performed among the population in those areas showed a need to improve the diagnostic capabilities of cardiovascular and respiratory diseases, as well as a need to optimize healthcare delivery for females in remote rural hospitals. Health facilities in remote areas need this equipment at the primary healthcare level. In addition, due to the increase in the incidence of encephalitis in the Archangelsk region, there is a need to re-equip laboratories to improve the quality of diagnostics. It is planned to purchase a PCR analyzer along with other auxiliary equipment, along with express tests and supplies.
The planned activities of the strategy below are mid-term; to cover the period from 2011 and include basic elements, though many of them will continue beyond. The work begins with a strategic objective established by a regional system that is capable of providing a rapid response in cases of abnormal weather temperature (the responsible person is the Minister of Health and Social Development of the Arkhangelsk Region, L.I. Menshikova, execution – the 3d quarter of 2011). Expected outcomes:

- An inter-agency group on project management will be established and the head institution will be The Ministry of Health and Social Development of the Arkhangelsk Region;
- A medium-term action plan will be drafted, and a verification of its comprehensive activities will be performed (at the quarterly meetings);
- A sustainable inter-agency cooperation will be provided in planning, implementing and coordinating the response in support of public health services;
- Effective measures of communication with the bilateral movement based on reliable information, transparency of sources, objective risk assessment and consequently, decision making based on rational measures of precautions;
- Multi-disciplinary activities and coordination of the MES medical service of the Arkhangelsk Regional Center for Disaster Medicine and Emergency Care is ensured.

<table>
<thead>
<tr>
<th>Priority</th>
<th>Sector</th>
<th>Person in charge</th>
<th>Measurable outcomes and indicators</th>
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<tbody>
<tr>
<td>1. Improvement of accessibility and quality of medical care in the AR and NAD by strengthening healthcare services, including primary healthcare in order to reduce incidence and mortality among the population.</td>
<td>The Ministry of Health and Social Development of the Arkhangelsk Region&lt;br&gt;The Health Department of the Nenets Autonomous District</td>
<td>The Minister of Health and Social Development in the Arkhangelsk Region&lt;br&gt;The Head of the NAO Health Department</td>
<td>Improvement of material recourses of healthcare institutions, including feldsher’s units, outpatient clinics and district hospitals in the rural areas. Increase in the number of treatment and preventive care facilities equipped in accordance with the requirements for medical care delivery Better staffing of primary healthcare clinics with physicians and nurses, increased number of the mobile medical teams for work in the rural areas in the Arkhangelsk Region and NAD. An expanded list of the civilians and the services staff trained as paramedics (homemakers, sanitary instructors, teachers, policemen, transportation service officers, pharmacy staff, veterinarians, and post office workers). Delivery of the emergency care instructions and of multi-usage first-aid kits for paramedics. (Timeline – continuously during 2011–2012)</td>
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<tr>
<td>2. Optimization of the system for developing healthy lifestyle. Activities aimed at decreasing the population’s mortality</td>
<td>The Ministry of Health and Social Development of the Arkhangelsk Region&lt;br&gt;Health Department of the Nenets Autonomous District</td>
<td>The Minister of Health and Social Development of the Arkhangelsk Region&lt;br&gt;The Head of the Health Department, NAD</td>
<td>Process indicators: expansion of counseling and control of risk factors among healthy populations. Statistics on incidence, mortality and disability (Timeline – continuously during from 2011)</td>
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<td>3. Postgraduate education of medical specialists in the context of the current problem.</td>
<td>The Northern State Medical University</td>
<td>The NSMU Dean</td>
<td>Proportion of the trainees and medical staff trained at the refresher courses regarding the impact of heat waves on human health as well as on the prevention of those effects. Development of the curriculum for the primary healthcare physicians and nurses on the integral disease prevention based on modification (elimination) of risk factors, including abnormal weather impacts in the framework of postgraduate education. Developed and approved practical recommendations and instructions on the implementation of protective measures during abnormal weather conditions. (Timeline – continuously during from 2011)</td>
</tr>
<tr>
<td>4. Paramedic training (homemakers, policemen, teachers, veterinary specialists, postal workers, transport workers, pharmacists). Development of the methodical recommendations for medical workers and paramedics.</td>
<td>The Ministry of Health and Social Development of the Arkhangelsk Region The NSMU The AR Ministry of Internal Affairs The AR Ministry of education, science and culture The AR Ministry of Agriculture and Trade Sberbank of Russia, the Arkhangelsk branch The State Unitary Enterprise of “Pharmacia”, AR Department of the Federal Postal Service in the AR, a branch of the “Russian Post” Joint-Stock Company “Nordavia”, Russian Railways, Northern branch</td>
<td>The Minister of Healthcare and Social Development of the Arkhangelsk Region The NSMU Dean The Head of the AR Ministry of Internal Affairs The AR Minister of education, science and culture The AR Ministry Agribusiness and Trade The Head of the Arkhangelsk branch of Sberbank Director of State Unitary Enterprise of the AR “Pharmacia” The head of the Federal Postal Service Department in the AR – a Branch of the “Russian Post”</td>
<td>Number of trained paramedics Availability of practical recommendations for all kinds of paramedics. (Continuously within 2011–2012)</td>
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<tr>
<td>5. Health education of the population related to climate change (social advertisement, booklets, mass media, and internet). Development of emergency alert systems to inform the population and various services in case of heat waves.</td>
<td>The AR Department of Informational Policy NSMU</td>
<td>The Head of the AR Department of Informational Policy The NSMU Dean</td>
<td>Information and advocacy materials developed for mass media on the mitigation of extreme temperature impacts on humans and on the necessary preventive activities during transmission of specific infectious diseases. Related TV and radio to increase broadcasting during the fall and spring seasons. The system for timely informing the population and various auxiliary services prior to the heat/cold waves. A number of published materials. Contracts with mass media and TV companies. A number of targeted broadcastings (Continuously within 2011–2012)</td>
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<tr>
<td>6. Improvement of the material resources of healthcare institutions, first of all in the rural areas (felsher’s units, outpatient clinics and district hospitals). Supplies of first-aid kits, diagnostic equipment etc.</td>
<td>The Ministry of Health and Social Development of the Arkhangelsk Region</td>
<td>The Minister of Health and Social Development of the Arkhangelsk Region</td>
<td>A number of paramedics and hygiene instructors equipped with the first-aid kits. A number or percentage of the medical facilities with improved diagnostic equipment. (Continuously within 2011–2012)</td>
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<td>Priority</td>
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<td>7. Methodical and resource assistance to social isolation units (pre, real detention centers, colonies, boarding schools, nursing homes) and to organized groups of children and adolescents.</td>
<td>The Ministry of Health and Social Development of the Arkhangelsk Region Department of Social Development at the Ministry of Health and Social Development of the Arkhangelsk Region Administration of the Federal Penitentiary Service of Russia in AR The AR Ministry of education, science and culture</td>
<td>The Minister of Health and Social Development of the Arkhangelsk Region The Head of Department of Social Development at the Ministry of Health and Social Development of the Arkhangelsk Region The Head of the Federal Penitentiary Service of Russia in AR The AR Minister of education, science and culture</td>
<td>Training workshops in the target institutions Supplies of the first-aid kits, diagnostic equipment and methodical recommendations (Continuously from 2011)</td>
</tr>
<tr>
<td>8. Epidemiological and ecological safety. Improvements to the system for collection, recording and automatic timely processing of information on the population’s health</td>
<td>The Ministry of Health and Social Development of the Arkhangelsk Region The Department of Rospotrebnadzor in the Arkhangelsk Region</td>
<td>The Minister of Health and Social Development of the Arkhangelsk Region The Head of the Department of Rospotrebnadzor in the Arkhangelsk Region</td>
<td>Improvement of the material and technical resources and activity methods of institutions of the Federal Service of Surveillance of Consumer Rights protection and Human Well-being (Rospotrebnadzor) Incidence of tick-borne encephalitis, hepatitis A, dysentery etc. Introduction of the system for collection, recording and automated processing of information on the population’s health (Continuously within 2011–2012)</td>
</tr>
<tr>
<td>9. Coordination of activities of EMERCOM (The RF Ministry of Civil Defense, Emergency Management and Natural Disaster Response), the Emergency Medicine Center, emergency ambulance and fire departments.</td>
<td>Ministry of Health and Social Development of the Arkhangelsk Region EMERCOM in AR The Arkhangelsk Center of hydrometeorology and environmental monitoring</td>
<td>Minister of Health and Social Development of the Arkhangelsk Region The Head of EMERCOM in AR The Head of Arkhangelsk Center of hydrometeorology and environmental monitoring</td>
<td>Number of meetings of Level 1 Steering Group (Continuously from 2011)</td>
</tr>
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In the management structure of strategy implementation, four levels can be distinguished:

1. A strategy leader;
2. An interagency Working Group by sector;
3. Responsible persons in the sectors;
4. Frontline workers.

The strategy implementation will be discussed with the Administration of the Arkhangelsk Region in order to assign a person responsible for project coordination – a Deputy Governor on Social Issues (Level 1 – strategy leader), who is to establish a Working Group at the regional level (Level 2 – Working Group by the sectors) for immediate control of activity implementation based on identified priorities. This (the highest) level of leadership for the region should provide a legal framework to ensure responsibility for decisions made, diligence and legal support to the Strategy and supervision.

The Working Group should include: the Minister of Health and Social Development of the Arkhangelsk Region, the Head of the Department of Health and Social Development of the NAD, the Head of the AR Rospotrebnadzor, The Dean of Northern State Medical University, the Head of the AR Department of Internal Affairs, the AR Minister of Education, Science and Culture, the AR Minister of agribusiness and trade, the Head of the Arkhangelsk branch of Sberbank of Russia, Director of the PMU “Pharmacy” in the Arkhangelsk Region, the Head of the Information Policy Department at the Arkhangelsk Region administration, The Head of the FSSE in the Arkhangelsk Region, the Head of EMERCOM in the Arkhangelsk Region, the chief meteorologist of the Arkhangelsk Center for Hydrometeorology and Environmental Monitoring, the Head of the department of the Federal postal service of the Arkhangelsk Region – a branch of the Federal State Unitary Enterprise “Russian Post”, Directors of JSC “Aeroflot-Nord” and the Northern Branch of Railways.

The Members of the Working Group provide horizontal and vertical coordination of strategy implementation. They are responsible for its performance in their own sectors and they appoint frontline workers of specific interventions (level 3). Since the essence of this strategy is healthcare, we believe that there are key differences in the structural organization of activities. In the services with their own medical systems (Department of Internal Affairs, FSSE, Railways, etc.) the heads of the corresponding medical institutions are responsible for the sectors; included in the services where such systems are not available, the heads of medical services and healthcare facilities (district chief physicians, chief doctors of the municipal hospitals etc.). The doctors, nurses, NSMU staff, mass media, social workers, trained paramedics (household medical instructors, homemakers, policemen, teachers, postal workers, librarians, bank workers, etc.) will become the direct frontline workers (Level 4) depending on the priorities and a particular sector.
<table>
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<tr>
<th>Strategy priority</th>
<th>Intervention</th>
<th>Intervention targets</th>
<th>Responsible in sectors</th>
<th>Deadline</th>
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<tbody>
<tr>
<td>Increased access to medical care in AR and NAD. Strengthening primary healthcare.</td>
<td>Strengthen the human resource capacity (professional development); Ensuring access to the primary healthcare services; Optimization of institutional functionality; Establish mobile medical teams; Expansion of the community care</td>
<td>Doctors, Paramedics, Healthcare institutions</td>
<td>Chief doctors of the medical facilities</td>
<td>End of 2011 and 2012</td>
</tr>
<tr>
<td>Optimization of the healthy lifestyle advocacy systems. Activities on reduction of mortality.</td>
<td>Informational measures (lectures, talks, publications, interviews in mass media, etc.); Differentiation of impact (healthy population, biological, social, clinical groups); Optimization of the “Health Center’s” performance</td>
<td>General population, Children, adolescents, Vulnerable population groups</td>
<td>Chief doctors of medical facilities</td>
<td>2011–2012</td>
</tr>
<tr>
<td>Under and Postgraduate education of medical specialists.</td>
<td>Inclusion into the program of professional development of healthcare workers (first of all from the primary healthcare), the topics related to this problem; conducting the cycles of thematic advanced training for physicians;</td>
<td>Doctors, Nurses</td>
<td>Dean of the NSMU Department of Postgraduate Education</td>
<td>2011–2012</td>
</tr>
<tr>
<td>Paramedic training (homemakers, policemen, teachers, veterinarians, pharmacists, postal workers, transport workers, pharmacists and ect.).</td>
<td>Issues related to climate and health. Basics for the diagnostics of conditions directly threatening human life. Measures of first aid delivery. Methods for establishing mobile medical teams; “refreshing centers”, first aid kits; Inform the population</td>
<td>Police, teachers, veterinarians, pharmacists, Librarians, bank specialists, transport workers (rail, air, etc.), postal workers, Homemakers</td>
<td>Chief doctors of medical facilities. Head of the Medical Unit at the Department of Internal Affairs in the Arkhangelsk Region; Head of the Medical Department of the FSSE in the Arkhangelsk Region; Chief Doctor of the district hospital at the Isakogorka station, JSC “RZD”; Head of the Medical Unit, LLC “Nordavia”; Head of Outpatient Clinic of Main Directorate of the Central Bank of Russia in the Arkhangelsk Region</td>
<td>2011–2012</td>
</tr>
<tr>
<td>Strategy priority</td>
<td>Intervention</td>
<td>Intervention targets</td>
<td>Responsible in sectors</td>
<td>Deadline</td>
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</tr>
<tr>
<td>Develop methodological recommendations for paramedics and medical workers.</td>
<td>Developing methodological recommendations</td>
<td>Doctors, Nurses, Policemen, Teachers, Veterinarians, Pharmacists, Bank officers, Librarians, Transport workers, Postal workers, Homemakers</td>
<td>The NSMU staff Head of the NSMU Printing and Publication Department</td>
<td>2011</td>
</tr>
<tr>
<td></td>
<td>Publication of recommendations</td>
<td>Dissemination among the target audiences</td>
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<td>blossom</td>
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<tr>
<td>Health education of the population related to climate change</td>
<td>Public service advertisings</td>
<td>Population of the region</td>
<td>Director of the Federal State Unitary Enterprise “AGTRK” Pomorye (a branch of VGTRK)</td>
<td>2011–2012</td>
</tr>
<tr>
<td></td>
<td>Develop, publish, and distribute leaflets;</td>
<td></td>
<td>Head of the NSMU Printing and Publication Department</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Informing through media</td>
<td></td>
<td>Head of the department of the Federal Postal Service in AR, (branch of the “Russian Post”)</td>
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<tr>
<td></td>
<td>Develop the Internet page at Ministry of Health of AO</td>
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<tr>
<td>Improvement of material recourses of healthcare institutions.</td>
<td>Equipping the fieldshers’ units and district hospitals with the appropriate medical equipment and air conditioners</td>
<td>Healthcare institutions</td>
<td>Chief doctors in the districts, Director of State Healthcare Institution “Medical informational and analytical center”</td>
<td>2011–2012</td>
</tr>
<tr>
<td></td>
<td>Supply first aid kits, especially to district hospitals, fieldsher’s units, health units</td>
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<td></td>
<td>Establish rooms of temperature comfort at the municipal polyclinics;</td>
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<tr>
<td></td>
<td>Monitor the impact of heat waves on health</td>
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<tr>
<td>Methodological and resource assistance to “social isolation units”</td>
<td>Develop and dissemination of leaflets</td>
<td>Individuals under investigation, Convicted persons, Clients of the nursing homes, Children from the boarding schools and orphanages</td>
<td>The NSMU staff Head of Editorial Department of NSMU</td>
<td>2011–2012</td>
</tr>
<tr>
<td></td>
<td>Establish the temperature comfort rooms</td>
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<tr>
<td></td>
<td>Provision of medical kits</td>
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<tr>
<td>Epidemiological and ecological safety, Improvement of the system for collection recording and timely, automatic processing of information about the population’s health</td>
<td>Vaccination</td>
<td>The population of the region, Groups, territories at risk</td>
<td>Head of the Federal Service on Surveillance for Consumer Rights Protection and Human Well-being in Arkhangelsk, Head of the Center for Hygiene and Epidemiology in the North - West Federal District in the Arkhangelsk Region, FGUZ Branch, Chief doctor of the Center for Hygiene and Epidemiology in the Arkhangelsk Region, FGUZ, Director of State Healthcare Institution “Medical informational and analytical center”</td>
<td>2011–2012</td>
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<tr>
<td></td>
<td>Epidemiological surveillance</td>
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<td>Emergency diagnostics</td>
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<td>Raise the level of awareness on the necessary personal protection measures</td>
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<td></td>
<td>Carry out the immunological studies on tick-borne encephalitis</td>
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<td>Acaricidal treatment</td>
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<td>Prevention of salmonellosis; veterinary activities aimed at disease prevention among the farm livestock;</td>
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<td>Monitor the condition of anthrax cattle burials;</td>
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<td></td>
<td>Organization and performance of the monitoring of the number, species composition and their contamination with infections of bloodsucking arthropods in their natural habitat.</td>
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<tr>
<td>Strategy priority</td>
<td>Intervention</td>
<td>Intervention targets</td>
<td>Responsible in sectors</td>
<td>Deadline</td>
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<tr>
<td>Coordination of activities between the EMERCOM medical service, the Emergency Medicine Center, emergency care and fire emergency etc.</td>
<td>Joint activities plan for these agencies</td>
<td>System of interagency cooperation</td>
<td>Chief doctors in the districts, Director of State Healthcare Institution Medical Informational Analytical Center, Chief of EMERCOM of Russia in the Arkhangelsk Region, Head of the Arkhangelsk Center of Hydrometeorology and Environmental Monitoring</td>
<td>2011–2012</td>
</tr>
</tbody>
</table>
All activities associated with the process of communication are subject to monitoring and supervision. It is necessary to evaluate the following issues:

- Were activities that raise awareness performed prior to the onset of a critical situation?
- What is the role of communication in the public?
- What was the reaction of the target group (or groups) to the provided information materials?
- What could be improved in the future?
Postgraduate education of primary care medical workers that is focused on climate change are to pay particular attention to the effects of temperature fluctuations on health, prevention of these impacts, and first aid. This program can be implemented by the NSMU department of Postgraduate Education of the Northern State Medical University.
Since no estimations have been performed in relation to this part of the Working Group’s strategy and modeling, this section is presented from a theoretical prospective.

Medical effectiveness – is the extent of a medical achievement. With regard to an individual patient (from an identified vulnerable group) who was subject to interventions in a situation of extreme temperature waves, cure or improvement of health, rehabilitation of lost functions of individual organs and systems should be observed. At the healthcare facilities level and the health sector in general, medical effectiveness is measured by indicators: the number of saved lives, the proportion of cured patients, inpatient lethality, a reduction in the number of cases of developed disease conditions, a reduction in incidence.

Social effectiveness – is the extent of positive social outcomes achieved. With regard to an individual patient – the indicator is the ability to return to work and social life, and satisfaction with the level of medical care. At the level of the entire sector – an increase in life expectancy of the population, a reduction in mortality and disability, satisfaction of the society with the system of medical care (availability, quality, and responsiveness to the challenges of a changing climate).

Cost-effectiveness – is the ratio of achieved results and costs incurred. Calculation of cost-effectiveness is related to the search for the most cost-efficient use of available resources. This indicator is necessary to assess the healthcare system as a whole, its individual units, as well as economic justification of measures to protect the population’s health. During the implementation of the proposed priorities and broad public awareness, investment prospects of the region are expected to increase, along with retention of the labor force (reduced disability, mortality, and migration of the working-age population).

A specific mission of the healthcare sector lies in the fact that quite often treatment and preventive medical interventions may not be cost-effective, but their medical and social effects require their implementation. Thus, for example, when organizing healthcare for elderly people with chronic diseases, people in social isolation units, and patients with mental retardation there will be obvious medical and social effectiveness, but the economic effect will be negative.

In addition, in case of successful strategy implementation, the ecological and epidemiological situation in the region should improve. Establishment of a more favorable “social” climate may attract work migrants and investors to the region.
This system is one of the tools for prevention of negative effects of temperature fluctuations on human health. The most important and most common components of the system are:

- Identification of weather conditions adversely affecting human health;
- Monitoring of weather forecasts;
- Implementation of mechanisms for notification and public warning when extreme weather conditions are forecasted by the Meteorology Services.

22.1. PLAN FOR RAISING PUBLIC AWARENESS OF HEAT IMPACT ON HEALTH

It is advisable to include the awareness of the risks associated with hot weather and abnormal heat into the strategy of preventive measures for health protection, and to provide the recommendation for behavior under these circumstances. But even prior to the summer season it is recommended to develop a well-structured and proven communication strategy, aimed at specific target groups.

Target audiences – general population, vulnerable groups (children, elderly, people with chronic diseases and those located in the “social isolation units”).

Means of communication: for general population - mass media, Internet - resources; for vulnerable groups - individual, group discussions, and booklets.

The content of information to be conveyed to the audience is the following: behavior rules for prevention of negative effects of thermal waves on health, measures of first aid delivery.

Time to perform these activities: ten days prior (and then to repeat two days in advance) to the onset of heat or cold waves during abnormal temperature.

With regard to the informational materials, six categories of public messages on the following topics have been identified:

- Maintaining cool air temperature at home;
- Avoidance of heat exposure;
- Avoidance of overheating while being exposed to the sun, a necessity to drink plenty of fluids;
- Assistance to affected people;
- What needs to be done if you have health problems?
- What needs to be done when you see that someone feels bad?

The information materials contain key recommendations for:

- Population;
- Vulnerable groups;
- General practitioners;
- Administration of nursing homes for senior citizens and people with disabilities, and other “social isolation units”.
To limit the effect of heat on health; at the beginning of and during the entire summer season it is necessary to provide general health recommendations. They should be:
• Published in a form of leaflets;
• Presented on specific Internet sites or in mass media;
• Broadcasted by radio and television.
Informational materials should be distributed in the congregate areas – post offices, banks, shops, polyclinics and public transportation.

2. Impact of global climate changes on the population’s health in the Russian Arctic. UNDP, UNEP, M., 2008 (Влияние глобальных климатических изменений на здоровье населения Российской Арктики. ПРООН, ЮНЕП, М., 2008).


7. A review of the international experience in adapting cities to climate change and the prospects of developing the adaptation strategies for the city of Moscow, “EKOLAIN” 2009, Moscow (Обзор международного опыта в области адаптации больших городов к климатическим изменениям и перспективы разработки стратегии адаптации для города Москвы. М.: РОО ЭКОЛАИН, 2009.)


ANNEX 1

Development and introduction of the automatic computer system for early detection of exceeding levels of incidence, self-referral and mortality rates in the Arkhangelsk Region

The goal for development and introduction of the system is to modernize the monitoring system and timely automatic analysis of the rates for incidence, self-referrals (to emergency units and polyclinics) and mortality in the Arkhangelsk Region in order to obtain evidence-based and mathematically sound arguments needed for prompt responses to negative impacts of natural and anthropogenic risk factors, such as heat and cold waves, pandemic flu and outbreaks of infectious infections, natural and technological disasters, etc. Many European countries realized the need for such systems right after the heat wave of 2003, which took more than 30,000 lives. At the same time, systems for detection of excessive incidence rates of infectious diseases have been used in many countries since 1990; they were used as a basis for the development of the system for identification of exceeding thresholds of incidence and mortality. Various systems for rapid identification of additional mortality caused by heat waves were developed in Italy, Spain, France, and Portugal in 2003–2005. However, due to differences in analytical approaches and data collection procedures in each country, they did not allow comparison of the results or coordination of activities when generating signals in one of the systems.

In order to reach a consensus on issues of monitoring and identifying excessive mortality in 2007, the EuroMOMO project was initiated in 20 European countries and funded by the European Commission. One of the project’s goals was to establish a universal system for identifying exceeded thresholds of mortality and the number of additional deaths in the real time mode with corrections to data delays in order to even out the difference in speed for data reception between the countries. Currently the system is functioning in many countries; national coordinators send the weekly reports to the Head Quarters of the Project. In 2009 a new system registered an excessive mortality rate during the pandemic flu, and in the winter of 2010 an excessive mortality rate was recorded during the days of temperature decline. In addition to the systems for identification of excess mortality, many countries have systems for syndromic surveillance allowing prompt responses to an increase in requests for medical care, and follow-up the frequency of information searches on particular diseases on the Internet.

For the Arkhangelsk Region, development of the monitoring system and timely automatic analysis of incidence, and requests for medical care and mortality is even more urgent than for European countries due to the impact of heat and cold waves, significant anthropogenic risks and frequent natural disasters. In addition to the local practical applications, introduction of the system would allow using it as a pilot project aimed at the monitoring and timely automatic identification of incidence levels, requests for medical care and mortality in other regions of the RF, and at the national level.

Monitoring self-referrals to policlinics and calls for emergency care are even more urgent, as they precede mortality fluctuations, and thus, they are considered to be more sensitive, but mortality fluctuations are a more “reliable” indicator.
The system could be extended to the analysis of any discrete outcomes, such as infectious diseases (the program used by Rospotrebnadzor for the “Analysis of the Population Incidence” does not have such capacity), the number of traffic accidents, a number of phone calls to different services, etc. With further development of the information systems in the healthcare facilities and routine use of the electronic documentation (EPJ), the system established at this stage would be used to generate and automatically send signals in real time mode which has been already implemented in some European countries. In addition to the practical functions of early identification of exceeded thresholds of self-referrals and incidence and mortality, the system could be used by researchers at NSMU for a retrospective identification of any possible causes of unexplainable exceeded thresholds of self-referrals, incidence and mortality associated with launches at Plesetsk, as well as major emissions at industrial facilities, anthropogenic disasters zones, volcanic eruptions in other parts of the world, etc.

Implementation of activities aimed at modernization of the healthcare system in the Arkhangelsk Region in 2011–2012 that are related to the information systems, and in particular, to the introduction of the medical information systems for routine practice of healthcare facilities will become an informational base for the system under development, and will guarantee its functionality. The system for monitoring and identifying excessive self-referrals, incidence and mortality, will become additional information tool to support managerial decisions at the local and regional levels.

The following work packages (WP) are suggested:

- Development of activity plan for the establishment and introduction of the monitoring system and time-ly automatic analysis of the rates for incidence, self-referrals (to the emergency units and polyclinics) and mortality in the Arkhangelsk Region in cooperation with Project Management, WHO representatives, organizations potentially interested in the system (The Ministry of Health and Social Development of the Arkhangelsk Region, SOI MIAC, NSMU, the Department of Rospotrebnadzor in the Arkhangelsk Region, etc) and heads of corresponding Working Groups (self-referrals to the policlincs and calls for emergency medical care — T.N.Unguryanu, infectious diseases — T.V. Balaeva/Bushueva V.A., mortality — Z.L. Varakina).
- Inventory of the current mathematical algorithms for identification of exceeded thresholds of self-referrals, incidence, mortality).
- Testing of the mathematical algorithms used in other countries with set of a data used within a project in Arkhangelsk as well as adaptation of the system, which exists in European countries, to the conditions of the SHCI MIAC and other potential users.
- Mathematic modeling of self-referrals for medical care, and analysis of the generated signals in situations with an excessive number of emergency calls in Arkhangelsk, medical aid appeal ability in Navodvinsk and mortality in Arkhangelsk using the Project data for comparison of algorithms’ sensitivity to variation in the number of outcomes under study and for choosing algorithms which would be the most appropriate for the local circumstances.
- Development of the Standard Operational Procedures (SOPs) for work with the system, holding of meetings for discussion of practical application of the system in the field, and training of the SHCI MIAC staff, along with other interested users.
- Application of developed algorithms, installation of software and prospective system testing in the SHCI MIAC and in other interested organizations.

ANNEX 2

Recommendations to the population under abnormal heat conditions

*Maintain cool indoor temperatures*

- During the day, keep the windows /shutters closed, especially those facing the sunny side. Open the windows (if it is safe to do so) at night when the outdoor temperature is lower than indoor;
- If your home has an air conditioner, close the doors and windows.
- Electric fans may provide some relief, but when the temperature is above 35 °C, fans may not prevent heat-related illness. Try not to be exposed to the heat.
- Do not go outside at the hottest time of the day.
• Try to stay in the shade.
• Move to the coolest room of your house/apartment, especially for the night.
• Do not leave children or animals inside parked vehicles.

Do not allow body overheating and dehydration
• Make a cold compresses, take footbaths or make foot wrapping, use wet, towels, sponge with cool water, etc.
• Take cool showers
• Wear light and loose fitting clothes of natural materials.
• When outside wear a wide brimmed hat or a cap and sunglasses.
• Drink regularly and avoid beverages with sugar or alcohol.

Help others
• If anyone you know is at risk due to abnormal heat, help them to get the necessary care. Elderly or sick people living alone should be visited at least once a day.
• If a person takes any medications, check with the treating doctor to find out how those drugs may influence thermoregulation and fluid balance.

If you have any health problems:
• Keep medicines at below 25 °C or refrigerated (follow the storage instructions specified on the package);
• Seek medical care if you have a chronic medical condition or take multiple medications.

If you or other people do not feel well:
• Ask for help if you feel dizzy, weak, anxious or have an intense thirst and a headache;
• Try to move to a cool place as soon as possible and measure your body temperature;
• Drink some water or fruit juice to rehydrate;
• Immediately move into a cool place and get some rest if you have painful muscular spasms (most often in the legs, arms or abdomen, in many cases due to sustained exercise) in very hot weather, and drink special solutions containing electrolytes to normalize mineral metabolism, if heat cramps last for more than one hour immediately ask for medical help;
• Consult your doctor if you experience unusual symptoms or if symptoms persist.
• If one of your family members or people you assist have hot dry skin and delirium, convulsions and/or unconsciousness, immediately call the doctor/ambulance. While waiting for the doctor/ambulance move the person to a cool place and put him/her in a horizontal position with legs and hips elevated, undress the person and initiate external cooling, apply cold packs on the neck, underarms and inguinal regions, provide excess of fresh air and spray the skin with water at 25–30°C. Measure body temperature. Do not give acetylsalicylic acid or paracetamol. If a person is unconscious turn him/her on the right side.

Recommendations for vulnerable population groups
In addition to general information, information for elderly and well-advanced in years people and people with chronic diseases (see table below for more detail) should contain:
• Practical tips on how to avoid overheating and dehydration;
• Information on first aid; and
• Important contact details of social and medical services as well as ambulance and local district polyclinics or telephone numbers of general practitioners.
• Other population groups that may need to be considered for specific information may include workers, athletes, tourists and parents of little children.

Conditions that increase the risk of death due to abnormal heat
• Diabetes mellitus, other endocrine disorders.
• Organic psychiatric disorders, dementia, Alzheimer’s disease.
• Mental and behavioral disorders due to psychoactive substance use, alcoholism.
• Schizophrenia, schizotypal and delusion disorders;
• Extrapyramidal and movement disorders
• Cardiovascular disease, hypertension, coronary artery disease, heart conduction.
• Diseases of the respiratory system, chronic lower respiratory disease (COPD, bronchitis).
• Diseases of the renal system, renal failure, urolithiasis.
• Acute gastroenteritis.
• Fever of any origin.
• Skin infections.

Recommendations for general practitioners:

What should general practitioners know and be able to do? Proactive approach:

• Understand the thermoregulatory mechanisms and haemodynamic responses to excessive heat exposure;
• Understand the mechanisms of heat illnesses, their clinical manifestations, diagnosis and treatment;
• Recognize early signs of a heatstroke, which is a medical emergency posing a threat to a patient’s life;
• Facilitate proper body cooling and resuscitative measures (initial symptoms and ways to provide first aid at the pre-hospital stage);
• Be aware of the risk and protective factors in heat related illness;
• Identify the patients at risk and encourage proper education regarding heat illnesses and their prevention, educate care providers working with the elderly, infirm and severely sick people;
• Prior to the summer season, regularly perform medical screening for people with chronic diseases and consults them on how to protect themselves from heat (reduction of heat exposure, sufficient fluid intake, medical treatment);
• Be aware of the potential side effects of the medications prescribed and adjust the doses if necessary during hot weather and abnormal heat;
• Make decisions on an individual basis depending on the situation, since according to current knowledge there are no standards or formal recommendations for alteration in treatment regimens during heat;
• Be aware that high air temperatures can adversely affect efficacy of drugs, according to the manufacture’s recommendations. Most drugs should be stored at temperatures of up to 25 °C; therefore the drugs used in emergencies should be stored and transported at a proper temperature;
• Be prepared to monitor drug therapy and fluid intake, especially in old, infirm and severely sick people as well as those with advanced cardiac diseases.

Health education, consulting and informing the patients on the following:

• Importance of adhering to the recommendations presented in leaflets for the public;
• Individual adjustment of behavior medication and fluid intake according to the clinical status of the patients;
• Contact details of social, medical and emergency services.

Information and recommendations for the administration of nursing homes and disabled individuals:

• Recommendations on how to maintain cool temperatures in the facilities and recommendations for how patients and residents of those facilities should be presented in the information leaflets “Recommendations for the population under abnormal heat conditions”
• Monitor indoor temperatures. Provide at least one cool room (e.g. an air-conditioned room with a temperature below 25 °C). Move residents to this cool area for several hours each day.
• Ask the general practitioners to review clinical management of the residents at risk, for example due to chronic disease.
• Monitor fluid intake. Offer non-alcoholic, unsweetened beverages.
• Monitor body temperature, pulse rate, blood pressure and hydration of nursing homes residents.
• Monitor closely for any early signs of heat illness, and if needed, initiate appropriate treatment.
• Inform and train staff and increase staffing levels if necessary.
List of measures that can help protect patients and medical personnel in hospitals, from the impact of heat waves:

- Establish and maintain active monitoring of patients subjected to high risk during heat waves to determine the symptoms associated with exposure to heat;
- Make the necessary changes in the treatment regimen;
- Postpone all elective surgeries;
- Ensure the availability of beds, especially in emergency units;
- Increase the number of medical staff to ensure full coverage in the case of increased hospital morbidity;
- Ensure procedures to provide proper medical and social care for the patients in high risk groups, discharged from the inpatient clinics, or extend their stay in the hospital until the end of abnormal heat;
- Ensure placement of patients from the high-risk groups into rooms with air conditioning. Patients in less severe conditions should have access to air-conditioned rooms at the time of day with the highest temperature;
- Patients must increase fluid intake;
- Change the diet to include a larger amount of fruits and vegetables;
- Provide patients with adequate clothing and bedding.

Recommendations are prepared by MD Zaroslikova L.A., assistant professor of the Department of public health and healthcare, Northern State Medical University.

### Adverse effects of the drugs during hot weather

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Examples</th>
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<tbody>
<tr>
<td>Drugs can:</td>
<td>Drugs with anticholinergic effects are potent inhibitors of sweating.</td>
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<tr>
<td>Directly affect the central and peripheral mechanisms of thermoregulation;</td>
<td>Antipsychotic drugs may also interfere with the central control of body temperature.</td>
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<td>Affect afferent and efferent pathways, sweating, cutaneous vasodilatation;</td>
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<tr>
<td>Affect cardiac output and thereby heat elimination.</td>
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<tr>
<td>Drugs can aggravate heat illness.</td>
<td>Vasodilators (including nitrates and calcium channel blockers) can worsen hypotension in vulnerable patients.</td>
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<tr>
<td>Heat exposure can increase toxicity and/or decrease the efficacy of drugs.</td>
<td>Toxicity of drugs with a narrow therapeutic index, such as digoxin or lithium, may be enhanced.</td>
</tr>
<tr>
<td>Dehydration and changes in blood volume distribution associated with excessive heat exposure and thermoregulatory response can have an effect on drug levels their kinetics, excretion and hence their pharmacological potency</td>
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</tbody>
</table>

### Considerations for medical professionals regarding drinking recommendations during hot weather and heat waves

“Drinking a lot,” means consumption of the amount of water needed to compensate for fluid deficiency (essentially the urine and sweat losses) by approximately 150%.

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

Excessive drinking of pure water can lead to severe hyponatremia, and potentially leading to such complications as stroke or death. The addition of sodium chloride and other soluble substances can be added to beverages (20–50 mmol/l of beverage) to decreases urinary water loss and facilitates recovery of the body’s fluid balance.

Every senior person or a patient needs to receive individual recommendations:
Three main categories of persons in need of those recommendations:

- Healthy seniors;
Vulnerable people who are exposed to higher risks in cases of heat stress due to hemoconcentration (increased viscosity, increase in red cell and platelet counts) and possible coronary thrombosis, cerebrovascular ischaemia and renal insufficiency;

Patients with a history of stroke, hypertension, diabetes, coronary events, renal insufficiency or dementia.

It is necessary to accept and adopt appropriate recommendations. They should be comprehensible and understandable for the general public, as well as healthcare workers and medical staff.

### Mild and moderate heat illnesses and their management

<table>
<thead>
<tr>
<th>Medical condition</th>
<th>Signs and symptoms/mechanisms of development</th>
<th>Treatment</th>
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<tr>
<td>Heat rash</td>
<td>Small red itchy papules appear on the face, neck, upper and lower chest areas, groin and scrotum areas. It can occur at any age but is prevalent in young children. Sometimes infection with Staphylococcus can occur. It is attributed to heavy sweating during hot and humid weather.</td>
<td>Rash subsides with no specific treatment. Staying in an air-conditioned environment, taking frequent showers and wearing light clothing help to minimize sweating. Keep the affected area dry. Topical antihistamine and local antiseptics can be used to reduce discomfort and prevent secondary infection.</td>
</tr>
<tr>
<td>Heat oedema</td>
<td>Oedema of the lower limbs, usually ankles, appears at the beginning of the hot season. This is attributed to heat-induced peripheral vasodilatation and retention of water and salt.</td>
<td>Treatment is not required as oedema usually subsides following acclimatization. Diuretics are not recommended.</td>
</tr>
<tr>
<td>Heat syncope</td>
<td>This involves a brief loss of consciousness or orthostatic dizziness. It is common in patients with cardiovascular diseases or taking diuretics, before acclimatization takes place. It is attributed to dehydration, peripheral vasodilatation and decreased venous return, resulting in the reduced cardiac output.</td>
<td>Move the patient to a cool place, lay him or her with the legs and hips elevated to increase venous return. It is necessary to rule out other serious causes of fainting.</td>
</tr>
<tr>
<td>Heat cramps</td>
<td>Painful muscular spasms occur, most often in legs, arms or abdomen, usually at the end of sustained exercise. This can be attributed to dehydration, loss of electrolytes through heavy sweating and muscle fatigue.</td>
<td>Immediate rest in a cool place is recommended. Stretch muscles and massage gently. Rehydration with a solution containing electrolytes may be needed. Medical attention should be sought if heat cramps last for more than one hour.</td>
</tr>
<tr>
<td>Heat exhaustion</td>
<td>Symptoms include intense thirst, weakness, discomfort, anxiety, dizziness, fainting and headache. Core temperature may be normal, subfebrile and febrile. Pulse is threadlike with postural hypotension and rapid shallow breathing. There is no alteration of the mental status. This can be attributed to water and/or salt depletion resulting from exposure to high environmental heat or strenuous physical exercise.</td>
<td>Move to a cool shaded room or air-conditioned place. Undress the patient. Apply a cold wet sheet or cold water spray and use fan if available. Lay the patient down and raise legs and hips to increase venous return. Start oral hydration. If nausea prevents oral intake of fluids, consider intravenous hydration. If hyperthermia above 39 °C or impaired mental status or sustained hypotension occurs, treat as heatstroke and refer to hospital.</td>
</tr>
</tbody>
</table>
**Management of life-threatening heatstroke**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Intervention</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-admission stage</td>
<td>Measure body temperature (rectal probe). If &gt; 39 °C, move to a cooler place, undress, initiate external cooling procedures: apply cold compress on the neck, underarm and groin. Provide supply of fresh cool air (a fan, an air conditioner), spray patient’s skin is sprayed with water at 25–30 °C.</td>
<td>Diagnose heatstroke. Decrease body temperature to low-grade fever. Cooling of the body, ensuring air movement Cooling by evaporation.</td>
</tr>
<tr>
<td>Changes in mental status (anxiety, delirium, seizures, coma).</td>
<td>If the patient is unconscious, position him or her on a side and clear the airways. Administer oxygen therapy 4 l/min. Give isotonic solution. Rapidly transfer the patient to the resuscitation unit.</td>
<td>Minimize the risk of aspiration. Increase arterial blood oxygen saturation to &gt; 90%. Increase the blood volume.</td>
</tr>
<tr>
<td>In-patient period</td>
<td>Confirm the diagnosis with a thermometer calibrated to measure high temperatures, monitor skin and rectal temperature; continue cooling procedures.</td>
<td>Maintain skin temperature &gt;30 °C. Stop cooling procedures when rectal temperature is &lt;39.4 °C.</td>
</tr>
<tr>
<td>Hyperthermia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seizures</td>
<td>Consider the indication of benzodiazepines.</td>
<td>Control seizures</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>Consider elective intubation (for impaired gag and cough reflexes or respiratory function deterioration).</td>
<td>Protect airways and augment oxygenation (arterial blood oxygen saturation to &gt; 90%).</td>
</tr>
<tr>
<td>Hypotension</td>
<td>Initiate plasma-substituting therapy, if necessary add vasoconstrictor, and consider monitoring the central venous pressure.</td>
<td>Increase mean arterial pressure &gt; 60 mm of Hg, restore organ perfusion and tissue oxygenation (consciousness, urinary output, lactate level).</td>
</tr>
</tbody>
</table>

**Reducing indoor temperatures during hot weather**

**Short-term measures for existing buildings**

<table>
<thead>
<tr>
<th>Measures</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermometers to measure indoor temperatures</td>
<td>Measuring the indoor temperature to indicate when to take action is strongly advised.</td>
</tr>
<tr>
<td>Improve external shading</td>
<td>External shading of windows reduces solar heat gains. Internal shading of windows to avoid solar loads inside the room is always advisable.</td>
</tr>
<tr>
<td>Installation of electric fans</td>
<td>Electric fans may provide a relief, but when the temperature is above 35 °C, fans may not prevent heat-related illness – it is important to consume enough fluids.</td>
</tr>
<tr>
<td>Using local air conditioning systems</td>
<td>Air conditioning systems provide protection from heat. When purchasing or installing an air conditioner, preferably choose the one with low power consumption. To prevent negative effects of air conditioners on health, split systems are to be cleaned and properly maintained. Do not forget about power outages during the summer period.</td>
</tr>
</tbody>
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