IMPACT OF CLIMATE CHANGE ON THE HEALTHCARE SYSTEM IN BELGIUM

STUDY COMMISSIONED BY THE FEDERAL PUBLIC SERVICE HEALTH, FOOD CHAIN SAFETY AND ENVIRONMENT

Summary for Policymakers

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INTRODUCTION

Rising emissions of greenhouse gases have been accompanied by changes in weather and climate. Many places, including Belgium, have seen changes in rainfall, resulting in more floods, droughts, or intense rain, as well as more frequent and severe heat waves. As these changes will likely become more pronounced in the coming decades, they will increasingly present challenges to our society and environment.

Climate change poses risks for all sectors of society and environment: health, labour productivity, infrastructure, energy, agriculture, forestry, ecosystem services, insurance etc. The impacts are projected to worsen in the coming decades, the 2020 report of the Lancet Countdown on health and climate change reported the worst outlook since its establishment in 2015. Climate related health effects come in many forms. Firstly, the direct health impacts from weather extremes such as high temperatures and heat waves, floods, storms, are visible in figures of mortality and injuries or morbidity effects. In Belgium, heat waves cause hundreds of additional deaths per year, especially among the elderly and people with chronic conditions. Secondly, climate change is altering ecological and environmental conditions, and some areas are becoming more suitable for various infectious diseases. This results in ecosystem-mediated indirect health impacts such as vector-, food- and waterborne diseases, respiratory diseases due to increasing air pollution, exacerbation of allergic reactions due to pollen. Thirdly, there are indirect health impacts linked to occupational health and stresses to mental health and well-being.

Mitigation measures are essential to limit climate change. At the same time, adaptation measures are time essential to reduce the impact of the consequences related to climate change. A climate resilient health system is a system that can anticipate, respond to, recover from, and adapt to climate-related stresses and shocks to sustainably improve the health of the population despite an unstable. Health systems must therefore be increasingly strengthened so that they remain effective in improving the health of the population, including of the most vulnerable groups, in an unstable and changing environment.

This *Summary for Policymakers* provides a condensed overview of the impact of climate change on the healthcare system in Belgium and ways to improve the resilience of health systems, resulting from a literature-based study in combination with interviews and an online survey conducted with different stakeholders of the health sector. It presents the main outcomes of the full report, which interested readers are referred to for a more detailed account, including the literature sources, the approach followed, and the detailed results.

First, the main characteristics of climate change scenarios for Belgium are presented in terms of standard climatic indicators such as temperature and precipitation. We continue with a presentation of the relevant actors in the Belgian healthcare sector as well as international and Belgian climate adaptation initiatives that are of interest to the healthcare sector. Subsequently, for various health effects and aspects of the functioning of the healthcare sector, the impacts of climate changes are assessed and current adaptation measures discussed. This leads to the proposal of additional adaptation measures and recommendations (*indicated in **blue***) to ensure the functioning of the healthcare system.

CLIMATE SCENARIOS FOR BELGIUM

Since 2018 high-resolution climate hazard data are available for Belgium through the Cordex.be project, there are also regional initiatives providing high-resolution climate information at regional level.

While global **temperature** has increased by approximately 1.2°C compared to pre-industrial times, the observed temperature increase in Uccle currently amounts to 2.5°C, this higher value being related to higher land warming rates and the effects of urbanization. The projected future temperature increase, relative to 1976-2005, is about 2°C for the middle (2036-2065) and 3°C towards the end of the century (2071-2100), under a high (RCP8.5) climate scenario. This increase is expected to be somewhat higher in summer than in winter, and temperature extremes are expected to increase more still, by an additional 0.5-1.5°C.

Consequently, the number of **heatwave days** will increase. Using a health-oriented heatwave definition based on the exceedance of both night and day temperature thresholds, it is expected that under a medium climate scenario (RCP4.5) the exceptional conditions of the hot summer of 2003 will become average by mid-century. In case of a high scenario (RCP8.5), at the end of the century we should expect several tens of heatwave days occurring annually, on average. When accounting for heatwave duration and intensity (the degree to which temperature extremes exceed threshold values) together, an increase by a factor 5-10 is expected towards the middle of the century under scenario RCP4.5, as compared to the early 21th century. Strikingly, recent in-situ observations show that over the past three summer periods (2018-2020), heatwave metrics already appear to have attained values projected for the middle of the century.

Because of the **urban heat island (UHI) phenomenon**, urban dwellers are exposed to higher temperature extremes, thus adversely affecting future warming levels and the associated human exposure. This warrants due attention, considering the large share of Belgians living in cities, together with the fact that urban residents often present a higher vulnerability profile.

Projected changes in **precipitation** exhibit a very strong seasonal component, with a relatively large increase in winter accompanied by a large (but lesser in magnitude) decrease in summer precipitation. Under scenario RCP8.5, winter precipitation is expected to increase by 12% and 18% by the middle and end of the century, respectively; for summer, a decrease of 7% and 11% is expected. In recent decades, Belgium has experienced an increase in the number of days with extreme precipitation; such precipitation extremes (5-year return period) are expected to increase in all seasons, by 21-23% in winter and 34-37% in summer. All this leaves an image of wet winters, combined with dry summers which are characterized by intermittent very heavy rain showers. As was the case for heat, cities are also vulnerable to extreme precipitation, since the large share of impermeable surfaces makes them prone to excessive overland flow and flooding.

Reduced summer precipitation, together with the relatively reduced infiltration of water into the soil during extreme precipitation and with higher evapotranspiration levels (owing to higher temperatures), will lead to depletion of soil moisture and **drought**. Past years have already seen abnormally dry conditions during the summer months. Already by the middle of the century, climate change is expected to further induce a considerably enhanced summer drought frequency and severity, worsening considerably towards the end of the century, especially under scenario RCP8.5.

Surface downwelling **shortwave (solar) radiation** has an impact on human health through its effect on human thermal stress (e.g., outdoor workers) and through its effect on harmful UV radiation. In recent decades an increase in the amount of surface solar radiation has been observed, mainly related to a reduced cloud cover. While projections of radiation abundance for Belgium are fraught with a large uncertainty, there is evidence that during summer we will experience a few extra Wm^{-2} of downwelling solar radiation flux by the middle of the century, under RCP4.5, compared to the end of the 20th century. The extent to which this would affect harmful downwelling UV radiation is less clear, as the latter is also affected by future stratospheric ozone concentrations.

With respect to storms and the occurrence of **extreme wind speed,** the observed trend is not very clear. Projections for the daily average wind speed do not show a clear trend towards the future, although it is expected that wind speed during the most intense storms may increase by up to 30%. The enhanced intensity of summertime thunderstorms may induce very high wind speed values locally, such as during the Pukkelpop festival disaster in August 2011 that caused several casualties.

Projections of **sea level rise** at Ostend show values of approximately 25 cm rise at mid-century (irrespective of the scenario), steeply rising towards the end of the century in all scenarios, but especially in scenario RCP8.5 with an average sea level increase of 70 cm. From these trends in sea level rise, it is expected that the surface area, the water depth and number of dangerously floodable vulnerable facilities for a millennial storm surge will increase under climate change towards the end of the century.

In general, climate change is expected to adversely affects **air quality**, owing to a higher temperature (enhanced atmospheric chemical reactivity) and the occurrence of drought spells (reduced washout from precipitation), as experienced during the hot and dry summer of 2003. With respect to ozone, it has been observed in recent decades that background concentrations increase while peak values decrease. Yet, it is important to notice that projections of air quality tendencies under a changing climate are difficult to establish given the high uncertainty regarding the levels of pollutant (precursor) emissions.

In the 6th IPCC Assessment Report socio-economic pathway (SSP) scenarios have been used in the CMIP6- climate data.

> Establishment of new high-resolution projections for Belgium making use of CMIP6-climate data, for general climate parameters as well as for health-, flooding-, drought- and wildfire-related indicators.

The effects of climate projections on indoor human comfort has not been studied intensively. However the quality of the indoor environment is important for health as people living in a temperate climate such as in Belgium, and especially elderly, typically spend about 90% of their time indoors. In analogy to the dynamic activity-based assessment of exposure to air pollutant, the consideration of both indoor and outdoor thermal stress is important in health impact assessments.

> Research on the coupling of climate models with indoor environment, especially in the context of thermal comfort.

HEALTHCARE SECTOR IN BELGIUM

In Belgium, the **federal** authorities are competent for matters of general interest, such as the national compulsory health insurance, the setting of the hospital budget and general organization rules, the regulation of health products and activities, the regulation of health care professionals, and patients' rights. The Federal Public Service Health, Food Chain Safety and Environment (FPS Health) aims to protect and improve the health of all citizens and is responsible for the general organization and planning of the health system. The three Belgian **communities** are the main competent authorities in the fields of care for elderly, disabled care, mental health care, primary and home care and rehabilitation. They are also responsible for health promotion and disease prevention. The main organizations involved are AVIQ, AZG and COCOM for Wallonia, Flanders and Brussels, respectively. The National Environment and Health Action Plan (NEHAP) is a framework for planning and implementing environmental health actions at all institutional levels in Belgium.

Primary care includes care provided by general practitioners (GPs), dentists, physiotherapy, pharmacy care, home nursing, social work, psychological care, etc. Different initiatives exist to optimize the collaboration between local actors of primary care. In Flanders and Brussels there is a geographical division of 60 primary care zones, a similar initiative of creating geographical divisions of primary care actors is under consideration in Wallonia. The implementation of prevention policies and operational plans at a local level is coordinated by local health promotion centres (15 in Flanders and Brussels, 9 in Wallonia). They support local actors in the development of projects and actions, initiate and/or strengthen networks of local actors, support and raise awareness of local authorities on the integration of health promotion in their policies or plans etc.

The **second and third lines** cover healthcare providers in hospitals. They are organized in regional networks. Every hospital (network) has a Hospital Emergency Plan (HEP) with procedures to follow in case of major accidents inside and outside the hospital.

In case of a potential **public health hazard**, the Risk Assessment Group (RAG) prepares risk assessments and proposes actions that can be implemented by the Risk Management Group (RMG). Crisis management and emergency planning is organized at different levels, in the event of a national crisis the National Crisis Centre (NCCN) takes the coordination.

Integrated healthcare services cover **health promotion**, **disease prevention** as well as **curative care**. The first two aspects are particularly important to increase resilience of the population, but they are underfinanced and not promoted through the performance-based financing system in the Belgian healthcare sector.

CLIMATE CHANGE ADAPTATION POLICIES

The **United Nations (UN)** adopted in 2013 the **Sendai Framework** to make communities safer and more resilient to disasters amongst which climate-related emergencies. The Sustainable Development Goals of the UN also include targets related to climate change and resilient infrastructure. In 2015, the **Paris Agreement** was concluded at the 21st Conference of the Parties (COP21) under the UN Climate Convention. Besides climate mitigation, the Paris Agreement also contains clear commitments and obligations for adaptation. Each party is obliged to set up an adaptation planning process and to implement the adaptation measures.

At the global level the **World Health Organization** (**WHO**) provides guidelines for health adaptation to climate change, to increase the resilience of the population, including vulnerable group, as well as of healthcare facilities and the healthcare personnel.

At the European level the **European Commission (EC)** recently adopted a climate adaptation strategy aiming to make adaptation smarter, swifter, more systemic and more internationally oriented. In order to achieve this, knowledge on adaptation needs to be increased and better disseminated, adaptation plans must be implemented at all levels of governance and in all sectors with priorities for macro-fiscal policy, nature-based solutions (NBS) and local adaptation action. The EC's Covenant of Mayors for Climate and Energy, stimulates local governments to adopt an integrated approach to climate change mitigation and adaptation.

The European Environment Agency (EEA) supports the development and implementation of adaptation policies in Europe, together with the EC they recently launched the European Climate and Health Observatory. The European Centre for Disease Prevention and Control (ECDC) focuses principally on adaptation actions concerning air-, food-, vector- and water-borne diseases.

In the **Belgian federal system**, responsibilities and policy-making powers regarding climate change are shared between the Federal State and the three Regions, each entity sets up its own priorities and objectives within the scope of their powers. There are several ministries in Belgium responsible for climate change: FPS-Health, Wallonia Agency for Air and Climate (AwAC), department of Environment (dOMG), and Environment Brussels (BE/LB), for the federal level, Walloon, Flemish and Brussel Capital Regions, respectively.

The National Climate Commission (CNC/NKC) is the **national** coordination mechanism, the Belgian National Adaptation Plan 2017-2020 (NAP) contains specific adaptation measures to be taken at national level to improve cooperation and to develop synergies between the federal and regional entities. The **federal** contribution to the NAP formulates measures for transport, crisis management as well as transversal issues. The three **regions** dispose of specific adaptation plans (currently in revision for Flanders) or of climate-energy and environment-health related plans that often contain climate change adaptation measures.

> The development of a Belgian Centre of Excellence on Climate could provide a forum for collecting scientific expertise and knowledge both at national and international level, facilitating the dialogue with stakeholders of various regions and sectors such as healthcare, energy, environment, etc

Currently in Belgium, within the multi-institutional structures working on climate change, mitigation & adaptation, the health sector is not represented. No ministry is responsible for health and climate change in Belgium.

The development of a national health and climate change plan, which considers health risks of climate change as well as of adaptation and mitigation measures, and which assesses health resilience to climate change.

At the **local** level, most Belgian cities and municipalities dispose of an energy and climate action plan. In the design and implementation of the plans local authorities are often assisted by the regional, community, provincial and intercommunal governments and associations.

Vulnerability assessments have been carried out at the federal/national and regional scale. Vulnerability mapping can be done at the level of the statistical sector as several indicators are available. However, a local vulnerability assessment can provide more detailed information, these data need regular updates. Vulnerability maps can be crossed with hazard maps (for e.g. heat, flooding) to create impact maps.

Assessment of the vulnerability of the Belgian population at the level of a statistical sector, making use of publicly available datasets based on e.g. census data.
Development and application of a methodology for local assessments (resulting in homogenous data).

IMPACTS ON THE HEALTHCARE SYSTEM AND ADAPTATION IN BELGIUM

Climate change gives rise to various health effects, affecting healthcare infrastructure and personnel. Below we give an overview of the current situation, the expected impact as well as adaptation measures already taken or planned. New adaptation actions and recommendations are added in ***blue***.

HEAT-RELATED HEALTH EFFECTS

At present, exposure to heat causes the largest **climate-related burden of disease**. In Belgium, as in most temperate climate zones, heatwaves claim more victims than any other weather-related disaster. Heatwaves currently cause tens to hundreds of excess deaths per year, especially among the elderly and in people with chronic disease. Considerably higher values are observed during exceptional years, such as the year 2003, 2006, 2010 and 2020 with an estimated excess mortality between 1500 and 1800 for Belgium.

Several **Belgian studies** indicate that the largest effects are observed for elderly people, people with chronic illnesses and multi-morbidity, people with lower socio-economic status and for the urban population owing to the enhanced exposure to high temperatures (urban heat island effect). High ambient temperature also causes illnesses such as heat exhaustion, heat stroke, renal diseases and exacerbates respiratory diseases.

Heat-related hospitalization data from **European studies** show increased hospital admissions of elderly people, but also children and adolescents are at risk. Hospital admissions during heat waves are related to health complaints such as dehydration, hyperthermia, heat stroke, urinary tract infections, renal diseases, respiratory diseases. However, they are not associated with cardiovascular diseases, whereas cardiovascular diseases are a cause of increased mortality during hot weather. Exposure to heat has negative effects on birth outcomes, medication use, performance, sleep quality, cognitive performing, labour productivity, etc.

> availability of (near-) real-time health data from emergency services, hospitals, general practitioners, laboratories, medication use, etc. both on physiological and mental health. A retrospective analysis of health data can determine the burden of disease for various climate-related stressors such as heat, allergy, ticks, flooding, etc. Sensitivity analyses on parameters such as age, urban population, socio-economic status, etc. can be performed to determine vulnerable groups in the population. A surveillance or monitoring system can be put in place, this can be used as activation criteria of e.g. heat-health plans.

Climate projections for Belgium indicate that the number of days with high heat stress levels will be increasing everywhere in the country. Heat-related impacts are expected to increase substantially through the combined effects of climate change, as well as increases in degree of urbanization, the ageing population and increases chronic diseases, multi-morbidity, further development of home-based and community-based care. For some European countries the change in vulnerability of the population to health impacts of heat has been studied, with diverse results since there are location-specific and socio-economic drivers.

> A heat-related vulnerability assessment using mortality and morbidity data.

Heat forecast and warnings by the Royal Meteorological Institute are timely provided by different media channels, warnings are issued at the provincial level. However, for the urban population it might be of interest to account for the UHI-effect in a high-resolution monitoring and forecasting system, such as implemented in Antwerp. Some Belgian cities dispose of heat maps using apparent temperature metrics such as WBGT, indicating the location of cooling zones at high spatial resolution.

Set-up of high-resolution weather monitoring and forecasting system, especially for urban areas (see also further concerning flooding).

The **federal and regional ozone and heat plans** have three phases: the vigilance phase is fixed, the activation of the warning phase as well as alert phase consider forecasted maximum temperatures and ozone levels. IRCELINE is competent for issuing the warning phase, RMG is responsible for the alert phase.

Investigation of other activation criteria for ozone-heat plans such as minimum temperature as well as the use of local forecasts, especially for warning urban dwellers (UHI). The retrospective analysis of mortality and morbidity data could be used in the assessment. The results of this analysis could also highlight (health) indicators for which real-time information through surveillance can guide the activation of health action plans/alarms.

The federal, regional and provincial plans provide general guidelines for the implementation of **proactive and reactive measures** that can be taken by an individual or an organization/authority. They address **vulnerable groups** and give sectorial advice with a large focus on (health) care professionals working with vulnerable groups.

Inclusion of specific actions for obese people, pregnant women, workers, drug users, homeless people in ozone-heat plans. More attention should be given to the effects of medication in the general sections dealing with vulnerable subgroups (currently missing or only in detailed sections for care workers). Inclusion of health effects due to UV radiation as stressor and measures are the same.

Heat-health action plans are set up in nearly all types of **healthcare facilities**, however institutions for persons with disabilities, rehabilitation and psychiatric hospitals have a lower implementation degree. For the effective implementation of these plans, sensibilization of personnel and encouraging behavioural changes is required.

Compulsory set-up of heat-health action plan for all facilities and hospitals, both residential and non-residential (including child care facilities, schools, shelters for the homeless, drug rehabilitation centres, etc.).

The **local implementation of a heat plan** is often described in the climate energy plan of municipalities. There is a large variation in the number of activities often focusing on spatial planning and energy efficiency. However, heat prevention actions are often also included in other local (social) programs.

Set-up of a governance structure at the (supra-) local level to create a platform with all stakeholders related to climate, social care, health care, education, spatial planning, etc. Further development community-based care initiatives and increase surveillance (e.g. by telephone, visit) of vulnerable people at home during extreme weather events.

Concerning **communication channels** for the ozone-heat plans, the activation of the warning phase is covered by (social) media, information and materials (in easy language) are available on the website of the regional health authorities. During the alarm phase FHS-Health coordinates the execution of measures. To reach **vulnerable groups**, it is important to map their social network and to have an overview of organizations and intermediaries through which one can reach them.

Regular identification of vulnerable groups and their networks to develop communication strategies.

The national, federal and regional **energy and climate plans** promote (legislative, fiscal, financial, etc.) measures to increase the energy efficiency and indoor comfort of the building sector. These climate mitigation measures are preferably done using passive techniques for cooling as well as for heating.

Green & blue infrastructures are an efficient way of tackling heat stress primarily by providing shade, they also reduce air temperatures through the cooling process of evaporation and evapotranspiration. Furthermore, the water-buffering capacity of green spaces reduces the risk of flooding and drought. Different plans at the regional and local scales mention actions to further develop green & blue spaces in the public as well as in the private domain (e.g. roof greening, tree planting).

Further greening of public and private domain, to provide shade and cooling and to reduce the risks of flooding and drought. An important aspect is that recreational green and blue spaces should be easily accessible for vulnerable groups and offer infrastructure (e.g. resting bank, playing area, sports area, etc.) for recreation. The aspect of gentrification should be taken up in planning.

VECTOR-BORNE DISEASES

Tick borne diseases, such as tick-borne encephalitis (TBE) and Lyme disease, currently constitute the greatest vector-borne disease risks in Europe. In Belgium, about 14% of ticks are infected with *Borrelia burgdorferi sensu lato (s.l.),* the causative agent of *Lyme borreliosis* being endemic since many years in Belgium. In 2018 and 2020, human TBE-cases with possible/probable autochthonous infection were reported. Vulnerable groups of contracting ticks all people who regularly come into contact with nature, either professionally or during leisure time.

The main **mosquito-borne diseases** that are transmitted to humans include Zika, West Nile fever, Chikungunya, dengue, and malaria. The different pathogens are transmitted by different types of mosquitoes, both indigenous and exotic species to Belgium. Aedes mosquitoes have been found episodically in different locations in Belgium. No autochthonous infections have been reported so far.

For both ticks and exotic mosquitoes, climate change, land use changes and increased travel and trade, will increase their prevalence and activity in Belgium.

A **reporting** system for tick bites and a **surveillance** system of tick-borne diseases (through sentinel GP & laboratories, hospital data) are in place. The MEMO exotic mosquito monitoring programme ended in 2020, a continuation of this project will start soon.

> Set-up of an adequate sustainable governance structure to continuously monitor (preferentially both native and) invasive mosquito species

Surveillance of mosquito-borne diseases is in place through the NRC and at the regional level for notifiable infectious diseases. Within the One World, One Health concept, the monitoring of a number of vectors and their pathogens in wildlife is in place, this allows to early detect the distribution and prevalence of these vectors.

> Extension of existing active and passive monitoring programmes for exotic pathogens in wildlife and investigation of pathways of their introduction.

At the European level, **VectorNet** (joint EFSA-ECDC project) provides detailed maps of surveillance activities and current known distributions of various tick and mosquito species in Europe and neighbouring regions.

Management measures for preventing ticks (e.g. mowing policy) and mosquitoes (e.g. avoiding still water) can be taken by local authorities and individuals.

> Management measures for ticks and mosquitoes in spatial green & blue planning.

Sensibilization campaigns with information and preventive measures are in place, they target at children and their parents, citizen science projects are in place to create evidence-based data and to raise awareness.

> Sensibilization campaigns on vector-borne diseases should also address vulnerable groups such as professionals working in nature (ticks) and travelers (mosquitoes).

Vector-borne diseases **protocols** have low implementation rates in healthcare facilities except for university hospitals. The **information flow** to the medical practice is **limited**, even though communication channels are in place.

> Improve communication channels for medical practices (see further).

Eradication of exotic mosquitoes is in place, this is a regional responsibility.

> Set-up of a common mosquito control plan.

WATER- AND FOOD-BORNE DISEASES

In Belgium, the highest population health impact for water- and food-borne diseases results from **Norovirus infection**, followed by **campylobacteriosis** (increasing over time), **giardiasis**, **listeriosis** and **botulism**. For bathing waters there is also concern for **Cyanobacteria**, blue-green algae, inhalation or ingestion of its toxins can cause gastrointestinal, neural and dermal diseases. **Mycotoxins** in maize and cereals are harmful food contaminants, especially in the light of climate change. European regulation requires monitoring of bathing water and inspection of specific food safety and food processes. Bathing water quality has improved in recent years, but warm weather, low water levels as well as accidental discharges of wastewater in times of flooding pose a risk. Surveillance of food-borne diseases is performed by the Federal Agency for the Safety of the Food Chain, regional authorities for notifiable infectious diseases and through the network of sentinel laboratories and NRL.

For many infectious diseases, the **transmission routes to humans** (e.g. drinking water, recreational water, food) are affected by climate change, mostly through increased occurrence of heavy rain, but also in periods of drought and higher temperatures.

> Limitation of sewage water discharges into surface in case of very dry or wet periods to prevent contamination of surface and groundwater.

For **bathing water**, monitoring of bacterial pathogens, monitoring of dead fish and birds as well as visual inspection for trash/litter is in place.

> To protect bathers against infections with viral and protozoan parasites that persist longer in water, it is recommended to perform research to determine the added value of monitoring coliphages.

Cyanobacteria blooms are monitored in different ways, in Flanders an app will be launched soon to report blooms, while in Wallonia the use of remote sensing data is being explored. Different authorities carry out pilot projects for effective and sustainable control of cyanobacterial blooms.

> Sharing of good practices on monitoring (including bloom models) and control measures for cyanobacteria blooms between authorities and research centres.

In case of algae blooms, criteria are in place to close water for recreation as well as captation.

> Revision of the captation and recreation criteria in case of cyanobacteria blooms, considering recent guidelines by WHO and US EPA.

In the surveillance of incidents of food- and water-borne infection there is in general a systematic **underestimation** in the numbers: not all frequently occurring pathogens can be monitored and most people do not seek medical attention for gastroenteritis symptoms.

Sensibilization campaign for general public and e-learning modules for GPs in order to better assess the health effects of food- and water-borne infections. For better surveillance of health complaints with respect to water quality for bathing, a questionnaire system could be developed, with a digital questionnaire sent at the end of the bathing season requesting local health departments and provinces to enter the bathing water related health complaints they have received/noted. That information can be compiled into an annual surveillance overview and communicated to stakeholders.

For foodborne outbreaks a **causative agent** often cannot be found, as only a limited number of microbial parameters is investigated. If the share of foodborne outbreaks with unknown causative agent is increasing, this could be related a.o. to changes in biological hazards due to climate change.

An alert system based on the monitoring of the number of foodborne outbreaks of unknown causative agents could identify a possible trend in an early stage. This alert would dictate further investigation (retrospective or future oriented monitoring). To facilitate data collection and information gathering, citizens can be encouraged to report their symptoms via an app or social media channels. A similar reporting system could be set up for estimation of the incidence of water-borne diseases.

Further research and monitoring is needed for the impact of climate change on mycotoxin contamination of cereal grains. Food supplements made from natural ingredients might contain **natural toxins**, this is currently under investigation for food supplements produced by microalgae or cyanobacteria.

More research is needed to investigate adverse health effects of natural toxins.

With the promotion of **circular use of water** due to increasing drought periods during summer, EU regulation is being put in place to use surface water or wastewater for irrigation of agricultural land. The use of (bacterially loaded) surface water or wastewater for watering urban green spaces poses risks for everybody who comes directly or indirectly into contact.

A legal framework for the safe reuse of water must be set up in the regions, in collaboration with the federal government and European legislation, e.g. the use of surface water for irrigation in urban environments should be regulated. The health consequences of the use of bacterially loaded surface water for crop irrigation must be studied in detail, as currently is performed for cyanotoxins within the Cyantir project.

POLLEN & SPORES, ALLERGIES AND RESPIRATORY DISEASES

In Europe, **grasses** (Poaceae family) are the major cause of allergic reactions due to pollen, about 18% of the Belgian population is estimated to be allergic to grass pollen. For **tree** pollen, birches (*Betula* spp.) are highly allergenic species with a strong health impact. In Belgium, at least 10% of the population might be allergic to pollen of the Betulaceae family (including birch, hazel and alder). Cladosporium spp. and Alternaria spp. are currently the most common allergenic fungal **spores**. Epidemiological research attributes the most severe respiratory health effects **of air pollution** to exposure to particulate matter and ozone. Besides asthma, rhinosinusitis, chronic obstructive pulmonary disease (COPD) and respiratory tract infections are the main diseases of concern. **Allergic rhinitis** is **underdiagnosed** and often **un- or maltreated** as there are no structural initiatives on the improvement of treatments. The current allergy-related burden of disease is not sufficiently known.

Set-up of relevant and homogeneous protocols of clinical data collection in relation to specific allergic diseases. This requires the data-availability of emergency department visits, hospitalization, general practitioner and medication data. Improved allergen characterization and alignment of treatments.

Higher temperatures but also elevated atmospheric **CO_2 and NO_2** concentrations have implications for seasonal distribution (timing and duration) of the pollen season, concentration, allergenicity and geographical distribution of allergenic species and aeroallergens. Also **new allergenic plants** are establishing, e.g. **ragweed** has a long-lasting and high pollen production capacity and high pollen allergenicity. Wallonia recently intensified the from-the-field monitoring of ragweed plants and is developing control techniques.

Set-up of monitoring and control for emerging and/or exotic species with known allergenic potency (e.g. ragweed in Flanders and Brussels, fungus Cryptostroma corticale in Belgium). Research on new allergenic plants, their pollen production and sensitivity of population under climate scenarios, health risks of combined exposure to pollen and air pollution. Establishment of hypoallergenic green spaces through careful tree species selections (considering climate related effects).

The Belgian aerobiological **surveillance network** (AirAllergy) managed by Sciensano is the only long-term monitoring system of outdoor aeroallergens (pollen & fungal spores) in Belgium. A **forecast system** for airborne pollen levels has been developing for birch and grass pollen in collaboration with RMI. IRCELINE has a Belgium-wide forecasting system for various air pollutants.

Transition and standardization to automatic real-time bioaerosol monitoring. Development of operational bioaerosol forecast systems (short-term prevention, long-term climate scenarios).

MENTAL HEALTH

Mental health is both directly and indirectly affected by physical effects of climate change on the environment. **Natural disasters** such as severe storms, wildfires and floods can lead to damage to or loss of property and other physical impacts in the environment. Post-disaster social support and care is important, this aspect is present in the HEP and taken care of by local organizations.

Foreign studies have found effects of **heat** on mental health, such as an increase in suicide and visits to the emergency room for psychological complaints. It is not clear whether this is the case in Belgium.

Assessment of the effects of heat on mental health in the Belgian population. During

extreme weather events, the elderly and chronically ill people living at home are an important risk group, they are more susceptible to feelings of **anxiety and loneliness**.

Intense surveillance (e.g. by telephone, home visits) of vulnerable people at home during extreme weather events.

In the survey, medical doctors active in psychiatric hospitals point out that impact of **heat** on medication treating somatic symptoms is well known, in contrast to **medication for psychological symptoms**.

Research on the impact of heat on the effectiveness of medication for psychological symptoms.

Climate anxiety, especially among young adults, is a general feeling of anxiety related to the global climate crisis. The implementation of green-blue infrastructures at local and regional scales is beneficial for many climate-related aspects, including mental health. Spending time in nature, or even the view on it, reduces feelings of anxiety and loneliness. It is unclear to what extent the Belgian population is affected by feelings of fear and uncertainty due to climate change.

Research on climate anxiety and into which groups are most affected is needed to develop effective interventions against it.

Healthcare personnel

Throughout the entire (health)care sector there is a general **lack** of (health)care **personnel** and appropriate **financing**. The funding of the Belgian healthcare system is performance-based, **prevention** and health **promotion** are **underfinanced**. The tendency towards more home- and community-based care requires the further development of population health management systems and initiatives to increase the health literacy and resilience of patients.

Increase financing of entire (health)care sector, including health promotion and prevention programmes. Roll-out of health management systems and local organization of home- and community-based care.

Concerning **education**, in the curriculum of (health)care disciplines (caregiving, nursing, medicine, etc.) there are medical courses on heat effects on the human body, infectious diseases, respiratory diseases etc. However, the link between environment (climate) and health, as well as promotion/prevention is covered to a lesser extent in the basic training. E-learning modules dealing with this theme are under development by umbrella organizations, scientific institutes as well as governments. Within the medical practice, knowledge- and good practices sharing is in place, but this can be improved between the different lines.

Financial compensation to focus more on trainings for health promotion and prevention. Initiatives related to good practice sharing of adaptation measures, for example in existing structures of environmental coordinators, prevention advisors, etc

The **information flow from surveillance and meteorological organizations to the medical practice** is in place but is rather fragmented as responsibilities are distributed over different authorities (e.g. regional health authorities (notifiable infectious diseases), Sciensano (national reference & sentinel labs and GPs), regional and federal health authorities (ozone- and heat plan, developments abroad), federal authorities (health crisis and/or disaster), etc.). From the survey it follows that many healthcare facilities do not receive alerts from a governmental organization, especially in the case of forecasted storms, rainfall, flooding and concerning vector-borne diseases. About half of the respondents indicate that they would prefer additional alerts.

Streamline communication channels from surveillance and meteorological organizations to medical practise (as well as general population including vulnerable groups). The information should be tailored specifically to the needs of the (possibly different types of) receivers, this might involve the set-up of a multisectoral organ. The establishment of clear points of contact is especially important during crises.

During a **crisis**, a sudden increase in casualties has an impact both on the healthcare personnel as well as on the capacity of the healthcare infrastructure. For curative care this mainly affects the personnel in general hospitals and GPs. For ambulatory, residential and home-based care more personnel is required to implement action plans in order to guarantee a high level of care.

(Near-) real-time monitoring of GP and hospital data.

Currently climate-related extra workload and difficult working circumstances for healthcare personnel is mainly caused by the implementation of heat-action plans during periods of warm weather. The current practice of cancelling non-essential activities in order to compensate for the extra heat-related care is not sustainable in the view of longer and more intense future heat waves.

Development and implementation of sustainable action and personnel management plans during crises, especially heat-related, compulsory for residential care facilities and hospitals.

In the context of the COVID-19 pandemic several initiatives have been taken to surge hospital capacity (through HEP, HTSC) and medical care capacity.

Establishment of legal framework for implementation of current measures (and others, e.g. list of reserve doctors) concerning surge capacity in future health crises, increase flexibility between different lines.

HEALTHCARE INFRASTRUCTURE

There is large variation in the implementation degree of cooling and ventilation technology in healthcare infrastructure. **Cooling** techniques used in the rooms of residents/patients include the opening of windows (59% of respondents, from which 1/3 hospitals) and standard air-conditioning (40% of respondents, from which 2/3 hospitals). This is complemented with external sunscreens (83% of respondents) or internal sunscreens (58%). For residential care and short-stay centres additional heat-related requirements are taken up in the accreditation criteria (e.g. central cooling room).

To guarantee good air quality and to prevent mould formation, **aeration and ventilation** measures are important. The most prevalent ventilation systems used are D (mechanical supply and discharge), A (natural supply and discharge) and C (natural supply, mechanical discharge).

Various types of **legislation** exist on the quality of the indoor (working) environment: in Wallonia there is no additional legislation for healthcare facilities; for Flanders and Brussels there are additional sectoral decrees and advices. **Funding** mechanisms for energy audits and the implementation of energy-efficient HVAC-systems are available for the healthcare sector, through the VIPA- and UREBA-programmes for Flanders and Wallonia, respectively. Within the VIPA programme there is a recent tendency towards adaptation investments in green and blue infrastructures. Only large healthcare infrastructures dispose of in-house expertise related to energy efficiency, indoor climate, etc.

> Provision of technical guidelines (not additional legislation) and means of application related to energy efficiency, cooling and ventilation etc., for use specifically in the healthcare sector. Elaboration of VIPA- and UREBA-programmes for adaptation measures, including green and blue infrastructures to create healthy environments.

The healthcare sector is a huge **energy** consumer, responsible for approximately 5.5 % of the CO_2-emissions in Belgium. Reliable power supply is a requirement in hospitals and for critical medical treatment. Hospitals mostly have a power and **IT management** platform allowing for continuous monitoring, integrated into the hospital's building management system. In case of a longer power failure hospitals have a back-up power generation system in place, mostly consisting of diesel generator(s) which can feed essential loads throughout the facility. In the event of **energy shortage**, the Belgian load shedding plan can be activated manually. Hospitals, being critical infrastructures, have priority energy supply. However this is not the case for psychiatric hospitals, residential elderly care, revalidation centres, centres for persons with disabilities etc.

> Identification of energy needs of non-critical healthcare infrastructures in crisis situations.

Currently investments in healthcare infrastructure are often made on an ad hoc basis, due to a **lack of funding and insufficient long-term vision**.

> Establishment of long-term climate-resilience action plan for healthcare infrastructure.

CRISIS- AND RISK MANAGEMENT IN HEALTHCARE SECTOR

Extreme weather events, including heat, drought, wildfire, flooding (coastal, pluvial, fluvial) may occur more frequently and more intensely in the future.

At the local level, both in urban and agricultural areas, **nature-based solution strategies** are in place to avoid run-off of rainwater, erosion and mud streams and to promote re-use of water, by collecting, buffering and infiltrating rainwater. At the regional level large green spaces act as buffer basins to collect water.

A **flood warning and forecasting** system is operational in Wallonia and Flanders, they combine measured water levels and flood forecast models. Detailed flood risk maps indicating the location and characteristics (inundation area, maximum inundation depth) of the flooded zones, are only available for some larger cities.

> Promotion of set-up of detailed high-resolution risk maps for flooding, using hydrological modelling with detailed local data

Real-time forecasting of storms, at the scale of a city or agglomeration, including the locations and type of storm can give important information such that rescue services can better deploy their equipment and expected impacted neighbourhoods can be better informed.

> Exploration of use of X-band radar precipitation data in hydrological models for high-resolution flooding forecast.

No detailed risk maps are available for **wildfire**, a wildfire ignition probability map is available for Belgium but no dynamic fire propagation map (considering fuel type and moisture, topography and meteorological data) is set up. Wildfire warning levels are issued at municipality and provincial level.

> Set-up of an adequate governance structure to establish and regularly update risks maps for wildfire, as well as for monitoring and forecasting (considering dynamic data on fire ignition and propagation).

Defense intervenes in the national crisis management in case of natural disasters to reinforce the civil capacities (fire brigade, civil protection, police, etc.). E.g. they support in providing helicopters for extinguishing forest and heath fires which are difficult to reach.

For most hospitals the **Hospital emergency plan (HEP)** covers emergency power, backup of water and medical gases, ICT infrastructure. However from the survey it follows that important aspects are not implemented generally by all HEP e.g. fuel supply, an electricity disconnection plan, non-return valves in sewers, anchoring of storage tanks, etc. This type of measures is however important in the light of more severe and more prolonged climate-related hazard crises in the future.

Extension of HEP and internal emergency plans to account for longer, more severe hazards, including cascade effects. Appointment or strengthening of function of emergency coordinator, training of emergency plans.

Stress testing assesses the risk and vulnerability of healthcare (and other) infrastructure e.g. in case of climate-related hazards. Within the stress test one starts with the evaluation of systems within the physical boundaries of the healthcare facility, this aspect is foreseen in a tool of the HEP. But it is important to identify how external services are critical to healthcare operations, as well as to assess their vulnerability. This is especially the case for the energy sector, also because of its high interdependencies with other sectors increasing the risk for cascade effects. Stress testing hence involves the commitment of various stakeholders inside and outside the healthcare facility.

Set-up of protocol for stress testing of healthcare infrastructures, including new risks as well as cascade effects in the scenario-based exercises.

DATA AVAILABILITY AND COMMUNICATION

We recommend the development of a Belgian Centre of Excellence on Climate. This could provide a forum for collecting scientific expertise and knowledge both at national and international level, facilitating the dialogue with stakeholders of various regions and sectors such as healthcare, energy, environment, etc.

It would be of interest if the platform would contain a **'Climate Service for Belgium'** including basic climate parameters as well as sector-specific derived indicators.

Set-up of a central website/app 'Climate Service for Belgium' including basic climate parameters as well as sector-specific derived indicators (e.g. high-resolution climate projections on drought, wildfires, flooding, apparent temperature).

Currently there are several local and regional initiatives that deliver climate-health services for general public and local authorities within their community or region, e.g.:

- Several cities have maps with the indication of cooling zones (calculated using apparent temperature metrics), cooled public buildings, resting areas in the shade, location of drinking water fountains, etc. This type of information can be further used to indicate cycling- and walking paths in the shade between different green zones;
- Allergy risk assessment of green spaces;
- Tick risk maps.

Upscaling of local/regional climate-health services to the scale of Belgium and provide the information through the 'Climate Service for Belgium' app.

There are several **citizen science** initiatives dealing with heat, drought, ticks, mosquitoes etc.

Further deployment of citizen science initiatives to derive evidence-based local information but also to create awareness amongst the participants and general population.

As mentioned before the current **burden of disease** due to different climate-sensitive factors and the influence of climate change on this, is not or not completely known. For the assessment of the current situation, health and epidemiological data (e.g. data of GPs, hospitalization, emergency visits, medication use) are needed.

(Near-)real time availability of health data.

To investigate the influence of climate on health, projections on the hazards are needed, together with knowledge of human behaviour (for exposure determination) and vulnerable groups. This is not well developed for many aspects in Belgium and involves the collaboration of climate- and environmental sciences, epidemiology and medical sciences, behavioural sciences, social sciences.

Dedicated research is needed to assess the current future burden of disease related to climate-change, time-series of annual data can be set up and compared to the burden by other environmental stressors.

Indicators are indispensable to monitor of implementation and effectiveness of adaptation measures. Indicators making use of health data as well as of environmental data are needed in this respect.

Set-up of climate-health indicators to assess the evolution of hazard, exposure, vulnerability and impact and the effectiveness of mitigation or adaptation measures.

OVERVIEW OF RECOMMENDATIONS

	Theme	Aspect	Recommendation
1	Climate	Data, research	Establishment of new high-resolution projections for Belgium making use of CMIP6-climate data, for general climate parameters as well as for health-, drought-, flooding-, wildfire-related indicators.
2	Climate, health	Research	Research on the coupling of climate models with indoor environment, especially in the context of thermal comfort.
3	Climate, health	Communication	The development of a Belgian Centre of Excellence on Climate could provide a forum for collecting scientific expertise and knowledge both at national and international level, facilitating the dialogue with stakeholders of various regions and sectors such as healthcare, energy, environment, etc.
4	Climate, health	Policy, data, risk management	The development of a national health and climate change plan, which considers health risks of climate change as well as of adaptation and mitigation measures, and which assesses health resilience to climate change.
5	Vulnerability	Data, monitoring, research	Assessment of the vulnerability of the Belgian population at the level of a statistical sector, making use of publicly available datasets based on e.g. census data. Development and application of a methodology for local assessments (resulting in homogenous data).
6	Health	Data	Availability of (near-) real-time health data from emergency services, hospitals, general practitioners, laboratories, medication use, etc. both on physiological and mental health.
7	Health	Data, monitoring, research	A retrospective analysis of health data can determine the burden of disease for various climate-related stressors such as heat (but also allergy, ticks, flooding, etc). Sensitivity analyses on parameters such as age, urban population, socio-economic status, etc. can be performed to determine vulnerable groups in the population. A surveillance or monitoring system can be put in place, this can be used as activation criteria of e.g. heat-health plans. Remark: this requires the availability of health data.

	Theme	Aspect	Recommendation
8	Heat, health, vulnerability	Data, research	A heat-related vulnerability assessment using mortality and morbidity data.
9	Heat, flooding, storms	Monitoring, forecast, risk management	Set-up of high-resolution weather monitoring and forecasting system, especially for urban areas
10	Heat, health, vulnerability	Policy, risk management	Investigation of other activation criteria for ozone-heat plans such as minimum temperature as well as the use of local forecasts, especially for warning urban dwellers (UHI). The retrospective analysis of mortality and morbidity data could be used in the assessment. The results of this analysis could also highlight (health) indicators for which real-time information through surveillance can guide the activation of health action plans/alarms.
11	Heat, health, vulnerability	Policy, action plan	Inclusion of specific actions for obese people, pregnant women, workers, drug users, homeless people in ozone-heat plans. More attention should be given to the effects of medication in the general sections dealing with vulnerable subgroups (currently missing or only in detailed sections for care workers). Inclusion of health effects due to UV radiation as stressor and measures are the same.
12	Heat, health, healthcare facilities	Policy, risk management	Compulsory set-up of heat-health action plan for all facilities and hospitals, both residential and non-residential (including child care facilities, schools, shelters for the homeless, drug rehabilitation centres, etc.).
13	Health, local	Policy	Set-up of a governance structure at the (supra-) local level to create a platform with all stakeholders related to climate, social care, health care, education, spatial planning, etc. Further development of community-based care initiatives and increase surveillance (e.g. by telephone, visit) of vulnerable people at home during extreme weather events.
14	Local, vulnerability	Communication	Regular identification of vulnerable groups and their networks in order to develop communication strategies.

	Theme	Aspect	Recommendation
15	Heat, flooding, drought	Green & blue	Further greening of public and private domain, to provide shade and cooling and to reduce the risks of flooding and drought. An important aspect is that recreational green and blue spaces should be easily accessible for vulnerable groups and offer infrastructure (e.g. resting bank, playing area, sports area, etc.) for recreation. The aspect of gentrification should be taken up in planning.
16	Vector-borne	Policy, monitoring	Set-up of an adequate governance structure to continuously monitor (preferentially both native and) invasive mosquito species.
17	Vector-borne	Policy, monitoring	Extension of existing active and passive monitoring programmes for exotic pathogens in wildlife and investigation of pathways of their introduction.
18	Vector-borne	Green & blue, control	Management measures for ticks and mosquitoes in spatial green & blue planning.
19	Vector-borne	Communication	Sensibilization campaigns on vector-borne diseases should also address vulnerable groups such as professionals working in nature (ticks) and travelers (mosquitoes).
20	Vector-borne	Policy, control	Set-up of a common mosquito control plan.
21	Water-borne	Policy	Limitation of sewage water discharges into surface in case of very dry or wet periods to prevent contamination of surface and groundwater.
22	Water-borne	Monitoring	To protect bathers against infections with viral and protozoan parasites that persist longer in water, it is recommended to perform research to determine the added value of monitoring coliphages.
23	Water-borne	Monitoring, control	Sharing of good practices on monitoring (including bloom models) and control measures for cyanobacteria blooms between authorities and research centres.
24	Water-borne	Policy	Revision of the captation and recreation criteria in case of cyanobacteria blooms, considering recent guidelines by WHO and US EPA.

	Theme	Aspect	Recommendation
25	Water-borne	Communication	Sensibilization campaign for general public and e-learning modules for GPs in order to better assess the health effects of food- and water-borne infections.
26	Water-borne	Monitoring, communication	For better surveillance of health complaints with respect to water quality for bathing, a questionnaire system could be developed, with a digital questionnaire sent at the end of the bathing season requesting local health departments and provinces to enter the bathing water related health complaints they have received/noted. That information can be compiled into an annual surveillance overview and communicated to stakeholders
27	Food-borne	Monitoring	An alert system based on the monitoring of the number of foodborne outbreaks of unknown causative agents could identify a possible trend in an early stage. This alert would dictate further investigation (retrospective or future oriented monitoring).
28	Food-borne, water-borne	Monitoring, data	To facilitate data collection and information gathering, citizens can be encouraged to report their symptoms via an app or social media channels. A similar reporting system could be set up for estimation of the incidence of water-borne diseases.
29	Food-borne	Data, research	More research is needed to investigate adverse health effects of natural toxins.
30	Water-borne	Policy	A legal framework for the safe reuse of water must be set up in the regions, in collaboration with the federal government and European legislation, e.g. the use of surface water for irrigation in urban environments should be regulated. The health consequences of the use of bacterially loaded surface water for crop irrigation must be studied in detail, as currently is performed for cyanotoxins within the Cyantir project.
31	Pollen, allergies	Data	Set-up of relevant and homogeneous protocols of clinical data collection in relation to specific allergic diseases. This requires the data-availability of emergency department visits, hospitalization, general practitioner and medication data.
32	Pollen, allergies	Research	Improved allergen characterization and alignment of treatments.

	Theme	Aspect	Recommendation
33	Pollen	Monitoring, control	Set-up of monitoring and control for emerging and/or exotic species with known allergenic potency (e.g. ragweed in Flanders and Brussels, fungus Cryptostroma corticale in Belgium).
34	Pollen & spores	Research	Research on new allergenic plants and spores, their pollen production and sensitivity of population under climate scenarios, combined exposure to pollen and air pollution.
35	Pollen, allergies	Green & blue	Establishment of hypoallergenic green spaces through careful tree species selections (considering climate related effects).
36	Pollen	Monitoring, forecast	Transition and standardization to automatic real-time bioaerosol monitoring. Development of operational bioaerosol forecast systems (short-term prevention, long-term climate scenarios).
37	Heat, mental health	Data, research	Assessment of the effects of heat on mental health in the Belgian population.
38	Vulnerability	Communication	Intense surveillance (e.g. by telephone, home visits) of vulnerable people at home during extreme weather events.
39	Heat, health	Research	Research on the impact of heat on the effectiveness of medication for psychological symptoms.
40	Climate, vulnerability	Research	Research on climate anxiety and into which groups are most affected is needed to develop effective interventions against it.
41	Healthcare personnel & infrastructure	Financing	Increase financing of entire (health)care sector, including health promotion and prevention programmes.
42	Healthcare, local	Policy, financing	Roll-out of health management systems and local organization of home- and community-based care.
43	Healthcare personnel	Communication, financing	Financial compensation to focus more on trainings for health promotion and prevention. Initiatives related to good practice sharing of adaptation measures, for example in existing structures of environmental coordinators, prevention advisors, etc.

	Theme	Aspect	Recommendation
44	Health, extreme weather, Healthcare personnel	Communication, risk management	Streamline communication channels from surveillance and meteorological organizations to medical practise (as well as general population including vulnerable groups). The information should be tailored specifically to the needs of the (possibly different types of) receivers, this might involve the set-up of a multisectoral organ. The establishment of clear points of contact is especially important during crises.
45	Healthcare personnel	Action plan, risk management	Development and implementation of sustainable action and personnel management plans during crises, especially heat-related, compulsory for residential care facilities and hospitals.
46	Healthcare personnel	Policy, risk management	Establishment of legal framework for implementation of current measures (and others, e.g. list of reserve doctors) concerning surge capacity in future health crises, increase flexibility between different lines.
47	Healthcare infrastructure	Guidance	Provision of technical guidelines (not additional legislation) and means of application related to energy efficiency, cooling and ventilation etc., for use specifically in the healthcare sector.
48	Healthcare infrastructure	Guidance, Green & blue, financing	Elaboration of VIPA- and UREBA-programmes for adaptation measures, including green and blue infrastructures to create healthy environments.
49	Healthcare infrastructure, extreme weather	Data, risk management	Identification of energy needs of non-critical healthcare infrastructures in crisis situations.
50	Healthcare infrastructure	risk management	Establishment of long-term climate-resilience action plan for healthcare infrastructure.
51	Flooding, storms	Monitoring, forecast, risk management	Promotion of set-up of detailed high-resolution risk maps for flooding, using hydrological modelling with detailed local data.
52	Flooding, storms	Research, risk management	Exploration of use of X-band radar precipitation data in hydrological models for high-resolution flooding forecast.

	Theme	Aspect	Recommendation
53	Wildfire	Monitoring, forecast, policy	Set-up of an adequate governance structure to establish and regularly update risks maps for wildfire, as well as for monitoring and forecasting (considering dynamic data on fire ignition and propagation).
54	Healthcare infrastructure, extreme weather	Risk management	Extension of HEP and internal emergency plans to account for longer, more severe hazards, including cascade effects.
55	Healthcare infrastructure, extreme weather	Risk management	Appointment or strengthening of function of emergency coordinator, training of emergency plans.
56	Healthcare infrastructure, extreme weather	Risk management	Set-up of protocol for stress testing of healthcare infrastructures, including new risks as well as cascade effects in the scenario-based exercises.
57	Climate, health, extreme weather	Communication	Set-up of a central website/app 'Climate Service for Belgium' including basic climate parameters as well as sector-specific derived indicators (e.g. high-resolution climate projections on drought, flooding, wildfires, apparent temperature).
58	Climate, health, extreme weather	Communication	Upscaling of local/regional climate-health services to the scale of Belgium and provide the information through the 'Climate Service for Belgium' app.
59	Climate, health, extreme weather	Research, communication	Further deployment of citizen science initiatives to derive evidence-based local information but also to create awareness amongst the participants and general population.
60	Climate, health	Data, research	Dedicated research is needed to assess the future burden of disease related to climate-change, time-series of annual data can be set up and compared to the burden by other environmental stressors.
61	Climate, health	Monitoring	Set-up of climate-health indicators in order to assess the evolution of hazard, exposure, vulnerability, impact and the effectiveness of mitigation or adaptation measures.