

Policy and practice

PROTECTING HEALTH FROM CLIMATE CHANGE: A SEVEN-COUNTRY APPROACH

Bettina Menne,¹ Vladimir Kendrovski,¹ James Creswick¹

¹ World Health Organization European Centre for Environment and Health, Bonn, Germany

Corresponding author: Bettina Menne (email: menneb@ecehbonn.euro.who.int)

ABSTRACT

During 2008–2012, the WHO Regional Office for Europe coordinated the largest pilot project to date to strengthen health systems to cope with climate change. Of the wide range of activities in this seven-country initiative, this article reports on two: (i) the results of the national or subnational health vulnerability, impact and adaptation assessments of climate change and (ii) development of national or subnational health adaptation plans. For the assessments, a variety of qualitative and quantitative methods were used including: literature reviews; focus group interviews; time-series and regression analyses; risk-

mapping exercises; damage and adaptation cost estimations; and scenario-based assessments. The process of developing each adaptation plan was done through the activities of a national multisectoral government committee, stakeholder engagement and dialogue, capacity development, policy impact assessment and monitoring. Correlations between weather factors and human health were detected in all countries. The evidence for near-term adverse health effects was strongest for extreme weather events and changes in infectious-disease patterns. Based on these findings, and guided by the European regional framework

for action, a range of adaptation measures to strengthen health systems were analysed. The assessments showed that a number of current measures, policies and strategies needed to be revised or strengthened to respond to current and projected levels of risks from climate change. The analyses also identified measures that needed to be newly developed, such as weather early warning and integrated information systems, or where cooperation with other sectors needed strengthening. The methods, tools and experiences developed during this seven-country initiative can be shared across countries in Europe and beyond.

Keywords: ADAPTATION, CLIMATE CHANGE, HEALTH, PUBLIC HEALTH, ASSESSMENT

BACKGROUND

Climate change has complex and wide-ranging impacts on human health, both directly through increased frequency and intensity of extreme weather events and indirectly via changes in major environmental, social and economic determinants of health (1). Recent estimates suggest that climate change will cause approximately 250 000 additional deaths per year globally between 2030 and 2050 (2). The most recent report of the Intergovernmental Panel on Climate Change highlighted the evidence for greater risk of injury, disease, and death owing to more intense heatwaves and fires; increased risks of diseases transmitted by food, water and vector-borne diseases; and consequences for health of lost work capacity and reduced labour productivity in vulnerable populations (3). Climate change is likely to widen existing health inequalities between and within populations.

In the near term, many of these health impacts can be reduced by strengthened health systems that have public health measures in place and the capacity to manage and adapt to climatic risks (3, 4).

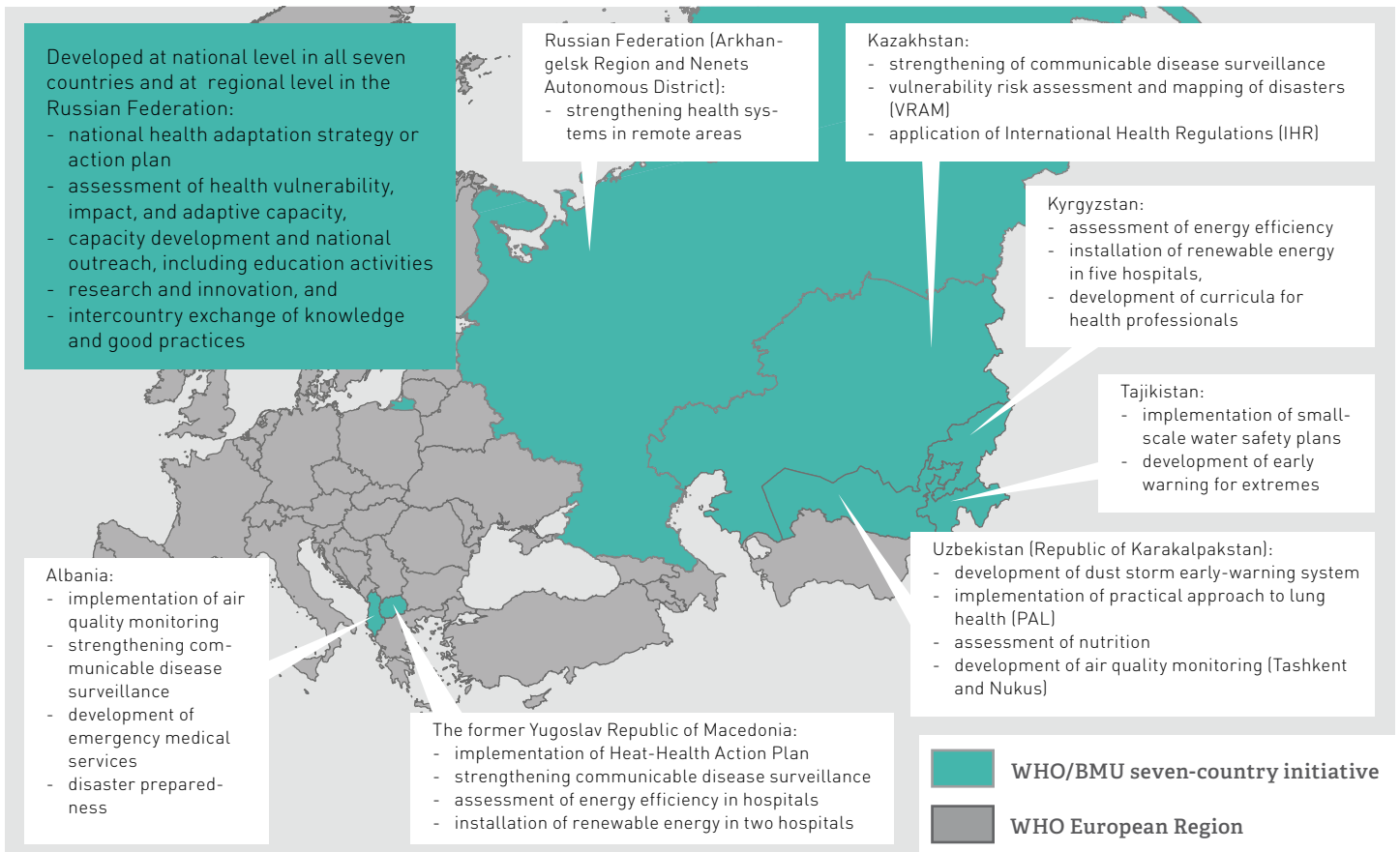
The necessity to mitigate and adapt to climate change has been recognized through resolutions of the World Health Assembly (5) and World Health Organization (WHO) regional committees (6). At the regional level, the Parma declaration on environment and health was adopted in 2010, whereby the 53 WHO European Member States pledged to integrate health issues into climate change mitigation and adaptation measures in all sectors, and to implement the European regional framework for action (7). Creation of resilient communities was identified as a priority area in the WHO Regional Office for Europe's Health 2020 policy framework and strategy (8).

Observations of climate change and associated health effects across Europe have highlighted that implementation of adaptation strategies to protect human health should be accelerated and strengthened. This paper reports components of a pilot initiative for protecting health from climate change in seven countries from 2008 to 2012. Described below are (i) the findings of the national or subnational health vulnerability, impact and adaptation assessments of climate change and (ii) the results of the development of national, or subnational, health adaptation plans of action carried out in seven countries: Albania, Kazakhstan, Kyrgyzstan, the Russian Federation, Tajikistan, the former Yugoslav Republic of Macedonia and Uzbekistan. The work reported here was part of a larger initiative, which had the aim of protecting health from climate change through strengthening of health systems (Fig. 1) (9).

LOCAL CONTEXT

The seven-country initiative covered four different geographical and climatic zones: arid and semi-arid water-stressed areas (Kazakhstan and Uzbekistan); high mountainous areas (Kyrgyzstan and Tajikistan); Mediterranean countries (Albania and the former Yugoslav Republic of Macedonia); and a sub-Arctic region in the northern Russian Federation (Arkhangelsk Oblast and Nenets Autonomous Okrug). Each country had already experienced climate-related exposures, such as extreme events, water scarcity, glacier melting and permafrost thawing. This initiative, by drawing upon the experiences of countries already affected by climate change, gave a firm foundation for future action by providing examples of the priorities, challenges and emerging solutions utilized by the seven countries in the project (9).

FIG. 1. ACTIVITIES OF THE SEVEN-COUNTRY INITIATIVE



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source and map production:

Climate change, green health services and sustainable development (CGS)
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WHO: World Health Organization; BMU: Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, Germany.
Source: Protecting health from climate change: a seven-country initiative. Copenhagen: WHO Regional Office for Europe; 2014 (9).

APPROACH

The overall aim of the seven-country initiative was to protect health from climate change through strengthening health systems through building capacity in assessing vulnerability, impacts and adaptive capacity in each country. This process formed the basis for the development of national health adaptation strategies or action plans; promotion of awareness raising activities; and facilitation of sharing of knowledge and experiences. A range of parallel activities, such as health worker training and specific interventions, also took place (Fig. 1).

MANAGEMENT AND COORDINATION

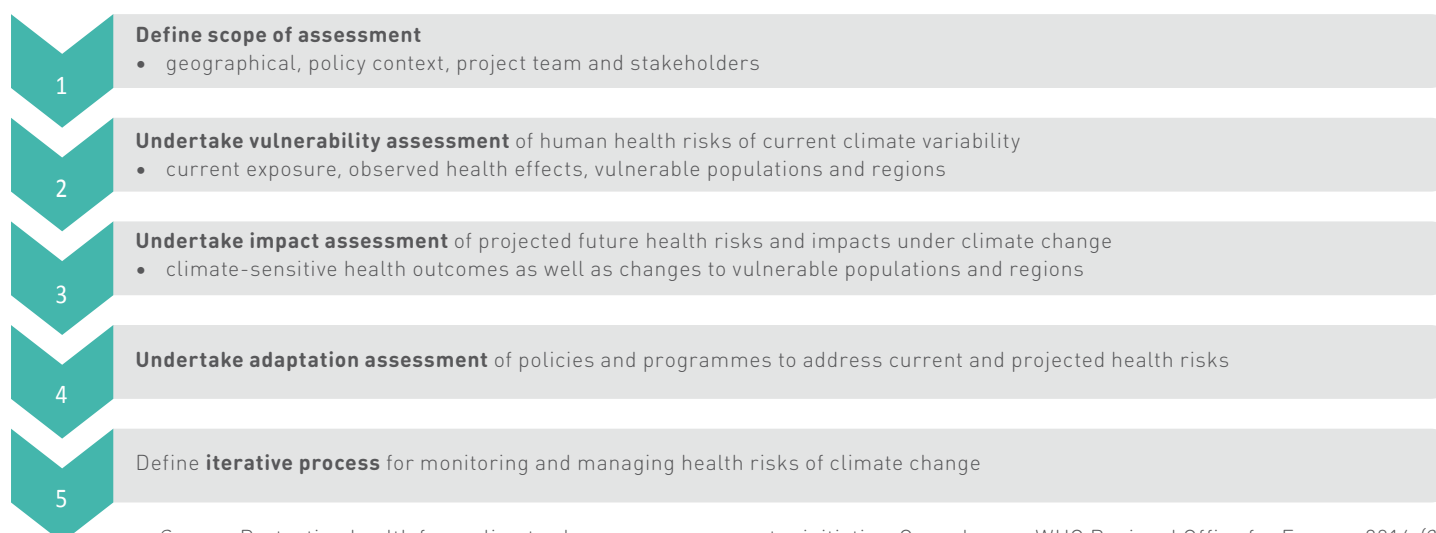
This initiative involved several hundred people within the seven countries and at the intercountry coordination level. Governments of each of the seven pilot countries appointed a national multisectoral steering committee to guide political and technical implementation. Each national steering committee appointed a technical working group of scientists and professionals from national research institutions, public health organizations, universities and nongovernmental organizations, to carry out the assessment. Each steering committee also identified possible stakeholders, based on interest and influence, and developed a stakeholder engagement plan. Several dialogue workshops were organized in each country to develop the national health adaptation strategies or action plans.

The WHO Regional Office for Europe (Rome/Bonn office) coordinated the implementation of the project by sharing a common logical framework; setting up a project implementation facility; coordinating with WHO country offices; providing technical expertise; coordinating with an international scientific advisory committee; building capacity across disciplines and providing methods and tools; and developing a mechanism of sharing experiences between countries. Seven WHO national project officers were appointed to serve within the country offices and work directly with the chairs of the steering committees and working groups. These officers were a constant driving force in the project: seeking out technical expertise where needed and liaising between all the partners involved at the national level. Each national steering committee identified major climate change exposures and risks by means of a stakeholders' dialogue workshop. Their technical working groups identified readily available data and sources for assessing health risks and impacts.

HEALTH VULNERABILITY, IMPACT AND ADAPTATION ASSESSMENTS

A step-wise health vulnerability and impact assessment was done in each country using a range of qualitative and quantitative methodologies based on guidance developed by the WHO Regional Office for Europe in 2003 (Fig. 2) (10). Assessments were tailored to national data availability and the nature of the challenges under

FIG. 2. STEPS IN THE HEALTH VULNERABILITY, IMPACT AND ADAPTATION ASSESSMENT



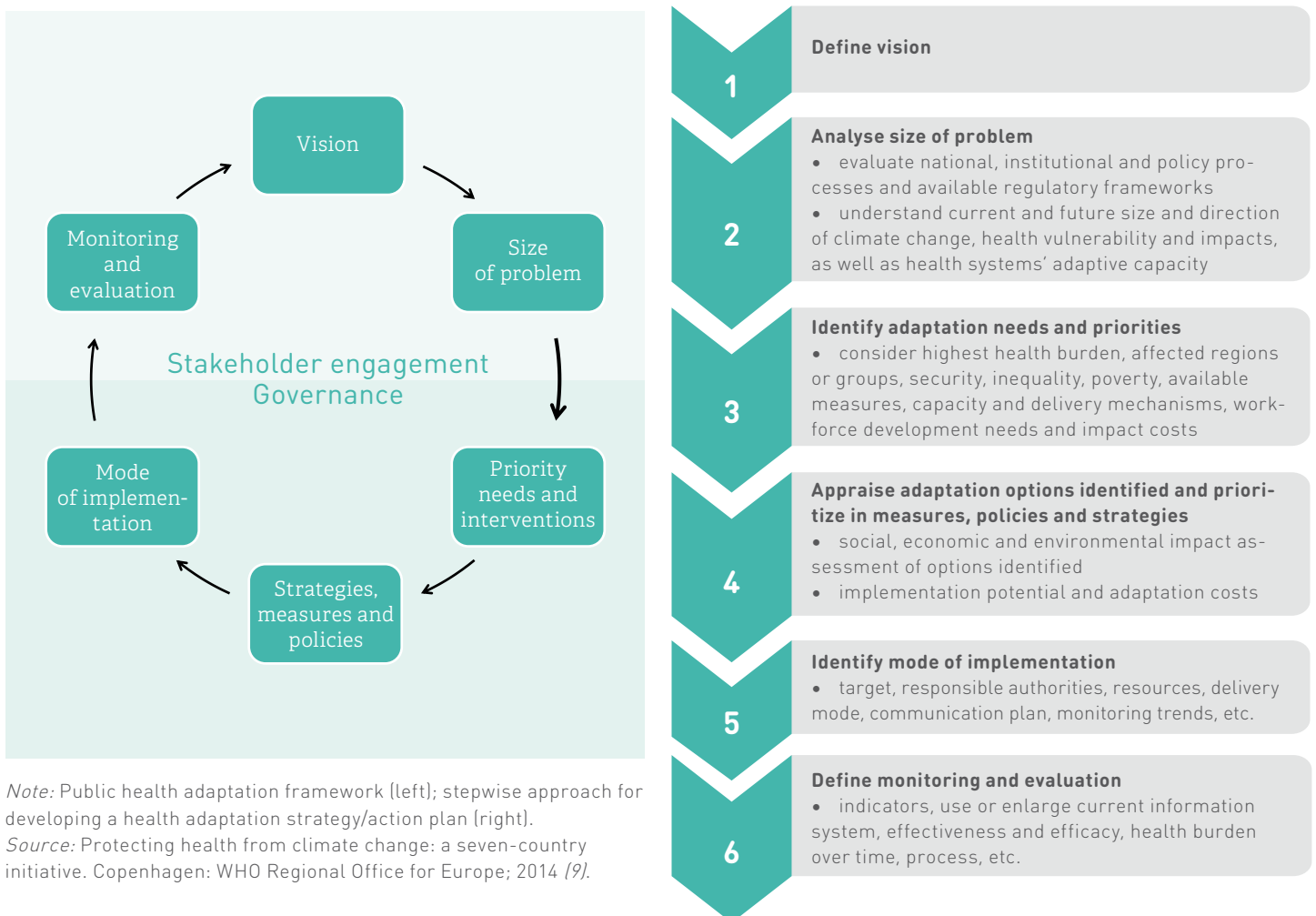
review (10, 11). Several additional tools were developed and tested to support national implementation. Examples include: a statistical tool for climate-related exposure effects analysis; the economic damage and adaptation cost tool (12); and a disaster mapping tool, which was used to determine vulnerability to flooding in 99 health facilities in Kazakhstan. In addition, existing tools were adapted for climate change purposes. For example, the hospital safety index (13) was applied in the former Yugoslav Republic of Macedonia in order to identify climate-vulnerable health services. Additional data were collected through specific research, case studies, stakeholder interviews and focus group discussions. Where specific vulnerabilities had been identified, in-depth analyses were performed to improve understanding of the scope and scale of the exposures and risks (9). A risk-criteria approach was used to identify near-term outcomes of the highest burden of disease which could be mitigated through efficient interventions. Where future projections were developed,

the Intergovernmental Panel on Climate Change special report on emissions scenarios were used (mainly A2). The data collected contributed to WHO information platforms through the sharing of tools, results and lessons learned.

DEVELOPMENT OF HEALTH ADAPTATION PLANS OF ACTION

The WHO Regional Office for Europe developed a public health framework and a step-wise approach to develop national health adaptation plans (Fig. 3) (9). Several other frameworks were also considered, in particular to align with the United Nations Framework Convention on Climate Change national adaptation plans for action guidance (14). For each step, guiding questions were debated within the national steering committee and among stakeholders. Key factors considered included: (i) the size and the nature of the problem related to each of the priorities; (ii) effective

FIG. 3. ADAPTATION FRAMEWORK AND APPROACH



Note: Public health adaptation framework (left); stepwise approach for developing a health adaptation strategy/action plan (right). Source: Protecting health from climate change: a seven-country initiative. Copenhagen: WHO Regional Office for Europe; 2014 (9).

interventions; (iii) the goal and objectives of the strategy for each of the priorities; (iv) involvement of institutions and roles and responsibilities; (v) indicators; and (vi) financial implications of each proposed intervention.

As guiding document for the development of the action plan, the five pillars of the European regional framework for action were used, namely:

- integrate health into all climate change related policies;
- strengthen health systems to prevent, prepare for and respond to health effects of climate change;
- raise awareness and build capacity;
- encourage greening of the health sector;
- share best practices, research, data, information, technology and tools at all levels (7).

CAPACITY DEVELOPMENT AND AWARENESS RISING

Capacity development and outreach activities within the project were targeted at a broad range of society: from training of medical professionals

to awareness raising among the general public. As far as was possible, a whole-of-society approach was used. Training programmes and curricula development within the education systems were developed. The World Health Youth Environment and Health Communication Network was involved in producing and delivering education materials, including a video (15). Policy-makers, civil society and the private sector were also involved in the outreach programme, often as project stakeholders.

RELEVANT CHANGES

This project generated a range of important results. The evidence collected through the health vulnerability, impact and adaptation assessments clearly demonstrated that climate change exposures are likely to have both direct and indirect impacts on population health in all seven countries, with the highest near-term health effects resulting from extreme weather events (Table 1). The quantitative results of observed and projected health effects in the seven countries are summarized in Table 2. This evidence highlighted that these impacts are happening now and exist alongside

TABLE 1. COMPONENTS OF THE VULNERABILITY ASSESSMENT BY COUNTRY

Country	Climate change exposures assessed			
	Temperature change expected	Precipitation expected	Types of frequent and intense extreme weather events expected	Other social and environmental determinants of health to be affected
Albania (9, 17)	↑	↓	Fires, drought, heatwaves, floods	Air quality, water safety/security, sea-level rise, coastal erosion
Kazakhstan (9, 18)	↑	↑	Floods, heatwaves, fires, droughts, extreme cold, wind storms, mudflows, landslides	Food security, water safety/security, air quality, waste management
Kyrgyzstan (9, 19)	↑	↓	Floods (also mudflows, landslides, storms, heatwaves, extreme cold)	Availability of arable land, food and water safety/security
Russian Federation (northern pilot region) (9, 20)	↑	↑	Floods, fire, windstorms, heatwaves, extreme cold	Air quality, food safety/security, water safety, coastal zones, ice thickness, permafrost retreat
Tajikistan (9, 21)	↑	↑ / ↓	Drought, floods, heatwaves, extreme cold	Food and water safety/security
The former Yugoslav Republic of Macedonia (9, 22)	↑	↓	Drought, fires, heatwaves, floods	Ultraviolet exposure, water security, food/water safety, air pollution
Uzbekistan (9, 23)	↑	↑ / ↓	Drought, floods, dust storms, heatwaves, extreme cold	Air quality, waste management, pollution, food and water safety/security

↑ – increase; ↓ – decrease; ↑ / ↓ – depends on region

TABLE 2. VULNERABILITY ASSESSMENT BY COUNTRY: OBSERVED AND PROJECTED^a DIRECT AND INDIRECT HEALTH IMPACTS

Country	Heat-related illnesses	Respiratory diseases (cold, heat and air-pollution related)	Communicable diseases	Allergic diseases	Other
Albania (9, 17)	<ul style="list-style-type: none"> Possible correlation between number of emergency visits and high daily temperatures. Heat-related illnesses likely to increase, especially among those with pre-existing chronic conditions 	<ul style="list-style-type: none"> About 200 deaths per year are attributed to air pollution in Tirana, with an approximate life-expectancy loss of 1.5–2 years 	<ul style="list-style-type: none"> Expanding vector distribution and behaviour changes (e.g. ticks, mosquitoes, rodents) occurred in the past 20–30 years. An increased risk of vector-borne diseases is expected Increasing temperatures are expected to increase the risk of waterborne and foodborne diseases 	<ul style="list-style-type: none"> Pollen-related allergic diseases expected to increase 	<ul style="list-style-type: none"> Increasing extreme weather events (e.g. heavy precipitation) expected to cause increased rates of mental illness, injuries, communicable diseases
Kazakhstan (9, 18)	<ul style="list-style-type: none"> A 1°C increase in daily maximum apparent temperature was associated with a 2–9.5% increase in mortality due to external causes in Astana during 2005–2010 Frequent heatwaves are expected to increase risk of death among those with chronic respiratory and cardiovascular diseases Cerebrovascular mortality during summers increased from 1.2% to 2.7% with a 1°C increase in ambient temperature (2000–2009) 	<ul style="list-style-type: none"> More research needed 	<ul style="list-style-type: none"> A 1°C temperature increase in Astana was associated with a 5.3% increase in monthly salmonella cases (2000–2009) Recent outbreaks of Crimean-Congo haemorrhagic fever have occurred 	<ul style="list-style-type: none"> A 1°C increase of temperature was associated with a 0.5–3.6% decrease in ambulance calls for asthma during the warm season (2006–2011) 	<ul style="list-style-type: none"> Increase of 1°C in daily maximum apparent temperature in Astana was associated with a 2% increase in suicides
Kyrgyzstan (9, 19)	<ul style="list-style-type: none"> Thermoregulation stress and deterioration in well-being recorded when temperatures are more than 26–27°C. Requests for ambulance assistance in Bishkek city are greater in summer than in winter Overall winter mortality is expected to decrease 	<ul style="list-style-type: none"> Overall mortality from respiratory diseases is predicted to decline by up to 5.1% in some groups by 2100, which is likely to be due to reductions in cold weather 	<ul style="list-style-type: none"> Morbidity of infectious diseases in children aged <1 year expected to increase by 17.8–18.2% from 2010 to 2100. Incidence of acute intestinal infections expected to increase by 10.6–15.9% from 2005 to 2100 	<ul style="list-style-type: none"> Not assessed 	<ul style="list-style-type: none"> Deaths and injuries from natural disasters have increased, with most related to floods and mudslides Increasing extreme weather events are expected to threaten mental health, food safety/security and nutrition status. Approximately 11.5% of children aged <1 year are underweight and 5.3% of those aged 1–11 years are malnourished (2009). 8% of women aged 18–29 are underweight (2009) and chronic caloric shortage is present in 3% of the population

Country	Heat-related illnesses	Respiratory diseases (cold, heat and air-pollution related)	Communicable diseases	Allergic diseases	Other
Russian Federation (northern pilot region) (9, 20)	<ul style="list-style-type: none"> Heatwaves in Arkhangelsk (temperature threshold 21°C) were associated with an increase in mortality from both cardiovascular diseases and all natural causes in people older than 65 years, and from all external causes in people older than 30 years (1999–2008) Each 1°C increase in maximum temperature above 20.9°C was associated with a 5.3% increase in calls for medical assistance for diseases of the circulatory system the following day (1998–2009) 1°C increase in apparent temperature was associated with 1.6% increase in calls for medical assistance for men with injuries, poisonings and other consequences of external effects 1°C temperature increase above 16.1°C was associated with 3.9% increase in calls for medical assistance for cerebrovascular diseases (1998–2009) 	<ul style="list-style-type: none"> 1°C apparent temperature increase is associated with 1.6% increase in calls for medical assistance for respiratory diseases in children and 3% increase in calls for people aged >60 years (1998–2009) 1°C temperature increase above 16.1°C is associated with 3.7% increase in calls for medical assistance for respiratory diseases among adults aged >60 years (1998–2009) 	<ul style="list-style-type: none"> Sixtyfold increase in incidence of tick-borne encephalitis between 1980–1989 and 2000–2009 associated with expansion of <i>Ixodes</i> spp. tick habitat Average monthly air temperature increase of 1°C was associated with 1.9% increase in salmonellosis cases in the following month. However, overall, salmonella cases have reduced substantially in the region (1992–2009) 	<ul style="list-style-type: none"> Not assessed 	<ul style="list-style-type: none"> Not assessed
Tajikistan (9, 21)	<ul style="list-style-type: none"> Number of patients presenting with myocardial infarction 5.1% higher in summer than in winter 	<ul style="list-style-type: none"> Increasing temperatures associated with increasing morbidity due to asthma and pneumonia 	<ul style="list-style-type: none"> During the past 20–30 years, the yearly incidence of typhoid fever has been 2–3 times higher than average in years when mean annual temperature of the two preceding years was higher than overall mean annual temperature. Risk of increased cases of falciparum malaria 	<ul style="list-style-type: none"> Not assessed 	<ul style="list-style-type: none"> Increased risk of pregnancy complications associated with warmer temperatures, and increased average annual temperature associated with increased infant mortality. Low birth rate incidence is 15%, with maternal malnutrition and anaemia among the leading contributors
The former Yugoslav Republic of Macedonia (9, 22)	<ul style="list-style-type: none"> Temperature increase of 1°C above cut-off point of 30.8°C increases mortality by 4.8% Summer mortality is expected to increase by up to 4–11% by 2035 Increased cardiovascular mortality observed during heatwaves 	<ul style="list-style-type: none"> Respiratory diseases due to pollen, air pollution and forest fires expected to increase. Increased cardiorespiratory morbidity and mortality expected due to increasing levels of tropospheric ozone 	<ul style="list-style-type: none"> Increase in weekly temperature of 1°C above a threshold of 17.9°C associated with 2.8% increase in salmonellosis cases in Skopje and 2–5% increase in campylobacter. Currently, salmonella infection peaks during summer. However new peak during winter expected due to increasing temperatures Changes in distribution of vector-borne diseases expected (dengue, malaria, West Nile virus) 	<ul style="list-style-type: none"> Prevalence of allergy to pollen increased from 16.9% in 1996 to 19.8% in 2009/2010. Pollen-associated allergic diseases and incidence of skin cancers (including melanoma) expected to increase 	<ul style="list-style-type: none"> Increased water temperatures causing algal blooms, threatening water safety

Country	Heat-related illnesses	Respiratory diseases (cold, heat and air-pollution related)	Communicable diseases	Allergic diseases	Other
Uzbekistan (9, 23)	<ul style="list-style-type: none"> • Temperature in central desert areas may reach 45–49°C, with significant risk of dehydration and heat stroke • Temperature increases expected to be associated with increased rates of cardiovascular, neurological, genitourinary and gastrointestinal diseases • Cardiovascular diseases expected to increase due to air pollution, dust storms and extreme heat • Noncommunicable diseases expected to account for 73% of overall disease burden by 2020 	<ul style="list-style-type: none"> • Cases of respiratory diseases in children increased by a factor of 1.3 during 2000–2010 	<ul style="list-style-type: none"> • Each 1–2°C increase in maximum temperature associated with 10–13% increase in incidence of acute intestinal infections • Vector-borne diseases such as malaria expected to spread • Drought periods may cause increase in infectious and respiratory diseases 	<ul style="list-style-type: none"> • Allergic diseases expected to increase 	<ul style="list-style-type: none"> • Health effects of droughts on malnutrition were assessed in the Karakalpakstan region and local changes to dietary content and seasonal micronutrient deficiencies were identified

^a Projections were developed by use of the Intergovernmental Panel on Climate Change special report on emissions scenarios (mainly A2). See: IPCC Special report. Emissions scenarios. Geneva: Intergovernmental Panel on Climate Change; 2000 (<https://www.ipcc.ch/pdf/special-reports/spm/sres-en.pdf>, accessed 24 May 2015).

and potentially exacerbate prevailing challenges to health, social, environmental and economic systems.

The findings also underscored the gaps and difficulties in assessing health risks; for example, quantitative attribution to climate change in most cases is difficult if not impossible. Where data are available, detection of health effects or correlation with weather patterns over time is possible. However, many results are based on qualitative or even anecdotal evidence, which are not reported here. The assessments cover mainly what is known today based on past exposures and do not reflect the full scale of the observed or potential health effects. For example, potential conflicts associated with resource scarcity and population movements, retardation of economic growth and poverty exacerbation, were not assessed or not assessed in detail. Furthermore, a scenario-based assessment was possible for only a few countries, thus only a limited assessment of health futures was possible.

Nevertheless, epidemiological evidence based on local and national data was sufficiently important and strong to form a decision-making resource for policy-makers. The evidence provided a robust knowledge base for the selection and implementation of policy options; support of monitoring to improve health systems; and enhancement of a preventive approach to climate change risks for population health in the near term.

This initiative has created a foundation of climate change impact research upon which national and regional academic communities in each of the seven countries may build. A number of doctoral theses have been written, thereby achieving another project objective—improving learning. In many cases, the vulnerability assessments and some of the methodologies used were the first of their type to be conducted nationally, regionally and globally. Thus, they also provided important contributions to global guidance development (16).

The resulting wide range of information on the epidemiological, demographic, health, social and environmental situations; rules and regulations in place; and levels of health system preparedness served as a solid evidence base on which to develop an adaptation policy. The assessment process identified a number of specific climate-sensitive conditions and diseases where adaptation is required in all countries.

It showed that a number of current measures, policies and strategies needed to be revised or strengthened to respond to current and projected levels of risks from climate change, e.g. strengthening the surveillance and monitoring of infectious diseases or capacity building among health professionals. The assessment also identified measures that needed to be newly developed, such as weather early warning and integrated information systems, or where cooperation with other sectors needed strengthening (Table 3).

The processes and methods developed, such as performance of vulnerability assessments and strategy development, were regularly shared between the seven countries. In five of the seven countries the national or subnational action plans were approved and endorsed by the government, creating the foundation or stimulus for further multisectoral national adaptation plans. In two countries the action plans became part of the multisectoral adaptation plan development but were not separately approved or endorsed.

LESSONS LEARNED

A range of lessons have been learned during the process of implementation. At the managerial level, the level of implementation depended strongly on the level of engagement, power and continuous efforts of the national steering committee. While all countries experienced specific project benefits, such as increasing the awareness among health professionals of the health impacts of climate change, the broader benefit was the increased engagement of key stakeholders and policy-makers with the agenda. Before the process was initiated, health was largely marginalized in policy developments in climate change and environment; at the same time, climate change was largely marginalized in health policy development.

In many cases, the vulnerability assessments were the first of their type to be conducted in the country or region. The seven-country initiative therefore provided case studies of practical on-the-ground action, built on robust assessments, delineating the areas where human health vulnerability to climate change were likely to occur. By defining areas of increased risk and exposure, the teams from the seven

countries were able to provide a firm foundation for health officials, planners and decision-makers to develop and focus adaptation strategies, highlighting the relationships between climate change, specific environmental, cultural, social and geographical factors and human health outcomes.

While the specific priorities for each of the countries were different, based on their analysis and interpretation of their vulnerability and exposures to the effects of climate change (17–23), and the capacity and capability of their health systems to respond to these threats, the process identified a number of common areas of concern. These included:

- limited understanding of assessment processes and scientific project planning within this field of practice to support the identification and analysis of impact and vulnerability adequately to inform adaptation planning;
- paucity of existing data sources;
- limited knowledge of environment and health epidemiological and statistical methods;
- limited experience of implementing national or local impact, vulnerability and adaptation assessments across different stakeholder groups.

In addition, the adaptation strategies aim to increase society resilience; they are frameworks for managing future climate risk and offer the potential to reduce future economic, environmental and social costs, particularly in the health sector. To reach this goal, more new knowledge is required on climate impacts, particularly on regional impacts as well as on the economic costs of action or inaction.

By illustrating how climate change adaptation and mitigation measures can be applied to the health sector, this seven-country initiative served as a true pilot for further development and investment in the field. The project has not only contributed to policy changes, but has also heralded the start of a new era in terms of thinking about inter-relationships between climate change and health. The pilot activities specific to each country aimed to address current climate change vulnerability. These included strengthening preparedness and response for extreme weather events; increasing surveillance and response for climate-sensitive infectious diseases; developing water safety plans; reducing the risk for respiratory diseases; fostering innovation in energy efficiency and use

TABLE 3. STRATEGIC PROPOSED ACTIONS BY COUNTRY, GROUPED BY THE FIVE PILLARS OF THE WHO REGIONAL FRAMEWORK FOR ACTION

Country	Integrate health into other related policies	Strengthen health systems to prevent, prepare and respond	Raise awareness	Encourage greening of health systems	Research, data, information
Albania (9, 17)	<ul style="list-style-type: none"> Increase coordination between sectors and stakeholders Integrate health into national emergency planning 	<ul style="list-style-type: none"> Develop extreme weather health action plans Improve management of health problems caused by exposure to pollen, ultraviolet radiation and extreme heat/cold 	<ul style="list-style-type: none"> Educate health professionals Launch media campaigns 	<ul style="list-style-type: none"> Introduce energy efficiency and innovative green technology in the health sector 	<ul style="list-style-type: none"> Develop and adapt environment and health information systems (e.g. air quality monitoring) Develop integrated surveillance systems (e.g. for weather, invasive species, diseases, environmental pollution)
Kazakhstan (9, 18)	<ul style="list-style-type: none"> Strengthen health sector engagement in emergency planning and develop health-focused cross-sector plans 	<ul style="list-style-type: none"> Integrate climate change into health policy Strengthen environmental health, laboratory and primary health services Develop extreme weather health action plans (e.g. for floods, mudslides, dust storms, heatwaves) Ensure adequate staffing and resources in priority areas Increase health infrastructure resilience to extreme weather events 	<ul style="list-style-type: none"> Develop university curricula Launch media campaigns Share health information with other sectors 	<ul style="list-style-type: none"> Introduce energy efficiency, waste and water management safety plans in health systems Ensure resource security during extreme weather events Use climate-proofing technologies 	<ul style="list-style-type: none"> Monitor air, water, food quality and population nutrition status Research health and climate change Strengthen integrated surveillance of climate sensitive (waterborne and vector-borne) diseases
Kyrgyzstan (9, 19)	<ul style="list-style-type: none"> Strengthen health sector engagement in emergency planning for extreme weather events and develop cross-sector plans 	<ul style="list-style-type: none"> Integrate climate change into health policy Strengthen environmental health, laboratory and primary health services Develop extreme weather early-warning and action plans (e.g. for floods, mudslides, dust storms, heatwaves) Strengthen noncommunicable-disease prevention (in particular respiratory/cardiovascular diseases and injuries) Ensure adequate staffing and resources in priority areas Increase health infrastructure resilience to extreme weather events 	<ul style="list-style-type: none"> Integrate training on climate change and health into undergraduate and postgraduate programmes Develop communications plans for other sectors and the general public 	<ul style="list-style-type: none"> Increase energy efficiency, safe waste disposal and clean water in health care Ensure resource security during extreme weather events Support technology transfer 	<ul style="list-style-type: none"> Monitor air, water, food quality and population nutrition status Research health and climate change Strengthen surveillance of climate sensitive (waterborne and vector-borne) diseases
Russian Federation (northern pilot region) (9, 20)	<ul style="list-style-type: none"> Promote interagency cooperation to develop and strengthen prevention and mitigation efforts Coordinate activities with the Ministry of Civil Defence, Emergency Management and Natural Disasters Response, emergency medical centres, emergency ambulances and fire departments 	<ul style="list-style-type: none"> Strengthen health services (e.g. environmental, laboratory, public health, primary care services) and equipment supply (e.g. in rural areas) Develop extreme weather action plans and early-warning systems (e.g. for heatwaves) Optimize noncommunicable-disease prevention (e.g. encourage healthy lifestyles) Provide resource assistance to social isolation units (e.g. pretrial detention centres, colonies, boarding schools, nursing homes) and children/adolescents 	<ul style="list-style-type: none"> Educate the postgraduate health workforce Train paramedics, homemakers, policemen, teachers, veterinary specialists, postal workers, transport workers and pharmacists through mass media Provide training on emergency medical aid 	<ul style="list-style-type: none"> Improve data collection, recording and processing Research health and climate change Strengthen surveillance of climate sensitive (waterborne and vector-borne) diseases 	

Country	Integrate health into other related policies	Strengthen health systems to prevent, prepare and respond	Raise awareness	Encourage greening of health systems	Research, data, information
Tajikistan (9, 21)	<ul style="list-style-type: none"> Improve the legal framework of health sector action in line with the ratified United Nations Framework Convention on Climate Change 	<ul style="list-style-type: none"> Integrate climate change into the national council of health workplan Improve quality of public health and health care services (e.g. wastewater treatment, water loss minimization) Improve regulatory/legal services, logistic support, resource availability and emergency management for hospitals, primary care and the state epidemiological service Optimize reproductive health care Strengthen noncommunicable-disease management (e.g. respiratory/cardiovascular diseases) Build institutional and technical capacity for adaptation issues Develop comprehensive programmes targeted at prevention of waterborne diseases Develop extreme weather early-warning systems 	<ul style="list-style-type: none"> Train health professionals in the use of geographical information systems, environmental impact assessments, water use and ecosystem conservation Educate the general public about climate change, non-communicable diseases, water safety, reproductive health and communicable diseases Involve the mass media to aid education delivery 	<ul style="list-style-type: none"> Develop sustainable health care systems Train staff in mitigation activities 	<ul style="list-style-type: none"> Improve forecasting, modelling and early-warning systems, Develop a research agenda, Monitor infectious and other diseases (e.g. nutritional status in children and young women, waterborne diseases, food security) Develop occupational health guidelines for extreme heat and cold
The former Yugoslav Republic of Macedonia (9, 22)	<ul style="list-style-type: none"> Establish an intersectoral body for effective/efficient use of resources Improve coordination between institutions Improve urban planning (e.g. to reduce urban heat island effects) 	<ul style="list-style-type: none"> Develop early-warning and management systems for extreme weather conditions (e.g. heatwaves, air pollution, cold weather, floods, fires) Increase control and prevention of allergic diseases caused by pollen Reduce the risk of climate change associated communicable diseases (including strengthening International Health Regulations core capacities) Strengthen health system preparedness (e.g. for heat and cold waves) 	<ul style="list-style-type: none"> Introduce climate-change related modules into graduate and postgraduate health curricula Launch regular public education campaigns 	<ul style="list-style-type: none"> Introduce measures to increase energy efficiency measures in health institutions 	<ul style="list-style-type: none"> Continuously and regularly monitor environmental risks (e.g. heatwaves, air pollution) Promote functional sharing of data and information
Uzbekistan (9, 23)	<ul style="list-style-type: none"> Develop national capacities and interagency cooperation 	<ul style="list-style-type: none"> Develop early-warning systems and response plans for extreme weather events Optimize noncommunicable-disease management (e.g. by educating health professionals and the general public), Refine national standards on management of infectious diseases Improve national standards for management of noncommunicable diseases related to climate (e.g. respiratory diseases) 	<ul style="list-style-type: none"> Raise awareness of medical staff of health effects of climate change (e.g. air pollution, cardiovascular/respiratory diseases, allergens, nutrition) Educate patients about healthy lifestyles, nutrition and hygiene Use mass media to disseminate information Train specialists to work on adverse climate factors 	<ul style="list-style-type: none"> Develop a database of health status depending on meteorological parameters Facilitate exchange of knowledge and experience in adaptation and mitigation strategies 	<ul style="list-style-type: none"> Develop a database of health status depending on meteorological parameters Facilitate exchange of knowledge and experience in adaptation and mitigation strategies

of renewable energy for health services; and air quality monitoring.

The initiative also illustrated that public health institutions at all operational levels will need consciously to modify their approaches to both science and practice in anticipation of climate change health impacts (24).

It also highlighted a series of difficulties, namely:

- lack of enabling mechanisms for gaps of inter-institutional cooperation;
- poor communication of the evidence base to decision-makers to inform adaptation planning to improve health;
- the need to build capacity and increase public awareness of the health effects and adaptation actions;
- limited practical experience of developing health adaptation plans with cross-sectoral stakeholder engagement;
- limited availability of integrated information systems and capability;
- limited experience in systematic monitoring of implementation.

A number of further mechanisms needed to be put into place within countries or at the subnational level to ensure implementation of the action plans. Countries will need to monitor the implementation of their national strategies and evaluate their actions to feed back into policy development, thereby completing the adaptation cycle. The lessons learned from this project will be applicable to both small and larger countries considering how best to improve adaptive capacity and the resilience of health systems to climate change and its associated impacts.

This initiative has underscored the need for systems to recognize, monitor, anticipate, communicate, and prepare for changing climate-related health risks, drawing upon and using the full spectrum of available knowledge and resources. More work is needed to develop these systems further, to ensure that the opportunities provided by recognition of the convergence of objectives between health and other sectors' activities is neither restricted by infrastructural inadequacies nor derailed by lack of ongoing funding.

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