

# WHO GUIDANCE FOR CLIMATE RESILIENT AND ENVIRONMENTALLY SUSTAINABLE HEALTH CARE FACILITIES





# WHO GUIDANCE FOR **CLIMATE RESILIENT AND ENVIRONMENTALLY SUSTAINABLE** HEALTH CARE FACILITIES



WHO guidance for climate-resilient and environmentally sustainable health care facilities

ISBN 978-92-4-001222-6 (electronic version)

ISBN 978-92-4-001223-3 (print version)

**© World Health Organization 2020**

Some rights reserved. This work is available under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 IGO licence (CC BY-NC-SA 3.0 IGO; <https://creativecommons.org/licenses/by-nc-sa/3.0/igo>).

Under the terms of this licence, you may copy, redistribute and adapt the work for non-commercial purposes, provided the work is appropriately cited, as indicated below. In any use of this work, there should be no suggestion that WHO endorses any specific organization, products or services. The use of the WHO logo is not permitted. If you adapt the work, then you must license your work under the same or equivalent Creative Commons licence. If you create a translation of this work, you should add the following disclaimer along with the suggested citation: "This translation was not created by the World Health Organization (WHO). WHO is not responsible for the content or accuracy of this translation. The original English edition shall be the binding and authentic edition".

Any mediation relating to disputes arising under the licence shall be conducted in accordance with the mediation rules of the World Intellectual Property Organization (<http://www.wipo.int/amc/en/mediation/rules/>).

**Suggested citation.** WHO guidance for climate-resilient and environmentally sustainable health care facilities. Geneva: World Health Organization; 2020. Licence: CC BY-NC-SA 3.0 IGO.

**Cataloguing-in-Publication (CIP) data.** CIP data are available at <http://apps.who.int/iris>.

**Sales, rights and licensing.** To purchase WHO publications, see <http://apps.who.int/bookorders>. To submit requests for commercial use and queries on rights and licensing, see <http://www.who.int/about/licensing>.

**Third-party materials.** If you wish to reuse material from this work that is attributed to a third party, such as tables, figures or images, it is your responsibility to determine whether permission is needed for that reuse and to obtain permission from the copyright holder. The risk of claims resulting from infringement of any third-party-owned component in the work rests solely with the user.

**General disclaimers.** The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of WHO 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.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by WHO in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by WHO to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall WHO be liable for damages arising from its use.

Editing, design and layout by Inis Communication

# CONTENTS

Acknowledgements.....	iv
Abbreviations.....	v
Executive summary.....	vi
<b>CHAPTER 1 INTRODUCTION.....</b>	<b>1</b>
1.1 Public health rationale for climate resilient and environmentally sustainable health care facilities.....	4
1.2 The investment case for climate resilient and environmentally sustainable health care facilities.....	10
<b>CHAPTER 2 BACKGROUND.....</b>	<b>13</b>
2.1 Fundamental requirements to provide safe and quality care.....	13
2.2 Policy context.....	17
<b>CHAPTER 3 APPLYING A CLIMATE RESILIENT AND ENVIRONMENTALLY SUSTAINABLE LENS TO HEALTH CARE FACILITIES.....</b>	<b>21</b>
3.1 Goals and objectives of the proposed framework.....	21
3.2 Increasing climate resilience in health care facilities.....	22
3.3 Increasing environmental sustainability in health care facilities.....	25
3.4 A framework for action.....	26
3.5 Suggested process and steps for increasing climate resilience and environmental sustainability in health care facilities.....	27
<b>CHAPTER 4 INTERVENTIONS TO BUILD CLIMATE RESILIENCE AND ENVIRONMENTAL SUSTAINABILITY IN HEALTH CARE FACILITIES.....</b>	<b>31</b>
4.1 Health workforce interventions.....	32
4.2 Water, sanitation and health care waste interventions.....	40
4.3 Energy interventions.....	48
4.4 Infrastructure, technology and products interventions.....	54
<b>CHAPTER 5 CONCLUSIONS.....</b>	<b>65</b>
<b>ANNEX A. RESPONDING TO GLOBAL MANDATES.....</b>	<b>66</b>
<b>REFERENCES.....</b>	<b>71</b>

# ACKNOWLEDGEMENTS

This guidance on climate resilient and environmentally sustainable health care facilities represents the work and contributions from several experts within and outside the World Health Organization (WHO). WHO extends its gratitude to Health Canada, Norway and the United Kingdom Department for International Development (DfID) for its financial and technical support to develop this guidance.

Lead authors and editors of the report are Carlos Corvalan, Elena Villalobos Prats, Aderita Sena and Diarmid Campbell-Lendrum.

WHO appreciates the contribution from Health Care Without Harm (HCWH), who prepared the first draft of the current document. Authors from HCWH are Josh Karliner, Antonella Risso, Susan Wilburn, Scott Slotterback, Megha Rathi and Ruth Stringer.

WHO is also grateful to the following authors, who made invaluable contributions to the current document: Peter Berry, Sally Edwards, Paddy Enright, Arabella Hayter, Guy Howard, Jaz Lapitan, Maggie Montgomery, Annette Pruss-Ustun, Linda Varungu and Salvatore Vinci.

Lastly, WHO extends its gratitude to the following reviewers: Heather Adair-Rohani, Charlotta Brask, Matthias Braubach, Jonathan Drewry, Kersten Gutschmidt, Nasir Hassan, Alex von Hildebrand, Qudsia Huda, Dorota Jarosinsk, Vladimir Kendrovski, Nargiza Khodjaeva, Rokho Kim, Togos Lkhasuren, Boni Magtibay, Marina Maiero, Robert Marten, Frank Pega, Maria del Rosario Perez, Adrienne Rashford, Jetri Regmi, Nathalie Roebbel, Oliver Schmoll, Paula Virginia Vasconcelos Lopes, Carolyn Vickers and Sonam Yangchen.

# ABBREVIATIONS

<b>AMR</b>	antimicrobial resistance
<b>ARV</b>	antiretroviral
<b>COVID-19</b>	coronavirus disease of 2019
<b>DNA</b>	deoxyribonucleic acid
<b>GHGs</b>	greenhouse gases
<b>HCWH</b>	Health Care Without Harm
<b>HIV/AIDS</b>	human immunodeficiency virus infection/acquired immune deficiency syndrome
<b>HSI</b>	Hospital Safety Index
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>Lao PDR</b>	Lao People's Democratic Republic
<b>MERS-CoV</b>	Middle East Respiratory Syndrome–coronavirus
<b>NDCs</b>	Nationally Determined Contributions
<b>NRGH</b>	Nanaimo Regional General Hospital
<b>PAHO</b>	Pan American Health Organization
<b>PHC</b>	primary health care
<b>POP</b>	persistent organic pollutants
<b>SAICM</b>	Strategic Approach to International Chemicals Management
<b>SARS</b>	severe acute respiratory syndrome
<b>SDGs</b>	Sustainable Development Goals
<b>UHC</b>	universal health coverage
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>UNGA</b>	United Nations General Assembly
<b>UNICEF</b>	United Nations Children's Fund
<b>V&amp;A</b>	vulnerability and adaptation
<b>WASH</b>	water, sanitation and hygiene
<b>WASH FIT</b>	Water and Sanitation for Health Facility Improvement Tool
<b>WHA</b>	World Health Assembly
<b>WHO</b>	World Health Organization

# EXECUTIVE SUMMARY

The aim of this guidance is to enhance the capacity of health care facilities to protect and improve the health of their target communities in an unstable and changing climate; and to empower health care facilities to be environmentally sustainable, by optimizing the use of resources and minimizing the release of waste into the environment. Climate resilient and environmentally sustainable health care facilities contribute to high quality of care and accessibility of services, and by helping reduce facility costs also ensure better affordability. They are, therefore, an important component of universal health coverage (UHC).

This document aims to:

- Guide professionals working in health care settings to understand and effectively prepare for the additional health risks posed by climate change.
- Strengthen capacity to effectively conduct surveillance of climate-related diseases; and monitor, anticipate, manage and adapt to the health risks associated with climate change.
- Guide health care facility officials to work with health determining sectors (including water and sanitation, energy, transportation, food, urban planning, environment) to prepare for the additional health risks posed by climate change through a resilience approach, and promote environmentally sustainable practices in providing services.
- Provide tools to assist health care facility officials assess their resilience to climate change threats, and environmental sustainability based on appropriate use of resources (in particular water and energy and sustainable procurement), and release of hazardous materials (biological, chemical, radiological), into their surrounding environment.
- Promote actions to ensure that health care facilities are constantly and increasingly strengthened and continue to be efficient and responsive to improve health, and contribute to reducing inequities and vulnerability within their local settings.

The guide builds upon *WHO's Operational framework for building climate resilient health systems (1)* by focusing on health care facilities and specifically on opportunities to enhance their climate resilience while also taking steps towards their environmental sustainability. It expands on the information related to the four fundamental requirements for providing safe and quality care in the context of climate change.

- (i) **Health workforce:** adequate numbers of skilled human resources, with decent working conditions, empowered and informed to respond to these environmental challenges.
- (ii) **Water, sanitation, hygiene and health care waste management:** sustainable and safe management of water, sanitation and health care waste services.
- (iii) **Energy:** sustainable energy services.
- (iv) **Infrastructure, technologies and products:** appropriate infrastructure, technologies, products and processes, including all the operations that allow for the efficient functioning of a health care facility.

The guidance, implemented through a framework based on the above four broad areas, provides a set of suggested interventions. Chapter 1 discusses the public health rationale, and the investment case for climate resilient and environmentally sustainable health care facilities. Chapter 2 provides the policy context and background information on the baseline or essential requirements for health care



facilities to be able to provide safe and quality health care, upon which resilience and environmental sustainability should be built. Chapter 3 introduces key concepts, the goals, objectives and proposed framework for the implementation of interventions aiming to strengthen climate resilience and environmental sustainability. Chapter 4 provides proposed interventions, organized into 24 tables around the four broad areas of the framework.

This document acts as a guide and needs to be adapted to local realities and requirements. New advances in knowledge, experiences and lessons from several health care facilities as well as changed circumstances (as those brought about by public health emergencies, such as the coronavirus disease of 2019 (COVID-19) pandemic), imply that this guide must be used with flexibility, and more as a model on how to improve operations, than as a prescription with expected actions. Whether large or small, all health care facilities can improve their operations while addressing key environmental concerns. Also, although health care facilities may have an important influential role to play with regards to climate resilience and environmental sustainability, some improvements will have to be implemented at higher levels (i.e. national or regional).



CHAPTER 1

# 1 INTRODUCTION

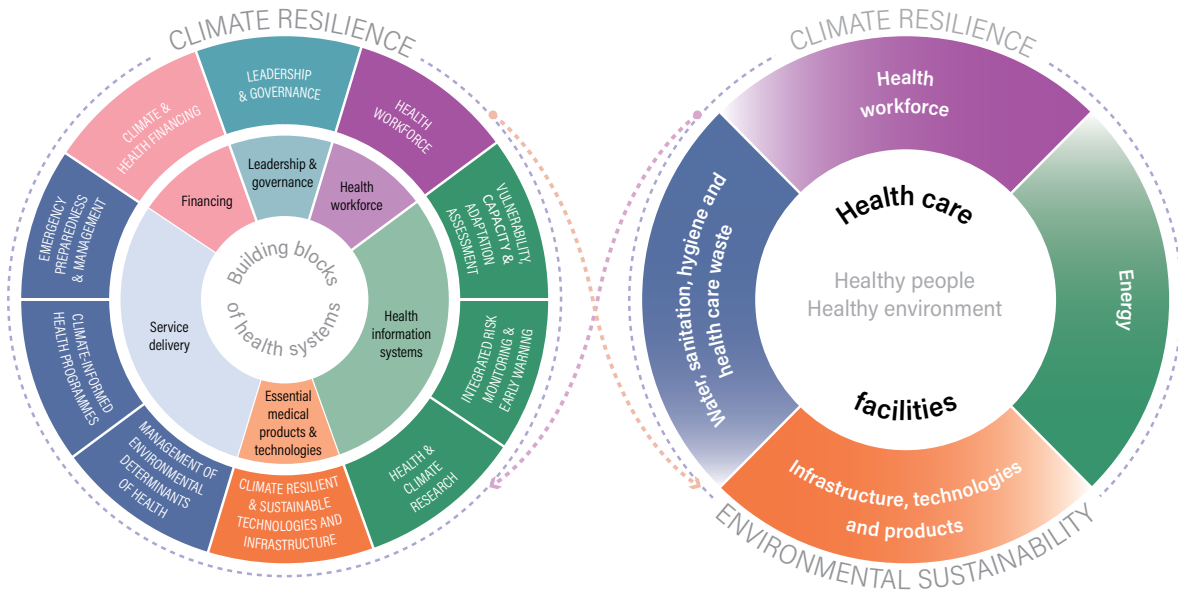
As the climate continues to change, risks to health systems and facilities – including hospitals, clinics and community care centres – are increasing, reducing the ability of health professionals to protect people from a range of climate hazards. Health care facilities are the first and last line of defence to climate change impacts as they can be responsible for large emissions of greenhouse gases (GHGs), and because they provide the needed services and care to people harmed by extreme weather and other long-term climate hazards. Health care facilities can also produce large amounts of environmental waste and contamination (GHGs and other contaminants) which may be infectious, toxic or radioactive and therefore a threat to the health of individuals and communities.

Health care facilities provide health services to patients and vary in size from small health care clinics to very large hospitals. Health care facilities are vulnerable to climate change and other environmental stresses, and they can also have a negative impact on the environment, and consequently on health. They may lack functioning infrastructure and trained health workforce, and predisposed to inadequate energy supplies, and water, sanitation and waste management services. Improving these is a priority and is key to building resilience and contribute to environmental sustainability.

The aim of this guidance is to enhance the capacity of health care facilities to protect and improve the health of their target communities in an unstable and changing climate; and to enable health care facilities to be environmentally sustainable, by optimizing the use of resources and minimizing the release of waste into the environment. The guide builds upon *WHO's Operational framework for building climate resilient health systems* (the WHO Operational Framework); (1) by focusing on health care facilities and specifically on opportunities to enhance their climate resilience while also taking steps towards their environmental sustainability. Climate resilient and environmentally sustainable health care facilities contribute to a high quality of care and accessibility of services, and by helping reduce facility costs, also contribute to better affordability. They are, therefore, an important component of universal health coverage (UHC).

The components designed to strengthen the climate resilience of health systems are also relevant to health care facilities (see Figure 1). While all blocks and components (such as climate change and health information systems, financing, and leadership and governance) of the WHO Operational Framework are relevant to facilities, this guidance provides further information on the specific application of the components related to the health workforce, climate resilient and sustainable technologies and infrastructure, as well as management of environmental determinants of health. Users of this guide should keep in mind the overall climate resilient health systems framework, as when framing of improvements towards climate resilience and environmental sustainability of health care facilities they may have to also strengthen other components (such as integration of weather/ climate information in surveillance) and influence significant stakeholders at national or regional levels to implement relevant improvements (such as policies related to water, sanitation and hygiene (WASH), energy or siting of infrastructure).

**Figure 1.** Climate resilience and environmental sustainability in health care facilities



This document highlights four fundamental requirements for providing safe and quality care.



**HEALTH WORKFORCE:**

adequate numbers of skilled human resources with decent working conditions, empowered and informed to respond to these environmental challenges.



**WATER, SANITATION, HYGIENE AND HEALTH CARE WASTE MANAGEMENT:**

sustainable and safe management of water, sanitation and health care waste services.



**ENERGY:**

sustainable energy services.



**INFRASTRUCTURE, TECHNOLOGIES AND PRODUCTS:**

appropriate infrastructure, technologies, products and processes, including all the operations that allow for the efficient functioning of the health care facility.

## Target audience

The document targets health care facility managers in particular, and the health workforce in general. It attempts to cover health care facilities of all sizes (from small primary health care units to tertiary hospitals), and level of resources and development. This implies that the topics covered and interventions proposed in this document are not necessarily relevant to every health care facility. For this reason, the sets of interventions can be used as listed, modified as required, or supplemented with new interventions following the model proposed.

Although focused on the health system, and in particular on health care facilities, this document acknowledges that effective interventions towards strengthening climate resilience and environmental sustainability often depend on good cross-sectoral action. This is particularly true for water and energy access, construction, building, retrofitting, treatment and removal of health care waste, environmental standards, supply chains and information, and surveillance. Many actions will need to be undertaken by sectors and decision-makers outside the health care facility and therefore health sector officials will need to influence, inform and request interventions by local and national governments and policymakers (such as issue improved WASH standards for health facilities).

## How to use this guide

Most users would benefit from reading the whole document before deciding to implement interventions. Chapter 1 discusses the public health rationale, and the investment case for climate resilient and environmentally sustainable health care facilities. It is key to understanding the approach to be taken. Chapter 2 provides the policy context and background information on the baseline or essential requirements for health care facilities to be able to provide safe and quality health care, upon which resilience and environmental sustainability should be built. Chapter 3 introduces key concepts, the goals, objectives and proposed framework for the implementation of interventions aiming to strengthen climate resilience and environmental sustainability. This chapter is key to understanding how interventions are chosen, and the process to implement them. Chapter 4 presents the proposed interventions, organized into 24 tables around the four broad areas of the framework. Additional interventions can be added using the model provided.

## 1.1 PUBLIC HEALTH RATIONALE FOR CLIMATE RESILIENT AND ENVIRONMENTALLY SUSTAINABLE HEALTH CARE FACILITIES

Health care facilities and more broadly the health sector, though profoundly impacted by climate-related shocks and stresses, have an opportunity to significantly reduce global GHG emissions. Therefore, facilities can respond to the growing climate emergency by not only building resilience to extreme weather events and long-term stresses so as to continue protecting the health of their population, but also through reduction and eventual elimination of all environmental contaminants released by their operations. Box 1 provides examples of key areas of risk within health care facilities.

### Box 1. Climate resilience and environmental sustainability in relation to environmental determinants of health in health care facilities

**Water:** Much of the health care delivery in developing countries still takes place in settings with inadequate or non-existent municipal water supply or water and wastewater treatment facilities, and in drought-prone areas made worse by climate change. Health care facilities need sufficient quantities of safe water to provide quality health care services. Hand hygiene, drinking and cooking, showering and bathing, and a variety of general and specialized medical procedures all require reliable supply of safe water (note that some medical uses, such as dialysis would require higher quality than would be expected from a public water supply). Water is also essential for cleaning of rooms, beds, floors, toilets, sheets and laundry. It is also central to health care, as it enables patients to remain hydrated, to clean themselves and thus reduce their risk of infection.

**Health care waste:** Over half of the world's population is estimated to be at risk from environmental, occupational or public health threats resulting from improperly treated health care waste (2). Improper health care waste management can occur for several reasons, such as lack of awareness about the health hazards related to health care waste, inadequate training in proper waste management, lack of infrastructure or energy, lack of appropriate regulations or enforcement of existing regulations (3). In addition, transporting health care waste in vehicles using fossil fuels, inadequate incineration, inappropriate incinerator technology, or the incineration of unsuitable materials results in GHG emissions and the release of pollutants into the air.

**Sanitation and wastewater:** In some settings wastewater can be treated on site to remove chemicals that cannot be eliminated in municipal systems. In many countries it is mandatory to reduce biological loading, and then treat the water in a municipal system. However, this is not always possible in rural areas where no service is available or in cities where the municipality requires on-site treatment. In these situations, a range of affordable wastewater treatment technologies are available. One example is sewage treated in a bio-digestion system which will generate methane gas that can be utilized as fuel within the facility. Such technology can be appropriate for small-to-medium scale health care facilities in developing countries. If such systems are functional and well maintained more resilient health care delivery is possible (4).

**Chemicals:** An estimated 1.6 million lives and 45 million disability-adjusted life-years were lost in 2016 due to exposure to selected chemicals (5). Chemicals are ubiquitous in health care facilities and used for unique purposes, such as in chemotherapy to treat cancer, or as disinfectants for cleaning and sterilization. In addition, many medical devices such as thermometers which contain mercury are still in use. By addressing chemicals in use, potential exposure and related environmental and health risks in health care facilities, the health sector

can not only protect patient and worker health and the health of surrounding communities, but also actively help demonstrate management of chemicals. The WHO Chemicals road map provides a framework for addressing chemical safety by the health sector in general and health care facilities in particular (6).

**Radiation:** Direct patient exposure to ionizing radiation during medical procedures constitutes the largest anthropogenic source of population radiation exposure overall. Annually worldwide, there are more than 3600 million radiography examinations, 37 million nuclear medicine procedures and 7.5 million radiotherapy procedures. Every year an estimated seven million health workers are exposed to radiation due to their professional activities. While new health technologies, applications and equipment are rapidly being developed to improve the safety and efficacy of procedures, incorrect or inappropriate handling of these technologies may result in potential health hazards for patients, health workers, and the general public. Beyond certain dose thresholds, radiation can impair tissues and/or organs and produce acute effects. If the radiation dose is low and/or delivered over a long period of time there is still a risk of long-term effects, such as cancer (7). This demands radiation safety policies that recognize the multiple health benefits that can be obtained, while addressing and minimizing health risks.

**Air quality:** Ambient air pollution, which is principally driven by fossil fuel combustion, kills an estimated 4.2 million people annually (8). Its health impacts, which include damages to the heart, lungs and every other vital organ, are exacerbated by climate change (9). Many health care facilities contribute to ambient air pollution through on-site fossil fuel energy combustion, medical waste incineration, purchase of energy generated from fossil fuel sources, and procurement of goods that are produced and transported using fossil fuels. Facility vehicle fleets, as well as patient and staff transport systems also contribute to air pollution emitted from transportation, which generates smog, resulting in poor air quality that negatively impacts human health. Health facilities can implement transportation planning and procurement strategies that minimize air pollution and associated GHG emissions. Changing to cleaner fuels and cooking technologies can also reduce indoor air pollution.

**Food:** Health care facilities in many countries are major consumers of food and can therefore model and promote health and sustainability through their food choices. A growing number of health care facilities in high income and low- and middle-income countries that purchase and serve food to patients and workers are reducing their environmental footprint and improving patient and worker health by making changes in hospital service menus and practices. These include limiting the amount of meat in hospital meals, cutting out fast and junk food, composting food waste, producing their own food on site, as well as promoting sustainability by holding farmers' markets for local producers to sell healthy food to the community leading to community resilience.

## Risks to health care facilities from climate change

Climate threats to health systems are particularly disruptive for individuals and communities when they affect health care facilities. Climate change can impact the delivery of health care services in large hospitals and small facilities, in high- and low-income settings alike. Table 1 provides information on the expected health impacts of climate change and risks to health care facilities.

**Table 1. Examples of expected health impacts of climate change and risks to health care facilities**

	<b>Climate change effects</b>	<b>Health risks</b>	<b>Health related impacts (IPCC rating)</b>	<b>Consequences for health care facilities (impacted areas)</b>
<b>Direct effects</b>	Increased number of warm days and nights; increased frequency and intensity of heat waves; increased fire risk in low rainfall conditions	Excess heat-related mortality; increased incidence of heat exhaustion and heat stroke; exacerbated circulatory, cardiovascular, respiratory and kidney diseases; increased premature mortality related to ozone and air pollution produced by fires, particularly during heat waves	Greater likelihood of injury, disease and death due to more intense heat waves and fires <i>(very high)</i>	Infrastructure damage; increase in energy and water usage; threats to patients from heat and air pollution; sudden increase in community cases of heat stroke, asthma and other respiratory diseases overwhelming the facility's capacity; mental health impacts on facility staff <i>(health workforce, energy, infrastructure, technologies and products)</i>
<b>Effects mediated through natural systems</b>	Higher temperatures and humidity; changing and increasingly variable precipitation; higher sea surface and freshwater temperatures	Accelerated microbial growth, survival, persistence, transmission; shifting geographic and seasonal distribution of diseases (such as cholera, schistosomiasis); ecological changes, droughts and warmer temperatures leading to cyanobacterial blooms, pathogen multiplication; extreme events leading to disruption of water supply system and contamination; insufficient or intermittent water access for health care practices; insufficient quality and quantity of water leading to poor hygiene; flood damage to water and sanitation infrastructures; contamination of water sources through overflow	Increased risks of food- and water-borne diseases <i>(very high)</i>	Unexpected outbreaks of food- and water-borne diseases; heat stroke; lack of water or contaminated water in facilities; disrupted supply chain for essential supplies and medicines; issue of boil water advisories; disruption of food supplies; damage to medical equipment <i>(water, sanitation and health care waste; infrastructure, technologies and products)</i>
	Higher temperatures and humidity; changing and increasingly variable precipitation	Accelerated parasite replication and increased biting rates; prolonged transmission seasons; re-emergence of formerly prevalent diseases; changing distribution and abundance of disease vectors; reduced effectiveness of vector control interventions	Increased risks of vector-borne diseases <i>(medium)</i>	Unexpected outbreaks of vector-borne diseases overwhelming response capacity; need for increased surveillance of climate sensitive diseases <i>(health workforce, water, sanitation and health care waste)</i>
<b>Effects mediated by human systems</b>	Higher temperatures and changes in precipitation	Lower food production in the tropics; lower access to food due to reduced supply and higher prices; combined effects of undernutrition and infectious diseases; chronic effects of stunting and wasting in children	Increased likelihood of undernutrition resulting from diminished food production in poor regions <i>(high)</i>	Increased number of patients (particularly children) with diseases related to, or made worse by, undernutrition <i>(health workforce)</i>
	Higher temperatures and humidity	Outdoor and unprotected health workers obliged to work either in physiologically unsafe conditions or to lose income and livelihood opportunities	Consequences on workers' health include risks from lost work capacity and reduced productivity <i>(high)</i>	Risk to health care workers and patients from higher temperatures; mental health impacts on facility staff; power outages <i>(health workforce; infrastructure, technologies and products)</i>

Sources: (1,10)

IPCC: Intergovernmental Panel on Climate Change



The increased frequency and intensity of many natural hazards challenges the infrastructure, support systems and supply chains that health care facilities and their communities depend upon. For example, sea level rise, rain and winds from hurricanes, cyclones, typhoons and tropical storms with increased intensity can cause increasingly widespread and prolonged flooding that disrupts vulnerable infrastructure and transportation systems, as well as the delivery of materials and food, which can lead to release of hazardous substances, the contamination of the environment and health risks (11). Often, health care facilities are not built to physically and operationally cope with these and other climate-related risks, such as droughts, extreme temperatures, fires and changed patterns of climate-sensitive diseases. In some countries, water scarcity and unpredictability in supply is increasingly affecting health care facilities, preventing them from providing essential hand washing, hygiene and infection prevention control services. This is particularly important for facilities to respond to outbreaks.

All risks associated with climate change can impact the functioning of health care facilities directly, and also result in increased demand for their services. For example, flooding can cause significant damage to hospital mechanical equipment while contaminating available water sources. Prolonged high winds can damage roof-top equipment and cause structural damage to buildings and electric transmission lines and other public infrastructure. Health workers protect the health of their communities before, during and after disasters, as first responders to emergencies, but are also vulnerable to the impacts of extreme weather events.

### **Risks to environmental sustainability from health care facility operations**

Health care facilities, when not well designed, equipped and managed, produce adverse environmental impacts, affecting their health workforce and the community they aim to protect. A minimum requirement for climate resilient, safe and quality care is access to reliable sources of energy and safe water; yet many health care facilities lack even these basic resources. Environmental sustainability, from this perspective, means implementing interventions that optimize the consumption of resources (such as water, energy, food), and reduce GHG emissions and waste discharge (including biological, chemical, radiological and wastewater). It also includes procuring goods and services that follow the principles of environmental sustainability. Importantly, sustainability measures need to be evaluated for their performance and functionality, because quality of care should be the most important criteria. Therefore, more sustainable goods, materials and services should be considered when they do not compromise health care provision, and do not adversely affect the health and safety of health care workers. Table 2 lists examples of impacts of unsustainable environmental practices on health care facilities.

Health care contributes to air pollution and GHG emissions through energy consumption (transport, electricity, heating and cooling) as well as product manufacture, procurement, use and disposal. Direct emission sources include those emanating directly from on-site fuel consumption in health care facilities and vehicles owned by health care facilities (known as Scope 1 GHG emissions). Indirect emissions refer to energy used by facilities, such as electricity, steam, cooling and heating (Scope 2 GHG emissions). A third significant source of emission primarily derived from the health care supply chain is through the production, transport and disposal of goods and services, such as pharmaceuticals and other chemicals, food and agricultural products, medical devices, hospital equipment as well as instruments purchased and used by health care facilities (Scope 3 GHG emissions) (12). Several tools are available to measure GHG emissions, such as the Greenhouse Gas Protocol (13), and the Intergovernmental Panel on Climate Change (IPCC) guidelines for national GHG inventories (14).

**Table 2. Examples of impacts on health care facilities from unsustainable environmental practices**

<b>Environmental sustainability concerns from health care facility operations</b>	<b>Health risks to patients, health workforce and the wider community</b>	<b>Health impacts to patients, health workforce and the wider community</b>	<b>Consequences for health care facilities (impacted areas)</b>
<b>Water</b>	Excess water withdrawals leading to water shortages; water inefficiency (broken pipes and plumbing) leading to shortages; not using rainwater harvesting where available; incorrect water storage leading to increased vector breeding sites; potential concentration of pathogens, nutrients or chemicals in local water sources	Exposure to infectious disease agents; increased risks of water- and vector-borne diseases through reduced water access and untreated wastewater reuse for food production; increased likelihood of impacts from concentration of arsenic, iron, manganese, fluorides, phosphorus; increased risk of liver damage, neurotoxicity, risk of cancer, cardiovascular disease	Declining water supply reduces function of water-reliant sanitation systems and hygiene practices (flush toilets, sewerage, treatment, hand washing, medical procedures); unexpected outbreaks of food-, vector- and water-borne diseases; disrupted medical procedures and treatments; increased likelihood of hospital admissions and complex treatment for liver damage, neurotoxicity, cancer <i>(health workforce; water, sanitation and health care waste)</i>
<b>Sanitation</b>	Insufficient numbers and/or unsanitary toilets; damaged and unrepaired sewers resulting in overflow during storms and floods; insufficient cleaning, laundry and sterilization practices	Increased risk of diseases from exposure to pathogens and hazardous substances through increased environmental contamination	Health workers may experience additional risks depending on their work context and level of occupational health and safety; unexpected outbreaks of infectious diseases <i>(health workforce; water, sanitation and health care waste)</i>
<b>Health care waste; chemical and radiological hazards</b>	Untreated or insufficiently treated health care waste in or near the facility; exposure to multiple hazardous chemicals (pesticides, lead, mercury, silver, cleaning products), and pharmaceuticals; accidents from improper handling and disposal of radioactive wastes; waste anaesthetic gases and refrigerants; untreated wastewater used for agricultural irrigation; environmental pollution from waste dumping; production of dioxins and furans from open burning and low-temperature incineration	Exposure to hazardous wastes (biological, chemical, radiological); physical injuries (chemical burns), increased noncommunicable diseases (respiratory, dermal); increased risk of intoxication from absorption, inhalation or ingestion of chemicals; radioactive poisoning, injuries with tissue damage, and DNA damage; increased risk of absorption, inhalation, ingestion or injection of pathogens resulting in infectious diseases (tuberculosis, HIV/AIDS, hepatitis, SARS)	Increased infectious disease cases from health care waste contamination; increased threat to the health workforce resulting in infectious diseases, physical injuries, intoxications and reproductive problems, leading to psychological stress; long-term impacts related to noncommunicable diseases (cancers, respiratory diseases); increased admissions for complex treatments; increased workforce absenteeism <i>(health workforce; infrastructure, technologies and products)</i>

<b>Environmental sustainability concerns from health care facility operations</b>	<b>Health risks to patients, health workforce and the wider community</b>	<b>Health impacts to patients, health workforce and the wider community</b>	<b>Consequences for health care facilities (impacted areas)</b>
<b>Energy</b>	Fossil fuel-based energy leading to air pollution and GHG emissions from transport, medical waste incineration, heating spaces and other equipment and operation processes powered by fossil fuels; insufficient or intermittent access to electricity leading to malfunction or failure of medical equipment and devices (refrigeration of vaccines and some medications, sterilization processes, diagnosis and therapy equipment)	Increased health impacts of air pollution to the health workforce, patients and visitors including respiratory and cardiovascular diseases; increased risk of infectious diseases and deaths due to lack of power for medical electrical equipment and devices	Increase in respiratory disease in patients, communities or staff, overwhelming the facility's capacity; long-term impact to staff (cardiovascular diseases, cancers); increased threat to the health workforce and patients from infectious diseases <i>(health workforce; energy)</i>
<b>Procurement and the supply chain</b>	Inadequate, unsafe and unsustainable procurement (mercury containing medical equipment and devices, lack of energy efficient technologies and renewable energy production, steam equipment, mechanical equipment, refrigerants, transportation, chemical and radioactive products, pharmaceuticals, food, building materials) leading to hazardous waste disposal, air pollution and GHG emissions; unsustainable supply chain products and services leading to air pollution, soil and water, and possibly food contamination; unsafe storage of products	Increased health impacts of air pollution to staff, patients and visitors including respiratory and cardiovascular diseases; increased water- and food-borne diseases from contaminated products; increased risk to human health from biological, chemical, radiological hazards, causing chemical intoxication, infectious diseases, cancers, cardiovascular diseases and respiratory diseases	Increased likelihood of intoxication, infectious diseases, cancers, acute and chronic respiratory diseases, cardiovascular diseases overwhelming the health system and increasing medical expenses <i>(health workforce; infrastructure, technologies and products)</i>

Sources: (3,6,12,15–17)

DNA: deoxyribonucleic acid; HIV/AIDS: human immunodeficiency virus infection/acquired immune deficiency syndrome; SARS: severe acute respiratory syndrome

## 1.2 THE INVESTMENT CASE FOR CLIMATE RESILIENT AND ENVIRONMENTALLY SUSTAINABLE HEALTH CARE FACILITIES

Health care facilities need to take effective measures to withstand the impacts of increasing extreme weather events and other climate-related hazards such as higher temperatures, increasing precipitation over longer periods of time (causing increased flooding), intense but short-lived rainfall (causing flash flooding), decreasing precipitation (affecting places where rainwater harvesting contributes to the water supply systems of health care facilities), and higher winds and storms. Climate change can also create new or exacerbate existing environmental problems, such as increasing contamination of groundwater during droughts, or increasing air pollution. In many countries it is also increasing the risk to people and communities from new and emerging infectious diseases (such as Lyme diseases and West Nile Virus). Many of these hazards can have severe, acute and long-term impacts on mental health (including that of health workers) putting greater pressure on health systems.

Thus, with climate change increasing the risk of severe impacts on health care facilities and placing complex, multifaceted and unpredictable demands on health systems, all new investments in the health sector should contribute to building resilience to climate change (18).

### Box 2. Assessing costs of extreme weather events: Kerala, India and New York, USA

Extreme weather events can increase health system costs in a number of ways. By disrupting health care facilities, including their infrastructure and supply chains of essential food, medicines and other equipment, they increase capital, operating expenses and other costs. The 2018 floods in Kerala, India greatly impacted the public health system in the state. Backup power is set at 72 hours in many countries. In Kerala, hospitals faced power outages anywhere from three to nine days causing inadvertent shutdown of cold storage systems. Many hospitals reported damage to entire stocks of vaccines and other essential refrigeration-dependent medical supplies, along with damage to computer equipment with several hospitals losing patient records (19). The Directorate of Health Services estimated a loss of over US\$ 15 million to government hospitals (20).

In the United States, as per Federal Emergency Management Agency estimates, a single extreme weather event can cost a hospital anywhere from US\$ 600 000 to US\$ 2 billion in infrastructure damages (21), and create ongoing disruption caused by repairs, while trying to maintain hospital operations. In 2012, Hurricane Sandy forced the evacuation of more than 6400 patients from six hospitals and 31 residential care facilities. NYU Langone Medical Center, one of the hospitals with the most damage, experienced nearly US\$ 1 billion in damages, remained fully closed for two months and went without an emergency room for a year and a half (22).

In many settings, resilience can be built incrementally to respond to extreme weather events and stress exacerbated by climate change. In remote low-resource settings, an extreme weather event may be too strong for a health care facility to withstand and rebuilding the facility in a new location may not be realistic as the main intervention. In such cases, in order to strengthen resilience, it may be considered more cost-effective to invest in alternatives (such as temporary infrastructure or solar panel kits in case of energy disruption). Nevertheless, if a new facility is built, the siting (meaning where the facility is physically located) should be the first area of consideration and intervention. By understanding the vulnerability of health care facilities to extreme weather events and investing in climate resilience, catastrophic damage can be avoided, saving money in the long run, and potentially saving lives.

Some interventions require upfront investments, such as installing renewable energy systems. Such investments fuel economic growth, create new employment opportunities, enhance human welfare, contribute to a climate-safe future, and yield economic returns in the medium term (23). Increasingly, in some countries power purchase agreements enable institutions such as hospitals to contract for renewable energy without needing to provide the initial funding for capital investment (24).

Many resilience building actions can be taken at the local level for immediate financial returns, principally through efficiency savings (such as closing doors in a colder climate, switching off lights and computers) and using new energy efficient technologies. These require sufficient training, education, involvement and feeling of ownership among staff (25). The cost of education for such programmes can often be recouped within a year (26).

### **Box 3. Reducing economic costs through cartonless packaging for first-line antiretroviral (ARV) treatments**

The shift to cartonless packaging for first-line ARV drugs has been shown (Global Fund in Zambia, PAHO in Bolivia and Venezuela) to reduce the economic costs of procuring and in-country receipt of pharmaceutical products. Just as an example, changing an order for 200 flasks of ARV drugs from “with carton” to “cartonless” packaging in Venezuela, resulted in a saving of US\$ 62 000 in product costs and US\$ 9150 in transport costs. The product and the quantity remained the same, and the quotes were for travel via air freight.

The nationalization cost of approximately US\$ 18 000 includes clearing the items through customs which has a cost per flight, and not per order. By reducing the number of flights (in this case from 12 to 3) hugely reduced these costs, but represent only a small proportion of the total savings.

The unit cost saving at just under 5% accounts for the majority of the direct financial savings. However, many other unquantified savings exist:

- Reduction in paper used for cartons, single boxes and leaflets.
- Reduction in-country distribution costs due to reduced volume.
- Reduction in storage costs due to reduced space requirements. In addition, to the true cost of this procurement, there are considerable savings to the environment:
- Reduction in carbon dioxide emissions due to reduced volume and therefore reduced number of flights.
- Reduction in chemicals and energy used due to limited printing.

In this example, the saving for one order of 200 flasks equates to US\$ 89 132 (6.25%) with a carbon dioxide saving of 2193 tonnes (15.75%), equivalent to 8 75 754 kilometres driven by an average passenger vehicle.

Note: The total kilogram of carbon dioxide for freight is calculated by multiplying the total tonne km travelled by the kilogram of carbon dioxide per tonne km (0.606 for long-haul flights >3500 km) and then by the km uplift factor (109%).

Sources: (80,81)



# CHAPTER 2

## 2 BACKGROUND

### 2.1 FUNDAMENTAL REQUIREMENTS TO PROVIDE SAFE AND QUALITY CARE

#### Health workforce and the global action plan on health employment and inclusive economic growth

A skilled health workforce is necessary to accelerate UHC and global health security. However, a global shortage of 18 million health workers is projected by 2030 (27). The United Nations General Assembly (UNGA) recommended that governments facilitate investments in education, skills and decent job creation in the health and social sectors recognizing that “these actions are not only essential to the achievement of the health-related Sustainable Development Goals (SDGs), but will also generate benefits across the Goals, including the creation of decent jobs, the reduction of youth unemployment, the enhancement of women’s economic empowerment and participation and inclusive growth” (27). In 2017, the World Health Assembly (WHA) adopted a Resolution to implement the UNGA recommendation, recognizing the need to substantially increase the protection and security of health and social workers and health facilities in all settings, including acute and protracted public health emergencies and humanitarian settings; and emphasizing that skilled and motivated health and social sector workers are integral to building strong and resilient health systems (28).

Countries with climate change vulnerability present specific workforce challenges requiring the involvement of the health workforce in implementing adaptation measures to climate change in the health sector (29). “Accelerate progress towards universal health coverage and attaining the goals of the 2030 Agenda for Sustainable Development by ensuring equitable access to health workers within strengthened health systems” is the vision of WHO/ILO’s five year action plan (30). Addressing the challenges to build climate resilient and environmentally sustainable health care facilities is an important part of this work.

Many hazardous chemicals that are present and in use in health care facilities can pose a health risk to health care workers, patients and others. Availability of environmental services are critical for promoting and facilitating the use of safer alternatives to currently used chemicals and the sound management of toxic health care waste, as well as to reduce the use of mercury in health care devices and manage mercury-contaminated wastes (6,31,32). WHO’s Chemicals road map to enhance health sector engagement calls for action on risk management of chemicals in health care settings (6). In relation to health care workers, the road map asks for actions to develop and implement awareness campaigns about chemicals of concern and established best practices for safe chemicals management (6).

An important concern is the need to protect health workers from violence, harassment and discrimination, and promoting safe working environments and conditions at all times (33). A WHO review found that there were 594 attacks on health care emergency settings in 19 countries during 2014 and 2015, resulting in 959 fatalities and 1561 injured persons (34). The biggest current challenge to the health workforce is the COVID-19 pandemic (Box 4).

#### **Box 4. Occupational safety and health in public health emergencies: the case of the COVID-19 pandemic**

In recent decades the world has experienced a range of disasters and public health emergencies including radiation emergencies (Chernobyl, Fukushima), chemical emergencies (the Bhopal toxic gas leak, Deepwater Horizon oil spill), and weather-related emergencies including floods, droughts, storms, heat waves and wildfires. There have also been emergencies from infectious disease outbreaks such as severe acute respiratory syndrome (SARS), Middle East Respiratory Syndrome–coronavirus (MERS-CoV), Ebola virus disease, and more recently the COVID-19 disease caused by SARS CoV-2. All these events have posed a high risk of injuries, chronic and infectious diseases, and in some cases resulted in fatalities among health and emergency response workers.

Health workers are at the frontline of the COVID-19 outbreak response and thus exposed to hazards that put them at risk of infection. Insufficient measures for infection prevention and control, occupational safety and health, mental health and psychosocial support for health workers in case of SARS CoV-2 infections, have resulted in high rates of absenteeism and depleted the health workforce. The major occupational risks for SARS CoV-2 infection among health workers include late recognition of COVID-19 disease in patients, working in a high-risk department, longer duty hours, suboptimal adherence to infection prevention and control measures, such as hand hygiene practices, and lack of or improper use of personal protective equipment. Besides the threat of infection, health workers face psychosocial hazards, which are exacerbated during emergencies where demands increase. Long working hours, shift work, high workload and other psychosocial hazards can lead to fatigue, occupational burnout, increased psychological distress or declining mental health, affecting the health of health workers, and the quality and safety of care delivered.

*Sources: (35,36)*

#### **Global movement to provide better water, sanitation and hygiene services and minimum standards**

The availability of sustainable WASH and waste management services supports the core UHC aspects of quality, equity and dignity for all people, especially in maternity and primary care settings where they are often absent (37,38). Basic WASH services in health care facilities are fundamental to providing quality care and for ensuring that primary health commitments are achieved (30). It can also improve health outcomes at the community level. The lack of adequate sanitation and safe drinking water increases the spread of health care-acquired enteric infections and contributes to unnecessary disease as well as antibiotic resistance. Facility hygiene is key to preventing nosocomial infections and critical for outbreak control in the context of COVID-19 and other epidemic diseases such as cholera. Failure to provide good WASH services may lead health care facilities to become the loci of infections in outbreaks. Thus, adequate WASH services in health care facilities can lower the risk and spread of expensive, hard-to-treat and life-threatening antibiotic-resistant infections. Access to energy, water and hygiene facilities also contributes to health worker retention (39). WASH services in health care facilities are substandard the world over with one in four health care facilities globally having no basic water services, and one in five having no sanitation services, impacting 2.0 and 1.5 billion people, respectively. Across all regions, WASH services in health care facilities fall short of WHO and national standards, with WHO African Region being the worst impacted (40).



In 2018, a Global Call to Action to elevate the importance of and prioritize action on WASH in all health care facilities (including primary, secondary and tertiary facilities in both public and private sectors), issued by the UN Secretary-General recognized the important role WASH plays in preventing infections, saving lives and improving the quality of care. All UN agencies, Member States and partners are being asked to invest more in this critical component for health and well-being (40). In 2019, 194 Member States unanimously committed to greater leadership, investments and tracking through a WHA Resolution (WHA72.7), calling for universal access to WASH in health care facilities (41). WHO and the United Nations Children's Fund (UNICEF) are coordinating a global effort to support countries in implementing the Resolution and share tools, experiences and strategies (42).

#### **Box 5. Lao People's Democratic Republic (PDR) safe, clean and green health care facilities**

A 2014 service availability and readiness assessment in Lao PDR showed that less than half of the health centres and district hospitals had improved water and sanitation services. The Ministry of Health (MoH) has since prioritized the development of policies strategies, basic health facility environmental standards and health care waste management regulations. The need to establish a nationwide monitoring system, provide systematic operational funding support, enhance staff capacity to manage WASH operation and maintenance in facilities and develop more "climate smart" standards was identified. In 2016, the MoH began implementing the Water and Sanitation for Health Facility Improvement Tool (WASH FIT) (43) in two flood- and drought-prone provinces to ensure that health care facilities meet climate smart standards for infrastructure and in an effort to prevent accelerated degradation from environmental exposure, particularly from climate-related events such as flooding.

The MoH has begun implementing a set of comprehensive interventions in 46 districts and seven provincial hospitals to make them "Safe, Clean and Green" by making buildings and operations more resilient, and thereby mitigating their impact on the environment and reducing pollution. Training, assessment, improvement and monitoring plans are developed with supportive supervision to ensure they are followed. Green technologies such as autoclaves are supplied, broken lamps replaced with LEDs, heat reflective paint is used, and water quality testing equipment is made available. Lastly, repairs to WASH infrastructure are undertaken, including rehabilitating hand washing stations, toilets, water filters and tanks, sharps pits and waste management facilities, and building pit latrines. Hospitals are then scored using the country tailored "Safe, Clean, Green and Climate Resilient WASH for health care facility indicators" based on essential environmental health standards for health care facilities and considered to be a "Safe, Clean and Green" facility. WASH FIT implementation will be scaled up to ensure more health facilities have sustainable water, sanitation and hand hygiene services to help in responding to public health emergencies, during the COVID-19 pandemic and beyond.

### **Global movement to provide increased energy access and minimum standards for energy**

Access to adequate, reliable, sustainable and affordable modern energy services is crucial for socioeconomic development. In health services, power, cooling and thermal heating is required for the operation of basic services, including lighting, refrigeration, ventilation, communications, cooking, cleaning, laundry and computer systems. It is also required for the safe management of medical wastes, as well as for the operation of essential medical devices, such as emergency surgical, laboratory and diagnostic equipment (44). Nevertheless, many health care facilities in less developed countries lack adequate energy access. A study of 11 sub-Saharan African countries found that roughly one in four health facilities had no access to electricity, and only about one-third

of hospitals had access to reliable electricity (45). A study of health care facilities in 78 low- and middle-income countries, showed 59% lacking reliable energy services (46). These and many other health care facilities contribute marginally to emissions from electricity generation, and the priority is to grant them access to electricity as soon as possible. Also as many unelectrified public service institutions, including health care facilities, are located in poor remote areas where traditional energy service providers are not available, off-grid solar photovoltaic power, or other forms of renewable energy, could be an opportunity to provide clean, cost-effective and reliable electricity (47).

Health care facilities have an important role in helping reduce GHG emissions. This can be achieved by switching to off-grid renewable sources of energy as well as reducing wasted resources by improving efficiency in transport and electricity. A first step is to measure energy usage to set targets for optimal usage. There are a few estimates of the fraction of global or national GHG emissions that result from health care sector activities. Most national estimates are from high-income countries, which are responsible for the majority of overall emissions. In 2015, the United Kingdom's National Health Service reported that health care sector emissions represented 39% of England's public sector emissions. A 2007 study in the United States found that 8% of all emissions were health care related, and a revised 2013 study increased this fraction to 9.8% (18). An estimated 5–15% of carbon emissions are from health systems in developed countries in the WHO European Region (48). Global modelled estimates indicate that health care is responsible for 4.4% of global GHG emissions, with the largest share coming from the US, China and the European Union. Over 70% of these emissions are primarily derived from the health care supply chain through the production, transport and disposal of goods and services, such as pharmaceuticals and other chemicals, food and agricultural products, medical devices, hospital equipment and instruments (12). This calls for urgent action on low-carbon procurement. The recently launched Health and Energy Platform of Action aims at strengthening political and technical cooperation between the health and energy sectors to accelerate transition to clean energy, which is particularly important in unserved areas (49).

#### **Box 6. Access to electricity**

Where grid electricity is unreliable (or non-existent), renewable energy systems have the potential to supply a health care facility with cost-effective and reliable electricity. These include solar photovoltaic systems in countries with abundant sunlight; aeolic energy in countries with sufficient wind; and small hydroelectric systems in countries with suitable water resources for generating clean energy to power health care facilities and local communities (50).

However, while renewable energy systems contribute towards climate resilience, climate change risks (such as extreme weather events) are a threat; for example strong storms may severely damage systems such as photovoltaic panels (51). Climate-related threats include several of the climate change related risks: storms, floods and other severe weather events, and also droughts, heat waves and wildfires, all of which can affect both power generation and power delivery (52). Therefore, special attention is needed in the identification, location, installation and maintenance of appropriate sources of renewable energy.

### **Global actions to protect health care facility infrastructure**

This document focuses on the basic systems and services that allow a health care facility to function. This includes both structural and non-structural components, such as the premises, both in their strength of structure and location (i.e. climate resilience aspects), as well as their impact to the surrounding environment and communities, resulting from transport, procurement practices of products and services, machines and medical devices and other equipment (i.e. environmental

sustainability aspects). One of the seven global targets of The Sendai Framework for Disaster Risk Reduction, is to “substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030” (53). SDG 9 (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation) calls for the development of quality, reliable, sustainable and resilient infrastructure, and also upgrading infrastructure and retrofitting industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and processes. WHO’s Safe Hospital Initiative (54) provides specific guidance to ensure the safety, security and functionality of health infrastructure from threats emerging from a range of hazards, including from extreme weather events.

### Box 7. The Hospital Safety Index

A “safe hospital” is a facility whose services remain accessible and functional at maximum capacity, with the same infrastructure, before, during, and immediately after the impact of emergencies and disasters (54). A key element of global progress towards safe hospitals is its operationalization through the development and application of the Hospital Safety Index (HSI) – a rapid and low-cost diagnostic tool for assessing the probability that a hospital will remain operational during emergencies and disasters. HSI yields useful information about a hospital’s strengths and weaknesses and points to the actions required to improve the safety and disaster risk management capacities of a hospital. The HSI guide for evaluators (55) has provided a step-by-step explanation on how to use the 151-item checklist to obtain ratings for structural safety, non-structural safety and functional capacities of the hospital leading to the calculation of HSI.

In summary, the HSI has been a useful global tool thus far. In the WHO Region of the Americas (where more than half of the 16 000 hospitals are located in areas at high risk for disasters in Latin America and the Caribbean), the HSI has helped health facilities to assess their safety and thus avoid becoming a casualty of disasters. In the Republic of Moldova (WHO European Region), all government hospitals have been evaluated using the HSI. Thus, HSI provides a useful method for ascertaining which hospitals need further investment of resources to improve their overall safety and functioning for health system strengthening and disaster risk management. Serbia has used the HSI to assess the safety of a primary health care centre and found it to be a useful tool at the primary care level, as most items were considered of same relevance for primary health care centres as for hospitals.

## 2.2 POLICY CONTEXT

Of the several global and regional mandates for responding to climate resilient and environmentally sustainable health systems and health care facilities, the WHO Global Strategy on Health, Environment and Climate Change, and the 2030 Agenda for Sustainable Development, are especially relevant.

In 2019, the 72nd WHA approved the WHO global strategy on health, environment and climate change, covering all aspects of health and environment with emphasis on climate change, and response to health risks and challenges up to 2030. The strategy has 12 goals under the following heads: (i) people; (ii) UHC; (iii) air pollution; (iv) climate change; (v) water, sanitation and hygiene; (vi) chemical safety; (vii) radiation safety; (viii) health care settings; (ix) workplaces; (x) global and regional settings; (xi) emergencies; and (xii) governance. Under health care settings, the goal is that “All health care facilities and services are environmentally sustainable: using safely managed water and sanitation services and clean energy; sustainably managing their waste and procuring

goods in a sustainable manner; are resilient to extreme weather events; and capable of protecting the health, safety and security of the health workforce." (56). Achieving all other goals will have an impact on health care settings, facilities and the overall health system. The Assembly also approved a Resolution on WASH in health care facilities, ensuring among other actions, that health care facilities have reliable and safely managed water supplies, accessible and safely managed toilet facilities for staff and patients, hand hygiene infrastructure as well as safe waste management systems. It also calls for investments in a sufficient and well-trained health workforce (41).

The 2030 Agenda for Sustainable Development, adopted by all UN Member States in 2015, provides a shared blueprint for peace and prosperity for the people and the planet, now and into the future (57). At its heart are the 17 SDGs, which are an urgent call for action by all countries – developed and developing – in a global partnership. SDGs recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality and spur economic growth – all while tackling climate change. Making health care facilities climate resilient and environmentally sustainable would contribute to achieving SDGs related to climate change, sustainable consumption, water and sanitation, energy, employment, resilient infrastructure and health and well-being (Table 3).

**Table 3. Selected SDGs and targets with implications for health care facilities**

<b>SDGs</b>	<b>Targets</b>	<b>Health care facilities area</b>
13. Take urgent action to combat climate change and its impacts	13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries	Health workforce; infrastructure, technologies and products
	13.2 Integrate climate change measures into national policies, strategies and planning	Health workforce; infrastructure, technologies and products
	13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	Health workforce
12. Ensure sustainable consumption and production patterns	12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	Water, sanitation and health care waste; chemicals management
	12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	Water, sanitation and health care waste; chemicals management
	12.7 Promote public procurement practices that are sustainable, in accordance with national policies and priorities	Infrastructure, technologies and products
6. Ensure availability and sustainable management of water and sanitation for all	6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all	Water, sanitation and health care waste
	6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	Water, sanitation and health care waste; chemicals management
	6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	Water, sanitation and health care waste

<b>SDGs</b>	<b>Targets</b>	<b>Health care facilities area</b>
7. Ensure access to affordable, reliable, sustainable and modern energy for all	7.1 By 2030, ensure universal access to affordable, reliable and modern energy services	Energy
	7.2 By 2030, increase substantially the share of renewable energy in the global energy mix	Energy
	7.3 By 2030, double the global rate of improvement in energy efficiency	Energy
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	8.8 Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment	Health workforce
9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities	Infrastructure, technologies and products; chemicals management
3. Ensure healthy lives and promote well-being for all at all ages	3.8 Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all	Access to health care facilities
	3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination	Water, sanitation and health care waste; chemicals management

Source: (57)

Other relevant global mandates include: universal health coverage, primary health care, Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC), Kigali Amendment to the Montreal Protocol on substances that deplete the ozone layer, Strategic Approach to International Chemicals Management (SAICM) and the Sound Management of Chemicals and Waste Beyond 2020, Stockholm Convention on Persistent Organic Pollutants, Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, Minamata Convention on Mercury, and Sendai Framework for Disaster Risk Reduction (see Annex A for details on all these mandates).



CHAPTER 3

# 3 APPLYING A CLIMATE RESILIENT AND ENVIRONMENTALLY SUSTAINABLE LENS TO HEALTH CARE FACILITIES

## 3.1 GOALS AND OBJECTIVES OF THE PROPOSED FRAMEWORK

### Goals

The proposed framework aims to increase the climate resilience of health care facilities to protect and improve the health of their communities in an unstable and changing climate, while optimizing the use of resources and minimizing the release of wastes by becoming environmentally sustainable.

### Objectives

Specifically, this document aims to:

- Guide professionals working in health care settings to understand and effectively prepare for the additional health risks posed by climate change.
- Monitor, anticipate, manage and adapt to the health risks associated with climate change.
- Guide health care facility officials to work with health determining sectors (including water and sanitation, energy, transportation, food, urban planning, environment) to prepare for additional health risks posed by climate change through a resilience approach, and to promote environmentally sustainable practices in providing these services.
- Provide tools to assist health care facility officials assess their resilience to climate change threats, and their environmental sustainability based upon the appropriate use of resources (in particular water and energy and sustainable procurement), and release of hazards (biological, chemical, radiological), to their surrounding environment.
- Promote actions to ensure that health care facilities are constantly and increasingly strengthened and continue to be efficient and responsive to improve health and contribute to reducing inequities and vulnerability within their local settings.

### Box 8. Key definitions

**Health systems** include an ensemble of all public and private organizations, institutions and resources mandated to improve, maintain or restore health as well as incorporate disease prevention, health promotion, and efforts to influence other sectors to address health concerns in their policies (58).

**Health care facilities** provide direct health treatment procedures for patients, and include hospitals and health care clinics. In the context of emergencies, health care facilities are hospitals, primary health care centres, isolation camps, burn patient units, feeding centres and others (59).

**Resilience** in the context of climate change is the capacity of social, economic and environmental systems to cope with a hazardous event, trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation (60).

**Health system resilience** is the capacity of health actors, institutions and populations to prepare for and effectively respond to crises; maintain core functions when a crisis hits; as well as stay informed through lessons learned during the crisis and reorganize if conditions require it (61). It is the ability to absorb disturbance, to adapt and to respond with the provision of needed services (62).

**Climate resilient health systems** are capable of anticipating, responding to, coping with, recovering from and adapting to climate-related shocks and stress, so as to bring about sustained improvements in population health, despite an unstable climate (1).

**Environmentally sustainable health systems** improve, maintain or restore health, while minimizing negative impacts on the environment and leveraging opportunities to restore and improve it, for the benefit of the health and well-being of current and future generations (63).

**Climate resilient and environmentally sustainable health care facilities** anticipate, respond to, cope with, recover from and adapt to climate-related shocks and stresses, while minimizing negative impacts on the environment and leveraging opportunities to restore and improve it, so as to bring ongoing and sustained health care to their target population and protect the health and well-being of future generations (1,63).

## 3.2 INCREASING CLIMATE RESILIENCE IN HEALTH CARE FACILITIES

### What is climate resilience?

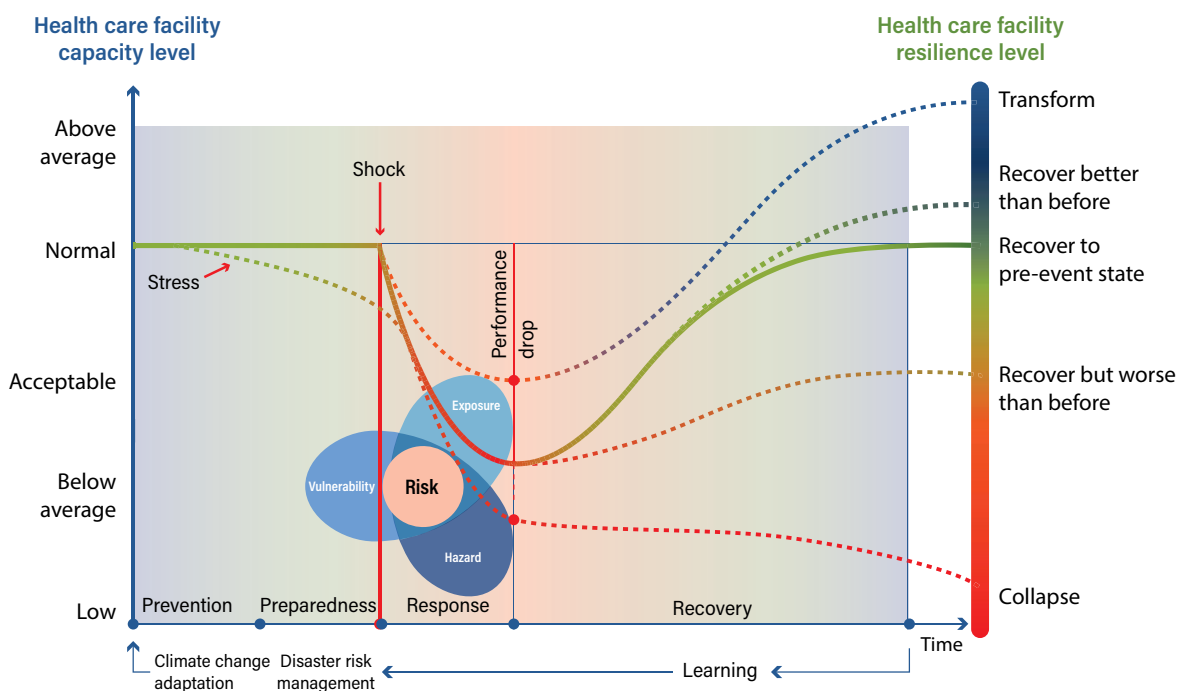
In the context of this guidance **climate resilient health care facilities** are those that are capable to anticipate, respond to, cope with, recover from and adapt to climate-related shocks and stress, so as to bring ongoing and sustained health care to their target populations, despite an unstable climate (1).

Figure 2 illustrates the important dynamics affecting the climate resilience of health care facilities. Building on the concept of risk as a function of hazards, vulnerabilities and exposures (60,64) (illustrated as a triangle, as defined by IPCC), it depicts how hazards, in the form of a sudden event (a shock, such as a storm or sudden flood), or a slow-onset event (a stress, such as a drought, sea-level rise, or high volume of cases from a climate-related disease), will reduce the health care facility's level of performance and capacity (left axis), through a combination of impacts on key facility elements (for example, increasing vulnerability of the health workforce, or increasing exposures from WASH



and health care wastes, energy or infrastructure), and in turn increasing risks. The level of resilience (right axis) will define whether the facility will recover its pre-event state, recover but to a state worse than before, or recover and attain a level of resilience greater than before the event. Figure 2 also highlights the risk management steps for prevention, preparedness, response and recovery (65).

**Figure 2.** Climate resilience in health care facilities



Sources: (50,64,66)

**Box 9. Stress-testing to identify vulnerabilities to climate change and adaptation measures**

Building climate resilience at the health facility level requires an understanding of current and projected climate conditions, health system demands (such as population growth, demographic changes) and anticipated health system capacity (such as health workforce, financing, technology adoption, connections with community partners and stakeholders). Stress-testing is a tool that allows health authorities to develop and use evidence-based climate scenarios in a table-top simulation to work through future scenarios and identify potential vulnerabilities to climate change impacts and effective adaptation measures. For example, a scenario describing a flood event could be developed based on available climate data, the experiences of climate impacts in similar jurisdictions and the opinion of climate and health research experts. Coupled with the knowledge of health facility stakeholders regarding facility characteristics and capacity (such as health workforce surge capacity, the elevation of the facility and key transport networks, the state of facility structures, available stockpiles of medicines and key resources if access is limited), an understanding of the facility's vulnerability and adaptation needs can be developed. Conducting a scenario-based stress-test is an opportunity to build partnerships with key stakeholders within and external to the health facility (such as for emergency response) that can be leveraged for both ongoing climate-resilience building and when responding to future events.

Source: (67)

Key interventions to build resilience in health care facilities include bolstering the health workforce (such as training, communications), optimizing access to food, water, sanitation and health care waste services through monitoring, assessment and management, improving access and reliability of energy sources (such as back-up systems, alternative sources of energy, emergency plans), as well as the adaptation of infrastructures and technologies (such as building retrofits, adoption of new systems and technologies, sustainability of operations). The WHO Operational Framework provides additional areas to be considered in specific contexts for strengthening climate resilience in health care facilities, such as strengthening health information systems. Climate change, health vulnerability and adaptation assessments (68) can provide the necessary information and stakeholder partnerships to aid in these activities.

#### **Box 10. Integration of the COVID-19 pandemic into heat-stress planning**

In addition to dealing with climate change related health risks to the general population (such as heat stress), health workers and facilities will have to ensure that adaptation measures (e.g. heat-stress plans) integrate relevant current programmes and responses in a comprehensive way, rather than approaching climate change and health as a vertical programme.

The COVID-19 pandemic amplifies the health risks for the general population and health workers during extreme weather events. During hot weather for example, some groups – older people, persons with pre-existing health conditions, living in crowded or poor-quality housing – are susceptible to both COVID-19 disease and heat stress, which could add to the burden of health care facilities. Health workers may also be exposed to heat stress due to the use of personal protective equipment which may impede cooling. However, it is essential that health workers are protected from both infection and heat stress. Thus, crucial considerations for health services and systems in relation to heat stress safety and COVID-19 disease prevention include:

- Priority and focus by medical and public health workers on COVID-19 pandemic preparedness and response activities that may compromise the capacity of health services and systems to prevent and manage heat stress.
- Public fear of seeking health care during the COVID-19 pandemic that may result in preventable heat-related deaths.
- Heat stress that can present a range of symptoms similar to early COVID-19 disease symptoms.

Given the compound risks from heat stress and COVID-19 disease, it will be essential to integrate both considerations into awareness-raising communications, and strengthen coordination among decision makers. Communities and health services should update and review communications and heat action plans in a way that potential COVID-19 pandemic preparedness responses are properly integrated (such as physical distancing), and make periodic changes to these plans as the situation evolves. In these unprecedented circumstances, strategic and collaborative actions can significantly enhance community and health system resilience to prevent avoidable illness and death from hot weather during the COVID-19 pandemic.

*Source: (69)*

### 3.3 INCREASING ENVIRONMENTAL SUSTAINABILITY IN HEALTH CARE FACILITIES

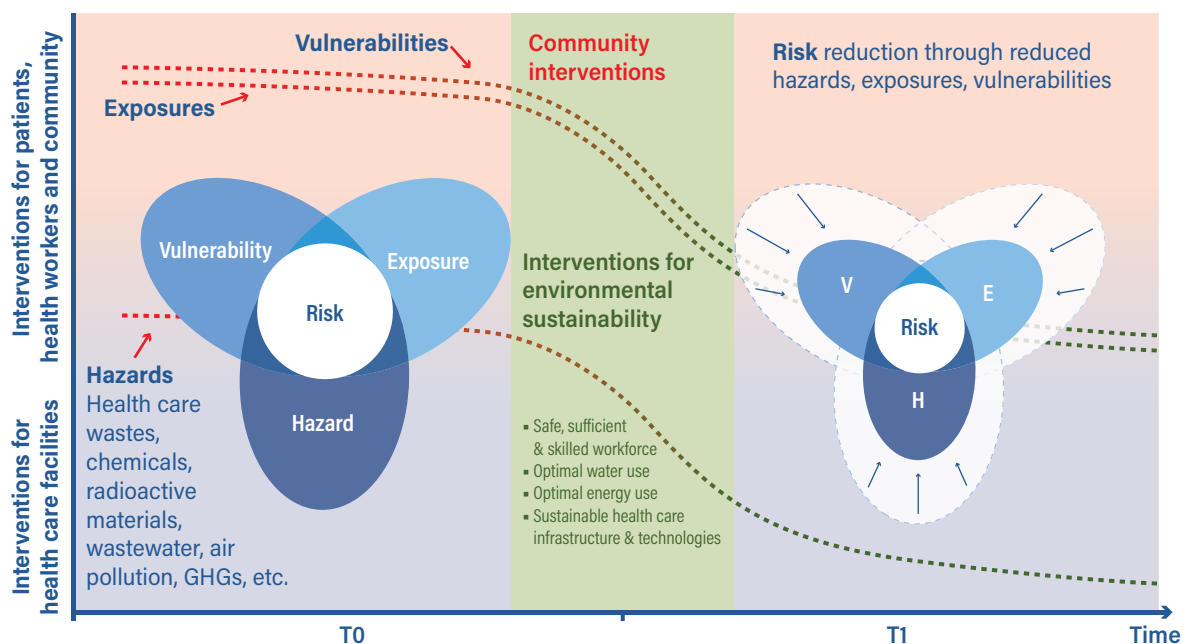
#### What is environmental sustainability?

There are several definitions of environmental sustainability. In the context of this guidance **environmentally sustainable health care facilities** are those that improve, maintain or restore health, while minimizing negative impacts on the environment and leveraging opportunities to restore and improve it (63).

Following the concept of risk as defined by the IPCC (60,64), environmental sustainability aims to reduce hazards resulting from health care facility operations (such as health care waste), while simultaneously working towards decreasing exposures and vulnerabilities (both within and outside the health care facility) (Figure 3). IPCC notes with very high confidence that the most effective vulnerability reduction measures for health in the near-term are programmes that implement and improve basic public health measures such as provision of clean water and sanitation, secure essential health care including vaccination and child health services, increase capacity for disaster preparedness and response, and alleviate poverty (60).

Facilities need to also optimize their use of natural resources, principally that of water and energy, ensuring a balance that is not too low to maintain good functioning, nor too high to waste and deplete resources. Thus, in many health care facilities in low resource settings, the aim is to increase their access and use of water and energy. Interventions for environmental sustainability are key to move from higher risk (see left side of graphic in Figure 3) to lower risk situations (see right side of graphic in Figure 3). Examples of hazards that threaten environmental sustainability include biological hazards (epidemics, pests) and human made hazards (chemical, radiological, biological wastes, water and energy supply disruptions, air pollution, food and water contamination, insufficient health workforce). Interventions to reduce hazards occur mostly in health care facilities (see lower half of graphic in Figure 3), while interventions to reduce vulnerability and exposure occur mostly on patients, the health workforce and the wider community (see upper half of graphic in Figure 3).

**Figure 3.** Environmental sustainability in health care facilities



### Box 11. Green Deal on sustainable health care in the Netherlands

The Green Deal on sustainable health care aims to reduce the negative impact of the health care sector on the environment. Health care institutions, government authorities and companies work together to ensure that health care benefits the people, society and the planet, and does not cause more pollution or health problems. More than 200 parties, including health care providers and a range of profit and non-profit organizations, have signed the Green Deal. While each one has its own goals, they all contribute to the following four targets.

(i) A 49% reduction in carbon emissions by 2030 (as compared with 1990), and reaching carbon neutrality by 2050 – in line with the goals set out in the National Climate Agreement, through striving for energy-efficient buildings, transport and procurement, use of renewable energy, as well as reducing the amount of energy used by hospitals and other care institutions.

(ii) Circular health care – using less raw materials and minimizing waste; examples are pilots for recycling medical materials (such as single use plastics, incontinence materials), reducing food wastage, and developing sustainable procurement guidelines.

(iii) Less pharmaceutical residues in surface water – includes a wide range of initiatives aimed at good use of pharmaceuticals and reducing wastage; examples are efforts aimed at proper disposal of unused medicines or pilot actions such as the use of urine collection bags for patients treated with diagnostic contrast agents.

(iv) A healthy environment for health workers and patients – means providing a good living and working environment in care homes and hospitals which improves the health and well-being of patients and workers. Initiatives are aimed at gathering knowledge and creating collaborative networks; examples are building a repository of best practices and effective interventions of partners, and creating a network to mobilize leadership towards sustainable nutrition in health care facilities.

The Sustainable Care project team at the Netherlands Ministry of Health, Welfare and Sport stimulates, supports and facilitates partners with knowledge on overcoming obstacles towards sustainability, through a newsletter, organizing events to share knowledge and good examples, and creating collaborative networks.

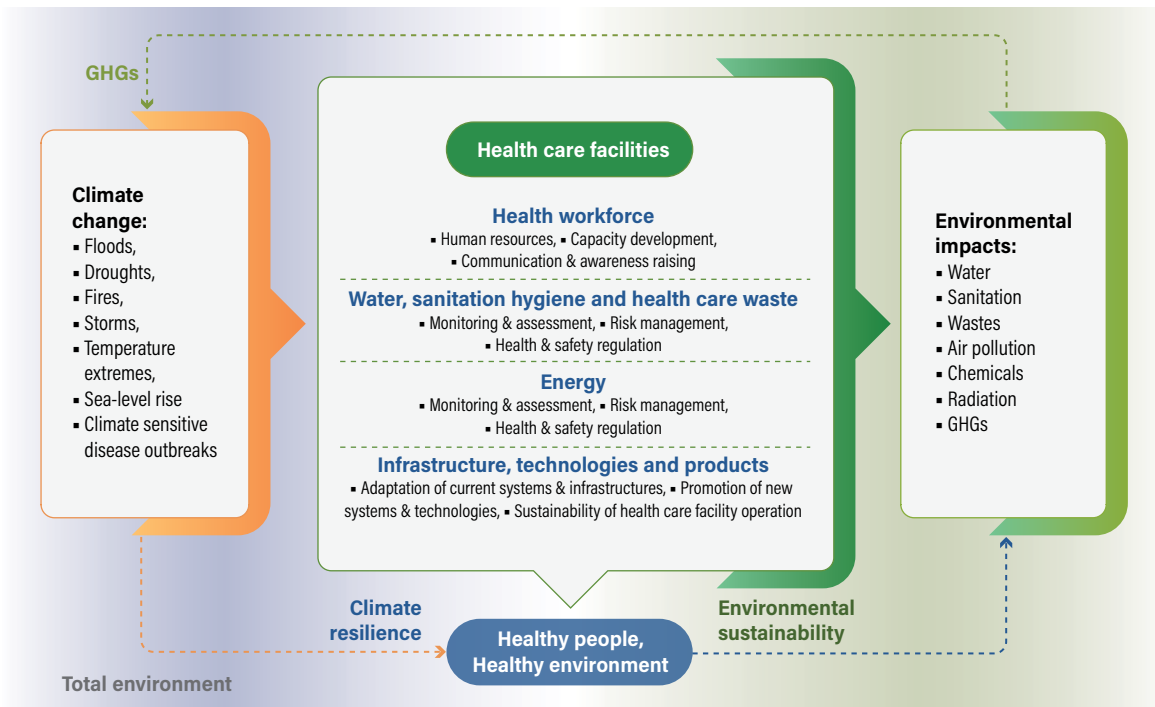
Source: (70)

## 3.4 A FRAMEWORK FOR ACTION

**Climate resilient and environmentally sustainable health care facilities** can be defined as those capable to anticipate, respond to, cope with, recover from and adapt to climate-related shocks and stresses, while minimizing negative impacts on the environment and leveraging opportunities to restore and improve it, so as to bring ongoing and sustained health care to their target population and protect the health and well-being of future generations (1,63).

As depicted in Figure 4, there are three objectives under each of the four fundamental requirements to provide safe and quality care that are central to the action framework (1). These focus specifically on health care facilities and expand the scope of the work to include environmental sustainability. A set of potential interventions that health sector decision makers can employ to enhance both climate resilience and environmental sustainability are discussed in the next section.

**Figure 4.** Framework for building climate resilient and environmentally sustainable health care facilities

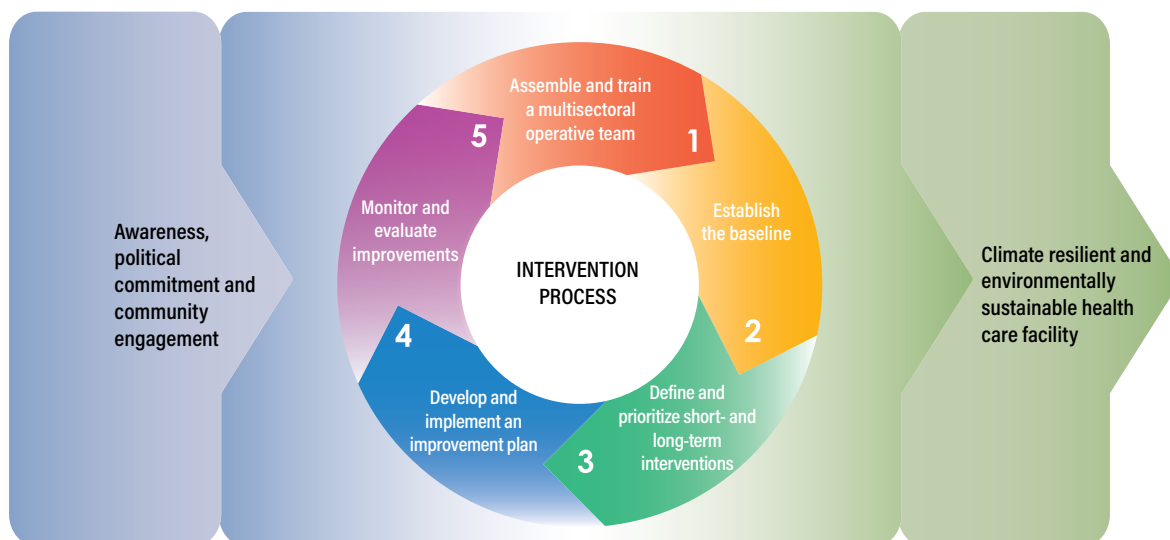


Many of the required interventions are linked and therefore may address multiple objectives that do not always fall neatly into one category. For example, a climate resilient intervention to cope with recurrent drought may be to harvest rainwater during the rainy season and store it in containers for later use. An environmentally sustainable intervention would be to ensure that the containers are properly sealed so that they do not become mosquito breeding sites and lead to dengue outbreaks. Building climate resilience and environmental sustainability are best addressed together for achieving synergies and resource efficiency.

### 3.5 SUGGESTED PROCESS AND STEPS FOR INCREASING CLIMATE RESILIENCE AND ENVIRONMENTAL SUSTAINABILITY IN HEALTH CARE FACILITIES

As the interventions proposed here are for individual health care facilities, what may be applicable to one, may not be applicable to others. Interventions do not allow for comparisons between facilities, and therefore an index is not proposed, although health care facilities could develop one in the process. Thus, although there is no prescribed process for implementing these suggested interventions, there are common approaches that can be adapted depending on the size of the health care facility, the identification of key areas of concern, and their capability. Figure 5 describes these steps.

**Figure 5.** Proposed process and steps for increasing climate resilience and environmental sustainability in health care facilities



### 1. Assemble and train a multisectoral operative team

Most processes will need supportive senior management to get started and begin by the facility manager assembling a team to assess the baseline situation and needs of the health care facility. Staff awareness, involvement of key non-health sectors and community engagement are needed early in the process. Many of the interventions can only be implemented with the involvement and support of local or national governments, and wherever possible, policy actors from outside the health care facility should be involved in the assessment.

### 2. Establish the baseline

A baseline, and current situation in terms of climate resilience and environmental sustainability is determined by the team. The team will ascertain the scope of the assessment, i.e. all areas of work included in this guidance or just a priority focus (such as climate resilient WASH). The team will also decide whether additional considerations should be added to the assessment to determine baseline conditions of the health care facility. The checklists included in section 4 of this guidance can be used and adapted to conduct the baseline assessment.

To better understand the baseline conditions and current and future vulnerabilities of health care facilities to climate change, facilities may consider conducting a climate change and health vulnerability and adaptation (V&A) assessment using WHO suggested methodology (71). The results of the V&A assessment will also inform the prioritization of improvement interventions.

Similarly, to understand and assess the baseline conditions of health care facilities in terms of environmental sustainability, these facilities are encouraged to assess their climate or environmental footprint. This will provide the baseline upon which improvements towards environmental sustainability will be monitored and measured.

### Box 12. Assessing health care facility vulnerabilities and adaptation options

Systematic approaches to assess climate vulnerabilities and identifying and assessing adaptation options can aid health facilities and health supporting infrastructure in building climate resilience, both within specific programme areas or infrastructure assets, and across health systems. Completion of a climate change and health vulnerability and adaptation (V&A) assessment at the local, regional or national level can provide insight on the current and projected health

impacts of climate change in addition to effects on health facilities from extreme weather events or other climate hazards, all of which may contribute to the demands placed on health facilities and health supporting infrastructure. V&A assessments can take different forms and be tailored to the specific needs of the health system or health facility in question, and to the availability of data, time and resources. The process of completing a V&A assessment can help identify and build a coalition of key stakeholders to help advance sustainability and climate resilience building. Tools have also been developed for health care officials to undertake assessments of vulnerability to climate change impacts of specific health facilities – Smart Hospitals Toolkit (Pan American Health Organization (PAHO)/WHO), Sustainable and Climate-Resilient Health Facilities Toolkit (Department of Health and Human Services, USA) and the Health Care Facility Climate Change Resiliency Toolkit (Canadian Coalition for Green Health Care).

Canada's Nanaimo Regional General Hospital (NRGH) applied the Public Infrastructure Engineering and Vulnerability Committee protocol to assess the vulnerability of their hospital infrastructure to climate change and to inform decision-making regarding infrastructure renewal or future development. This resulted in the identification of key vulnerabilities and the creation of a climate-risk matrix that allows decision-makers to apply climate considerations to health facility capital investment priorities. The outcomes of this initiative have inspired Island Health, the health authority responsible for the NRGH, to incorporate climate considerations into all health facility renovations or developments.

Sources: (68,71–79)

### 3. Define and prioritize short- and long-term interventions

Once climate change impacts to the environmental or climate footprint of health care facilities are properly understood, the team will use this information plus the baseline conditions of the health care facility to define and prioritize the interventions required to strengthen climate resilience and environmental sustainability. Prioritization will be determined by different considerations such as available financial resources and timeframe for interventions.

### 4. Develop and implement an improvement plan

The assessment and prioritization of improvement interventions will be followed by the development of an improvement plan. The plan should list suggested actions in order of urgency, as many health care facilities have limited resources for addressing all problems together. Similarly, the plan should detail the timeframe for the implementation of the suggested interventions, the lead actors in implementing them, as well as other potentially relevant stakeholders. Roles and responsibilities of all stakeholders (such as national regulators) should be properly described in the improvement plan.

### 5. Monitor and evaluate improvements towards climate resilience and environmental sustainability

The plan is implemented and monitored over time to assess changes from baseline conditions and decide on any required changes to the improvement plan. The assessment will be conducted in an iterative manner as the team sees necessary based on the context.



# CHAPTER 4






# 4 INTERVENTIONS TO BUILD CLIMATE RESILIENCE AND ENVIRONMENTAL SUSTAINABILITY IN HEALTH CARE FACILITIES

This section lists interventions organized into 24 tables, divided under health workforce; water, sanitation and health care waste; energy; and infrastructure, technology and products. Each of these is subdivided into three objectives for both climate resilience and environmental sustainability.

This guidance understands that health care facilities and health sector officials would need to reach out to decision makers outside of the health sector to collaborate on the implementation of some of the proposed climate resilience and environmental sustainability measures. Interventions that may need the support of local or national governments and of other sectors are marked with an asterisk in the tables. It is possible that health care facility officials may not be able to complete all of these at once, and that not all health care facilities will have the required capacity and resources to undertake these interventions. Moreover, as it may not be possible to complete all of these interventions in a short period of time, it may be better to approach the use of this framework as supporting continuous improvement over time. Therefore, identification of needed and priority interventions for a specific health care facility will depend upon the local context.

The proposed list of interventions does not cover every action that may be needed. However, this list provides a comprehensive set of interventions that would significantly increase climate resilience and environmental sustainability in the short and long term. Health care facility staff would benefit by integrating information from this framework and the interventions into regular health facility planning processes, so as to be more efficient and maximize the use of resources.

Interventions listed below can be rated as follows:

-  Indicates either low performance, or unavailable activity, or unable to complete
-  Indicates either medium performance, or activity in progress, or incomplete
-  Indicates either high performance or completed activity, or achieved and tested

## 4.1 HEALTH WORKFORCE INTERVENTIONS

Health workers have a key role in building climate resilience and environmental sustainability of health care facilities. Health care workers are the main actors in ensuring that interventions are effective for their own roles and activities, as well as other components of the framework. Because building climate resilience and environmental sustainability are relatively new approaches for health workers, building awareness, training and empowering health workers are key requirements for the successful implementation of interventions. In many settings, already stressed by lack of staff and resources, building resilience and environmental sustainability need to be integrated as a support to health care work and the protection of health and safety of staff, patients and communities.

### Objectives for the implementation of this component

**Human resources:** Health care facilities having sufficient number of health workers with healthy and safe working conditions, capacity to deal with health risks from climate change, as well as the awareness and empowerment to ensure environmentally sustainable actions.

**Capacity development:** Training, information and knowledge management targeted at health care workers to respond to climate risks and minimize environmental threats resulting from the operation of the health care facility.

**Communication and awareness raising:** Communicate, coordinate and increase awareness related to climate resilience and environmental sustainability among health workers, patients, visitors, target communities, and with other sectors.

#### 4.1.1 Interventions on climate resilience

The health workforce may be affected by two main mechanisms as a result of climate change. The first relates to changes in the frequency and intensity of extreme weather events and longer term climatic changes that may affect the facility or their ability to reach the facility. The second is through changed patterns of climate-sensitive diseases, to which the health workforce may not be able to respond in a timely manner. One key requirement is, therefore, to have in place sufficient numbers of skilled and informed health workers. This is a constraint in many countries and needs urgent attention. Another key requirement is ensuring the health and safety of health workers, by identifying occupational hazards to prevent and control exposures (climate and non-climate related).

The health workforce includes not only nurses and doctors and other health specialists, but also staff undertaking diverse occupational activities, such as administration, reception, radiography, maintenance, housekeeping, food service, laboratory work and specialist technicians, cleaning and laundry services, as well as hospital caretakers, dietitians, waste management staff, ambulance assistants and technicians, transport drivers. Workplace risks are therefore varied, and even those not in direct contact with patients can be exposed to contaminating agents of a biological, chemical, radiological or physical nature and prone to ergonomic and psychosocial hazards (17). Efforts to achieve sustainable, healthy and safe working conditions in the health sector are thus important to both improving patient and community well-being, and for reducing the risks to workers engaged in health care related activities. The interventions build overall resilience, and in particular climate resilience of the health workforce.

**Interventions table 4.11A – Human resources:** Health care facilities having sufficient number of health workers with healthy and safe working conditions, capacity to deal with health risks from climate change, as well as the awareness and empowerment to ensure environmentally sustainable actions.

(Health workforce – climate resilience)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Assessment of potential workplace hazards that may arise in emergencies, and planning to address measures to reduce those hazards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workers and local communities work together to promote a health care facility environment safe from climate-related impacts*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Established systems for management of occupational safety and health in all health care facilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Identified minimum needs in terms of health care workers to ensure the operational sufficiency of every health care facility department, in case of climate related disaster or emergency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Established a system of rapidly providing health workers (such as voluntary medical personnel) with necessary credentials in an emergency situation, in accordance with health care facility and health authority policies*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Established post-disaster employee recovery assistance programme according to staff needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Multidisciplinary psychosocial support teams in place for staff, families of staff and patients (such as in emergency and disaster situations)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
An early warning system in place to respond to climate related emergencies*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
A contingency plan for personnel transportation in place to respond to emergencies*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
A disaster risk reduction plan in place for the health workforce to manage measures of prevention, preparation response and recovery from extreme weather events (such as storms, sea-level rise, heat stress, floods, droughts, hurricanes)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
A contingency plan in place for evacuation during or following an extreme event*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Established mutual aid and assistance agreements (such as transfer of patients, sharing of resources and supplies) with other sectors or institutions to have health support (including of health workforce) during response and recovery from an extreme weather event or disaster*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Clearly defined security measures in place for safe and efficient hospital evacuation*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce able to assess potential health impacts and facility loss associated with climate related hazards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Interventions table 4.1.1B - Capacity development:** Training, information and knowledge management targeted to health care workers to respond to climate risks and environmental threats resulting from the operation of the health care facility.

(Health workforce - climate resilience)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Measures implemented to diminish disease burden of climate related hazards by increased health actions of staff and community through prevention and education programmes*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce participates in community educational programmes to assist the local community in reducing climate risks*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce trained to address climate change risks to health through WASH, and chemical and energy related hazards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Established Emergency Operational Committee or hospital Incident Command Group includes climate related emergencies*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
System in place for monitoring injuries and diseases from climate related hazards including monitoring health outcomes to health care workers and vulnerable patients (such as the elderly, immobile, infants, critical care patients) in the event of a climate related emergency or disaster	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Plan in place for relocating hospital equipment, medicines and medical devices during floods or permanent relocation of equipment to higher floors in flood-prone areas*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Improved staff capacity to provide safe and reliable infection prevention and control services, when a disaster or emergency crisis occurs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility staff trained to identify health threats made worse by climate change and climate related events, to reduce associated morbidities from respiratory and cardiovascular diseases, nutrient deficiency, mental health issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Training and exercises provided in areas of potential increased clinical demand following a climate related event or outbreak to ensure adequate staff capacity and competency*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce trained (including exercises, simulations) for early warning system, contingency plan, and disaster preparedness, response and recovery management to address climate change risks and to cope with any emergency from climate related disasters and outbreaks, epidemics and pandemics*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Health workforce trained to detect post-traumatic stress disorder among staff to take prompt action	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility staff responsible for critical systems trained in emergency preparedness and response and to communicate effectively in emergency situations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce receives training and exercises for preparing, responding and recovering from extreme weather-related emergencies*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce receives training and exercises on surveillance systems for climate related diseases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Facility staff trained in protecting their health and safety during an emergency situation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce can implement safe water management in weather-related emergencies and disasters, according to local conditions and disaster magnitude*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce trained to an appropriate standard to maintain the correct level of safety of water quality controls, supplies and alternative sources to the health care facility in both routine and emergency/disaster situations*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Plan in place for water system supplies (such as chlorine, filters or other water treatment technology, rapid water testing kit), during an emergency and disaster response*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Increased health workforce knowledge on waste stream constituents and waste related health care hazards for better monitoring and control in climate related emergency situations*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce trained to an appropriate standard to maintain correct level of chemical safety, and safety of waste management systems of the health care facility in both routine and emergency/disaster situations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce trained to an appropriate standard to maintain correct level of safety of electrical power supply and alternate source (such as generators) of the health care facility in both routine and emergency/disaster situations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Interventions table 4.1.1C - Communication and awareness raising:** Communicate, coordinate and increase awareness related to climate resilience and environmental sustainability among health care workers, patients, visitors, target communities, and with other sectors.

(Health workforce - climate resilience)

Interventions (level of achievement)	Action level			Observations
	Low, unavailable, unable	Medium, in progress, incomplete	High, completed, achieved	
Identified opportunities to learn and increase awareness about climate change, its impacts and co-benefits of sustainable practices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce aware of approaches to childhood development and social outcomes related to nutrition and avoidance of stunting and impaired neurological development due climate change impacts on water supply, food production, infectious diseases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Ongoing awareness raising of health care facility staff, patients, visitors and the community of risks to health from climate related hazards and effective health protection measures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce engaged in community health programmes to improve community health during particular climate risks (such as home care for asthma to reduce health vulnerabilities during episodes of high air pollution or heat waves)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Scheduling of outdoor work for cooler parts of the day and reduce physical demands during hot days	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Considering indoor and outdoor temperatures when planning group activities in hot days or heat waves	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility staff help organize and participate in community disaster planning committees*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Key messages for target audiences (such as patients, staff, public) drafted in preparation for the most likely extreme weather disaster scenarios*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Updated emergency plans as new knowledge on climate risks become available	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Awareness campaigns about chemicals of concern and established best practices for safe chemicals management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Sources: (6,19,54,55,75,82-86)

\* Actions that need the support of local or national governments, or of other sectors

#### 4.1.2 Interventions on environmental sustainability

Much of the environmental impacts from health care facilities relate to issues associated with WASH, wastes (including biological, chemical and radiological hazards), energy and procurement practices. However, these are mediated in part by what the health workforce does or is unable to do. Thus, the health workforce has a large responsibility in ensuring environmentally sustainable practices through their actions. Health care waste, for example, is highly dependent on the actions of health workers. Impacts from biological, chemical or radioactive sources, if not adequately managed and disposed of, will affect health workers, as much as patients, visitors and surrounding communities. Therefore, this is an area particularly amenable to health workforce actions. However, even a well-informed health workforce may be unable to implement all needed actions in all areas. Water sources and energy sources, for example, may not depend on the health care facility or their staff. Similarly, procurement may be done centrally, without consultation or inputs from specific health care facilities. This implies that many interventions proposed in this document may need to be taken at levels other than the health care facility itself and may depend on the local context including the health system, actions by local governments and national policies.

**Interventions table 4.1.2A – Human resources:** Health care facilities having sufficient number of health care workers with healthy and safe working conditions, with the capacity to deal with health risks from climate change, as well as the awareness and empowerment to ensure environmentally sustainable actions.

(Health workforce – environmental sustainability)

Interventions (level of achievement) <span style="color: orange;">■</span> Low, unavailable, unable <span style="color: yellow;">■</span> Medium, in progress, incomplete <span style="color: green;">■</span> High, completed, achieved	Action level			Observations
Ensured protection of the health workforce in vulnerable situations through environmentally sustainable practices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Measures implemented by health workforce to eliminate disease burden among vulnerable populations resulting from environmental hazards in health care facilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Identifying opportunities to improve work practices in environmentally friendly ways, and integrating initiatives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce trained to implement environmentally sustainable interventions for infection prevention and control; and combating antimicrobial resistance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Ensure rapid clean-up and recovery from extreme weather events to avoid indoor air quality problems (such as mold growth associated with floods)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility staff and patients drink filtered tap water when safe*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility staff trained to assess their water use for implementing potential savings measures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility staff monitor and assess water drips, leaks, and unnecessary flows in bathrooms, laundry facilities, kitchen, etc. for prompt repairs*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Interventions table 4.1.2B - Capacity development:** Training, information and knowledge management targeted to health care workers to respond to climate risks and environmental threats resulting from the operation of the health care facility.

(Health workforce – environmental sustainability)

Interventions (level of achievement)	Action level			Observations
	Low, unavailable, unable	Medium, in progress, incomplete	High, completed, achieved	
Education and training provided to health care facility staff and the community on environmental factors that contribute to the burden of disease	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Education and training provided to health care facility staff and the community on the relationship between public environmental health and disease prevention	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Education and training provided to health care facility staff and the community on how to evaluate and select environmentally sustainable products and services*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Access provided to environmental information and training, including priority setting approaches and effective procurement*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce trained in the management of chemicals and health care waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Developing and implementing awareness campaigns about chemicals of concern and established best practices for safe chemicals management within the health sector	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	



**Interventions table 4.1.2C – Communication and awareness raising:** Communicate, coordinate and increase awareness related to climate resilience and environmental sustainability among health care workers, patients, visitors, target communities, and with other sectors.

(Health workforce – environmental sustainability)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Increased awareness about water conservation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility staff informed on managing safe wastewater to combat antimicrobial resistance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce recycles all different types of non-hazardous waste (uncontaminated paper, plastic, glass, metal)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Increased knowledge about the environmental impact of pharmaceuticals and their disposal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce understand the benefits associated with correct equipment and systems operation to save energy*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workforce uses stairs and ramps, whenever possible, to reduce elevator usage and promote physical activity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Sources: (1775,87)

\* Actions that need the support of local or national governments, or of other sectors

## 4.2 WATER, SANITATION AND HEALTH CARE WASTE INTERVENTIONS

The availability of sustainable water, sanitation and environmental, chemical and health care waste management services are essential to quality of care and infection prevention and control in health care facilities. Important advances and commitments in this area have been achieved in recent years. WHO, UNICEF, Member States, and partners are now actively responding to this critical component for health and well-being (40). WHO and the UNICEF developed WASH FIT, a risk-based tool to prioritize risks and make improvements through a quality improvement process, addressing these concerns (43). These actions are also key to climate resilience and environmental sustainability as outlined in the proposed interventions below. The WHO Chemicals road map (6) requests for action to prevent and mitigate chemical health risks in health care facilities.

### Objectives for the implementation of this component

**Monitoring and assessment:** Information regarding water, sanitation, chemical use and health care waste management considers climate resilience and environmental sustainability for promoting action.

**Risk management:** Strengthened capacity of health care facilities to manage water, sanitation, chemicals and health care waste risks to workers, patients and served communities, by including assessments of climate resilience and environmental sustainability in responding to hazards and identifying and reducing exposures and vulnerabilities.

**Health and safety regulation:** Water, sanitation, chemical safety and health care waste regulations are implemented taking into consideration climate variability and change, and environmental sustainability.

#### 4.2.1 Interventions on climate resilience

Lack of good quality water, or irregular access, is a major problem in many health care facilities in less developed regions, particularly in areas of natural water scarcity, and has implications for sanitation and hygiene. This problem is increasingly aggravated by climate variability and change, and may result in shortage of water for prolonged periods or excess water for short periods (drought followed by heavy rains and flash floods). Floods may also adversely impact sanitation systems and overflow of wastewaters. Even when water becomes available or in periods of drought, people may take different initiatives to overcome shortages, such as storing water, or accessing water of lower quality. Sea-level rise may also increase salinity in coastal aquifers affecting water quality and flooding sewage systems. Achieving optimal use of water resources means that some health care facilities may need to conserve water, while others need to increase their use. This needs careful consideration to ensure that actions in one area do not impact on other areas.

**Interventions table 4.2.1A – Monitoring and assessment:** Information regarding water, sanitation, chemical and health care waste management considers climate resilience and environmental sustainability for promoting action.

(Water, sanitation and health care waste – climate resilience)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Verified safety conditions and proper functioning of all elements of the water distribution system, including storage tanks, valves, pipes and connections, and water disinfection*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Water pipe connections checked regularly for signs of deterioration*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Developed a monitoring mechanism to verify compliance with national standards, including the operation and maintenance of water and sanitation facilities*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Developed climate resilient water safety plans	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Water quality supply monitored regularly, including in emergencies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Water supply monitored regularly during emergencies to ensure adequate access throughout the duration of the event, ensuring that protocols are in place to guide rationing if required	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Identifying current or historical climate related hazardous events known to pose significant health risks to the collection, treatment, reuse and/or disposal of sanitation wastes (such as overflowing of pit latrines contaminating drinking water sources)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Monitoring of sewer overflows to fix pumps in advance of flood seasons	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Interventions table 4.2.1B – Risk management:** Strengthened capacity of health care facilities to manage water, sanitation, chemicals and health care waste risks to workers, patients and served communities, by including assessments of climate resilience and environmental sustainability in responding to hazards and identifying and reducing exposures and vulnerabilities.

(Water, sanitation and health care waste – climate resilience)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Developed a long-term drought management plan, including the identification of available alternative safe water sources*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility conserves and manages water to reduce water usage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Water services not affected by seasonality or climate change related weather extremes*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
WASH climate risk management plan implemented*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Improved training and support to health workforce on how and when to deliver water messaging	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Safe water storage available, avoiding mosquito breeding sites*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Water is not contaminated in the health care setting during storage, distribution and handling*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Kitchens have adequate supplies of clean potable water*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Water storage tanks have appropriate covers to prevent access or contamination	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Non-return valves on water supply pipes installed to prevent back flows*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Water storage in the health care facility sufficient to meet the needs of the facility in case of an extreme weather event*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Storm water safely managed (avoiding standing water near the facility or affecting nearby households)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility drinking water treated with a residual disinfectant to ensure microbial safety up to the point of consumption or use, especially after a flood related disaster	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Water storage tanks not located in areas susceptible to flooding, reducing the risk of contamination	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Plastic water storage tanks supported and anchored to resist strong winds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Natural floodwater infiltration in place to reduce risk of facility flooding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Assessments and mapping of climate change risks to the sanitation infrastructure of health care facilities in place to identify where services could be disrupted from floods, water scarcity, landslides, sea-level rise*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Planned schedule for emptying latrines in advance of flood seasons to avoid overflows	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Installation of sealed covers for septic tanks and non-return valves on pipes to prevent back flows	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Vents on sewers and septic tanks are above expected flood lines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Waste issues resulting from climate related hazards assessed to establish safe procedures and specialized treatment, when needed*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care waste transport (including health care facility hazardous waste) properly managed in case of extreme weather events*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Interventions table 4.2.1C – Health and safety regulation:** Water, sanitation, chemical and health care waste regulations are implemented taking into consideration climate variability and change, and environmental sustainability.

(Water, sanitation, chemical safety and health care waste – climate resilience)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Water of appropriate quality supplied for medical activities as well as for vulnerable patients (certain procedures should meet strict criteria and additional treatment or source, concerning microbial and chemical contaminants, including cyanobacterial toxins, and chlorine and aluminum which are commonly used in drinking water treatment)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Rainwater harvesting (with safe storage) installed, in places where rainfall is sufficient and regular or when possible to collect, and regularly inspected for damage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Collaboration with public health management or other responsible sector to reduce vector breeding sites (such as pools of water) on facility property and surrounding areas*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
No possibility that health care facility wastewater disposal contaminates local serviceable drinking water *	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Interventions (level of achievement) <span style="color: orange;">■</span> Low, unavailable, unable <span style="color: yellow;">■</span> Medium, in progress, incomplete <span style="color: green;">■</span> High, completed, achieved	Action level			Observations
Health care facility able to provide clean water for patients and the health workforce during climate related disasters *	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Readily available disaster response and recovery plan for the water system with adequate supplies (such as chlorine, filters or other water treatment technology, rapid water testing kit)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Long term water collection system in place to ensure water access during extreme climate events (such as capturing rain during the monsoon season and storing water in tanks for use during the dry season)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Ensured effective and timely delivery of safe water during emergencies over the short- and long-term*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Improved storage areas for storing extra waste generated through higher demands on health care facilities (such as in outbreaks or impacts from climate related events)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Waste pits are built to withstand climate events and emergencies*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility waste disposal is safe during climate-related emergencies or disasters	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Sanitation technologies designed to be more resistant to climate hazards and able to operate under a range of climate conditions, ensuring that failure in one part of the service chain does not cause the entire service to fail*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Sources: (17,55,75,84,88)

\* Actions that need the support of local or national governments, or of other sectors

#### 4.2.2 Interventions on environmental sustainability

Managing water, sanitation, chemical hazards and hazardous health care waste are essential components of a health care facility's environmental sustainability, in all countries and settings. According to WHO, of the total amount of waste generated by health care activities, 15% is considered hazardous, which may be infectious, toxic or radioactive. Concerns include lack of proper disposal of syringes, open burning and incineration of health care wastes with consequent emissions of particulate matter (and in some cases of dioxins and furans, and toxic metals), and unintended release into the environment of pharmaceuticals, or chemical and biological hazards, including drug-resistant microorganisms (89). Key areas of action include the substitution of harmful chemicals to improve the health and safety of patients, health care facility staff, communities and the environment by using safer chemicals, materials, products and processes throughout health care facilities. For the remaining waste (approximately 75–90%) generated in health care facilities, which is considered non-hazardous, it is key to promote proper segregation and recycling. There is also a need to eliminate non-essential single use plastics in health facilities and select plastic materials favouring reduced toxicity and the opportunity for reuse and/or recycling. Another concern is radiation safety. Direct patient exposure to ionizing radiations during medical procedures constitutes the largest anthropogenic source of population radiation exposure overall. Actions therefore include focus

on enhancing safety and quality in the use of ionizing radiation in health facilities. Antimicrobial resistance (AMR) is a major global public health concern and a food safety issue. When pathogens become resistant to antimicrobial agents, they can pose a greater human health risk as a result of potential treatment failure, loss of treatment options and increased likelihood and severity of disease. Problems related to AMR are inherently related to antimicrobial use in any environment, including human and non-human uses, and to wastewater disposal in health care facilities.

**Interventions table 4.2.2A - Monitoring and assessment:** Information regarding water, sanitation, chemical and health care waste management considers climate resilience and environmental sustainability for promoting action.

(Water, sanitation, chemical and health care waste – environmental sustainability)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Measure where and how water is used, and areas of potential savings and reuse examined	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Measures implemented to conserve and save water in staff training especially during the induction of new staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Surveillance of diseases related to insufficient quality water, sanitation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Classified and assessed types of waste issues and hazards to establish segregation collection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Implemented and monitored a waste reduction programme including waste management training for all staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Interventions table 4.2.2B - Risk management:** Strengthened capacity of health care facilities to manage water, sanitation and health care waste risks to workers, patients and serving communities by including assessments of climate resilience and environmental sustainability in responding to hazards and identifying and reducing exposures and vulnerabilities.

(Water, sanitation, chemical safety and health care waste – environmental sustainability)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Reinforced messaging about water use through signs and notices to promote saving	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Increased patient and visitor awareness about water conservation including signs and notices in patient rooms and visitor restrooms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Plastic bottled water eliminated where drinking tap water is available*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Eating utensils are washed immediately after use (reducing water and energy)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
	■	■	■	
Wastewater is safely managed through use of on-site treatment (such as septic tank followed by drainage pit) or sent to a functioning sewer system*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Established recycling programme for all types of non-hazardous waste*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Established segregation collection of different types of waste according to hazards*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Phased out of incineration of medical waste: a variety of non-burn technologies are available to safely disinfect, neutralize or contain waste (such as autoclaving)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Waste disposal system includes separate bins for potentially infectious waste, sharps, chemicals, pharmaceuticals, non-hazardous wastes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Cleaning products that contain hazardous chemicals such as those found in some soaps, disinfectants and pesticides are clearly labeled following the Globally Harmonized Classification System	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Reduced use of mercury-containing medical devices and measures in place to manage mercury spills and mercury-contaminated wastes*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Improved packaging, labeling and identification of chemical waste in separate chemical-resistant containers (i.e. not mixing hazardous chemical wastes of different types)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Improved packaging and identification of low-level radioactive waste that may be collected in containers clearly labeled with the international radioactive symbol and the words "radioactive waste"*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Improved packaging, identification and storage of radioactive waste in containers that prevent dispersion of radiation (storage behind lead shielding)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	



**Interventions table 4.2.2C - Health and safety regulation:** Water, sanitation, chemical safety and health care waste regulations are implemented taking into consideration climate variability and change, and environmental sustainability.

(Water, sanitation, chemical and health care waste – environmental sustainability)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Establish and inform on the water conservation policy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Harvested rainwater or grey water is safely used to flush toilets, clean outdoor pavement areas, water plants when possible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Monitoring systems in place for early detection and control of health care associated infections	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Hand hygiene facilities (water and soap and alcohol-based hand rub) are available at points of care and before health care facility entry during outbreaks, epidemics and pandemics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Hand hygiene facilities (water and soap and alcohol-based hand rub) are available within five metres of all toilets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility safely disposes of hazardous wastewater and liquid waste into the sanitation system through pre-treatment (such as oils and fats, corrosive waste and other wastes, depending on the level of concentration)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility safely disposes of hazardous wastewater and liquid waste that may be infectious*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Facilitate the use of safer alternatives and sound management of health care waste, drawing on relevant guidance from WHO and others, such as that adopted under multilateral environmental agreements*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Sources: (6,17,18,41,55,89–91)

\* Actions that need the support of local or national governments, or of other sectors

## 4.3 ENERGY INTERVENTIONS

Access to electricity in health care facilities is critical to achieving UHC and several SDG targets, including improving maternal health, reducing child mortality and preventing disease. Many health care facilities, particularly those in rural areas, lack reliable, affordable electricity supply for powering basic services such as lighting, communications, refrigeration, diagnostics and the medical devices required for health services (44,47). In addition, inefficient use of energy technologies, such as inefficient devices and appliances, contributes to fuel waste and costs and adds to air pollution.

### Objectives for the implementation of this component

**Monitoring and assessment:** Information regarding energy services should consider climate resilience and environmental sustainability for promoting action.

**Risk management:** Strengthened capacity of health care facilities to manage energy related risks to workers, patients and served communities, by including assessments of climate resilience and environmental sustainability in responding to hazards and identifying and reducing exposures and vulnerabilities.

**Health and safety regulation:** Regulations on energy use and access are implemented taking into consideration climate variability and change, and environmental sustainability.

#### 4.3.1 Interventions on climate resilience

Climate change can impact on energy access in many ways and in all types of health care facilities. Although many health care facilities lack regular electricity access (whether from an electricity grid or generated locally), climate change can further limit this access. Extreme weather events, such as storms, may destroy power lines or solar panels. Floods may affect generators or battery storage. Heat wave may increase electricity use in cities to power air conditioning, leading to rationing or outages. Most of these can be overcome with good planning for which an increasing number of resources are becoming available (51,52).

Nevertheless, a health care facility can reduce its GHGs and become more resilient to electricity grid disruptions and unreliability. When on-grid energy is unavailable or unreliable, health care facilities can develop and use off-grid systems. Solar energy can be harnessed through photovoltaic cells to heat water or generate electricity (which can be stored in batteries). District heating systems can create efficiency across cities and buildings, while closed loop or low enthalpy geothermal can provide a low carbon thermal heating alternative. Energy can also be produced on site through other renewable sources, such as wind, biomass, or hydroelectricity. The setting and scale of the health care facility as well as the availability of energy resources can influence the selection of the most appropriate sustainable energy solution.

Renewable energies can be deployed using both centralized and decentralized approaches. As renewable energies are clean, in both cases it contributes to environmental sustainability. Renewable energies can be deployed on site with a decentralized approach in places already connected to the grid (such as facilities in urban areas) and those not connected to the grid (such as in rural areas). Decentralized renewable energy systems play a crucial role in climate resilience, such as during extreme weather events if the national grid gets damaged or on-site diesel generators could have issues due to problems in the fuel supply chain.

**Interventions table 4.3.1A – Monitoring and assessment:** Information regarding energy services should consider climate resilience and environmental sustainability for promoting action.

(Energy – climate resilience)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Assessed energy needs, availability and alternative sources of renewable energy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Assessed points of greatest heat loss in buildings (such as roofs, especially flat ones) and added or upgraded insulation, and draught proofing*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Periodically checked emergency backup generators, even if rarely used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Renewable energy (such as solar) is sufficient to power equipment like refrigerators	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Assessed all heating, ventilation and air conditioning ductwork pipes, ensuring they are in good condition and supported adequately by the facility building structure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Assessed that location of energy backup or renewable energy infrastructure can withstand extreme weather events (such as strong winds, hail, floods)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Emergency backup covers at least all critical service areas and equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Interventions table 4.3.1B – Risk management:** Strengthened capacity of health care facilities to manage energy related risks to workers, patients and served communities, by including assessments of climate resilience and environmental sustainability in responding to hazards and identifying and reducing exposures and vulnerabilities.

(Energy – climate resilience)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Plan developed for managing intermittent energy supplies or system failure*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Established maintenance plan to fix easily preventable energy problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Mechanisms in place to filter indoor and ambient air pollutants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Combined heat and power systems in place to obtain energy efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Energy systems can cope with most extreme weather events*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Voltage stabilizers are available to protect equipment from electrical damage that may be caused by voltage frequency fluctuations (when using a generator), or voltage surges (such as due to power transmission problems in the grid)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Interventions table 4.3.1C - Health and safety regulation:** Regulations on energy use and access are implemented taking into consideration climate variability and change, and environmental sustainability.

(Energy – climate resilience)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Updated building insulation and windows to comply with energy codes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Emergency electricity generators available to provide required electrical power if the municipal grid, or if the internal normal electrical system fails*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Critical back-up power supplies available for building infrastructure (such as electrical power, heating and cooling)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Solar water heaters available for health care facility's hot water needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Backup energy equipment sufficiently elevated in areas prone to floods and anchored in areas prone to strong winds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Adequate backup energy source is available if the main source fails during an extreme weather event	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Adequate lighting, communications, refrigeration and sterilization equipment are available during climate related disasters or emergencies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Sources: (8,47,55,87,92)

\* Actions that need the support of local or national governments, or of other sectors

### 4.3.2 Interventions on environmental sustainability

Much of the environmental and public health harm produced by energy consumption is from the combustion of fossil fuels, such as oil, coal and gas. GHG emissions and air pollution generated from fossil fuel combustion are major contributors to global climate change and local health problems. By increasing energy efficiency and transitioning to clean, renewable energy sources, the health sector can reduce GHG emissions and contribute to protect public health from the impacts of climate change and air pollution. Indirectly, these changes may bring with them the health and economic co-benefits of reductions in hospital admissions and treatments for chronic illnesses such as asthma, lung and heart disease caused by the pollution created from the extraction, refining and combustion of coal, oil and gas.

Health care facilities can promote energy conservation and efficiency and implement renewable energy strategies and procurement, reducing GHG emissions and saving financial resources, while maintaining or improving quality care. Key areas requiring action include:

- **Building characteristics:** the quality of the building and its features affect the energy demand through the quality of insulation of walls and windows, the use of passive cooling and shading options, and its location and exposure to climate and weather.
- **Energy efficiency:** electric lighting fixtures can consume a large proportion of electrical energy, and depending upon the source can contribute to internal heat loads. Efficient appliances and thermal insulation also contribute to energy efficiency.
- **Transportation:** is a major source of both air pollution and GHG emissions, and the health sector – with its fleet of ambulances, hospital vehicles and delivery vehicles, as well as staff and patient travel – is a transportation-intensive industry.
- **Food:** that is purchased, prepared and provided in a variety of health care settings contributes to GHG emissions of the health care sector.
- **Pharmaceuticals:** these are produced in facilities that use a great deal of energy and emit significant GHGs. While selecting and prescribing medicines, it may be possible to consider those manufactured with least environmental impact.

**Interventions table 4.3.2A – Monitoring and assessment:** Information regarding energy services should consider climate resilience and environmental sustainability for promoting action.

(Energy – environmental sustainability)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Assessed health care facility's energy use and practices (such as percentage of grid-electricity, percentage of fuel oil and liquid gas used)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Improved training and capacity of health workforce on energy access and performance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Assessed the health care facility to determine how and where energy use can be reduced, or increased in energy poor areas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Use of air conditioning monitored, and use reduced depending on temperature conditions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Interventions table 4.3.2B – Risk management:** Strengthened capacity of health care facilities to manage energy related risks to workers, patients and serving communities, by including assessments of climate resilience and environmental sustainability in responding to hazards and identifying and reducing exposures and vulnerabilities.

(Energy – environmental sustainability)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Prioritized energy sources and saving measures which are least costly to introduce and/or those which would bring the biggest saving	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Installed energy-efficient lighting (such as light emitting diode (LED))	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Natural light used wherever possible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Opening windows (with installed mosquito nets where required) and making use of natural air flow and light	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Added occupancy sensor switches for lighting in frequently unoccupied spaces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Replaced older air conditioners, refrigerators and other appliances and medical equipment with energy efficient models	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Improved energy efficiency of the health care facility vehicles fleet, and encouraging staff, patients and visitors to walk or use car pools, public transport, or bicycles whenever possible*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility fossil fuel consumption reduced by use of renewable energy sources, including solar (photovoltaic) power, wind power, hydro power and biofuels*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Diesel-powered generator converted to use biofuels when feasible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Energy efficient ceiling fans installed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Plugged leaks in air conditioning devices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Freezers and refrigerators defrosted regularly when required	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Buildings and windows throughout the health care facility equipped with thermal insulation*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Interventions table 4.3.2C - Health and safety regulation:** Regulations on energy use and access are implemented taking into consideration climate variability and change, and environmental sustainability.

(Energy – environmental sustainability)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Established education and awareness campaigns to reduce energy use with the participation of all staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Developed system of good practices of energy use conservation with incentives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Developed a culture of energy saving by turning off office lights, computers and other equipment, and unplugging electronic devices when not in use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Established strategies to lower energy use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Designed features that maximize natural ventilation such as high ceilings, large windows and skylights (without compromising the structural integrity of the building)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Developed an energy management plan to measure energy consumption*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Optimized the use of on-site renewable energy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Renewable energy powers energy efficient lighting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Implemented a sustainable energy-saving programme in each department	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Installed on-site solar photovoltaic system with battery storage either as a primary or backup electricity source	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Provided proper maintenance and repair for off-grid solar photovoltaic power systems*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Installed bicycle storage facilities to support its use by staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Negotiated discounts for public transport for staff*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Sources: (8,17,47,87,91,92)

\* Actions that need the support of local or national governments, or of other sectors

## 4.4 INFRASTRUCTURE, TECHNOLOGY AND PRODUCTS INTERVENTIONS

There are both structural and non-structural elements (55). Structural elements are those that form part of the load-bearing system of the building, such as columns, beams, walls, floor slabs, foundations. Structural measures for health care facilities would include, construction built to resist floods, storms, strong winds or sea-level rise. Non-structural elements are those critical to the functioning of the health care facility. These include the architectural elements, emergency access and exit routes to and from the health care facility, critical systems (such as electricity, water supply, waste management, fire protection), medical, laboratory and office equipment (whether fixed or mobile), supplies used for analysis and treatment (55), as well as emerging technologies with important recent advances globally (such as digital health, including tracking of disease outbreaks). Non-structural measures now also include awareness raising, training and education (93), which this guidance discusses under health workforce.

### Objectives for the implementation of this component

**Adaptation of current systems and infrastructures:** Building regulations implemented in the construction and retrofitting of health care facilities to ensure climate resilience and environmental sustainability.

**Promotion of new systems and technologies:** Adopt new technologies and processes that can provide climate resilience, environmental sustainability and enhanced health service delivery.

**Sustainability of health care facility operations:** Adopt and procure low environmental impact technologies, processes and products to enhance climate resilience and environmental sustainability.

#### 4.4.1 Interventions on climate resilience

The structural and non-structural components and measures when fully functional would help health care facilities to remain operational during and after shocks or stress to protect the health of their communities. Components also include construction materials, which should not result in occupational or environmental hazards. Measures include climate resilience of essential environmental services to health facilities, such as water and sanitation services, chemical safety and electricity and energy services which may be compromised by climate variability and change (7). Because of their importance, water and sanitation, chemical safety and energy services are addressed separately.

**Interventions table 4.4.1A - Adaptation of current systems and infrastructures:** Building regulations implemented in the construction and retrofitting of health care facilities to ensure climate resilience and environmental sustainability.

(Infrastructure, technologies and products - climate resilience)

Interventions (level of achievement) <span style="color: orange;">■</span> Low, unavailable, unable <span style="color: yellow;">■</span> Medium, in progress, incomplete <span style="color: green;">■</span> High, completed, achieved	Action level			Observations
Established partnerships between the health care facility, community and local authorities to reduce climate vulnerability in the surrounding communities*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Assessed hazards that can put the health care facility's structural and non-structural elements in danger	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	



Interventions (level of achievement) <input type="checkbox"/> <b>Low, unavailable, unable</b> <input type="checkbox"/> <b>Medium, in progress, incomplete</b> <input type="checkbox"/> <b>High, completed, achieved</b>	Action level			Observations
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Mapped exposure of health care facility to all types of hazards and risk of the events (such as biological, chemical, geological, hydrometeorological, technological, societal)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Mapped the catchment area of the health care facility in terms of the geographical area and population for whom the health care facility would be expected to provide health care for extreme climate event emergencies and disasters*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Building is regularly inspected, both internally and externally, for signs of deterioration such as broken plaster, cracks or sinking structural elements, and the causes determined	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility has sufficient natural ventilation with protection against disease vectors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Siting of new health care facilities follows assessments to avoid high-risk coastal areas, or areas that are prone to damage from hurricanes, windstorms, floods or water surges, including rising sea-levels associated with climate change*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facilities built or retrofitted to cope with extreme weather events ensuring their resilience, safety and continuous operation*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Evaluated condition and safety of structural and non-structural elements of the health care facility, resulting from previous exposure to natural and other hazards*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
New infrastructure construction considers a range of climate related risk scenarios, such as drought, flood, prolonged rainfall, storms, strong winds, heat waves and sea-level rise*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Construction and retrofitting of health care facilities follows expert's advice incorporating the topography, flood history and local climate*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Assessed health care facility structures and trees along the access routes that would impede traffic if they fell during a climate related emergency or a disaster*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Verified that health care facility exit and evacuation routes are clearly marked and free of obstacles to enable emergency evacuation*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility building is built with fire-resistant and non-toxic materials*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Assessed safety of the location of critical services and equipment in case of flood	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Interventions (level of achievement) <input type="checkbox"/> <b>Low, unavailable, unable</b> <input type="checkbox"/> <b>Medium, in progress, incomplete</b> <input type="checkbox"/> <b>High, completed, achieved</b>	Action level			Observations
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Glass windows are laminated or otherwise protected to prevent threat from shattering during disasters	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Glass walls, doors and windows resist basic wind speeds of 200–250 kph*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Windows have wind and sun protection devices and are leakproof	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Power-operated doors can be opened manually to permit exit in the event of power failure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical systems safely secured with backup arrangement to satisfy the facility's demand for at least three days, at all times*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Information and telecommunications systems safely secured with backup arrangement (via cloud, satellite) to satisfy the facility's demand, at all times*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Heating, ventilation and air conditioning systems safely secured with backup arrangement to satisfy the facility's demand for at least three days, at all times	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Reflective white roofs on buildings installed to reduce heat impacts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Roofing materials completely and securely fastened, welded, riveted or cemented	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Roof drainage system has adequate capacity and is properly maintained	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Roof is leak-proof and insulated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Improved safety roofing designed to withstand wind velocity of 175–250 kph in high intensity tropical storm prone areas*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Water supply system has sufficient reserves, with backup arrangement, to satisfy the facility's demand for at least three days, at all times*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Sufficient resources allocated for mitigating and preventing climate change impacts of extreme weather events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment and supplies (furnishings, medical and laboratory equipment and supplies) safely secured in sufficient quantity and quality with backup arrangement to satisfy the facility's demand for at least three days, at all times*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Funding is available for newly planned improvements*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Interventions table 4.4.1B - Promotion of new systems and technologies:** Adopt new technologies and processes that can provide climate resilience, environmental sustainability and enhanced health service delivery.

(Infrastructure, technologies and products – climate resilience)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
National and local early warning system developed for early action to respond to extreme weather events*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility obtains alert information from early warning systems for extreme weather events to ensure prompt action*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Plans in place for operating and maintaining critical systems in emergencies and disasters	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Climate hazard vulnerability analysis is prepared and regularly updated (including the impacts of extreme weather risks on infrastructure)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Mapped the intensity and probability of extreme weather events across the health care facility (present and future)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Identified and mapped the health care facility's vulnerabilities and risks to climate-related impacts, emergencies and disasters	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Identified capacities and resources available within the health care facility to cope with any climate related emergency and disaster	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health workers trained to respond to new infectious diseases threats emerging from climate related events or environmentally related, including post-disaster case management and proper infection prevention and control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Strengthening health information systems with climate information to provide information for early health interventions*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Ensured that a mechanism exists for the prompt maintenance and repair of equipment required for essential services*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Building design responsive to assessment of local hazards*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Devices and equipment installed for monitoring indoor temperatures, cooling existing buildings and spaces, blocking direct sun, increasing air flow in case of extreme heat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Reliable and sustainable primary and backup communication systems (such as satellite phones, mobile devices, landlines, Internet connections, pagers, two-way radios, unlisted numbers) available including access to an updated contact list for emergency operation*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Established mechanisms to identify and incorporate new risks to food supply from climate related impacts*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility uses proven smart materials and applications, sensors, low power electronics and similar health care appropriate technology (such as telemedicine, remote sensing systems)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Interventions table 4.4.1C - Sustainability of health care facility operations:** Adopt and procure low environmental impact technologies, processes and products to enhance climate resilience and environmental sustainability.

(Infrastructure, technologies and products – climate resilience)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Climate related hazards (current and potential) are classified as high (indicating a high probability of hazards taking place or high-magnitude hazards, or both), medium (a high probability of moderate hazards) and low (a low probability or hazards of low magnitude)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Sufficient emergency room surge capacity available to manage climate-related emergencies and disasters (such as extreme heat events)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Disaster risk reduction plan to protect essential services is known and understood by all staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
A health care facility's health emergency plan available for preparedness and response with a clear budget line	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Actions implemented to improve work productivity and financial returns that would otherwise be lost from climate-sensitive health impacts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Medicines available to cover surge demand to ensure that the health care facilities can sustain the provision of essential and specialized services in an emergency or disaster*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Stockpiled essential supplies and pharmaceuticals in accordance with national guidelines ensuring timely use to avoid loss due to expiration*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Access to antibiotics, antiparasitic and antiviral drugs available for use in acute outbreaks of vector- or water-borne diseases made worse by climate change	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Interventions (level of achievement) <input type="checkbox"/> <b>Low, unavailable, unable</b> <input type="checkbox"/> <b>Medium, in progress, incomplete</b> <input type="checkbox"/> <b>High, completed, achieved</b>	Action level			Observations
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Estimated the consumption of essential supplies and pharmaceuticals (such as amount used per week) using the most likely extreme weather event scenarios	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Updated inventory of all equipment developed and maintained monthly, including a shortage alert and delivery mechanism	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Emergency standard operating procedures for extreme weather events includes how and where the health care facility would be evacuated, what disaster recovery steps would be taken to restore some level of services, and how to locate family members and staff who are off duty at the time*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Climate related disaster plans regularly updated, and workforce regularly trained on how to implement it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Anticipate the impact of the most likely disaster events on the supply of water, food and energy*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
A centralized emergency transportation system in place for shifting critically ill patients in case of emergencies or disaster*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Patient medical records are safely stored particularly in flood-prone areas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Established protocols for the health care facility's food service to respond and recover from an extreme weather event (such as emergency menus) and food-borne outbreaks (sanitation, disinfection, isolation)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Secure access to essential backup food sources via multiple agreements with different vendors and through cooperative agreements with other health care facilities*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Food resources monitored during emergencies to ensure adequate supplies throughout the duration of the event ensuring protocols are in place to guide the rationing of limited food supplies*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Food service staff adopts proper sanitary food handling and storage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Identified space within the health care facility for the storage and stockpiling of additional supplies, taking ease of access, security, temperature, ventilation, light exposure, and humidity level into consideration	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Safe access to critical backup supplies and resources are available (for medical equipment, laboratory and treatment supplies, personal protective equipment, technical experts, alternative energy supplies)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Established contingency agreements (such as memoranda of understanding, mutual aid agreements) with vendors to ensure the procurement and prompt delivery of equipment, supplies and other resources in times of shortage*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Verified measures taken to protect critical supplies such as emergency power, medicines and patients' records, in case of flood	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Appropriate backup arrangements available for essential lifelines, including water, power and oxygen*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Generator's housing or powerhouse protected from extreme weather events and movable if required	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Emergency generator with capacity to meet priority health care facility demands available	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Ensured uninterrupted cold chain for essential items requiring refrigeration*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Vaccine refrigerators with adequate holdover times available to keep vaccines cool during prolonged periods of power outages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Adequate supplies for safe water available (such as chlorine, filters or other water treatment technology, rapid water testing kit, water quality monitoring record sheets)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Identified alternative water sources to keep health care facility operational at all times (such as deep well, local water utility, mobile water storage tank)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Mechanisms in place to notify health care facility staff, patients and visitors of air pollution advisories and warnings*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Sources: (8,18,19,30,54,55,75,81–85,88,94–98)

\* Actions that need the support of local or national governments, or of other sectors

#### 4.4.2 Interventions on environmental sustainability

Low environmental impact technologies, processes and products need to be adopted for environmental sustainability. One key component is the procurement of goods and services. A sustainable procurement programme aims to reduce carbon emissions and chemical pollution, and conserve natural resources by identifying environmentally sustainable goods and services with fewer harmful effects on human health and the environment. The health care sector consumes vast amounts of natural and processed resources that are sourced, manufactured and delivered across the sector's supply chain. The production, transport and disposal of health care goods and services, such as pharmaceuticals and chemicals, food and agricultural products, medical devices, hospital equipment and instruments all make a substantial contribution to the sector's environmental footprint, including generation of waste, chemical contamination and GHG emissions.

**Interventions table 4.4.2A - Adaptation of current infrastructures:** Building regulations implemented in the construction and retrofitting of health care facilities to ensure climate resilience and environmental sustainability.

(Infrastructure, technologies and products – environmental sustainability)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Environmental sustainability criteria included in health care facility construction or renovation plans*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
New health care facilities designed and constructed based on low carbon approaches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Information and operational funds available for energy-saving interventions*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Medical gases and chemicals stored securely in well ventilated areas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility equipped with air pollution filters to improve indoor air quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Construction or retrofitting considers corridors with exterior walls to maximize use of daylight and natural ventilation*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Retrofitting of buildings implemented to cut energy waste*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Installed solar water heaters	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Installed hybrid systems (which include renewable energy, batteries, and backup generators)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Interventions table 4.4.2B - Promotion of new technologies:** Adopt new technologies and processes that can provide climate resilience, environmental sustainability and enhanced health service delivery.

(Infrastructure, technologies and products – environmental sustainability)

Interventions (level of achievement) <span style="color: orange;">■</span> <b>Low, unavailable, unable</b> <span style="color: yellow;">■</span> <b>Medium, in progress, incomplete</b> <span style="color: green;">■</span> <b>High, completed, achieved</b>	Action level			Observations
Selected an energy system according to factors relevant to the facility (such as facility size, level of care, budget, operational cost, resource availability, and geographic location)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Assessed and examined medical equipment to ensure they are energy efficient	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Appropriate technological devices in place according to energy availability and power (such as chest radiography and magnetic resonance imaging machines need considerable amount power to run)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Replaced oversized air conditioning and ventilation systems for smaller energy efficient models, when feasible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Established partnership with local government for the installation of off-grid energy systems supply*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Performed inventory of medical and other equipment to understand and determine an estimate of the facility's energy needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Evaluated renewable energy technologies available to power the facility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Improved off-grid solar photovoltaic power systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Installed clean and renewable energy sources (such as solar panels, wind turbines and biofuels) for lighting, heat generation, pumping and water heating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Installed solar lighting in health care facility car parks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Replaced medical devices with more water-efficient or energy-efficient models*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Replaced dishwashers and laundry machines with those having water-saving functions, whenever possible or when replacements are needed *	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Substituted mercury-containing thermometers and blood pressure measuring devices for affordable, validated and non-mercury-containing device alternatives*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	



**Interventions table 4.4.2C – Sustainability of health care facility operation:** Adopt and procure low environmental impact technologies, processes and products to enhance climate resilience and environmental sustainability.

(Infrastructure, technologies and products – environmental sustainability)

Interventions (level of achievement) <span style="color: orange;">■</span> Low, unavailable, unable <span style="color: yellow;">■</span> Medium, in progress, incomplete <span style="color: green;">■</span> High, completed, achieved	Action level			Observations
Implemented a clear environmentally sustainable procurement policy statement or protocol for all types of products, equipment and medical devices used in the health care facility*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility staff trained on effective and efficient procurement practices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility staff encouraged to use bicycles, public transportation and carpools to minimize transportation emission	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment and supplies purchased from local sources as much as possible, when available*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment and supplies purchased giving priority to environmentally friendly products (such as minimal packaging, reusable and recyclable products, avoiding hazardous chemicals and non-degradable plastics)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility purchases energy-efficient products (medical devices, vehicles, computers)*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility promotes local and sustainable food production*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Changes made in health care facility service menus and practices, including limiting the amount of meat and dairy products in meals when appropriate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
On-site garden set up as a means to introduce fresh food in the food service operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility composts food waste when possible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility plants indigenous trees and plants to obtain health co-benefits, such as the provision of natural shade for patients, staff and visitors during extreme heat events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Health care facility surroundings have drought-resistant plants in drought prone areas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Drainage for wastewater from health care facility is constructed and managed to avoid contamination of the health care setting or the surrounding environment*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Floor-care products are free of zinc, heavy metals, phthalates, glycol ethers and ammonia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Sources: (6,8,17,18,47,75,83,88,90–92,94,99–102)

\* Actions that need the support of local or national governments, or of other sectors



CHAPTER 5

# 5 CONCLUSIONS

Health care facilities are impacted by climate change and also by their surrounding environments. In turn, in their operations health care facilities produce GHGs, contributing to climate change, and through their emissions and unsustainable practices, they may contribute to environmental degradation. This guidance aims to ensure ongoing climate resilience and environmental sustainability of health care facilities. It builds on the premise that health care facilities need to satisfy as a minimum of four requirements to provide safe and quality care – (i) a skilled and informed workforce, (ii) adequate water, sanitation and waste services, (iii) energy services, and (iv) safe, functional and sustainable infrastructure, including technologies and products. Simultaneously, health care facilities need to consider how these four basic requirements can be strengthened to become climate resilient and how they can contribute to environmental sustainability.

It is important to note that this guide should be adapted to local realities and needs. New advances in knowledge, experiences and lessons from several health care facilities and changed circumstances (such as those brought about by public health emergencies like the COVID-19 pandemic), imply that the guide must be used with flexibility, and more as a model on how to improve operations, than as a prescription with expected actions. Whether large or small, all health care facilities can improve their operations while addressing key environmental concerns.

## ANNEX A. RESPONDING TO GLOBAL MANDATES

For over a decade WHO has been involved in the provision of technical support to countries aiming to increase the climate resilience of their health systems. In May 2008, the 61st WHA passed a Resolution (WHA61.19) where it agreed for the Secretariat to work with countries to address the increasing challenges of climate change to health. Specifically, it recognized the need to “assist Member States in assessing the implications of climate change for health and health systems in their country”. It also recognized that strengthening health systems to address both gradual changes and sudden shocks is a fundamental priority in terms of addressing the direct and indirect effects of climate change for health (103). A WHO 2014–2019 workplan, launched a year later, proposed four objectives, with one specifically addressing health systems: *strengthen health systems to cope with the health threats posed by climate change, including emergencies related to extreme weather events and sea-level rise* (104). Furthermore, the workplan has the following priority objectives on health care facilities: ensuring resilience to climate change risks; provision of environmental services (including access to electricity, clean water and sanitation and waste management); and reduction of GHG emissions from health sector operations (104).

WHO’s experience has led to the development of relevant guidance for all areas of work that fit under climate resilient health systems. These can be generally structured under the 10 components of WHO’s Operational Framework (1): (i) leadership and governance; (ii) health workforce; (iii) vulnerability, capacity and adaptation assessment; (iv) integrated risk monitoring and early warning; (v) health and climate research; (vi) climate resilient and sustainable technologies and infrastructure; (vii) management of environmental determinants of health; (viii) climate-informed health programmes; (ix) emergency preparedness and management; (x) climate and health financing.

“Building the environmental sustainability of health systems and reducing their environmental impact” was identified as one of the regional environment and health priorities, agreed by 53 Member States of the WHO Regional Office for Europe in 2017. Specifically, this priority item proposes “efficiency in the use of energy and resources, sound management of medical products and chemicals throughout their life cycle, and reduced pollution through safely managed waste and wastewater, without prejudice to the primary mission of health systems to promote, restore or maintain health” (105).

The 55th Directing Council of the Pan American Health Organization (PAHO/WHO) approved a Plan of Action for disaster risk reduction 2016–2019, with a Strategic Line of Action specifically addressing “safe and smart hospital”, with measures to address climate change through both adaptation and mitigation involving structural safety, as well as non-structural, organizational, and functional components (106).

### WHO global strategy on health, environment and climate change

The strategy has six objectives which if implemented will contribute to climate resilient and environmentally sustainable health care facilities. In turn, appropriate actions on health care facilities will contribute to the implementation of the strategy.

## WHO global strategy on health, environment and climate change: Strategic objectives and their relationship with climate resilient and environmentally sustainable health care facilities

Strategic objectives	Consequences for building climate resilient and environmentally sustainable health care facilities
Primary prevention: to scale up action on health determinants for health protection and improvement in the 2030 Agenda for Sustainable Development	This objective calls for massively expanded primary prevention, and the integration of preventive environmental health action into universal health coverage.
Cross-sectoral action: to act on determinants of health in all policies and in all sectors	This objective notes that decisions taken on the drivers of health risks should have the attainment and protection of good health as an explicit aim in key sectors such as energy, transport, housing, labour, industry, food systems and agriculture, water and sanitation, and urban planning. The health sector is included both as a key sector and because it relies on all these sectors for its proper functioning, including of its health care facilities.
Strengthened health sector: to strengthen health sector leadership, governance and coordination roles	This objective, directly addresses the health sector's urgent needs to ensure essential environmental services in health care facilities, maintain health and build environmental sustainability. Specifically, the Strategy states that in "low- and middle-income countries, it is necessary to address the major deficit in equipping health care facilities with safely managed water, sanitation and hygienic practices as well as reliable energy supplies, and ensuring their resilience to extreme weather events and other emergency situations. The health sector also needs to lead by example when it comes to procurement policies and services, waste management and energy-related choices in order to limit any negative impact on health, the environment and climate change".
Building support: to build mechanisms for governance, and political and social support	This objective calls for stepping up demand and leadership for health, with strong engagement by the health sector and the community to implement health supportive policies, which includes healthy design and management of environment. This can easily be translated to the design and management of health care facilities. There is a large set of information and tools to measure the disease burden from unsafe environments. Health care facilities also contribute to soil, water and air pollution including GHG emissions, making the need of leading by example more urgent than ever.
Enhanced evidence and communication: to generate the evidence base on risks and solutions, and to efficiently communicate that information to guide choices and investments	This objective calls for the development of evidence-based guidance to support effective action at the national and subnational levels, including making available tools for key stakeholders to guide action for health. This would include preparation of tools for action by health care facilities. It also makes the case for ensuring adequate funding allocation and influencing investments. This would include assessments of costs and benefits of building climate resilient health systems, including health care facilities, and the monetary justification to fund projects.
Monitoring: to guide actions by monitoring progress towards the SDGs	All SDGs have targets that are directly or indirectly linked to building climate resilient and environmentally sustainable health systems.

Source: (107)

### Universal health coverage (UHC)

UHC implies that all people and communities can use the promotive, preventive, curative, rehabilitative and palliative health services they need, of sufficient quality to be effective, while also ensuring that the use of these services does not expose the user to financial hardship. UHC cuts across all of the health-related SDGs and brings hope of better health and protection for the world's poorest. UHC has therefore become a major goal for health reform in many countries and a priority objective of WHO (108).

Climate change is threatening to undermine the achievement of UHC through negative health outcomes and health care system disruptions. Conversely, climate change and UHC agendas can bolster each other as they both strive to improve health and achieve health equity. For instance, UHC plans can work to improve the understanding of climate change and incorporate the mitigation of GHGs in the health sector, while implementing climate adaptation plans that prioritize climate resiliency (109).

A high-level meeting on UHC recognized the need for “health systems that are strong, resilient, functional, well-governed, responsive, accountable, integrated, community-based, people-centred and capable of quality service delivery, supported by a competent health workforce, adequate health infrastructure, enabling legislative and regulatory frameworks as well as sufficient and sustainable funding”. It also noted the adverse impact of climate change, natural disasters, extreme weather events and other environmental determinants of health, further recognizing that resilient health systems are necessary to protect the health of all people (110).

### Primary health care (PHC)

All people, everywhere, deserve the right care, within in their community. This is the fundamental premise of PHC and addresses the majority of a person's health needs throughout their lifetime. This includes physical, mental and social well-being that is people-centred rather than disease-centred. PHC is a whole-of-society approach that includes health promotion, disease prevention, treatment, rehabilitation and palliative care.

A PHC approach includes three components:

- (i) Meeting people's health needs throughout their lives;
- (ii) Addressing the broader determinants of health through multisectoral policy and action; and
- (iii) Empowering individuals, families and communities to take charge of their own health.

By providing care in the community as well as care through the community, PHC addresses not only the health needs of the individual and family, but also the broader issue of public health and the needs of defined populations (111). The principles of PHC were first outlined in the Declaration of Alma-Ata in 1978, and ratified forty years later by global leaders ratified in the Declaration of Astana in October 2018 (112). Health care based on low carbon climate resilient strategies such as renewable energy and energy-efficient medical devices can increase access, contributing to achieving PHC. In this regard PHC can become a powerful agent for advancing climate protection, community climate resilience and low carbon development. Health personnel in PHC settings must also create public health emergency response systems that are climate resilient in order to reliably provide essential health services to people affected by extreme weather events.

### Paris Agreement of the United Nations Framework Convention on Climate Change

The Paris Agreement entered into force in November 2016 to chart a new course in the global climate effort. It builds upon the 1992 UNFCCC, and for the first time brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. The Agreement's central aim is to strengthen the global response to the threat of climate change by keeping global temperature rise during this century well below 2 degrees Celsius above pre-industrial levels, and to pursue efforts to limit increase even further below to 1.5 degrees Celsius. This will require health facilities, systems and ministries in all countries to work to achieve not only resilience, but also net zero emissions by 2050 or before. Additionally, the Agreement aims to strengthen the ability of countries to deal with the impacts of climate change (113).

Based on the principle of “common but differentiated responsibilities and respective capabilities in light of different national circumstances,” those most responsible for emissions must take the greatest action. However, all can contribute to their countries’ Nationally Determined Contributions (NDCs) to the Paris Agreement, while simultaneously meeting global health goals such as UHC and working to achieve the SDGs.

The Paris Agreement requires all Parties to put forward their best efforts through NDCs and to strengthen these efforts in the years ahead. This includes requirements that all Parties report regularly on their emissions and implementation efforts. Countries can strengthen their NDCs by developing health-inclusive and health-promoting climate targets and policies. The inclusion of public health considerations in the NDCs provides an opportunity for increased motivation, such as through the consideration of the social co-benefits of climate action, the creation of climate-resilient health systems or through prioritized adaptation actions (114).

### **Kigali Amendment to Montreal Protocol on Substances that Deplete the Ozone Layer**

The Kigali Amendment entered into force on 1 January 2019, following ratification by 65 countries. The UN Environment Programme noted that it will help reduce the production and consumption of hydrofluorocarbons and potent GHGs, and thus avoid global warming by up to 0.4°C this century (115). Under the Amendment, all countries will gradually phase down hydrofluorocarbons by more than 80% over the next 30 years and replace them with more environmentally friendly alternatives (116).

### **Minamata Convention on Mercury (2017)**

This Convention is a global treaty to protect human health and the environment from the adverse effects of mercury. It draws attention to a global and ubiquitous metal that, while naturally occurring, has broad uses in everyday objects and is released into the atmosphere, soil and water from a variety of sources. Major highlights of the Convention include a ban on new mercury mines, the phase-out of existing ones, control measures on emissions to air and on releases to land and water, the regulation of the informal sector of artisanal and small-scale gold mining, and the phase out of mercury use in a number of products including mercury-containing medical devices, such as thermometers and blood pressure devices (117). Thermometers and sphygmomanometers are included in a wider category of non-electronic medical devices regulated under Article 4 of the Convention, with a phase-out date of 2020. Parties may not procure mercury-containing thermometers or sphygmomanometers after 2020 for routine use in health care settings, and should replace them with mercury-free alternatives (118). The convention also proposes nine measures to phase down the use of dental amalgam, which is made of approximately 50% of elemental mercury by weight (119).

### **Strategic Approach to International Chemicals Management (SAICM)**

The SAICM, adopted in 2006, is a policy framework to promote chemical safety around the world. SAICM’s overall objective is the achievement of the sound management of chemicals throughout their life cycle so that chemicals are produced and used in ways that minimize significant adverse impacts on the environment and human health (120). In May 2017, the WHO Chemicals road map was approved to enhance health sector engagement in SAICM. The road map identifies concrete actions where the health sector has either a lead or important supporting role to play in the sound management of chemicals, recognizing the need for multisectoral cooperation. Actions directly relevant to health facilities in the road map include providing guidance for health care settings to promote and facilitate the use of safer alternatives and sound management of health care waste; develop and implement awareness campaigns for health care workers about chemicals of concern and established best practices for safe chemicals management within the health sector, including occupational, patient, community and environmental impacts in health care settings (6).

## **Stockholm Convention on Persistent Organic Pollutants**

This is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health or on the environment. Exposure to persistent organic pollutants (POPs) can lead to serious health effects including certain cancers, birth defects, dysfunctional immune and reproductive systems, greater susceptibility to disease and damages to the central and peripheral nervous systems. Given their long-range transport, no government acting alone can protect its citizens or its environment from POPs. The Stockholm Convention which entered into force in 2004 is relevant to health facilities in that many products used in health care settings, ranging from pesticides, to cleaners, to plastics either contain POPs or generate POPs when burned, such as dioxin (121).

## **Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal**

This Convention was created to protect people and the environment from the negative effects of the inappropriate management of hazardous wastes worldwide. It is the most comprehensive global treaty dealing with hazardous waste materials throughout their lifecycles, from production and transport to final use and disposal (122).

## **Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade**

The Rotterdam Convention provides parties with a first line of defence against hazardous chemicals. It promotes international efforts to protect human health and the environment as well as enabling countries to decide if they want to import hazardous chemicals and pesticides listed in the Convention (123).

## **Sendai Framework for Disaster Risk Reduction 2015–2030**

The Sendai Framework adopted at the Third UN World Conference on Disaster Risk Reduction is the road map to make communities safer and more resilient to disasters. It proposes four priority areas for action, highly relevant to reducing risks to health care facilities: (i) Understanding disaster risk. Of relevance to health care facilities is the call for periodic assessments, baselines determination, information management, and development of disaster risk services which includes making data and scientific information usable to decision-makers. (ii) Strengthening disaster risk governance to manage disaster risk. Clear roles and responsibilities, and enhanced coordination in disaster risk management to ensure a multihazard and multisector understanding of disaster risk, can benefit health care facilities at the local level. Health care facilities would benefit from participating in preparations of local disaster risk reduction strategies and plans. (iii) Investing in disaster reduction for resilience. The framework emphasizes the need to build critical infrastructure “better from the start” and refers to ensuring the resilience of work places and of health systems. (iv) Enhancing disaster preparedness for effective response, and to “Build Back Better”. The Sendai framework calls for the preservation of the functioning of critical infrastructures, and the continued provision of services, very relevant to health care facilities. The call to “Build Back Better” refers to disaster risk reduction measures in recovery, rehabilitation and reconstruction measures (53).



## REFERENCES

1. Operational Framework for building climate resilient health systems. Geneva: World Health Organization; 2015 ([https://apps.who.int/iris/bitstream/handle/10665/189951/9789241565073\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/189951/9789241565073_eng.pdf), accessed 27 July 2020).
2. Harhay MO, Halpern SD, Harhay JS, Olliaro PL. Health care waste management: a neglected and growing public health problem worldwide. *Trop Med Int Health*. 2009;14(11):1414–17.
3. Chartier Y, Emmanuel J, Pieper U, Prüss A, Rushbrook P, Stringer R, et al. (eds). Safe management of wastes from health-care activities. 2nd edn. Geneva: World Health Organization; 2014 ([https://apps.who.int/iris/bitstream/handle/10665/85349/9789241548564\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/85349/9789241548564_eng.pdf), accessed 13 July 2020).
4. Guenther R, Vernon W. Global lessons in healthcare. *Healthcare Design Magazine*, October 1, 2010 (<https://www.healthcaredesignmagazine.com/architecture/global-lessons-healthcare/>, accessed 14 June 2020).
5. Public health impact of chemicals: knowns and unknowns; and Data addendum for 2016. World Health Organization [website] (<https://www.who.int/ipcs/publications/chemicals-public-health-impact/en/>, accessed 27 July 2020).
6. WHO Chemicals road map. Road map to enhance health sector engagement in the Strategic Approach to International Chemicals Management towards the 2020 goal and beyond. Geneva: World Health Organization; 2017 (<https://apps.who.int/iris/bitstream/handle/10665/273137/WHO-FWC-PHE-EPE-17.03-eng.pdf>, accessed 27 July 2020).
7. Ionizing radiation, health effects and protective measures. April 2016. World Health Organization [website] (<https://www.who.int/news-room/fact-sheets/detail/ionizing-radiation-health-effects-and-protective-measures>, accessed 27 July 2020).
8. Ambient air pollution: health impacts. World Health Organization [website] (<https://www.who.int/airpollution/ambient/health-impacts/en/>, accessed 4 August 2020).
9. Watts N, Amann M, Arnell N, Ayeb-Karlsson S, Belesova K, Boykoff M, et al. The 2019 report of The Lancet Countdown on health and climate change: ensuring that the health of a child born today is not defined by a changing climate. *Lancet*. 2019;394(10211):P1836–78.
10. Smith KR, Woodward A, Campbell-Lendrum D, Chadee DD, Honda Y, Liu Q, et al. Human health: impacts, adaptation, and co-benefits. In: *AR5 Climate Change 2014: impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field CB, Barros VR, Dokken DJ, Mach KJ, Mastrandrea MD, Bilir TE, et al. (eds.)]. Cambridge and New York: Cambridge University Press; 2014: pp. 709–754 ([https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap11\\_FINAL.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap11_FINAL.pdf), accessed 15 July 2020).
11. Chemical releases caused by natural hazard events and disasters: information for public health authorities. Geneva: World Health Organization; 2018 (<https://www.who.int/ipcs/publications/natech/en/>, accessed 27 July 2020).
12. Health care's climate footprint: How the health sector contributes to the global climate crisis and opportunities for action. Health Care Without Harm and Arup; 2019 ([https://noharm-global.org/sites/default/files/documents-files/5961/HealthCaresClimateFootprint\\_092319.pdf](https://noharm-global.org/sites/default/files/documents-files/5961/HealthCaresClimateFootprint_092319.pdf), accessed 14 July 2020).
13. We set the standards to measure and manage emissions. Greenhouse gas protocol [website] (<https://ghgprotocol.org>, accessed 27 July 2020).

14. 2019 Refinement to the 2006 IPCC Guidelines for national greenhouse gas inventories. Intergovernmental Panel on Climate Change; 2019 (<https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html>, accessed 14 July 2020).
15. Towards environmentally sustainable health systems in Europe. A review of the evidence. Copenhagen: WHO Regional Office for Europe; 2016 ([http://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0012/321015/Towards-environmentally-sustainable-HS-Europe.pdf](http://www.euro.who.int/__data/assets/pdf_file/0012/321015/Towards-environmentally-sustainable-HS-Europe.pdf), accessed 27 July 2020).
16. Climate resilient water safety plans: managing health risks associated with climate variability and change. Geneva: World Health Organization; 2017 (<https://apps.who.int/iris/bitstream/handle/10665/258722/9789241512794-eng.pdf>, accessed 27 July 2020).
17. HealthWISE Action Manual. Work improvement in health services. Geneva: International Labour Office; 2014 ([https://www.ilo.org/wcmsp5/groups/public/---ed\\_dialogue/---sector/documents/instructionalmaterial/wcms\\_237276.pdf](https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/instructionalmaterial/wcms_237276.pdf), accessed 14 July 2020).
18. Climate-smart healthcare: low-carbon and resilience strategies for the health sector (English). Investing in climate change and health series. Washington D.C.: World Bank Group; 2017 (<http://documents1.worldbank.org/curated/en/322251495434571418/pdf/113572-WP-PUBLIC-FINAL-WBG-Climate-smart-Healthcare-002.pdf>, accessed 27 July 2020).
19. Sambath V. Building climate resilient health systems. Assessment of response of health system to Kerala floods of August 2018. The Health Energy Initiative, Doctors for Care, Climate Action Network South Asia, Community Environmental Monitoring; 2019 ([http://www.healthenergyinitiative.org/wp-content/uploads/2019/03/Kerala-Study\\_Final-for-web-March-2019-.pdf](http://www.healthenergyinitiative.org/wp-content/uploads/2019/03/Kerala-Study_Final-for-web-March-2019-.pdf), accessed 15 July 2020).
20. Nair P. Kerala floods: Health directorate estimates Rs 110 crore loss | Kochi News – Times of India, Aug 29, 2018 (<https://timesofindia.indiatimes.com/city/kochi/kerala-floodshealth-directorate-estimates-rs-110-crore-loss/articleshow/65596649.cms>, accessed 14 July 2020).
21. Thomas WM. Code Grey: Protecting hospitals from severe weather. Earthzine, June 28, 2011 (<https://earthzine.org/code-grey-protecting-hospitals-from-severe-weather-2/>, accessed 15 July 2020).
22. Seltenrich N. Safe from the storm: Creating climate-resilient health care facilities. *Environ Health Perspect*. 2018;126(10) (<https://doi.org/10.1289/EHP3810>, accessed 15 July 2020).
23. Renewable energy benefits: Measuring the economics. Abu Dhabi: International Renewable Energy Agency; 2016 ([https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA\\_Measuring-the-Economics\\_2016.pdf](https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_Measuring-the-Economics_2016.pdf), accessed 14 July 2020).
24. Financial mechanisms and financial frameworks for renewables in developing countries. Abu Dhabi: International Renewable Energy Agency; 2012 (<http://www.irena.org/DocumentDownloads/Publications/IRENA%20report%20-%20Financial%20Mechanisms%20for%20Developing%20Countries.pdf>, accessed 14 July 2020).
25. Hospitals: Healthy budgets through energy efficiency. London: The Carbon Trust; 2010 (<https://www.thenbs.com/PublicationIndex/documents/details?Pub=CARBONTRUST&DocID=302817>, accessed 27 July 2020).
26. Changing energy behaviours in the NHS: Operation TLC. London: Barts Health NHS Trust; 2013 (<http://www.sduhealth.org.uk/news/214/barts-health-nhs-trust-saves-100000-with-a-bit-of-tlc/>, accessed 14 July 2020).
27. Human resources for development. United Nations General Assembly. Seventy-second session; 2017 (<https://undocs.org/A/C.2/72/L.64>, accessed 15 July 2020).

28. Human resources for health and implementation of the outcomes of the United Nations' High-Level Commission on Health Employment and Economic Growth. Seventieth World Health Assembly WHA70.6. Geneva: World Health Organization; 2017 ([http://apps.who.int/gb/ebwha/pdf\\_files/WHA70/A70\\_R6-en.pdf](http://apps.who.int/gb/ebwha/pdf_files/WHA70/A70_R6-en.pdf), accessed 27 July 2020).
29. Global strategy on human resources for health: workforce 2030. Geneva: World Health Organization; 2016 (<https://apps.who.int/iris/bitstream/handle/10665/250368/9789241511131-eng.pdf>, accessed 15 July 2020).
30. "Working for Health": Five-year action plan for health employment and inclusive economic growth (2017–21). Geneva: World Health organization; 2018 (<https://www.who.int/hrh/com-heeg/action-plan-annexes/en/>, accessed 27 July 2020).
31. Public health impacts of exposure to mercury and mercury compounds: the role of WHO and ministries of public health in the implementation of the Minamata Convention. Sixty-seventh World Health Assembly. Geneva: World Health Organization; 2014 ([https://apps.who.int/iris/bitstream/handle/10665/162849/A67\\_R11-en.pdf](https://apps.who.int/iris/bitstream/handle/10665/162849/A67_R11-en.pdf), accessed 15 July 2020).
32. Strategic planning for implementation of the health-related articles of the Minamata Convention on Mercury. Geneva: World Health Organization; 2019 (<https://apps.who.int/iris/bitstream/handle/10665/329449/9789241516846-eng.pdf>, accessed 27 July 2020).
33. Political Declaration of the High-level Meeting on Universal Health Coverage: "Universal health coverage: moving together to build a healthier world". United Nations; 2019 (<https://www.un.org/pga/73/wp-content/uploads/sites/53/2019/07/FINAL-draft-UHC-Political-Declaration.pdf>, accessed 15 July 2020).
34. Attacks on health care. Report on attacks on health care in emergencies. Geneva: World Health Organization; 2016 (<https://www.who.int/hac/techguidance/attacksreport.pdf>, accessed 27 July 2020).
35. WHO calls for healthy, safe and decent working conditions for all health workers, amidst COVID-19 pandemic. World Health Organization [website]; 2020 (<https://www.who.int/news-room/detail/28-04-2020-who-calls-for-healthy-safe-and-decent-working-conditions-for-all-health-workers-amidst-covid-19-pandemic>, accessed 27 July 2020).
36. Occupational safety and health in public health emergencies: A manual for protecting health workers and responders. Geneva: World Health Organization and International Labour Organization; 2018 (<https://www.who.int/publications/i/item/occupational-safety-and-health-in-public-health-emergencies>, accessed 27 July 2020).
37. Benova L, Cumming O, Campbell OM. Systematic review and meta-analysis: association between water and sanitation environment and maternal mortality. *Trop Med Int Health*. 2014;19(4):368–87.
38. Velleman Y, Mason E, Graham W, Benova L, Chopra M, Campbell OMR, et al. From joint thinking to joint action: a call to action on improving water, sanitation, and hygiene for maternal and newborn health. *PLoS Med*. 2014;11(12):e1001771.
39. Bouzid M, Cumming O, Hunter PR. What is the impact of water, sanitation and hygiene in healthcare facilities on care seeking behaviour and patient satisfaction? A systematic review of the evidence from low-income and middle-income countries. *BMJ Glob Health*. 2018;3:e000648.
40. Water, sanitation and hygiene in health care facilities: practical steps to achieve universal access to quality care. Geneva: World Health Organization; 2019 (<https://apps.who.int/iris/bitstream/handle/10665/311618/9789241515511-eng.pdf>, accessed 27 July 2020).
41. Water, sanitation and hygiene in health care facilities. Seventy-second World Health Assembly WHA72.7. Geneva: World Health Organization; 2019 ([https://apps.who.int/gb/ebwha/pdf\\_files/WHA72/A72\\_R7-en.pdf](https://apps.who.int/gb/ebwha/pdf_files/WHA72/A72_R7-en.pdf) accessed 27 July 2020).
42. WASH in health care facilities [website]. ([www.washinhc.org](http://www.washinhc.org), accessed 27 July 2020).

43. Water and Sanitation for Health Facility Improvement Tool (WASH FIT). A practical guide for improving quality of care through water, sanitation and hygiene in health care facilities. Geneva: World Health Organization; 2017. <https://apps.who.int/iris/bitstream/handle/10665/254910/9789241511698-eng.pdf>, accessed 27 July 2020).
44. Access to modern energy services for health facilities in resource-constrained settings A review of status, significance, challenges and measurement. Geneva: World Health Organization; 2014 (2015 reprint with changes) ([https://apps.who.int/iris/bitstream/handle/10665/156847/9789241507646\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/156847/9789241507646_eng.pdf), accessed 27 July 2020).
45. Adair-Rohani, Zukor K, Bonjour S, Wilburn S, Kuesel AC, Hebert R, et al. Limited electricity access in health facilities of sub-Saharan Africa: a systematic review of data on electricity access, sources, and reliability. *Glob Health Sci Pract.* 2013;1(2):249–61.
46. Cronk R, Bartram J. Environmental conditions in health care facilities in low- and middle-income countries: Coverage and inequalities. *Int J Hyg Environ Health.* 2018;221(3):409–422.
47. Lasting impact – Sustainable off-grid solar delivery models to power health and education. UN Foundation and SEforALL; 2019 ([https://www.seforall.org/system/files/2019-04/Powering-Health\\_042019.pdf](https://www.seforall.org/system/files/2019-04/Powering-Health_042019.pdf), accessed 15 July 2020).
48. Health central to climate change action. Fact sheet. Copenhagen: WHO Regional Office for Europe; 2015 ([http://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0020/295202/Factsheet3-health-central-climate-change-action.pdf](http://www.euro.who.int/__data/assets/pdf_file/0020/295202/Factsheet3-health-central-climate-change-action.pdf), accessed 27 July 2020).
49. Stakeholder meeting on building the health and energy platform of action. Geneva, 11–12 September 2019. World Health Organization [website] (<https://www.who.int/airpollution/news/health-and-energy-platform-of-action/en/>, accessed 27 July 2020).
50. Air quality and health. Energy access and resilience. World Health Organization [website] (<https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/health-care-activities/health-impacts>, accessed 4 August 2020).
51. Burgess C, Goodman J. Solar under storm: select best practices for resilient ground-mount PV systems with hurricane exposure. Boulder: Rocky Mountain Institute; 2018 ([https://rmi.org/wp-content/uploads/2018/06/Islands\\_SolarUnderStorm\\_Report\\_digitalJune122018.pdf](https://rmi.org/wp-content/uploads/2018/06/Islands_SolarUnderStorm_Report_digitalJune122018.pdf), accessed 13 July 2020).
52. Stout S, Lee N, Cox S, Elsworth J, Leish, J. Power sector resilience planning guidebook. A self-guided reference for practitioners. Washington D.C.: U.S. Department of Energy's National Renewable Energy Laboratory and United States Agency for International Development; 2019 (<https://www.nrel.gov/docs/fy19osti/73489.pdf>, accessed 15 July 2020).
53. Sendai Framework for Disaster Risk Reduction 2015–2030. Geneva: United Nations Office for Disaster Risk Reduction; 2015 (<https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030>, accessed 15 July 2020).
54. Safe hospitals in emergencies and disasters: structural, non-structural and functional indicators. Geneva: World Health Organization; 2010 ([https://apps.who.int/iris/bitstream/handle/10665/207689/9789290614784\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/207689/9789290614784_eng.pdf), accessed 15 July 2020).
55. Hospital safety index: guide for evaluators. Second ed. Safe Hospitals Initiative. Geneva: World Health Organization and Pan American Health Organization; 2015 (<https://apps.who.int/iris/bitstream/handle/10665/258966/9789241548984-eng.pdf>, accessed 27 July 2020).

56. WHO global strategy on health, environment and climate change: the transformation needed to improve lives and well-being sustainably through healthy environments. Geneva: World Health Organization; 2020 (<https://apps.who.int/iris/bitstream/handle/10665/331959/9789240000377-eng.pdf>, accessed 24 June 2020).
57. Sustainable Development Goals. United Nations. Department of Economic and Social Affairs [website] (<https://sustainabledevelopment.un.org/?menu=1300>, accessed 15 July 2020).
58. The Tallinn Charter: health systems for health and wealth. Copenhagen: WHO Regional Office for Europe; 2008 ([http://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0008/88613/E91438.pdf](http://www.euro.who.int/__data/assets/pdf_file/0008/88613/E91438.pdf), accessed 15 July 2020).
59. Environmental health in emergencies. Health-care facilities. World Health Organization [website] ([https://www.who.int/environmental\\_health\\_emergencies/services/en/](https://www.who.int/environmental_health_emergencies/services/en/), accessed 27 July 2020).
60. Summary for policymakers. In: Climate change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field CB, Barros VR, Dokken DJ, Mach KJ, Mastrandrea MD, Bilir TE, et al. (eds.)]. Cambridge and New York: Cambridge University Press; 2014 ([https://www.ipcc.ch/site/assets/uploads/2018/02/ar5\\_wgii\\_spm\\_en.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/ar5_wgii_spm_en.pdf), accessed 14 July 2020).
61. Kruk ME, Myers M, Varpilah ST, Dahn BT. What is a resilient health system? Lessons from Ebola. *Lancet*. 2015;385(9980):1910–2. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(15\)60755-3/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(15)60755-3/fulltext)
62. Kutzin J, Sparkes SP. Health systems strengthening, universal health coverage, health security and resilience. *Bull World Health Organ*. 2016;94:2.
63. Environmentally sustainable health systems: a strategic document. Geneva: World Health Organization; 2017 ([https://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0004/341239/ESHS\\_Revised\\_WHO\\_web.pdf](https://www.euro.who.int/__data/assets/pdf_file/0004/341239/ESHS_Revised_WHO_web.pdf), accessed 28 July 2020).
64. Managing the risks of extreme events and disasters to advance climate change adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field CB, Barros V, Stocker TF, Qin D, Dokken DJ, Ebi KL, et al. (eds.)]. Cambridge and New York: Cambridge University Press; 2012 ([https://www.ipcc.ch/site/assets/uploads/2018/03/SREX\\_Full\\_Report-1.pdf](https://www.ipcc.ch/site/assets/uploads/2018/03/SREX_Full_Report-1.pdf), accessed 14 July 2020).
65. Health Emergency and Disaster Risk Management Framework. Geneva: World Health Organization; 2019 (<https://apps.who.int/iris/bitstream/handle/10665/326106/9789241516181-eng.pdf>, accessed 27 July 2020).
66. Cimellaroa GP, Reinhornb AM, Bruneauc M. Framework for analytical quantification of disaster resilience. *Eng Struct*. 2010;32:3639–49.
67. Ebi KL, Berry P, Hayes K, Boyer C, Sellers S, Enright PM, et al. Stress testing the capacity of health systems to manage climate change-related shocks and stresses. *Int J Environ Res Public Health*. 2018;15(11):2370.
68. Protecting health from climate change: vulnerability and adaptation assessment. Geneva: World Health Organization; 2013 ([https://apps.who.int/iris/bitstream/handle/10665/104200/9789241564687\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/104200/9789241564687_eng.pdf), accessed 15 July 2020).
69. Technical brief: Protecting health from hot weather during the COVID-19 pandemic. Geneva: Global Heat Health Information Network; 2020 (<http://www.ghhin.org/assets/technical-brief-COVID-and-Heat-finalv2.pdf>, accessed 14 June 2020).
70. More sustainability in the care sector. The Hague: Government of the Netherlands; 2020 (<https://www.government.nl/topics/sustainable-healthcare/more-sustainability-in-the-care-sector>, accessed 14 June 2020).

71. Balbus J, Berry P, Brettle M, Jagnarine-Azan S, Soares A, Ugarte C, et al. Enhancing the sustainability and climate resiliency of health care facilities: a comparison of initiatives and toolkits. *Rev Panam Salud Pública*. 2016;40(3):174–180.
72. Berry P, Enright PM, Shumake-Guillemot J, Villalobos Prats E, Campbell-Lendrum, D. Assessing health vulnerabilities and adaptation to climate change: A review of international progress. *Int J Environ Res Public Health*, 2018;15(12):2626.
73. Nanaimo Regional General Hospital: Assessing climate risks & opportunities. Ministry of Environment and Climate Change Strategy, British Columbia. ([https://www2.gov.bc.ca/assets/gov/environment/climate-change/cng/resources/case-studies/casestudy\\_nanaimo-gen-hospital.pdf](https://www2.gov.bc.ca/assets/gov/environment/climate-change/cng/resources/case-studies/casestudy_nanaimo-gen-hospital.pdf), accessed 14 June 2020).
74. Smart Hospitals Toolkit. PAHO Health Emergencies [website]. Washington DC: Regional Office for the Americas; 2017 ([https://www.paho.org/disasters/index.php?option=com\\_content&view=article&id=1742:smart-hospitals-toolkit&Itemid=1248&lang=en](https://www.paho.org/disasters/index.php?option=com_content&view=article&id=1742:smart-hospitals-toolkit&Itemid=1248&lang=en), accessed 14 July 2020).
75. Paterson J, Berry P, Ebi K, Varangu L. Health care facilities resilient to climate change impacts. *Int J Environ Res Public Health*. 2014;11(12):13097–116.
76. Poitras A. The effects of climate change on hospitals. [website] (<https://climatedata.ca/case-study/the-effects-of-climate-change-on-hospitals/>, accessed 14 July 2020).
77. PIEVC Engineering Protocol. Public Infrastructure Engineering Vulnerability Committee (PIEVC) [website] (<https://pievc.ca/protocol>, accessed 14 July 2020).
78. NRGH climate change vulnerability assessment report. Victoria: RDH Building Science Inc.; 2018 (<https://www.egbc.ca/getmedia/c8863c8e-69cc-4957-932f-51034f5fd65f/NRGH-PIEVC-Climate-Change-Vulnerability-Assessment-Report.pdf.aspx>, accessed 15 July 2020).
79. Sustainable and Climate-Resilient Health Care Facilities Toolkit. U.S. Climate Resilience Toolkit [website] (<https://toolkit.climate.gov/tool/sustainable-and-climate-resilient-health-care-facilities-toolkit>, accessed 15 July 2020).
80. Carbon emissions of air freight compared to other modes of transport [website] (<https://www.airportwatch.org.uk/air-freight/carbon-emissions-of-air-freight-compared-to-other-modes-of-transport/>, accessed 27 July 2020).
81. Greenhouse Gas Equivalencies Calculator. United Nations Environmental Protection Agency [website]. (<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>, accessed 27 July 2020).
82. Hospital emergency response checklist: An all-hazards tool for hospital administrators and emergency managers. Copenhagen: World Health Organization Regional Office for Europe; 2011 ([http://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0020/148214/e95978.pdf](http://www.euro.who.int/__data/assets/pdf_file/0020/148214/e95978.pdf), accessed 15 July 2020). WHO/EURO, 2011.
83. Climate risks and community vulnerabilities assessment. Department of Health and Human Services. Sustainable and Climate Resilient Health Care Facility Initiative – Element 1 Resources. <https://toolkit.climate.gov/sites/default/files/SCRHCFI%20Resource%20Sheet%201%20081415.pdf>, accessed 15 July 2020).
84. Discussion paper: Climate, sanitation and health. Draft. Geneva: World Health Organization; 2019 ([https://www.who.int/water\\_sanitation\\_health/sanitation-waste/sanitation/sanitation-and-climate-change20190813.pdf](https://www.who.int/water_sanitation_health/sanitation-waste/sanitation/sanitation-and-climate-change20190813.pdf), accessed 27 July 2020).
85. Guenther R, Balbus J. Primary protection: enhancing health care resilience for a changing climate. A best practices document under the HHS Sustainable and Climate Resilient Health Care Facilities Initiative. Washington DC: U.S. Department of Health and Human Services; 2014 (<https://toolkit.climate.gov/sites/default/files/SCRHCFI%20Best%20Practices%20Report%20final%202014%20Web.pdf>, accessed 14 July 2020).

86. Health Care Facility Climate Change Resiliency Checklist. March, 2013 (Updated 2017).The Canadian Coalition for Green Health Care & Nova Scotia Department of Environment and Health Canada; 2017 ([https://www.crhnet.ca/sites/default/files/library/CCGHC.NS\\_2013.HealthCareFacilityResiliencyChecklist.pdf](https://www.crhnet.ca/sites/default/files/library/CCGHC.NS_2013.HealthCareFacilityResiliencyChecklist.pdf), accessed 13 July 2020).
87. Implement energy efficiency and clean, renewable energy generation. Global Green and Healthy Hospitals. Health Care Without Harm; 2014.
88. Water, sanitation and hygiene in health care facilities: Status in low- and middle-income countries and way forward. Geneva: World Health Organization; 2015 ([https://apps.who.int/iris/bitstream/handle/10665/154588/9789241508476\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/154588/9789241508476_eng.pdf), accessed 27 July 2020).
89. Health care waste. Key facts. [website] World Health Organization; 2018 (<https://www.who.int/news-room/fact-sheets/detail/health-care-waste>, accessed 27 July 2020).
90. Adams J, Bartram J, Chartier Y (eds). Essential environmental health standards in health care. Geneva: World Health Organization; 2008 ([https://apps.who.int/iris/bitstream/handle/10665/43767/9789241547239\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/43767/9789241547239_eng.pdf), accessed 15 July 2020).
91. Healthy Hospitals, Healthy Planet, Healthy People – Addressing climate change in health care settings. A discussion draft. Geneva: World Health Organization and Health Care Without Harm; 2009. [https://www.who.int/globalchange/publications/climatefootprint\\_report.pdf](https://www.who.int/globalchange/publications/climatefootprint_report.pdf), accessed 15 July 2020).
92. Powering Health: Electrification options for rural health centers. Washington D.C.: United States Agency International Development. <http://www.poweringhealth.org/Pubs/PNADJ557.pdf>, accessed 15 July 2020).
93. Structural and non-structural measures. Geneva: United Nations Office for Disaster Risk Reduction [website]; 2015 (<https://www.undrr.org/terminology/structural-and-non-structural-measures>, accessed 15 July 2020).
94. Healthy environments for healthier populations: Why do they matter, and what can we do? Geneva: World Health Organization; 2019 (<https://apps.who.int/iris/bitstream/handle/10665/325877/WHO-CED-PHE-DO-19.01-eng.pdf>, accessed 27 July 2020).
95. Health facility energy needs assessment – Ghana Country Summary Report. African Solar Design and United Nations Foundations; 2015 (<http://energyaccess.org/wp-content/uploads/2016/01/UNF-Health-Clinic-Electrification-Ghana-Country-Summary-Report.pdf>, accessed 13 July 2020).
96. Health facility energy needs assessment – Uganda Country Summary Report. African Solar Design and United Nations Foundations; 2015 (<https://poweringhc.org/wp-content/uploads/2018/04/Uganda-Country-Summary-Report-Final-Draft-090115.pdf>, accessed 13 July 2020).
97. Safe hospitals in emergencies and disasters: structural, non-structural and functional indicators. Geneva: World Health Organization; 2010. [https://apps.who.int/iris/bitstream/handle/10665/207689/9789290614784\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/207689/9789290614784_eng.pdf), accessed 27 July 2020).
98. Guidelines on non-structural safety in health facilities. Kathmandu: Ministry of Health of Nepal and World Health Organization Nepal; 2004 (<https://apps.who.int/iris/bitstream/handle/10665/205185/B0610.pdf?sequence=1&isAllowed=y>, accessed 15 July 2020).
99. Mercury and health. Fact-sheets [website]. World Health Organization; 2017 (<https://www.who.int/en/news-room/fact-sheets/detail/mercury-and-health>, accessed 27 July 2020).
100. Ramji A, Patnaik S, Mani S, Dholakia H. Powering Primary Healthcare through Solar in India: Lessons from Chattisgarh. New Delhi: Council on Energy, Environment and Water and Oxfam India; 2017 ([https://www.ceew.in/sites/default/files/CEEW-Powering-Primary-Healthcare-through-Solar-in-India-30Aug17\\_0.pdf](https://www.ceew.in/sites/default/files/CEEW-Powering-Primary-Healthcare-through-Solar-in-India-30Aug17_0.pdf), accessed 15 July 2020).

101. Buildings – Guidance Document for Members: Support green and healthy hospital design and construction. Global Green and Healthy Hospitals. Health Care Without Harm; 2014/2015 (<https://www.greenhospitals.net/guidance-documents/#Buildings>, accessed 27 July 2020).
102. Health facility energy needs assessment – Malawi Country Summary Report. African Solar Design and United Nations Foundations; 2015 (<https://poweringhc.org/wp-content/uploads/2018/04/Malawi-Country-Summary-Report.pdf>, accessed 13 July 2020).
103. World Health Assembly Resolution 61.19. Climate change and health. Geneva: World Health Organization; 2008 ([https://www.who.int/globalchange/A61\\_R19\\_en.pdf](https://www.who.int/globalchange/A61_R19_en.pdf), accessed 15 July 2020).
104. WHO Workplan on Climate Change and Health. Aims and objectives: 2014–2019. Geneva: World Health Organization; 2014 ([https://www.who.int/globalchange/health\\_policy/climate-change-and-health-workplan-2014-2019.pdf](https://www.who.int/globalchange/health_policy/climate-change-and-health-workplan-2014-2019.pdf), accessed 15 July 2020).
105. Annex 1. Compendium of possible actions to advance the implementation of the Ostrava Declaration. Sixth Ministerial Conference on Environment and Health. Copenhagen: WHO Regional Office for Europe; 2017 ([http://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0008/341945/Annex1\\_13June.pdf](http://www.euro.who.int/__data/assets/pdf_file/0008/341945/Annex1_13June.pdf), accessed 27 July 2020).
106. Plan of action for disaster risk reduction 2016–2021. 55th Directing Council, Washington D.C.: Regional Office for the Americas; 2016 (<https://www.paho.org/hq/dmdocuments/2016/CD55-17-e.pdf>, accessed 14 July 2020).
107. Health, environment and climate change. Draft WHO global strategy on health, environment and climate change: the transformation needed to improve lives and well-being sustainably through healthy environments. Seventy-Second World Health Assembly. A72/15. Geneva: World Health Organization; 2019 ([https://apps.who.int/gb/ebwha/pdf\\_files/WHA72/A72\\_15-en.pdf](https://apps.who.int/gb/ebwha/pdf_files/WHA72/A72_15-en.pdf), accessed 27 July 2020).
108. Universal health coverage. Health topics. World Health Organization [website] ([https://www.who.int/health-topics/universal-health-coverage#tab=tab\\_1](https://www.who.int/health-topics/universal-health-coverage#tab=tab_1), accessed 27 July 2020).
109. Salas RN, Jha AK. Climate change threatens the achievement of effective universal healthcare. *BMJ* 2019;366: l5302.
110. Political Declaration of the High-level Meeting on Universal Health Coverage “Universal health coverage: moving together to build a healthier world. Geneva: United Nations; 2019 (<https://www.un.org/pga/73/wp-content/uploads/sites/53/2019/07/FINAL-draft-UHC-Political-Declaration.pdf>, accessed 27 July 2020).
111. Primary health care. World Health Organization [website] ([https://www.who.int/health-topics/primary-health-care#tab=tab\\_1](https://www.who.int/health-topics/primary-health-care#tab=tab_1), accessed 27 July 2020).
112. Declaration of Astana. Global Conference on Primary Health Care, 25–26 October 2018. Geneva: World Health Organization; 2019 (<https://apps.who.int/iris/bitstream/handle/10665/328123/WHO-HIS-SDS-2018.61-eng.pdf>, accessed 26 July 2020).
113. Paris Agreement. Geneva: United Nations; 2015 ([https://unfccc.int/files/essential\\_background/convention/application/pdf/english\\_pari\\_agreement.pdf](https://unfccc.int/files/essential_background/convention/application/pdf/english_pari_agreement.pdf), accessed 27 July 2020).
114. WHO Review: Health in the Nationally Determined Contributions. WHO analysis and recommendations on health-promoting Nationally Determined Contributions (NDCs) to the Paris Agreement. Geneva: World Health Organization; 2020 (<https://www.who.int/publications-detail/who-review-health-in-the-ndcs>, accessed 27 July 2020).
115. Kigali Amendment Enters into Force, Bringing Promise of Reduced Global Warming. International Institute for Sustainable Development [website]; 2019 (<https://sdg.iisd.org/news/kigali-amendment-enters-into-force-bringing-promise-of-reduced-global-warming/>, accessed 27 July 2020).



116. The Montreal Protocol on substances that deplete the ozone layer. UN Environment Programme [website] (<https://ozone.unep.org/treaties/montreal-protocol#nolink>, accessed 27 July 2020).
117. Minamata Convention on Mercury. Text and annexes. UN Environment Programme [website]. (<http://www.mercuryconvention.org/Convention/Text>, accessed 27 July 2020).
118. Developing national strategies for phasing out mercury-containing thermometers and sphygmomanometers in health care, including in the context of the Minamata Convention on Mercury: key considerations and step-by-step guidance. Geneva: World Health Organization; 2015 (<https://apps.who.int/iris/bitstream/handle/10665/259448/9789241508339-eng.pdf>, accessed 26 July 2020).
119. Fisher J, Varenne B, Narveaez D, Vickers C. The Minamata Convention and the phase down of dental amalgam. *Bull World Health Organ.* 2018; 96:436–8.
120. Strategic Approach to International Chemicals Management. Overview. [website] (<http://www.saicm.org/About/SAICMOverview>, accessed 27 July 2020).
121. Stockholm Convention on Persistent Organic Pollutants. Overview. [website] (<http://www.pops.int/TheConvention/Overview/tabid/3351/Default.aspx>, accessed 27 July 2020).
122. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. [website] (<http://www.basel.int/TheConvention/Overview/tabid/1271/Default.aspx>, accessed 27 July 2020).
123. Rotterdam Convention on the Prior Informed Consent Procedure for certain hazardous Chemicals and Pesticides in international trade. [website] (<http://www.pic.int/TheConvention/Overview/tabid/1044/language/en-US/Default.aspx>, accessed 27 July 2020).







**World Health  
Organization**

Department of Environment, Climate Change and Health  
World Health Organization (WHO)  
Avenue Appia 20 – CH-1211 Geneva 27 – Switzerland  
[www.who.int/phe/en/](http://www.who.int/phe/en/)

