World Health Organization

CHECKLISTS TO ASSESS VULNERABILITIES IN HEALTH CARE FACILITIES IN THE CONTEXT OF CLIMATE CHANGE

World Health Organization

CHECKLISTS TO ASSESS VULNERABILITIES IN HEALTH CARE FACILITIES IN THE CONTEXT OF CLIMATE CHANGE

Checklists to assess vulnerabilities in health care facilities in the context of climate change

ISBN 978-92-4-002290-4 (electronic version)

ISBN 978-92-4-002291-1 (print version)

Suggested citation. Checklists to assess vulnerabilities in health care facilities in the context of climate change. Geneva: World Health Organization; 2021. Licence: CC BY-NC-SA 3.0 IGO.

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

Editing, design and layout by Inis Communication

CONTENTS

ACKNOWLEDGEMENTS

This document represents the work and contributions from experts within and outside the World Health Organization (WHO). WHO extends its gratitude to Health Canada, Norwegian Ministry of Foreign Affairs, the Swedish Agency for International Development Cooperation and the UK Foreign Commonwealth & Development Office for their financial and technical support to develop this checklist document.

This document was written by Aderita Sena, Carlos Corvalan, Elena Villalobos Prats and Diarmid Campbell-Lendrum of the WHO Climate Change and Health Unit.

WHO extends its thanks to the following reviewers: Peter Berry (Health Canada), Jose Gesti Canuto (independent consultant), Kersten Gutschmidt (WHO), Arabella Hayter (WHO), Qudsia Huda (WHO), Jaz Lapitan (WHO), Margaret Montgomery (WHO), Frank Pega (WHO), Megha Rathi (WHO), Linda Varangu (Canadian Coalition for Green Health Care) and Salvatore Vinci (WHO).

ABBREVIATIONS

CRESHCF	climate-resilient and environmentally sustainable health care facilities
COPD	chronic obstructive pulmonary disease
IPCC	Intergovernmental Panel on Climate Change
SDG	Sustainable Development Goal
UNGA	The United Nations General Assembly
WASH	water, sanitation and hygiene
WASH FIT	Water and Sanitation for Health Facility Improvement Tool
WHO	World Health Organization

1

1 BACKGROUND

Climate change is affecting health care facilities in many settings around the world – whether as overall temperature rise; intense and recurrent floods, storms, extreme temperatures, droughts, wildfires or sea-level rise; changing patterns of climate-sensitive infectious diseases or climate-related noncommunicable diseases, or injuries, individually or often combined. The World Health Organization (WHO) identifies four fundamental requirements for providing safe and quality care in the context of climate change. These are: (i) having adequate number of skilled workers in safe and decent working conditions, empowered and informed to protect and respond to environmental challenges; (ii) sustainable and safe management of water, sanitation and hygiene (WASH) and health care waste services; (iii) sustainable energy services; and (iv) appropriate infrastructure, technologies, products and processes, including all the operations that allow for the efficient functioning of a health care facility *(1).*

Simple tools are needed, particularly in low- and middle-income countries, to assess climate change risks and vulnerabilities on health care facilities. Although some tools to help countries in advancing specific areas related to climate change and health are available, very few specifically respond to questions regarding risks, vulnerabilities and impacts.

HOW TO USE THIS GUIDE

Designed as a complementary tool to the *WHO Guidance for climate-resilient and environmentally sustainable health care facilities* (henceforth referred to in this document as *WHO Guidance for CRESHCF*) *(1),* the primary purpose of this checklist document is to support users in establishing a baseline with regards to climate change resilience in health care facilities. This will be used to inform the design of interventions to strengthen overall resilience of health care facilities to climate change (Figure 1). The checklists can also be used for iterative vulnerability assessments in health care facilities.

Figure 1. Complementarity between the *WHO Guidance for climate-resilient and environmentally sustainable health care facilities* and the *Checklists to assess vulnerabilities in health care facilities in the context of climate change*

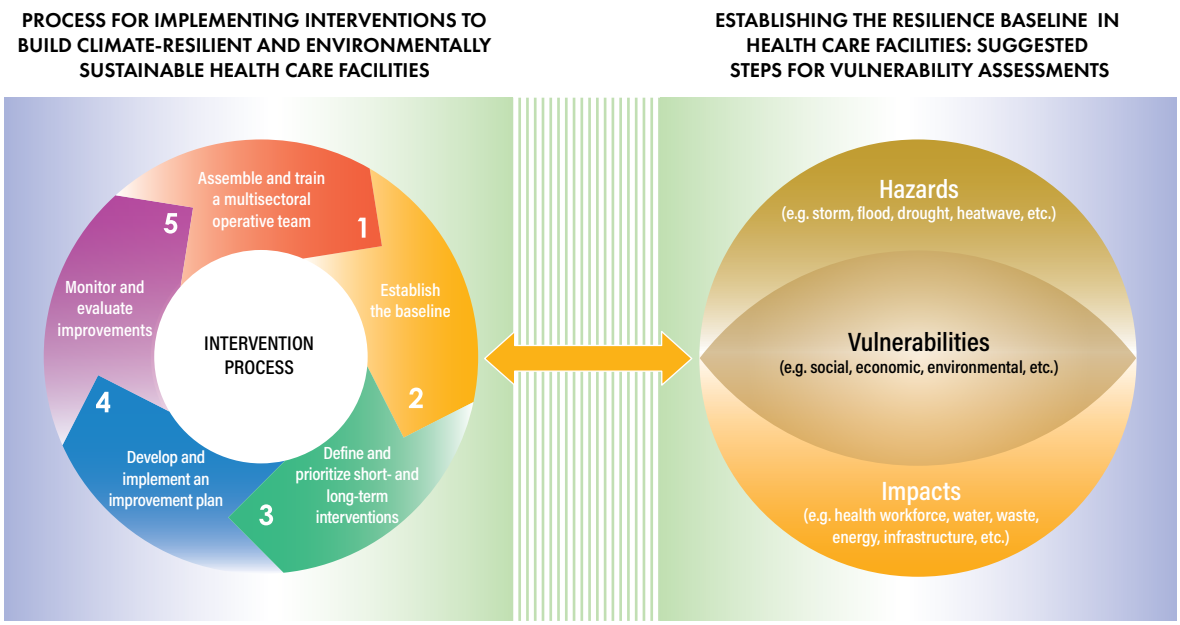


Figure 1 presents the key outputs that can be produced to establish a resilience baseline for health care facilities. While hazards will need to be understood in relation to both vulnerability and impacts, users may want to only focus their assessment on vulnerabilities or impacts and therefore use the relevant checklists included in this document.

Starting with an introduction to the concepts associated with risk (Section 2), this document proposes a three-step approach for the conduct of vulnerability assessments in health care facilities in Section 3. The three steps refer to: (i) identifying the main climate hazards that health care facilities face; (ii) assessing current vulnerability in health care facilities; and (iii) understanding potential climate change impacts in health care facilities. A set of checklists are provided in Annex A to support users in conducting each of the suggested steps in the vulnerability assessments. Section 4 explains how to use the checklists.

Health sector officials require robust information on current and future climate risks to health care facilities to be able to develop effective adaptation measures using the *WHO Guidance for CRESHCF (1)*. This document complements the *WHO Guidance for CRESHCF* by providing useful information in understanding climate change hazards and checklists to identify and assess climate-related vulnerabilities and impacts. All the proposed checklists may not be relevant to every health care facility in every location; and therefore may need to be selected, modified or supplemented with additional tools and guidance.

The *WHO Guidance for CRESHCF* also includes checklists, but rather than focusing on vulnerability, they provide example improvements to be implemented at the health care facility level to strengthen climate resilience and environmental sustainability. Information gathered through the vulnerability assessment (i.e. resilience baseline) will inform the design of improvements as part of the suggested process to strengthen resilience under the overall guidance (Figure 1).

Users of this document are encouraged to consult the *Hospital Safety Index: Guide for evaluators (2),* which provides detailed explanations on how to use its 151-item checklist to obtain ratings for structural safety, nonstructural safety and functional capacities of a hospital. Additionally, users who need more information on water, sanitation and health care waste interventions, are encouraged to consult the WHO *Water and Sanitation for Health Facility Improvement Tool* (WASH FIT) to prioritize risks and make improvements in health care facilities *(3)*.

TARGET AUDIENCE

This document and its checklists are intended for health care facility managers and other health workers aiming to understand the climate risks (large or small) that health care facilities may face, specifically in terms of existing vulnerabilities and possible impacts, and take action where required. Some of the topics covered cannot be responded to only by health care facility officials, and require discussions with partners in other sectors as well as local or national government agencies. Similarly, some actions to reduce vulnerabilities will need coordination between and across different sectors and agencies.

2

2 UNDERSTANDING THE RISKS, VULNERABILITIES AND IMPACTS OF CLIMATE CHANGE ON HEALTH CARE FACILITIES

CLIMATE CHANGE RISKS

Climate change risk is "the potential for adverse consequences of a climate-related hazard, or of adaptation or mitigation responses to such a hazard, on lives, livelihoods, health and well-being, ecosystems and species, economic, social and cultural assets, services (including ecosystem services), and infrastructure" *(4).* Risk is explained as a function of hazards, exposures and vulnerabilities. In other words, risk depends on the occurrence of a climate-related hazard, exposure to those hazards, and the vulnerability present in the system. Climate change risk is the likelihood that climate-induced shocks and stresses will adversely impact the functioning of a health care facility. This will vary based on:

- the intensity and magnitude of a specific climate-related hazard (such as flood, drought, storm, climate-sensitive disease outbreak)
- the level of exposure to the hazard of the health care facility, staff or communities
- the level of existing vulnerability, which will determine how much these hazards will impact the health care facility's functioning.

To reduce climate change risks, health care facilities need to be resilient. Climate-resilient health care facilities are those that are able 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 *(1,5).*

CLIMATE CHANGE HAZARDS

The United Nations General Assembly (UNGA) defines climate change hazard as "a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation" *(6).* The Intergovernmental Panel on Climate Change (IPCC) defines climate change hazard as "the potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources" *(4).* Climate change hazards may get escalated by simultaneous occurrence (such as storms producing floods and increase in vectorborne diseases; or heatwaves ensuing jointly with drought and wildfires); or by sequential occurrence (such as drought followed by floods followed by an increase in vectorborne diseases).

CLIMATE CHANGE EXPOSURES

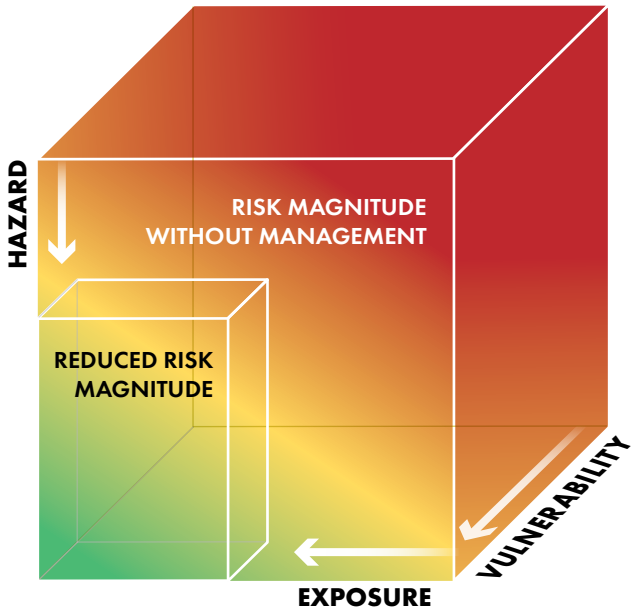
IPCC defines climate change exposure as "the presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected" by a climate hazard *(4).* From the point of view of health care facilities, exposure relates to the presence of health care workers, patients, services and infrastructure in the location of current or future climate hazards. Understanding exposure requires knowledge of whether people, housing, production capacities and other tangible human assets are located in hazard-prone areas *(6).*

CLIMATE CHANGE VULNERABILITIES

Climate change vulnerability as per the IPCC is "the propensity or predisposition to be adversely affected" by a climate risk *(4).* UNGA's more comprehensive definition includes "the conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards" *(6).* This implies that vulnerability extends beyond climate change and may exist before a climate hazard manifests. However, climate change stress and shocks may increase vulnerability over time, by also impacting on other social, environmental and economic factors.

Figure 2 explains the concept of risk reduction, with the aim to reduce overall risk by implementing actions to reduce hazards, exposures and vulnerabilities.

Figure 2. Risk reduction from hazards, exposures and vulnerabilities



CLIMATE CHANGE IMPACTS

Climate change impacts are "the consequences of realized risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather and climate events), exposure, and vulnerability. Impacts generally refer to effects on lives, livelihoods,

health and wellbeing, ecosystems and species, economic, social and cultural assets, services (including ecosystem services), and infrastructure" *(4).* The IPCC notes with high confidence that the severity of the impacts of climate extremes depends strongly on the level of the exposure and vulnerability to these extremes *(7).* Moreover, trends in exposure and vulnerability are major drivers of changes in disaster risk.

CLIMATE CHANGE RESILIENCE

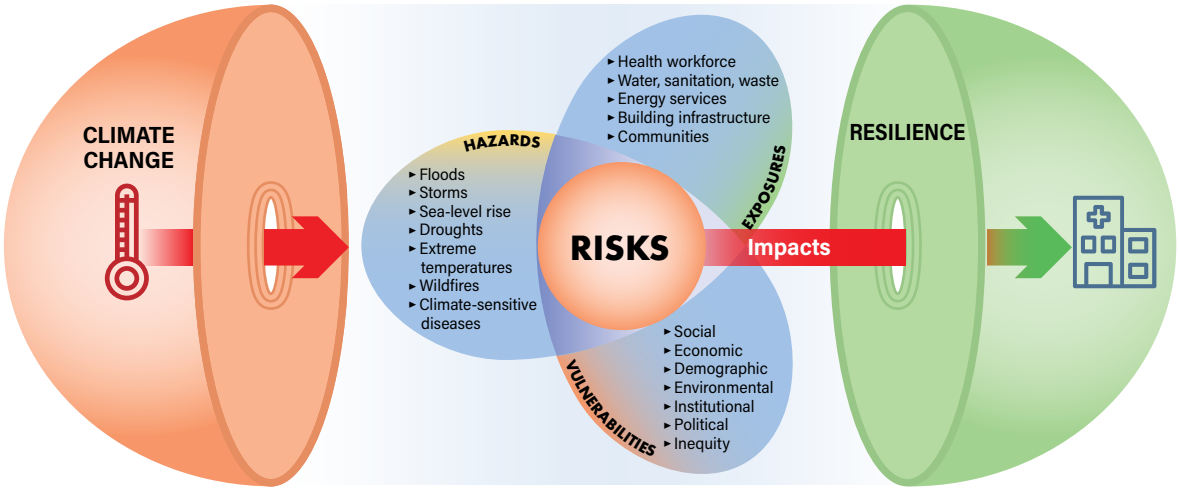
Resilience is "the capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation" *(4).*

Table 1 provides information on how the presence of climate hazards, exposures and vulnerabilities can lead to risks and impacts. In a simplified form, if there are no climate hazards or exposures (first two rows in the table), there would be no immediate climate change related risks or impacts (even if vulnerability is present). However, even when low levels of vulnerability are present, a large hazard (and resulting exposures) may increase risks and impacts (third row). When all three factors are present, risks may vary from low to high depending on the magnitude of the hazard, level of exposure and level of underlying vulnerability (last row). Figure 3 summarizes the links between all these concepts – and the importance of building climate-resilience – graphically.

Table 1. Risks and impacts in the presence of hazards, exposures and vulnerabilities

CLIMATE HAZARD PRESENT	EXPOSURE PRESENT	VULNERABILITY PRESENT	CLIMATE RISKS	IMPACTS PRESENT
No	N/A	N/A	None	No
Yes	No	N/A	None	No
Yes	Yes	None or low	None – low	Yes (possible)
Yes	Yes	Medium or high	Low – high	Yes (probable)

Figure 3. Impacts of climate-related risks on health care facilities



3

3 ASSESSING VULNERABILITIES IN HEALTH CARE FACILITIES

Although technical guidance exists to assess climate change and health vulnerability at the population level *(8),* this document provides specific checklists to assess vulnerability at the health care facility level. Establishing the resilience baseline for health care facilities is embedded in the overall process to strengthening resilience and environmental sustainability in health care facilities (see Figure 1). Therefore, the current document focuses on the following suggested steps to assess vulnerability and provides checklists for each climate hazard.

(i) Identify climate **hazards** of concern.

(ii) Assess current **vulnerability** for each of the hazards, in each of the key components of health care facilities.

(iii) Understand potential **impacts** posed by climate variability and change in each of the key components of health care facilities.

Strengthening resilience of health care facilities to climate change is done through the implementation of a risk assessment and management approach as described earlier (Figure 1).

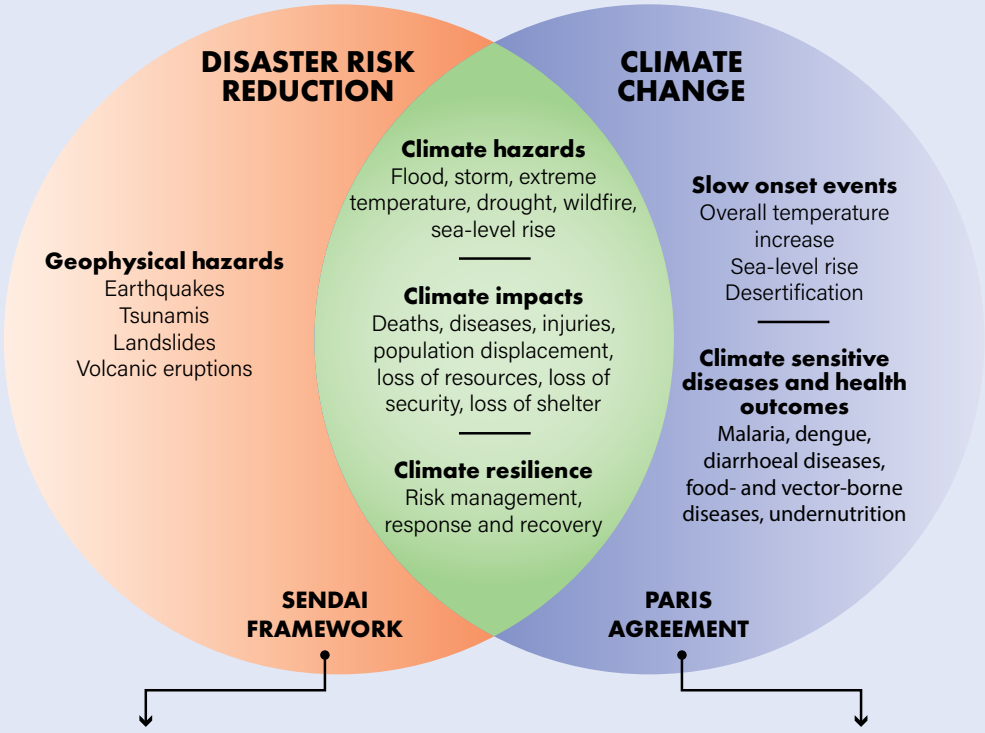
To assess the measurable risk to a health care facility, the first key step would be to identify which climate hazards they face. The presence of a hazard does not imply exposure, because adaptation measures can greatly reduce or eliminate harmful exposures and impacts. However, for the purpose of assessing health care facilities, it can be assumed that if a hazard is threatening a health care facility, it is because components of the facility and its operations are exposed. The second step would be to identify vulnerabilities, along with an analysis of the geographical location of the facilities and communities they serve. The third step would be to examine whether the four requirements (i.e. health workforce; WASH and health care waste services; energy services; infrastructure, technologies, products and processes) for safe and quality care could be impacted by the hazards. In this step it would also be important to identify whether different or stronger hazards associated with climate change, or other factors, may increase risks to the facility now or in the future.

IDENTIFYING CLIMATE HAZARDS OF CONCERN

When assessing climate-resilience of health care facilities, it is necessary to first understand their climate risks of concern, bearing in mind that the magnitude of risk depends on current hazards, exposures and vulnerabilities (Figure 2). The existing classification of hazards related to disasters can be adapted by considering those that are specifically climate related, such as hydro-meteorological, environmental and biological hazards. Climate hazards may also result in technological and societal hazards, which should be considered when assessing impacts on health care facilities. Assessing impacts on people (rather than the health care facility) however requires a different approach (i.e. with emphasis on the exposure pathways and the climate-sensitive health outcomes of each) *(9).* Box 1 highlights the links between climate change, disaster risk reduction and sustainable development actions to protect health.

Box 1. Climate change and disaster risk reduction: sustainable actions to protect health

Actions to protect health from climate change have many elements in common with those of disaster risk reduction. Although approached separately in many countries and institutions, it is increasingly clear that efforts to reduce risks should be coordinated with data monitoring, response and evaluation, which would reduce duplication and costs. Commonalities and differences in key hazards, impacts and resilience elements are highlighted in the figure below along with linkages to global agendas – the Sendai Framework for Disaster Risk Reduction, the United Nations Framework Convention on Climate Change Paris Agreement, and the Sustainable Development Goals (SDGs). Actions in any of these areas contribute to good health and well-being (SDG-3).



Paragraph 13:

Addressing climate change as one of the drivers of disaster risk, represents an opportunity to reduce disaster risk in a meaningful and coherent manner

SUSTAINABLE DEVELOPMENT GOALS

Goal 13, Take urgent action to combat climate change and its impacts

Goal 11, Make cities and human settlements inclusive, safe, resilient and sustainable

Article 7.1 and Article 8.1

Article 7.1 enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change

Article 8.1 averting, minimizing and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events

Sources: (10–13).

GLOBAL TEMPERATURE INCREASE

Presently, global temperatures are over 1.0°C above that of pre-industrial levels, and if temperatures continue to increase at the current rate, IPCC estimates with high confidence that it will increase by 1.5°C between 2030 and 2052 *(14).* The decade of 2010–2019 was the warmest recorded, as well as the five years between 2015 and 2019 *(15).* These altered global conditions indicate increases in mean temperature in land and oceans, hot temperature extremes, heavy precipitation in some areas, and higher probability of drought and precipitation deficits in others, i.e. all of these with different levels of variability across regions. This implies increased climate risks to health, food security, water security, human security, livelihoods and economic growth *(14).* Regions of permafrost are undergoing a process of thawing, which is affecting building infrastructures *(16).* By extension of the above, there will be implicit tangible impact on health systems and health care facilities, in particular.

The most direct health effects due to overall temperature increase are heat-related morbidity and mortality, as well as respiratory morbidity and mortality due to increase in ozone formation *(17)*. Indirect health effects may include changes in patterns of disease vectors and pathogen growth in warm waters, or changes in other health determining sectors (water, food and agriculture, energy) and systems (land and water ecosystem).

Table 2 shows the main climate hazards groups by hazard types (or subgroups) (highlighted, with direct hazards in orange and mediated in yellow), and a set of climate-specific examples of exposure pathways *(18,19)*. Most of the impacts on health care facilities result from climate hazards (as identified in Table 2). However, it is necessary to identify specific impacts to human health and health care facilities resulting from increase in mean temperatures. Even after excluding days of extreme heat (assessed separately below), increased mean temperatures will increase stress among health workers already living in regions with high average temperatures and experiencing days above their comfort level. Ozone formation adds to local air pollution, making it particularly difficult for health workers with pre-existing health conditions (respiratory diseases, cardiovascular diseases, overweight), as well as those at the community level who spend large part of their time outdoors. The quantity and quality of water are affected, both by the gradual reduction in access to freshwater (quantity), and increase in contamination by pathogens (such as cyanobacterial toxins, which cause a range of health problems including skin irritations, stomach cramps, vomiting, nausea, diarrhoea, fever, sore throat, headache, muscle and joint pain, mouth blisters and liver damage *(20,21))*, that grow in waters with increased levels of nutrients and warmer temperatures. Additionally, water may get contaminated by increased concentrations of metals, phosphorus and phytoplankton resulting in less oxygenated water, requiring additional treatment of drinking water *(21).*

Energy in health care facilities is affected by the gradual increase in the use of electricity for cooling purposes. The infrastructure, technologies, products and processes of many health facilities may also be affected by mean temperature increases. This may occur in facilities that were not constructed for warmer weather, and would incur costs for insulation, cooling and dehumidification. The area surrounding the facility may need to be altered with heat- and drought-resistant plants to avoid use of additional water to keep the area green (considering that a green, arborized area contributes to overall cooling).

Table 2. Classification of climate-related hazards to health care facilities and overall health

CLIMATE HAZARD GROUP		HAZARD TYPE	EXAMPLES OF EXPOSURE PATHWAYS
Hydro-meteorological	Hydrological	**Flood** ▪ Riverine ▪ Coastal ▪ Flash ▪ Mudslides ▪ Erosion	▪ Water, soil, food contamination ▪ Lack of power ▪ Increased vector habitat ▪ Flooded health care facilities ▪ Flooded sewage and waste areas ▪ Impaired access to health care facilities ▪ Impacts on the supply chain ▪ Impaired mobility and transportation
	Meteorological	**Storm** ▪ Tropical cyclones ▪ Local storms ▪ Winds ▪ Dust storms	▪ Lack of power ▪ Damaged health care facilities ▪ Impaired access to health care facilities ▪ Water, soil contamination ▪ Particulate matter (air pollution) ▪ Disruption of food productivity
		Extreme temperature ▪ Heatwaves ▪ Cold waves	▪ Power outages ▪ Water, food contamination ▪ Air pollution (ozone formation) ▪ Impaired access to food and water ▪ Frozen water pipes* ▪ Loss of water pressure* ▪ Internal flooding of health care facilities* ▪ Impaired mobility and transportation* *(*cold wave specific)*
	Climatological	**Drought** ▪ Meteorological ▪ Hydrological ▪ Agricultural	▪ Reduced water access ▪ Reduced hygiene ▪ Lack of power ▪ Water contamination ▪ Reduced ability to deliver services ▪ Increased water salinity ▪ Dust and air pollution ▪ Reduced land productivity causing food insecurity
		Wildfire	▪ Power outages ▪ Direct threats to health infrastructure ▪ Impacts on the supply chain ▪ Impaired access to health care facilities ▪ Air pollution
Environmental change		**Sea-level rise** ▪ Recurrent or permanent coastal floods and erosion	▪ Increased salinity intrusion (water, soil) ▪ Freshwater contamination ▪ Food contamination ▪ Flooded health care facilities ▪ Flooded sewage and waste areas ▪ Impaired access to health care facilities
		Direct hazard from increased temperatures ▪ Accelerated growth, transmission, virulence of certain pathogens leading to increased biological hazards ▪ Ozone formation	▪ Increased biological hazards ▪ Change in climate-sensitive diseases (increase in health care facility admissions) ▪ Water and food contamination ▪ Air pollution (ozone formation) ▪ Impacts on biodiversity (control of new pathogens) ▪ Threats to building infrastructure from melting permafrost

CLIMATE HAZARD GROUP	HAZARD TYPE	EXAMPLES OF EXPOSURE PATHWAYS
Biological (climate-sensitive diseases)	**Airborne diseases**	▪ Respiratory infections ▪ Meningococcal meningitis ▪ Influenza
	Waterborne diseases	▪ Diarrhoeal diseases ▪ Cholera ▪ Typhoid fever
	Foodborne diseases	▪ Hepatitis A ▪ Foodborne microbial hazards
	Zoonotic diseases	▪ Leptospirosis ▪ Hantavirus disease
	Vectorborne diseases	▪ Dengue ▪ Malaria ▪ Chikungunya ▪ Zika ▪ Rift Valley fever ▪ West Nile virus ▪ Lyme disease
Climate-sensitive health outcomes	**Noncommunicable diseases and injuries**	▪ Chronic respiratory diseases ▪ Cardiovascular diseases ▪ Unintentional injuries ▪ Mental health outcomes ▪ Malnutrition ▪ Kidney diseases
Technological (mediated by climate hazards)	Industrial hazards (as a result of a climate hazard such as a storm, flood, or wildfire)	▪ Chemical spill ▪ Structural collapse ▪ Occupational hazards (health workforce) ▪ Environmental pollution (air, water, soil) ▪ Food contamination ▪ Infrastructure disruption causing: power outages; contamination of water supply, solid waste, wastewater, food and water: communication system failure; medical equipment, products and services, supply system failure; build up of hazardous waste
Societal (mediated by climate hazards)	Displaced populations Famine	▪ Water and food scarcity ▪ Mental health problems ▪ Protein-energy malnutrition ▪ Conflict and violence

Note: Impacts for the main hazard are listed in separate tables in Annex A.

Sources for classification: (18,19,21,22).

Examples of potential hazards threatening each of the four components of health care facilities are presented in Box 2. A template to identify hazards related to specific vulnerabilities and impacts is included in the Annex A, which would help focus on the assessments proposed in the hazard-specific checklists for both vulnerabilities and impacts.

Box 2. Hypothetical scenario of climate hazards and impacts to a health care facility in a small island state

This is a hypothetical scenario of all hazards posing possible threats or affecting a health care facility in a small island state. The most common current hazards are tropical cyclones, which pose threats to the four health care facility components and occasionally also cause flooding. Sea-level rise is emerging as a serious threat, although not yet impacting widely. Multihazards have the potential to overwhelm the functioning of a health care facility.

CLIMATE HAZARD TYPE	IS A HAZARD OR EXPOSURE PRESENT?	WHAT ARE THE IMPACTS ON THESE AREAS? ● Current observed impacts ◆ Possible impacts with changed conditions			
	Yes/No*	Health workforce	WASH and health care waste	Energy services	Infrastructure, technologies, products, processes
Storm (tropical cyclone)	Yes	●	●	●	●
Flood	Yes	◆	●	●	●
Heatwave	No	◆		◆	
Drought	No	◆	◆		
Wildfire	No			◆	◆
Sea-level rise	Yes	◆	◆		●

**A yes/no categorization is used in this example. In some cases assessments may include the likelihood of occurrence and the intensity of the impact.*

ASSESSING CURRENT VULNERABILITIES

Vulnerabilities could exist prior to hazards affecting health care facilities, and such hazards in turn could increase vulnerability. The various types of vulnerabilities, including social, economic, demographic, environmental, institutional and political, can all occur simultaneously. In health care facilities, vulnerabilities can increase impacts on each or all of the key components of a health care facility, i.e. health workforce; WASH and health care waste services; energy services; infrastructure, technologies, products and processes.

Further information can be obtained from the companion report *WHO Guidance for CRESHCF (1).* Table 3 presents the objectives of these four key areas, which are reflected in the vulnerability checklists in Annex A.

Table 3. Vulnerability areas and objectives

KEY AREAS	OBJECTIVES
Vulnerabilities in the health workforce	**Human resources**: Health care facilities with capacity to deal with health risks from climate change, having healthy and safe working conditions and sufficient number of health workers who are aware and empowered 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: Communicating, coordinating and increasing awareness related to climate resilience and environmental sustainability among health workers, patients, visitors, target communities, and with other sectors
Vulnerabilities in WASH and health care waste management	**Monitoring and assessment:** Information regarding water, sanitation, chemical use and health care waste management considering 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
Vulnerabilities related to energy management	**Monitoring and assessment:** Information regarding energy services to 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
Vulnerabilities related to infrastructure, technologies, products and processes	**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: Adopting new technologies and processes that can provide climate-resilience, environmental sustainability and enhanced health service delivery
	Sustainability of health care facility operations: Adopting and procuring low environmental impact technologies, products, processes and services to enhance climate-resilience and environmental sustainability

Source: (1).

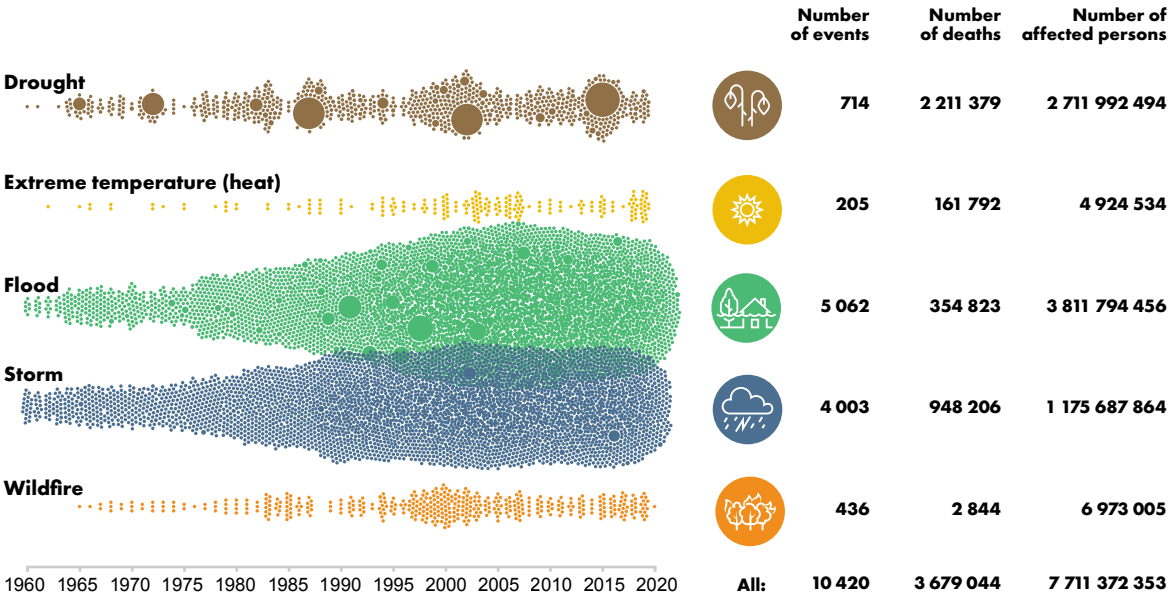
UNDERSTANDING POTENTIAL IMPACTS

The IPCC notes with very high confidence that impacts from recent climate-related extremes (such as heatwaves, droughts, floods, cyclones and wildfires), reveal significant vulnerability and exposure of some ecosystems and many human systems to current climate variability *(17)*. Highlighted impacts include disruption in the supply chain for medical (such as medicines, personal protective equipment and supplies for conducting tests) and nonmedical products (such as cleaning products and food)

and services, access to potable water supplies, energy supplies, damage to infrastructure and settlements, increased human morbidity and mortality, and overall reduction of human well-being, all of which are highly relevant to health care facilities *(23).* Countries at all levels of development lack preparedness in some sectors.

Global databases have information on many of the hazards listed in Table 2. Figure 4 shows the trends in five of them, for the six decades since 1960. During these 60 years, 10 480 separate events were recorded globally. The largest number of events recorded were floods (over 5000), followed by storms (over 4000). Although droughts were less numerous (714 events), they were the deadliest causing 2.2 million deaths; storms caused nearly 950 000 deaths. In terms of the number of people affected (including injured, homeless or displaced), floods affected over 3.8 billion, followed by drought that affected over 2.7 billion. Both, extreme temperatures (heat) and wildfires showed the lowest overall mortality numbers. In general terms, although not one single event (each corresponding to one dot) can be attributed to climate change, there is evidence of increasing numbers over time. Figure 4 also shows the magnitude of each event (dot size, corresponding to number of affected persons), and the large impacts that some storms, floods, and droughts have had in recent decades.

Figure 4. Number of events, deaths and affected persons since 1960, for drought, extreme temperature (heat), flood, storm and wildfire



Note: Each dot represents an event; circle size represents the number of affected persons.

Sources: (24); graphs produced with RAW Graphics (25).

CLIMATE-SENSITIVE DISEASES AND CLIMATE-SENSITIVE HEALTH OUTCOMES

All climate hazards discussed here have health impacts, which for the purpose of this section are separated as climate-sensitive infectious diseases and climate-sensitive health outcomes (specifically noncommunicable diseases and conditions and injuries). The linkages between climate hazards and climate-sensitive diseases and outcomes, and the possible pathways are shown in Table 4. All health outcomes impact health care facilities because they have the potential to overwhelm the delivery of health care, by increasing the pressure on: the health workforce (increase in number of patients and increase in diseases among health workers); WASH and health care waste services; energy services; and to overall infrastructure, technologies, products and processes.

Table 4. Climate-sensitive diseases and climate-sensitive health outcomes – hazards and exposure pathways

CLIMATE HAZARD	CLIMATE-SENSITIVE DISEASES (INFECTIOUS DISEASES)	CLIMATE-SENSITIVE HEALTH OUTCOMES (NONCOMMUNICABLE DISEASES AND UNINTENTIONAL INJURIES)	POSSIBLE EXPOSURE PATHWAYS
INCREASED TEMPERATURE 	Waterborne diseases (diarrhoeal diseases, *Naegleria fowleri* infection, campylobacter infection, cholera, harmful algal bloom toxins); vectorborne diseases (dengue, malaria, Lyme disease, West Nile virus, Rift Valley fever, tickborne encephalitis); zoonotic diseases (rodentborne diseases, hantavirus diseases, leptospirosis); foodborne diseases (salmonellosis, mycotoxin effects); airborne diseases (influenza and other respiratory infections)	Cardiovascular diseases; chronic respiratory diseases (asthma, chronic obstructive pulmonary disease (COPD), respiratory allergies); protein-energy malnutrition (adverse nutritional effects causing childhood stunting)	Changed weather patterns; accelerated survival, growth, virulence and transmission of certain pathogens; heat exposure; increased biological hazards; pathogens in warmer fresh waters; surface toxic algal bloom; water and food contamination; changes in vector habitat (including that of mosquitoes, ticks, rodents); reduced soil moisture and nutrients; increased food insecurity
FLOOD 	Water- and food-borne diseases (diarrhoea from bacterial, viral and parasitic diseases, hepatitis A, typhoid fever, gastroenteritis, salmonellosis, *Escherichia coli* infection, cholera, cryptosporidium, campylobacteriosis, intestinal nematode infections); vectorborne diseases (dengue, Zika virus disease, malaria, chikungunya, West Nile virus fever); zoonotic diseases (rabies, rodentborne diseases, hantavirus diseases, leptospirosis); acute respiratory infections (influenza, pneumonia); eye and skin infections; tetanus; legionellosis	Deaths; drowning; physical traumas; hypothermia; animal bites; chemical poisoning and intoxication; electrical shock; mental health effects (acute traumatic stress, anxiety and depression, insomnia); cardiovascular diseases (stroke, diabetes, heart attack); chronic respiratory diseases (asthma, COPD, respiratory allergies); venomous animal bites (snakes, scorpions); eye, nose and skin irritation; protein-energy malnutrition; renal failure (due to lack of access to health care, dialysis)	Damaged or flooded health care facilities; building collapse; water and food contamination; changes in vector habitat (including that of mosquitos, ticks and rodents); mold in indoor environment; flooded sewage and waste systems; lack of power; overcrowding increasing infectious diseases; release of and exposure to hazardous chemicals; food insecurity
STORM 	Diarrhoeal diseases; cholera; hepatitis A; vectorborne diseases; zoonotic diseases; intestinal nematode infections; tetanus; respiratory infections; polymicrobial wound infections (by *Escherichia coli, Klebsiella, Serratia, Proteus and Pseudomonas*); mucormycosis	Deaths; drowning; physical traumas; wounds; hypothermia; animal bites; chemical poisoning and intoxication; electrical shock; mental health effects (acute traumatic stress, anxiety and depression, insomnia); cardiovascular diseases; chronic respiratory diseases (asthma, COPD, respiratory allergies); protein-energy malnutrition; renal failure (due to lack of access to health care, dialysis)	Lack of power; building collapse; damaged or flooded health care facilities; water and food contamination; food productivity disruption; flooded or damaged sewage and waste systems; mold in indoor environment; high levels of particulate matter from dust storms; changes in vector habitat (including that of mosquitos, ticks and rodents); release of and exposure to hazardous chemicals; food insecurity; displaced populations; prolonged disruption of public health services

CLIMATE HAZARD	CLIMATE-SENSITIVE DISEASES (INFECTIOUS DISEASES)	CLIMATE-SENSITIVE HEALTH OUTCOMES (NONCOMMUNICABLE DISEASES AND UNINTENTIONAL INJURIES)	POSSIBLE EXPOSURE PATHWAYS
SEA-LEVEL RISE 	Diarrhoeal diseases; cholera; hepatitis A; vectorborne diseases; zoonotic diseases; respiratory infections	Deaths; drowning, electrical shock; mental health (acute traumatic stress, anxiety and depression); cardiovascular diseases (hypertension); chronic respiratory diseases (asthma, COPD, respiratory allergies); protein-energy malnutrition; kidney disease	Increased saline water intrusion; freshwater contamination; flooded health care facilities; damaged health care facilities due to erosion; lack of power; food contamination; flooded sewage and waste systems; loss of crop productivity due to inundation or salinization; permanently displaced populations
DROUGHT 	Diarrhoeal diseases; cholera; hepatitis A; vectorborne diseases (dengue, malaria, Zika virus disease, chikungunya, Lyme disease, West Nile virus fever, Valley fever); zoonotic diseases; intestinal nematode infections; respiratory infections; eye and skin infections (scabies, trachoma, conjunctivitis); meningococcal meningitis	Cardiovascular diseases; chronic respiratory diseases (asthma, COPD, respiratory allergies); kidney diseases; cancers (skin, bladder, lung); protein-energy malnutrition; mental health effects (stress, anxiety and depression); eyes, nose and skin irritation; musculoskeletal problems	Reduction in or lack of access to water; hygiene services reduction; water and food contamination; food insecurity; changes in vector habitat (including that of mosquitos, ticks and rodents); air pollution; increased dust; hot temperature; dry air; lack of power; water pollutants (iron, manganese, fluoride, arsenic) and salinity concentrations; cyanobacterial blooms; reduced soil moisture; increasing frequency of warm days and nights; displaced populations
HEATWAVE 	Respiratory infections; water- and food-borne diseases (campylobacteriosis, salmonellosis, diarrhoeal diseases, cholera, cryptosporidiosis); harmful algal bloom toxins	Death; cardiovascular diseases (stroke, heart diseases, diabetes, thrombogenesis); heat stress; heat exhaustion; heat syncope; heat oedema; heat rash; dehydration-induced heat cramps; chronic respiratory diseases (asthma, COPD, respiratory allergies); protein-energy malnutrition; kidney disorder; aggravated chronic pulmonary conditions; eyes and skin irritation; mental illness; metal and chemical toxicity	Heat exposure; air pollution (particulate matter and ozone); surface water algal blooms due to increased level of nutrients; water and food contamination; food insecurity; power outages; increasing frequency of warm days and nights; increased concentration of metals, phosphorus and phytoplankton in water due to warmer waters and less oxygenation; threat due to individual level risk factors (age, sex, culture, body weight, drug treatment, body acclimatization)

CLIMATE HAZARD	CLIMATE-SENSITIVE DISEASES (INFECTIOUS DISEASES)	CLIMATE-SENSITIVE HEALTH OUTCOMES (NONCOMMUNICABLE DISEASES AND UNINTENTIONAL INJURIES)	POSSIBLE EXPOSURE PATHWAYS
WILDFIRE 	Increased susceptibility to respiratory infections	Death; burns; injuries; mental health effects (acute traumatic stress, anxiety and depression, insomnia); chronic respiratory diseases (asthma, COPD, respiratory allergies); cardiovascular diseases (heat stroke, diabetes); dehydration-induced heat cramps; smoke intoxication (from particulate matter and other air pollutants); wheezing and shortness of breath; adverse pregnancy outcomes (e.g. low birth weight and preterm birth); carbon monoxide poisoning; eyes, nose and skin irritation (corneal abrasion)	Exposure to flames; radiant heat and smoke increasing mortality rate; ambient air pollution amplifying high temperatures; exposure to carbon monoxide, ozone and particulate matter (smoke- and heat-related diseases); toxic effects from oxidative and proinflammatory components of particulate matter; water contamination by ash (with polycyclic aromatic hydrocarbons and heavy metals); power outages
COLD WAVE 	Respiratory infections (such as influenza)	Deaths; cardiac workload leading to cardiovascular stress (heart diseases); exposure to extreme cold which causes veins and arteries to narrow and blood to become more viscous increasing cardiac workload; hypothermia leading to cardiac workload; aggravation of pre-existing chronic diseases such as diabetes, respiratory diseases (asthma, chronic bronchitis and emphysema) and cardiovascular conditions (heart diseases, stroke); frostbite (freezing of skin exposed to the cold)	Extreme cold exposure; power outages; water access reduction; hygiene reduction; agricultural disruption; food insecurity; broken water pipes and internal flooding of health care facility; disruption of health services; threat due to individual level risk factors (age, body weight, drug treatment, behaviour, clothing, smoking, drinking alcohol); reduced mobility; excess of outdoor physical activity; chronic diseases; malnutrition; certain neurological disorders; alteration of the body's core temperature (impairing body acclimatization)

Sources: (9,21,26–40).

4

4 INTRODUCTION TO THE CHECKLISTS

The checklist tables in Annex A address both the level of vulnerability of a health care facility and climate change impacts on the functioning of a health care facility. For each climate hazard (floods, storms, sea-level rise, drought, extreme temperatures (heat and cold), and wildfires) there are two sets of tables each for vulnerabilities and for impacts. These are further divided into four areas of concern – health workforce; WASH and health care waste; energy; and infrastructure, technologies, products and processes – for health care facilities. Increasing global temperature is the key driver for all hazards; climate-sensitive diseases and climate-sensitive health outcomes resulting from these hazards are discussed separately (Table 4).

(i) The hazards template in Annex A can be used to identify the health care facility areas which may be impacted by the hazards listed in Figure 5. If the likelihood of occurrence (unlikely, possible, likely) is not known, identify those that are possible.

(ii) Tables to assess vulnerabilities are divided based on objectives for the implementation of each component (Table 3), and follow the process and rating levels proposed in the *WHO Guidance for CRESHCF (1).* These tables are in the form of questions to identify if a health care facility is implementing measures to respond to climate hazard by reducing vulnerabilities in order to lessen or avoid potential damage and disruptions to service delivery. The level of vulnerability for each item in the list can be assessed as "high" (unprepared; or unable to respond), "medium" (basic or incomplete preparation; or low level of response) or "low" (prepared; or able to respond).

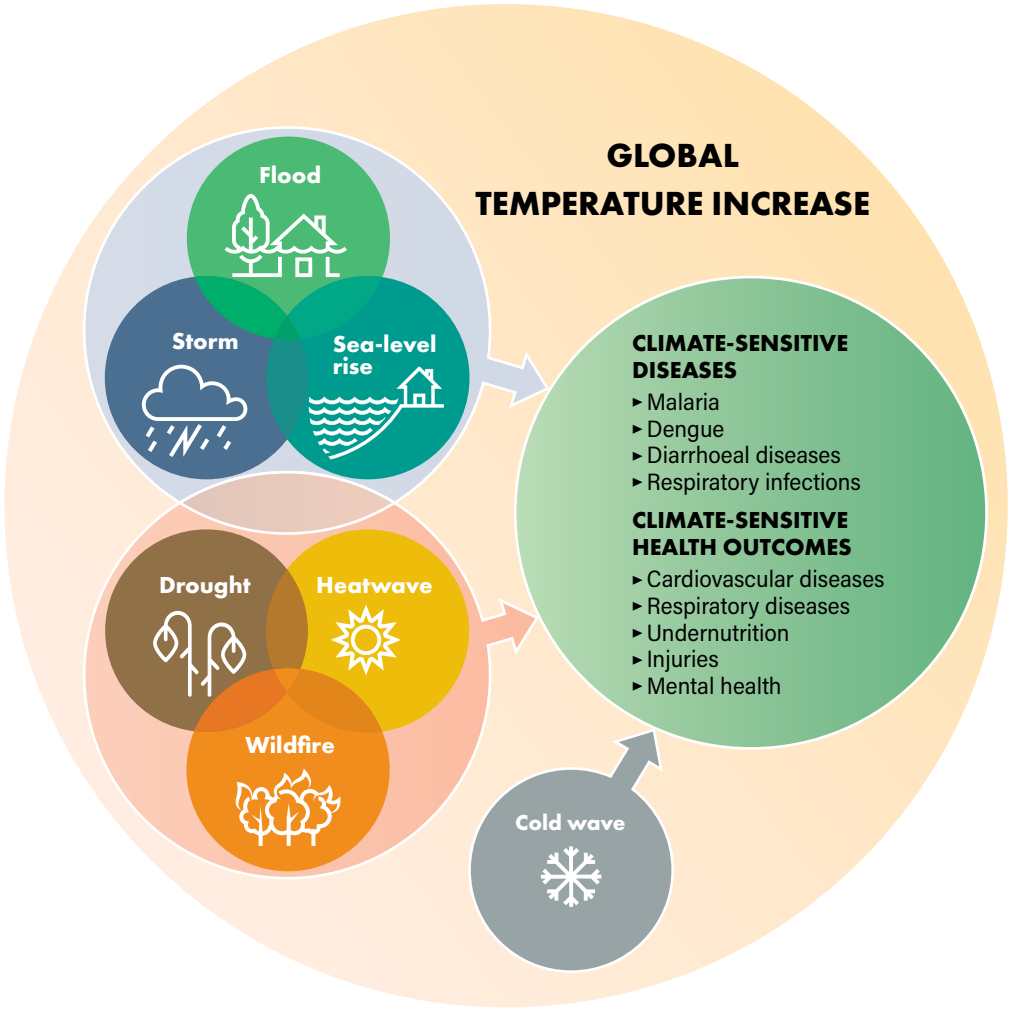
(iii) Tables for assessing impacts of climate change to health care facilities follow a risk matrix model, focusing on the severity of impact (major, moderate and minor), but assuming equal likelihood of occurrence. These tables show examples of impacts that a health care facility can suffer, and which the user can identify and evaluate based on the level of impact (major, moderate or minor). Once impacts are identified, the user can list the potential interventions to respond to the identified areas of concern. Relevant guidance to develop interventions is included in the *WHO Guidance for CRESHCF.*

Climate hazards vary across regions, and there are differences in impacts depending on exposures and vulnerabilities. These variations can also occur within a country. Therefore, these checklists can be applied locally or broadly within a larger region, all the while considering any underlying differences. Checklists are not expected to cover every situation; and therefore should be seen as a model for health care facilities to modify as needed (note that in the tables major impacts may also include those listed as moderate and minor; and moderate impacts may include those listed as minor).

Often these hazards occur simultaneously (multihazard events), or they immediately follow each other. For example, tropical storms, with strong winds and rain, may result in flooding; drought conditions may lead to wildfires, particularly during a heatwave; and wildfires in turn get exacerbated by strong winds. In other cases, a period of drought may be followed by flood. In addition, the impacts may not be singular catastrophic events, but take place as small events that may accumulate over time. For example, reduced access to potable water or disruptions in road access to a health care facility may start to occur more regularly due to more frequent periods of drought, landslides, heavy rains or melting permafrost, creating backlogs in service delivery that would need to be addressed as the frequency of hazards increase.

There are many overlaps in climate hazard impacts on health care facilities, and also significant overlaps in the health outcomes from the different hazards. This is the reason for the many overlaps in the checklists to assess vulnerabilities and impacts (Annex A). Figure 5 describes the main areas that overlap.

Figure 5. Overlap of climate hazards for health care facilities



5

5 CONCLUSIONS

The climate hazards covered here include all those that can potentially impact health care facilities in their four fundamental requirements for their proper functioning, i.e. health workforce; WASH and health care waste services; energy services; and infrastructure, technologies, products and processes. As the most relevant climate hazards, their impacts and the necessary actions to prepare health care facilities to reduce their vulnerabilities have many common elements, implementing actions that are common to all could help save resources. In addition, preventive actions or policy decisions taken from these checklists can result in health cobenefits, thereby increasing benefits to the society and the environment.

It is not possible to include every possible impact or response, given the different situations of health care facilities around the world. Therefore, this document should be taken as providing examples that can be modified and adapted according to local needs and realities. This document can also be used in conjunction with the *WHO Guidance for CRESHCF (1)* and other key guidance(s) mentioned earlier.

ANNEX A. CHECKLISTS

The hazards template can be used to identify hazards that are likely to affect the health care facility. Once identified, the user can proceed directly to the checklists of interest.

		ARE THESE AREAS IMPACTED?			
		X Current observed impacts **O** Possible impacts with changed conditions			
CLIMATE HAZARD TYPE	**IS HAZARD OR EXPOSURE PRESENT?** Yes/No	**Health workforce**	**WASH and health care waste**	**Energy services**	**Infrastructure, technologies, products, processes**
Flood					
Storm					
Sea-level rise					
Drought					
Heatwave					
Wildfire					
Cold wave					

A.1 FLOOD CHECKLISTS

Floods are defined as the overflowing of the normal confines of a stream or other body of water, or the accumulation of water over areas that are not normally submerged. Floods include river (fluvial) floods, flash floods, urban floods, pluvial floods, sewer floods, coastal floods, and glacial lake outburst floods *(4)*. Floods can significantly affect the functioning of a health care facility of any size, and depending on its severity may result in inability of a facility to function. There is medium confidence that projected increases in heavy rainfall would contribute to increases in local flooding in some regions *(7)*.

CHECKLIST FOR ASSESSING VULNERABILITY TO FLOODS

FLOODS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
HEALTH WORKFORCE — **Is the health workforce,**			
(Human resources)			
provided with programmes for supporting staff with regards to mental health, injuries, medical treatment and related support measures?*	☐	☐	☐
equipped with an emergency plan for shift relay or replacement of health professionals to ensure that staff get adequate rest?*	☐	☐	☐
prepared with a contingency plan for accessing additional health workforce to strengthen performance capacity?*	☐	☐	☐
provided with an information system to manage occupational safety and health in the facility during a flood?	☐	☐	☐
equipped with an emergency plan to protect health workers from multiple biological and chemical hazards?	☐	☐	☐
provided with a postflood employee recovery assistance programme according to staff needs?	☐	☐	☐
equipped with a coordinated plan, including volunteers on standby, to assist during an emergency or to support health professionals?*	☐	☐	☐
provided with full personal protective equipment, especially for clean-up crews (including waterproof safety boots, goggles, work gloves and masks)?*	☐	☐	☐
provided with safe water and food during an event?*	☐	☐	☐
(Capacity development)			
trained on public health and climate change hazards including health impacts related to floods?	☐	☐	☐
equipped with knowledge, experience, training and resources to manage flood risk reduction at the facility and in the local communities?*	☐	☐	☐
engaged in the development of plans and responses to flood risk?	☐	☐	☐
prepared and able to implement risk reduction actions for protecting themselves?	☐	☐	☐
prepared with a contingency plan for additional health workforce to strengthen performance capacity?*	☐	☐	☐

FLOODS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
HEALTH WORKFORCE			
Is the health workforce,			
prepared with a contingency plan for continuing to provide services at other facilities or in the local communities (health primary care), if necessary?*	☐	☐	☐
trained to detect posttraumatic stress disorder among staff to take prompt action?*	☐	☐	☐
trained to manage hazardous chemicals in emergency situations?	☐	☐	☐
trained to an appropriate standard to maintain the correct level of safety of electrical power supply, in both routine and emergency/disaster situations?*	☐	☐	☐
(Communication and awareness raising)			
provided with a safe internal communication system, specially in emergency situations?*	☐	☐	☐
informed on how to use and follow a surveillance system to track health outcomes?	☐	☐	☐
aware of contingency plans for accessing and leaving the facility during flood emergencies, and health workforce transportation?	☐	☐	☐
regularly participating in community disaster planning committees to: improve knowledge on how to reduce risks, be prepared and respond to floods, and recover better than before through adaptation measures?*	☐	☐	☐
prepared with clear messaging about water and food safety during and after a flood?	☐	☐	☐
prepared with clear messaging, and staff trained on exit and evacuation routes that are clearly marked and free of obstacles to enable emergency evacuation)?*	☐	☐	☐
equipped with a flood plan or programme with clear instructions on how to proceed during flood emergency situations?	☐	☐	☐
equipped with a community health educational programme to assist the community to reduce vulnerabilities to flood impacts?	☐	☐	☐
equipped with a community health educational programme to improve community health in the face of flood risks?	☐	☐	☐
WATER, SANITATION AND HEALTH CARE WASTE			
Does the health care facility,			
(Monitoring and assessment)			
have an updated assessment plan to map risks to the sanitation infrastructure in place, and to identify where services could be disrupted from floods?	☐	☐	☐
verify water safety conditions, including updated risk assessments to map water resources and water supplies for the facility?*	☐	☐	☐
have a quality monitoring plan for drinking water during and after the event?	☐	☐	☐
regularly assess its sanitation system for any possible damage in the event of flooding?	☐	☐	☐
monitor sewer overflows in order to fix pumps in advance of the flood season?	☐	☐	☐
regularly verify safety conditions and proper functioning of all elements of the water distribution system, including storage tanks, cisterns, valves, pipes and connections, and water disinfection?	☐	☐	☐
have information on water system installation that ensures lower risk of contamination?	☐	☐	☐
conduct a waste audit to reduce waste as much as possible?	☐	☐	☐
(Risk management)			
have a natural floodwater infiltration system to reduce risk of facility flooding?	☐	☐	☐

FLOODS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
WATER, SANITATION AND HEALTH CARE WASTE			
Does the health care facility,			
have anti-mosquito breeding measures?	☐	☐	☐
have a schedule for emptying latrines in advance of the flood season to avoid overflows?	☐	☐	☐
have a safe health care waste storage place?	☐	☐	☐
have a safe waste disposal system before, during and after floods?	☐	☐	☐
have an established safe management approach to health care waste transport (including hazardous waste) in case of floods?*	☐	☐	☐
have chemical, radioactive and biological hazardous waste stored in a safe place and on a level above the ground floor?*	☐	☐	☐
have water storage tanks appropriately covered to prevent access or contamination, and safety located for flooding events?*	☐	☐	☐
have onsite water purification equipment to provide safe drinking water?	☐	☐	☐
have nonreturn valves installed on water supply pipes to prevent backflows?*	☐	☐	☐
have waste pits able to withstand flood events?	☐	☐	☐
have a surveillance system for diseases related to water quality and sanitation?*	☐	☐	☐
keep waste sealed in rubbish bins to avoid rodents?	☐	☐	☐
(Health and safety regulation)			
have an emergency water supply plan?*	☐	☐	☐
staff who are trained to an appropriate standard to maintain the correct level of safety of water quality controls, use of supplies and alternative sources?	☐	☐	☐
have a water safety plan in place, in case of water contamination?*	☐	☐	☐
have a mechanism or regulation to carry out sanitary inspections of water supply, and when necessary, establish a temporary ban on use, until improvements are made?	☐	☐	☐
have a contingency plan to ensure effective and timely delivery of safe water during floods and emergencies over the short- and long-term?*	☐	☐	☐
have a plan to provide and maintain adequate cleaning and disinfection supplies (such as chlorine, filters or other water treatment technology, rapid water testing kit) for water safety?	☐	☐	☐
have an emergency plan for maintenance and restoration of waste management systems?*	☐	☐	☐
ENERGY			
Does the health care facility,			
(Monitoring and assessment)			
regularly assess its energy system to ensure that it can cope with flood events?*	☐	☐	☐
have an emergency backup generator (including fuel, where relevant) that is able to cover at least all critical service areas and equipment during and after a flood event?*	☐	☐	☐
periodically check emergency backup generators (including fuel, where relevant)?*	☐	☐	☐
assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment?	☐	☐	☐
identify priority areas within the facility which would require emergency power during and after a flood event?	☐	☐	☐

FLOODS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
ENERGY			
Does the health care facility,			
(Risk management)			
have a secure place to protect the backup generator (e.g. an elevated place; including fuel or battery storage, where relevant) from flood waters?*	☐	☐	☐
have adequate daylight to ensure proper visibility during a power outage?	☐	☐	☐
have power-operated doors that can easily be opened manually to permit exit in case of power failure?	☐	☐	☐
have appliance thermometers in the refrigerator and freezer to determine if food, vaccines and other essential refrigeration-dependent medical supplies are safe?	☐	☐	☐
have a clear guidance to alert staff on safety measures (e.g. never restore power when the power is off, until a professional inspects and ensures the integrity of the electrical system; do not use electrical equipment that has been exposed to flood waters until checked by an electrician; unless power is off, never enter flooded areas or touch electrical equipment if the ground is wet)?	☐	☐	☐
(Health and safety regulation)			
have an emergency plan for power outages in the short- and long-term (before, during and after a flood)?	☐	☐	☐
work with energy utility agencies to prevent suspension of electricity services?	☐	☐	☐
have a management plan for intermittent energy supplies or system failure?	☐	☐	☐
have a plan or regulation to determine ways to reduce overall energy use?	☐	☐	☐
have an emergency plan to ensure availability of adequate lighting, communication and information systems, and refrigeration and sterilization equipment during a flood?*	☐	☐	☐
INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES			
Does the health care facility,			
(Adaptation of current systems and infrastructures)			
have knowledge, experience (considering previous damages) and resources (including human, material, financial, supplies chain and logistics) to manage flood risk reduction?*	☐	☐	☐
provide greater advocacy on health workforce education to cover climate change risks and responses?	☐	☐	☐
work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning and implementation?	☐	☐	☐
conduct climate risk and vulnerability assessments for all facility sectors to identify risk scenarios, vulnerabilities and the facility's response capacity?	☐	☐	☐
utilize the assessed information as a basis to plan and prioritize measures to reduce risk impact?	☐	☐	☐
in their annual planning consider how climate risks may change in the future?	☐	☐	☐
have resources available to adopt risk reduction measures on the building and its infrastructure, technologies, products and processes?	☐	☐	☐
regularly update these assessments, considering emerging scientific information?	☐	☐	☐
have a schedule to inspect the facility regularly, both internally and externally, for signs of deterioration (e.g. cracks or sinking structural elements) to avoid or reduce flood impacts?	☐	☐	☐

FLOODS

High: unprepared; unable to respond (Higher risk)
Medium: basic or incomplete preparation; low level of response (Medium risk)
Low: prepared; able to respond (Lower risk)

INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES

Does the health care facility,	Vulnerability level: High	Medium	Low
evaluate the condition and safety of structural and nonstructural elements impacted by previous exposure to flood?*	☐	☐	☐
have a safe location for critical services and equipment in a flood emergency situation?*	☐	☐	☐
have a safety plan to prevent medical and laboratorial equipment and supplies, and food packages to be exposed to flood waters?	☐	☐	☐
have procedures to store food and bottled water on shelves that will be safely out of the way of contaminated water in case of flooding?	☐	☐	☐
have an effective emergency risk communication plan to reduce risks and impacts for health workers and patients?*	☐	☐	☐
have a contingency plan in place for safe and efficient personnel evacuation (including health staff and patients) before, during and following a flood?*	☐	☐	☐
have a clear and consistent mechanism for secure evacuation of health workers and patients?	☐	☐	☐
have a plan to transfer critical equipment and medical supplies to another health care facility or to a secure storage?	☐	☐	☐
explore the relationship between social learning and adaptation measures in the face of flood threats to identify and implement the best behavioural responses from successful health facilities?	☐	☐	☐
have evaluation tools (e.g. forms) to identify damages and minimum needs in terms of health workers and medical supplies to ensure continuous functioning of services?*	☐	☐	☐
have a mechanism for providing prompt maintenance and repair of equipment required for essential services?	☐	☐	☐
have a plan for relocating medical devices, medicines, mobile equipment and other supplies and services in case of operational disruption or outbreaks and epidemics that overwhelm the facility?	☐	☐	☐
have walls protected and insulated against moisture and mold?	☐	☐	☐
assess the performance and vulnerabilities of each critical part of the facility (structural and nonstructural elements) that can be affected by floods?	☐	☐	☐
have measures to remove mosquito breeding sites?	☐	☐	☐
have roof drainage systems for rainfall?*	☐	☐	☐
have rooftop structures and equipment revised for anticipated increased rainfall?*	☐	☐	☐
have roofs that are leak-proof and insulated?*	☐	☐	☐
have machine rooms that are resistant to flooding or rooftop damage?	☐	☐	☐
ensure removal of equipment and power supplies from basements and ground floor level to avoid damage from flooding?	☐	☐	☐
have a coordinated mechanism across the health sector in different levels of government, to manage the response and risks resulting from public health emergencies and disasters (including sharing of resources and supplies, transferring of patients, and health workforce support)?*	☐	☐	☐
have established procedures for procuring, and safely transporting and storing medical devices, pharmaceuticals, vaccines, laboratorial supplies, parenteral nutrition and blood supplies, and other essential medical supplies?	☐	☐	☐

FLOODS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES			
Does the health care facility,			
have established procedures or plans for procuring, transporting and storing bottled water and food supplies during an emergency?*	☐	☐	☐
have a space within or external to the facility for the storage and stockpiling of additional supplies, considering ease of access, security, temperature, ventilation, light exposure and humidity?	☐	☐	☐
have a plan to house staff at the health care facility if shelter is required (sleeping areas, food, water)?	☐	☐	☐
have an established postflood recovery plan of all infrastructure facilities (structural and nonstructural elements)?*	☐	☐	☐
(Promotion of new systems and technologies)			
have an information system between the health sector and meteorological services to communicate about climate hazards?	☐	☐	☐
have an established plan to review, evaluate and catalogue climate risks related to floods for the health care facility's location?*	☐	☐	☐
have an established plan to review, evaluate and catalogue risks related to floods for the health care facility's supply chain?*	☐	☐	☐
have electronic patient health records to make available to other receiving health care facilities, in case of evacuation?	☐	☐	☐
have information and communication systems safely secured with backup arrangements (via cloud, satellite) to satisfy the facility's demand?*	☐	☐	☐
ensure information and communication flow between the health workforce and policy makers, particularly during high-stress situations and demands created by emergencies?	☐	☐	☐
have an established, clear and consistent knowledge transfer procedure for a public health emergency?*	☐	☐	☐
have identified capacities, resources and needs to better cope and manage floods?	☐	☐	☐
perform site and building maintenance procedures that include specifications on how the weather may affect the safety and continued functioning of the facility?	☐	☐	☐
have an information system for tracking and monitoring diseases following flood events?	☐	☐	☐
(Sustainability of health care facility operations)			
have adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction and response?	☐	☐	☐
have partnerships established between the facility, community and local authorities to reduce vulnerabilities in the surrounding areas?	☐	☐	☐
have a secure storage for hazardous chemicals to avoid their damage or release during a flood event?*	☐	☐	☐
have a defined and sustained budget as part of core budgeting for emergency preparedness and response to flood events?*	☐	☐	☐
have an access route for public transportation which is likely to remain operational during or immediately following a flood event?	☐	☐	☐
review building code design baselines against rainfall volumes, and map each risk?*	☐	☐	☐
have trees planted in a secure place that will not block access to the facility or fall on the building during an event?	☐	☐	☐

FLOODS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
Does the health care facility,			
have estimates of the consumption (such as amount used per week) of essential medical, pharmaceutical, nutritional and laboratorial supplies, personal protective equipment, food, etc., using the most likely flood scenario?	☐	☐	☐
undertake risk assessments of the supply chain for essential medical and nonmedical products?	☐	☐	☐
have a secure plan to ensure continuity of the facility's supply and delivery chain?	☐	☐	☐
have secure access to essential backup services, such as sterilization, laundry and cleaning services, via multiple agreements with different facilities to maintain functioning of critical services?	☐	☐	☐
have secure access to essential backup food sources via multiple agreements with different vendors, and through cooperative agreements with other facilities to maintain functioning of critical services?*	☐	☐	☐

Note: For WASH and health care waste details see WASH FIT (3).

**For further details see Hospital Safety Index (2).*

IMPACTS CHECKLIST FOR FLOOD EVENTS

HEALTH WORKFORCE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Deaths or life-threatening injuries or illness (e.g. drowning, hypothermia and infectious diseases, such as diarrhoeal diseases, leptospirosis, cholera, vectorborne diseases) ☐ Health professionals are not able to arrive at or depart from the health care facility ☐ Large loss of work capacity ☐ Cessation of critical programmes or services ☐ Significantly reduced performance capacity of health workforce needing additional support (local, regional or national) ☐ Effects on mental health of staff due to disaster trauma, loss of a family member, friends or patients ☐ Increased demand for health services from infectious diseases (water-, food- and vector-borne diseases), animal bites (including poisonous animals), respiratory infections, zoonotic diseases (rodentborne diseases such as, hantavirus pulmonary syndrome, leptospirosis), noncommunicable diseases, electrical shock and toxic chemicals exposure ☐ Increased health workforce overload and stress	☐ Serious harm, injury or illness requiring hospitalization or medical treatment ☐ Health professionals have difficulty in arriving at or departing from the health care facility ☐ Reduction in health workforce functions ☐ Restrictions to provide services and programmes ☐ Unable to provide adequate care to patients ☐ Increased work overload along with stress ☐ Facility overcrowding ☐ Increased infectious disease cases among health workers from water and health care waste contamination	☐ Minor injuries to health workers, not requiring immediate medical treatment ☐ Difficulty in providing usual treatment and medication ☐ Reduced primary services at home for communities ☐ Service delivery and programme delays

WASH AND HEALTH CARE WASTE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Damage to water supply and storage infrastructure	☐ Temporary water supply interruption	☐ Reduced capacity to access drinking water
☐ Disruption of wastewater and sewage systems	☐ Reduced capacity to provide safe water for drinking or cooking	☐ Reduced capacity to use toilets, showers, etc.
☐ Water contamination	☐ Reduced capacity to provide disinfection or sterilization processes	☐ Reduced capacity to use laundry and dishwashing machines
☐ Shortage of safe water	☐ Cross-contamination from damages to sewage system	☐ Reduced capacity to provide cleaning services (floor, toilets, patient rooms, emergency rooms)
☐ Unable to provide hygiene services	☐ Reduced water quality as animal faeces and sewage get washed into surface water	☐ Heavy sediment and pollution loads make treatment ineffective
☐ Damage to waste storage causing environmental contamination by biological and chemical hazards	☐ Reduced capacity to maintain waste collection and treatment systems	☐ Possible rodent infestation around rubbish bins
☐ Lost sharps containers and hazardous waste bins		
☐ Damage to emergency water sources		
☐ Toilets unavailable		

ENERGY		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Power failure	☐ Temporary power supply interruption	☐ No ambient cooling
☐ Shutdown of cold storage systems	☐ Difficulty in providing critical health care service deliveries (dialysis, oxygen therapy, diagnosis equipment), causing patients to be evacuated to other health facilities	☐ Loss of food or difficulty in refrigerating food
☐ Interruption in providing health care services that require electricity such as dialysis, oxygen therapy, diagnosis equipment	☐ Reduced capacity to provide services that need electricity (laundry, dishwashing machines, etc.)	☐ Reduced capacity to follow boil water advisories
☐ Loss of vaccines, laboratorial supplies, drugs, parenteral nutrition and blood supplies, pharmaceuticals, food supply, and other essential refrigeration-dependent medical supplies	☐ Reduced capacity to provide disinfection services that need electricity (autoclave, microwave, water boiler)	
☐ Damage to emergency generator or other sources of energy		
☐ Disruption of the fuel supply chain		
☐ Disruption of energy-dependent water pumping and treatment systems		

INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Flood damage or destruction of structural components (full or parts of the facility) ☐ Partial destruction by floods causing land erosion ☐ Blocked transport systems and flooded ambulance stations ☐ Damage to building access ☐ Damage to machine room ☐ Damage to critical equipment ☐ Damage of internal and external communication and information systems ☐ Loss or damage of health care facility essential supplies (medications, medical devices, drugs, laboratorial supplies, blood, pharmaceuticals, vaccines) ☐ Interruption of complex and emergency health care services (surgery, complex treatments, urgent care) ☐ Disruption of health care services delivery and operation ☐ Cessation of services or prolonged disruption of services due to loss or damage ☐ Breakdown of routine health care services (such as ambulatory, immunization, maternity room, pharmacy, medication for chronic diseases, dental, and other primary services) ☐ Interruption of diagnosis due to equipment damage ☐ Contamination of medical devices, instruments and equipment ☐ Interruption of supply chains ☐ Long-term effect on the environment needing external assistance/interventions ☐ Damage to internal transportation systems (elevators, ramps, corridors) ☐ Increased immediate and long-term costs to recover from damage	☐ Disruption to communication and information systems and assets ☐ Damage to road, disrupting access to health care facility ☐ Difficulty in transporting patients due to damaged or disabled transportation systems ☐ Reduced capacity to deliver health care services due to damage and reduced supplies ☐ Temporary suspension of service deliveries ☐ Damage to paper medical record storage ☐ Reduced capacity to access clinical and laboratorial supplies ☐ Increased hospitalization rates requiring extra medical supplies and health workforce ☐ High demand for cleaning services in all facility buildings after flood event requiring extra personal protective equipment ☐ Increased demand in costs for repairing or buying damaged or lost medical equipment and devices, needed for short-term recovery ☐ Increased costs due to necessary postflood repairs ☐ Increased costs for repairing all damaged administrative equipment and furniture	☐ Localized disruption of services with minor loss and damage ☐ Damage or loss to health care facility documents and records ☐ No lasting effects on the external health care facility environment ☐ Minimal impact on local operations and equipment that do not compromise health care service deliveries ☐ Minimal impact on the supply chain, which can continue to support health care facility needs ☐ Possible mold, indoor and outdoor, requiring special cleaning-up or essential personal protective equipment for cleaners ☐ Increased demand for providing cleaning and disinfection supplies

Sources for tables of vulnerabilities and impacts: (1–3,8,21,29,32,41–48).

FLOODS: PROPOSED ACTIONS TO RESPOND TO THE IDENTIFIED IMPACTS

Health workforce
WASH and health care waste
Energy
Infrastructure, technologies, products and processes

A.2 STORM CHECKLISTS

Storm include tropical storms, local storms and strong winds. IPCC notes that there are statistically significant trends in the number of heavy precipitation events in some regions. It is likely that more of these regions have experienced increasing storm events, although there are strong regional and subregional variations in these trends *(7)*. Storms threaten health care facilities in many ways. Strong winds can destroy windows, roofs, or cause trees to fall damaging the facility, access roads and electricity poles. Rain can cause flooding leading to damage of medical equipment, affect water and sanitation services, and overall damage to the infrastructure. In dry areas or in periods of drought, strong winds can create sand or dust storms.

CHECKLIST FOR ASSESSING VULNERABILITY TO STORMS

STORMS		Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)		High	Medium	Low
HEALTH WORKFORCE	**Is the health workforce,**			
	(Human resources)			
	provided with programmes for supporting staff with regards to mental health, injuries, medical treatment and related support measures?*	☐	☐	☐
	equipped with an emergency plan for shift relay or replacement of health professionals to ensure that staff get adequate rest after their high-demand duties from a severe storm event?*	☐	☐	☐
	prepared with a contingency plan for accessing additional health workforce to strengthen performance capacity?*	☐	☐	☐
	provided with an information system to manage occupational safety and health in the facility during a storm?	☐	☐	☐
	equipped with an emergency plan to protect health workers from multiple biological and chemical hazards?	☐	☐	☐
	provided with a poststorm employee recovery assistance programme according to staff needs?	☐	☐	☐
	equipped with a coordinated plan, including volunteers on stand-by, to assist during an emergency or to support health professionals?*	☐	☐	☐
	provided with full personal protective equipment, especially for clean-up crews (including waterproof safety boots, goggles, work gloves and masks)?*	☐	☐	☐
	provided with safe water and food during an event?	☐	☐	☐
	(Capacity development)			
	trained on public health and climate change hazards, including health impacts related to different kinds of storms?	☐	☐	☐
	equipped with knowledge, experience, training and resources to manage storm risk reduction at the facility and in the local communities?*	☐	☐	☐
	engaged in the development of plans and responses to storm risks?	☐	☐	☐
	prepared and able to implement risk reduction actions for protecting themselves?	☐	☐	☐
	equipped with a contingency plan for continuing to provide services at other facilities or in the local communities (health primary care), if necessary?*	☐	☐	☐

STORMS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
HEALTH WORKFORCE			
Is the health workforce,			
trained to manage hazardous chemicals in emergency situations?	☐	☐	☐
trained in multihazard assessments?	☐	☐	☐
trained to maintain correct level of water quality controls in an emergency or disaster situations?*	☐	☐	☐
trained to an appropriate standard to maintain the correct level of safety of electrical power supply, in both routine and emergency/disaster situations?*	☐	☐	☐
trained to detect posttraumatic stress disorder among staff to take prompt action?*	☐	☐	☐
(Communication and awareness raising)			
provided with a safe internal communication system, specially in emergency situations?	☐	☐	☐
aware of contingency plans for accessing and leaving the facility during flood and strong wind emergencies, and health workforce transportation?	☐	☐	☐
regularly participating in community disaster planning committees to: improve knowledge on how to reduce risks, be prepared and respond to storm hazards, and recover better than before through adaptation measures?*	☐	☐	☐
prepared with clear messaging about water and food safety during and after a storm?	☐	☐	☐
prepared with clear messaging, and staff trained on exit and evacuation routes that are clearly marked and free of obstacles to enable emergency evacuation?*	☐	☐	☐
equipped with a community health educational programme to assist the community in reducing vulnerability to storm impacts?	☐	☐	☐
equipped with a community health educational programme to improve community health in the face of storm risks?	☐	☐	☐
WATER, SANITATION AND HEALTH CARE WASTE			
Does the health care facility,			
(Monitoring and assessment)			
assess the capacity of the existing stormwater management system, to ensure adequacy for anticipated 50- or 100-year storm events today?	☐	☐	☐
verify water safety conditions, including updated risk assessments to map water resources and water supplies for the facility?*	☐	☐	☐
regularly assess its sanitation systems for any possible damage in the event of storms and severe winds?	☐	☐	☐
have information on water system installation that ensures lower risk of contamination?	☐	☐	☐
have a water quality monitoring plan for drinking water during and after the event?*	☐	☐	☐
monitor sewer overflows to fix pumps in advance of a storm and after the event?	☐	☐	☐
(Risk management)			
have a stormwater management system able to cope with storm-caused floods?	☐	☐	☐
have a stormwater management system to avoid standing water near the facility?	☐	☐	☐
store hazardous chemicals, radioactive and biological wastes in a safe place and on a level above the ground floor?*	☐	☐	☐
have a schedule for emptying latrines in advance of storms to avoid overflows?	☐	☐	☐
have water storage tanks supported and anchored to resist strong winds and rainfall?	☐	☐	☐

STORMS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
WATER, SANITATION AND HEALTH CARE WASTE			
Does the health care facility,			
have a safe system for waste disposal after a storm?	☐	☐	☐
have an established safe management approach to health care waste transport (including hazardous waste) during and after a storm?	☐	☐	☐
provide appropriate covers for water storage tanks to prevent damage and water contamination?*	☐	☐	☐
have onsite water purification equipment to provide safe drinking water?	☐	☐	☐
have nonreturn valves installed on water supply pipes to prevent backflows, in case of flooding?*	☐	☐	☐
have a surveillance system for diseases related to water quality and sanitation?*	☐	☐	☐
(Health and safety regulation)			
have an assessment plan that maps risks to water and sanitation infrastructures to identify where services could be disrupted during storms, floods and landslides?	☐	☐	☐
have an emergency water supply plan?*	☐	☐	☐
have a plan to verify safety conditions and proper functioning of all elements of the water distribution system, including storage tanks, cisterns, valves, pipes and connections, as well as water disinfection to avoid or reduce impacts from a storm?*	☐	☐	☐
have a contingency plan to ensure effective and timely delivery of safe water during extreme temperatures and emergencies over the short- and long-term?*	☐	☐	☐
have an emergency plan for maintenance and restoration of waste management systems?*	☐	☐	☐
ENERGY			
Does the health care facility,			
(Monitoring and assessment)			
regularly assess its energy system to ensure that it can cope with storm events and minimize their impacts (e.g. solar photovoltaic panels, either rooftop or ground mounted)?	☐	☐	☐
have an emergency backup generator (including fuel, where relevant) that is able to cover at least all critical service areas and equipment during and after the event?*	☐	☐	☐
periodically check emergency backup generators (including fuel, where relevant)?*	☐	☐	☐
identify priority areas within the facility which would require emergency power when needed?	☐	☐	☐
assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment?	☐	☐	☐
(Risk management)			
have a secure place to protect the backup generator (e.g. elevated and anchored in areas prone to floods and strong winds; including fuel or battery storage, where relevant) from damage?*	☐	☐	☐
have appliance thermometers in the refrigerator and freezer to determine if food, vaccines and other essential refrigeration-dependent medical supplies are safe?	☐	☐	☐
have adequate daylight to ensure proper visibility during a power outage?	☐	☐	☐
have power-operated doors that can be opened manually to permit exit during power failure?	☐	☐	☐
have a clear guidance to alert staff on safety measures (e.g. never restore power when the power is off, until a professional inspects and ensures the integrity of the electrical system; do not use electrical equipment that has been exposed to flood waters until checked by an electrician; unless power is off, never enter flooded areas or touch electrical equipment if the ground is wet)?	☐	☐	☐

STORMS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
ENERGY			
Does the health care facility,			
(Health and safety regulation)			
have an emergency plan for power outages in the short- and long-term (before, during and after a storm)?	☐	☐	☐
work with energy utility agencies to prevent suspension of electricity services?	☐	☐	☐
have a management plan for intermittent energy supplies or system failure?	☐	☐	☐
have a plan or regulation to determine ways to reduce overall energy use?	☐	☐	☐
have an emergency plan to ensure availability of adequate lighting, communication and information systems, as well as refrigeration and sterilization equipment during a storm?*	☐	☐	☐
INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES			
Does the health care facility,			
(Adaptation of current systems and infrastructures)			
have knowledge, experience (considering previous damages) and resources (including human, material, financial, supplies chain and logistics) to reduce disaster risk related to storms?*	☐	☐	☐
work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning and implementation?	☐	☐	☐
conduct climate risk and vulnerability assessments for all facility sectors to identify risk scenarios, vulnerabilities and the facility's response capacity?	☐	☐	☐
have a monitoring and early warning system to manage and reduce the risks of storm-related health effects?	☐	☐	☐
utilize the assessed information as a basis to plan and prioritize measures to reduce risk impact?	☐	☐	☐
in their annual planning consider how climate risks may change in the future?	☐	☐	☐
have resources available to adopt risk reduction measures on the building and its infrastructure, technologies, products and processes?	☐	☐	☐
regularly update these assessments, considering emerging scientific information?	☐	☐	☐
have a schedule to inspect the facility regularly, both internally and externally, for signs of deterioration (e.g. broken plaster, cracks or sinking structural elements) to avoid or reduce storm impacts (including flood impacts)?	☐	☐	☐
evaluate the condition and safety of structural and nonstructural elements of the facility, impacted by previous exposures to storms or similar hazards?*	☐	☐	☐
have an effective emergency risk communication plan to reduce risks and impacts for health workers and patients?*	☐	☐	☐
have a contingency plan in place for safe and efficient personnel evacuation (including health staff and patients) before, during and following a storm?*	☐	☐	☐
have a plan to transfer critical equipment and medical supplies to another health care facility or to a secure storage?*	☐	☐	☐

STORMS

High: unprepared; unable to respond (Higher risk)
Medium: basic or incomplete preparation; low level of response (Medium risk)
Low: prepared; able to respond (Lower risk)

INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES	Vulnerability level		
Does the health care facility,	High	Medium	Low
have a plan for relocating medical devices, medicines, mobile equipment and other supplies and services in case of operational disruption or outbreaks and epidemics that overwhelm the facility?	☐	☐	☐
have evaluation tools (e.g. forms) to identify damages and minimum needs in terms of health workers and medical supplies to ensure continuous functioning of services?*	☐	☐	☐
have a mechanism for providing prompt maintenance and repair of equipments required for essential services?	☐	☐	☐
have procedures to store food and bottled water on shelves that will be safely out of the way of contaminated water in case of flooding?	☐	☐	☐
have established procedures or plans for procuring, transporting and storing bottled water and food supplies during an emergency?	☐	☐	☐
have established procedures for procuring, and safely transporting and storing medical devices, vaccines, pharmaceuticals, parenteral nutrition and blood supplies, laboratorial supplies, and other essential medical supplies?	☐	☐	☐
assess the performance and vulnerabilities of each critical part of the facility (structural and nonstructural elements) that can be affected by storm hazards?	☐	☐	☐
calculate possible losses and implement measures to reduce impacts?	☐	☐	☐
have a plan to house staff at the health care facility if shelter in place is required (sleeping rooms, food, water)?	☐	☐	☐
have roof drainage systems and adequate capacity in the event of excessive rainfall?*	☐	☐	☐
have roofs that are leak-proof and insulated?*	☐	☐	☐
have safe roofing designed to withstand wind velocity of 175–250 kph (e.g. in a high intensity tropical storm)?*	☐	☐	☐
have rooftop structures and equipment which have been reviewed for anticipated storm and high wind speeds?*	☐	☐	☐
have machine rooms that are resistant to flooding or high wind/rooftop damage?	☐	☐	☐
have stairwell construction fortified against high-wind events?	☐	☐	☐
have measures in place to remove mosquito breeding sites?	☐	☐	☐
have glass walls, doors and windows able to resist basic wind speeds up to 200–250 kph?*	☐	☐	☐
have laminated or protected glass windows to prevent risk of shattering during a storm?*	☐	☐	☐
have leak proof windows and doors with wind protection devices?	☐	☐	☐
have walls that are protected and insulated against moisture and mold?	☐	☐	☐
ensure removal of equipment and power supplies from basements and ground floor level to avoid damage from flooding?	☐	☐	☐
have health care agreements with other health care providers for additional health services and clinical resources?	☐	☐	☐
have a coordinated mechanism across the health sector in different levels of government, to manage the response and risks of public health emergencies and disasters (including sharing of resources and supplies, transferring of patients, and health workforce support)?*	☐	☐	☐
have a plan on continuity of operational processes during a storm and for building back better through training and workshops?	☐	☐	☐

STORMS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES			
Does the health care facility,			
conduct site and building maintenance procedures that include specifications on how the weather may affect the safety and continued functioning of the facility?	☐	☐	☐
have a space within or external to the facility for the storage and stockpiling of additional supplies, considering ease of access, security, temperature, ventilation, light exposure and humidity?	☐	☐	☐
have an established poststorm recovery plan for all infrastructure (structural and nonstructural elements) of the facility?*	☐	☐	☐
(Promotion of new systems and technologies)			
have an information system between the health sector and meteorological services to communicate about climate hazards?	☐	☐	☐
have an established plan to review, evaluate and catalogue climate risks related to storms for the health care facility location?*	☐	☐	☐
have an established plan to review, evaluate and catalogue risks related to storms for the health care facility supply chain?*	☐	☐	☐
have an established, clear and consistent knowledge transfer procedure in case of a public health emergency?*	☐	☐	☐
have electronic patient health records to make available to other receiving facilities in case of evacuation?	☐	☐	☐
ensure information and communication flow between the health workforce and policy makers, particularly during high-stress situations and demands created by emergencies?	☐	☐	☐
have information and communication systems safely secured with backup arrangement (via cloud, satellite) to satisfy the facility's demand?*	☐	☐	☐
have an information system for tracking and monitoring diseases following storm events?	☐	☐	☐
have more than one access route, especially if the facility is critical to higher demand following a storm event?*	☐	☐	☐
(Sustainability of health care facility operations)			
review building code design baselines against storm, wind speeds, rainfall volumes, and map each risk?*	☐	☐	☐
have a defined and sustained budget as part of core budgeting for emergency preparedness and response, including for storm hazards?*	☐	☐	☐
improve adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction and response?	☐	☐	☐
have trees planted in a secure place that will not block access to the facility or fall on the building during an event?	☐	☐	☐
have established partnerships between the facility, community and local authorities to identify and reduce vulnerabilities in the surrounding areas?	☐	☐	☐
have an access route for public transportation which is likely to remain operational during or immediately following a storm event?	☐	☐	☐
have a secure storage for critical chemicals and materials to avoid their damage or release during or following a storm event?*	☐	☐	☐
have estimates of the consumption of essential medical, pharmaceutical, nutritional and laboratorial supplies, personal protective equipment, food, etc. (such as amount used per week), using the most likely storm scenario (including flood impact)?*	☐	☐	☐

STORMS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
Does the health care facility,			
undertake risk assessments of the supply chain for essential medical and nonmedical products?	☐	☐	☐
have a secure plan to ensure continuity of the facility's supply and delivery chain?	☐	☐	☐
have secure access to essential backup services such as sterilization, laundry and cleaning services, via multiple agreements with different facilities to maintain functioning of critical services during or immediately following a storm event?	☐	☐	☐
have secure access to essential backup food sources via multiple agreements with different vendors and through cooperative agreements with other health care facilities to maintain functioning of critical services?*	☐	☐	☐

Note: For WASH and health care waste details see WASH FIT (3).

**For further details see Hospital Safety Index (2).*

IMPACTS CHECKLIST FOR STORMS

HEALTH WORKFORCE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Deaths, life-threatening injuries or illness among health workers	☐ Serious harm, injury or illness causing hospitalization and medical treatment	☐ Minor injuries to health workers requiring minimal or short-term medical treatment
☐ Loss of work capacity	☐ Health professionals not able to arrive at or depart from the health care facility	☐ Difficulty in providing medications and home primary services to the communities
☐ Cessation of critical programmes or service availability with possible overflow to other locations	☐ Reduction of health workforce functions	☐ Reduced functioning of health workers if the facility lacks a plan to respond to overcrowding of patients and visitors
☐ Significantly reduced performance capacity of health workforce; needing additional support (local, regional or national)	☐ Restrictions to the provision of some health care services and programmes	☐ Service delivery and programme delays
☐ Increased risks of occupational hazards, including water-, food- and vector-borne diseases, animal bites, electrical shocks and hazardous chemicals exposure	☐ Effects on mental health due to disaster trauma resulting in diminishing ability to provide adequate care to patients	
☐ Increased health care demand for infectious diseases (water-, food- and vector-borne diseases), animal bites (including poisonous animals), noncommunicable diseases, and toxic chemicals exposure, increasing health workforce overload and availability	☐ Increased respiratory diseases from dust storms	
☐ Increased work overload with stress		

WASH AND HEALTH CARE WASTE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Overflow of storm water and wastewater containment systems leading to surpassing the capacity of water treatment and distribution systems ☐ Severe damage to water supply system and infrastructure ☐ Severe disruption of wastewater and sewage systems ☐ Heavy rainfall risks the flushing of pathogens into water sources ☐ Large-scale water contamination ☐ Shortage of safe water ☐ No access to drinking water ☐ Unable to provide sanitation and hygiene services ☐ Damage to waste storage causing environmental contamination from biological and chemical hazards ☐ Sharps containers and specific biological and medical bins damaged, potentially releasing hazardous materials ☐ Increased risk of contamination of medical devices, instruments and equipment, and other medical supplies	☐ Increased health workforce infections from water and health care waste contamination ☐ Reduced capacity to provide efficient clean services (floor, toilets, patient rooms, emergency room and other rooms in the facility) ☐ Reduced capacity to provide water for drinking and cooking ☐ Reduced functioning of sanitation systems and hygiene practices (flush toilets, showers, sewerage, treatment, hand washing, medical procedures, etc.) ☐ Damaged sewage systems causing cross-contamination ☐ Possible damage to emergency water sources ☐ Increased nutrient loads ☐ Possible overflow of effluents into streams and rivers if surface water enters septic tanks ☐ Increased possibility of contamination of groundwater due to infiltration of pollutants (including during dust or sand storms)	☐ Reduced access to water for health care practices ☐ Reduced hygiene capacity (flush toilets, showers, etc.) ☐ Reduced capacity for using laundry and dishwashing machines ☐ Heavy sediment and pollution loads that make treatment ineffective ☐ Increased risk of breakdown of final waste collection and transportation systems within/outside the health care facilities

ENERGY		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Power outage (wind- and lightning-related) ☐ Interruption of acute medical care or other health services that rely on electricity (such as dialysis, intensive treatment rooms, oxygen therapy, radiotherapy, laboratory room, imaging and diagnostic equipment, and other areas) ☐ Loss of vaccines, laboratorial supplies, pharmaceuticals, drugs, milk, parenteral nutrition and blood supplies, and other essential refrigeration-dependent medical supplies ☐ Disruption of the fuel supply chain ☐ Damage to solar photovoltaic panels or other energy sources ☐ Disruption of energy-dependent water pumping and treatment systems	☐ Difficulty in providing health care services (such as dialysis, intensive care rooms, oxygen therapy, radiotherapy, imaging and diagnostic equipments), resulting in patients being transported to other facilities ☐ Reduced capacity to provide cleaning services that need electricity (laundry, dishwashing machines) ☐ Reduced capacity to provide disinfection services that need electricity (autoclave, microwave) ☐ Reduced electricity capacity resulting in loss of medical supplies and decrease in health care services ☐ Possible damage to the emergency generator or other sources of energy	☐ No ambient cooling, thereby increasing staff and patient discomfort ☐ Loss of food or difficulty in keeping food refrigerated ☐ Reduced capacity to follow boil water advisories

INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Direct damage to infrastructure (water storage tanks, roofs) from high winds ☐ Structural failure of the building ☐ Disruption to building access ☐ Damage to machine rooms ☐ Damage to communication and information systems and assets ☐ Loss or damage of essential supplies (medications, treatments, medical devices, drugs, pharmaceuticals, vaccines, etc.) ☐ Interruption of complex and emergency health care services (surgery, complex treatment, urgent health care, etc.) ☐ Disruption of health care services and operations ☐ Cessation of services or prolonged disruption of services due to loss or damage ☐ Breakdown of routine health care services (such as ambulatory, immunization, maternity room, pharmacy, medication for chronic diseases, and other primary services) ☐ Interruption of diagnosis due to equipment damages ☐ Interruption of supply chains ☐ Long-term effect on the environment, requiring external assistance/interventions ☐ Damage to internal transportation systems (elevators, ramps, corridors, garage, etc.) ☐ Increased treatment demand for infectious, cardiovascular and respiratory diseases ☐ Increase in complex and emergency health care services (complex treatments, outbreaks, etc.)	☐ Structural damage to the building ☐ Damage to road, impairing access ☐ Difficult to transport patients due to damaged or disabled transportation systems ☐ Reduced capacity to deliver health care services due to damaged and reduced supplies ☐ Temporary suspension of service deliveries ☐ Damage to paper medical record storage ☐ Reduced capacity to access clinical and laboratorial supplies ☐ Impacts from trees falling on the facility causing damage to building infrastructure and injuries to people ☐ Increased hospitalization rates requiring extra medical supplies and health workforce ☐ Increased costs due to high demand of critical supplies during and after the event ☐ Increased costs due to necessary financial investment in the recovery of facility infrastructure (structural and nonstructural), postevent	☐ Localized disruption of services with minor losses and damage ☐ Damage or loss of documents and records ☐ No lasting effect on the external environment of the facility ☐ Minimal impact on local operations and equipment, without compromising health care service deliveries ☐ Minimal impact on the supply chain

Sources for tables of vulnerabilities and impacts: (2,3,8,21,27,32,41,42,44–47).

STORMS: PROPOSED ACTIONS TO RESPOND TO THE IDENTIFIED IMPACTS

Health workforce
WASH and health care waste
Energy
Infrastructure, technologies, products and processes

A.3 SEA-LEVEL RISE CHECKLISTS

IPCC states that "it is very likely that mean sea level rise will contribute to upward trends in extreme coastal high-water levels in the future. There is high confidence that locations currently experiencing adverse impacts such as coastal erosion and inundation will continue to do so in the future due to increasing sea levels, all other contributing factors being equal". This is of particular concern for small island developing states given the contribution of mean sea-level rise in increasing extreme coastal high-water levels, coupled with the likely increase in tropical cyclone maximum wind speed *(7)*. Unlike most climate hazards that vary in intensity and duration, sea-level is a very long-term phenomenon, which from the point of view of the life-span of a health care facility is permanent.

CHECKLIST FOR ASSESSING VULNERABILITY TO SEA-LEVEL RISE

SEA-LEVEL RISE			Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)			**High**	**Medium**	**Low**
HEALTH WORKFORCE	**Is the health workforce,**				
	(Human resources)				
	aware of the potential risks of sea-level rise to the health care facility and to themselves?		☐	☐	☐
	equipped with a programme for assistance for mental health, injuries, medical treatment, etc.)?*		☐	☐	☐
	protected from impacts of storm surges?		☐	☐	☐
	equipped with an emergency plan to protect health workers from multiple biological and chemical hazards?*		☐	☐	☐
	provided with full personal protective equipment, especially, for clean-up crews (including waterproof safety boots, goggles, work gloves and masks?*		☐	☐	☐
	(Capacity development)				
	equipped with knowledge, experience, training and resources to manage risks and to be prepared to address actions to reduce impacts from sea-level rise?*		☐	☐	☐
	prepared and able to implement risk reduction actions and recover better than before the event?		☐	☐	☐
	trained on public health climate change issues related to effects of sea-level rise on human health?*		☐	☐	☐
	trained to manage hazardous chemicals in emergency situations?*		☐	☐	☐
	engaged in the development of plans and responses to sea-level rise and storm surge risks?		☐	☐	☐
	prepared and able to implement risk reduction actions for protecting themselves?		☐	☐	☐
	prepared with a contingency plan for storm surges and floods?		☐	☐	☐
	trained to maintain correct level of water safety, quality control and treatment supplies, in both routine and sea-level rise related events?		☐	☐	☐
	trained in multihazard assessments?		☐	☐	☐
	trained to an appropriate standard to maintain the correct level of safety of electrical power supply, in both routine and emergency/disaster situations?*		☐	☐	☐
	trained to detect posttraumatic stress disorder among staff to take prompt action?*		☐	☐	☐

SEA-LEVEL RISE	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
HEALTH WORKFORCE			
Is the health workforce,			
(Communication and awareness raising)			
provided with an established information system for managing occupational safety and health in emergency situations?	☐	☐	☐
regularly participating in community disaster planning committees to: improve knowledge on how to reduce risks, be prepared and respond to sea-level rise risks, and recover better than before through adaptation measures?*	☐	☐	☐
aware of contingency plans for accessing and leaving the facility during flood, erosion and storm surge emergencies, and health workforce transportation?	☐	☐	☐
provided with a contingency plan for continuing to provide services at other facilities or in communities (primary health care), if necessary?*	☐	☐	☐
prepared with clear messaging about water and food safety during and after a storm surge event?	☐	☐	☐
informed on how to reduce risks and vulnerabilities to flood and storm surge events resulting from sea-level rise?	☐	☐	☐
WASH AND HEALTH CARE WASTE			
Does the health care facility,			
(Monitoring and assessment)			
have an updated assessment plan to map risks to the water and sanitation infrastructure in place to identify where services could be disrupted from sea-level rise?	☐	☐	☐
regularly assess its sanitation system for any possible damage from sea-level rise impacts?*	☐	☐	☐
have an evaluation system to monitor its water system or supply before, during and after a storm surge event?	☐	☐	☐
have a contingency plan for monitoring and reducing contaminant concentrations in the facility's water supply system?	☐	☐	☐
regularly verify safety conditions and proper functioning of all elements of the water distribution system as early action for sea-level rise (e.g. storage tanks, cisterns, valves, pipes and connections, and water disinfection)?*	☐	☐	☐
have a water quality monitoring plan for human consumption?	☐	☐	☐
(Risk management)			
have a mechanism to protect freshwater sources around the facility from all types of contamination, including saline intrusion?	☐	☐	☐
have a safe water and wastewater management system for sea-level rise impacts, including standing water near the facility?	☐	☐	☐
store waste in a safe place to avoid release in case of flooding?*	☐	☐	☐
store hazardous chemical, radioactive and biological waste in a safe place and on a level above the ground floor?*	☐	☐	☐
have a schedule for emptying latrines regularly and in advance of flooding from high tides to avoid overflows?	☐	☐	☐
have safe waste disposal of debris after a high tide event?	☐	☐	☐
have an established safe management approach for health care waste transport (including hazardous waste) during and after a flood event due to sea-level rise?	☐	☐	☐

SEA-LEVEL RISE

High: unprepared; unable to respond (Higher risk)
Medium: basic or incomplete preparation; low level of response (Medium risk)
Low: prepared; able to respond (Lower risk)

		Vulnerability level		
		High	Medium	Low
WASH AND HEALTH CARE WASTE	**Does the health care facility,**			
	provide appropriate covers for water storage tanks to prevent damage, water contamination and saline water intrusion in case of flooding related to sea-level rise?	☐	☐	☐
	have nonreturn valves installed in water supply pipes to prevent backflows, in case of flooding?	☐	☐	☐
	build waste pits to withstand flood events?	☐	☐	☐
	have onsite water purification equipment to provide safe drinking water?	☐	☐	☐
	(Health and safety regulation)			
	have an alternative water source to supply the facility?*	☐	☐	☐
	have a water safety plan in place, in case of water contamination?*	☐	☐	☐
	have a mechanism or regulation to carry out sanitary inspections of water supply, and when necessary, establish a temporary ban on use, until improvements are made?	☐	☐	☐
	have a contingency plan to ensure effective and timely delivery of safe water during floods and emergencies over the short- and mid-term?*	☐	☐	☐
	have a coordinated cross-sectoral water management plan to protect local or alternative water sources?	☐	☐	☐
ENERGY	**Does the health care facility,**			
	(Monitoring and assessment)			
	regularly assess its energy system to ensure that it can cope with sea-level rise events (including flooding)?*	☐	☐	☐
	have an emergency backup generator (including fuel, where relevant) that is able to cover at least all critical service areas and equipment during and after the event?*	☐	☐	☐
	periodically check the emergency backup generator (including fuel, where relevant)?*	☐	☐	☐
	assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment?	☐	☐	☐
	(Risk management)			
	have a secure place to protect the backup generator (e.g. an elevated place; including fuel or battery storage, where relevant) from damage?*	☐	☐	☐
	have appliance thermometers in the refrigerator and freezer to determine if food, vaccines and other essential refrigeration-dependent medical supplies are safe?	☐	☐	☐
	have adequate daylight to ensure proper visibility during power outage?	☐	☐	☐
	have power-operated doors that can be opened manually to permit exit in case of power failure?	☐	☐	☐
	have a safety backup for telecommunication and information systems (e.g. via cloud and satellite)?*	☐	☐	☐
	have a clear guidance to alert staff on safety measures (e.g. never restore power when the power is off, until a professional inspects and ensures the integrity of the electrical system; do not use electrical equipment that has been exposed to flood waters until checked by an electrician; unless power is off, never enter flooded areas or touch electrical equipment if the ground is wet)?	☐	☐	☐

SEA-LEVEL RISE

High: unprepared; unable to respond (Higher risk)
Medium: basic or incomplete preparation; low level of response (Medium risk)
Low: prepared; able to respond (Lower risk)

		Vulnerability level		
		High	Medium	Low
ENERGY	**Does the health care facility,**			
	(Health and safety regulation)			
	have an emergency plan for power outages in the short- and long-term (before, during and after a sea-level rise flood event)?	☐	☐	☐
	work with energy utility agencies to prevent suspension of electricity services?	☐	☐	☐
	have a management plan for intermittent energy supplies or system failure?	☐	☐	☐
	have a plan or regulation to determine ways to reduce overall energy use?	☐	☐	☐
	have an emergency plan to ensure availability of adequate lighting, communication and information systems, as well as refrigeration and sterilization equipment during a flood?*	☐	☐	☐
INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES	**Does the health care facility,**			
	(Adaptation of current systems and infrastructures)			
	provide health workforce training to cover climate change risks and responses regarding sea-level rise?	☐	☐	☐
	have a monitoring and early warning system integrated with other areas to manage and reduce risks from storm surges and floods related to sea-level rise?	☐	☐	☐
	have knowledge, experience (considering previous damages) and resources (including human, material, financial, supplies chain and logistics) to manage risks from sea-level rise?	☐	☐	☐
	work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning and implementation?	☐	☐	☐
	map the facility's location relative to sea-level rise hazards?	☐	☐	☐
	assess the performance and vulnerabilities of each critical part of the facility (structural and nonstructural elements) that can be affected by sea-level rise hazards?*	☐	☐	☐
	have a plan for assessing vulnerable public infrastructure along the coastal area of the health facility (e.g. transit systems and roads, water and sewage systems, energy infrastructure, alternative route for other health care facilities, logistics and supply chain for medical and laboratorial supplies, drinking water, food and other supplies)?*	☐	☐	☐
	in their annual planning consider how climate risks may change in future?	☐	☐	☐
	have resources available to adopt risk reduction measures to the facility and its infrastructure, technologies, products and processes?	☐	☐	☐
	regularly update these assessments, considering emerging scientific information?	☐	☐	☐
	have a schedule to inspect the facility regularly, both internally and externally, for signs of deterioration (e.g. broken plaster, cracks, corrosion, or sinking structural elements) to avoid or reduce sea-level rise impacts?	☐	☐	☐
	evaluate the condition and safety of structural and nonstructural elements impacts resulting from previous exposure to sea-level rise event?*	☐	☐	☐
	have evaluation tools (e.g. forms) to check and identify damages and the minimum needs in terms of health workers, medical supplies and other essential supplies and services to ensure that operational care service functions continue during and after a storm surge event?*	☐	☐	☐
	have funding to protect the facility and vulnerable assets from sea-level rise?	☐	☐	☐
	have an evacuation plan to transfer critical medical, laboratorial and administration equipment to another health care facility or to a safety storage or location in a storm surge emergency situation?	☐	☐	☐

SEA-LEVEL RISE

High: unprepared; unable to respond (Higher risk)
Medium: basic or incomplete preparation; low level of response (Medium risk)
Low: prepared; able to respond (Lower risk)

INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES	Vulnerability level		
Does the health care facility,	**High**	**Medium**	**Low**
have established procedures for safely procuring, transporting and storing medical supplies (medical devices, pharmaceuticals, vaccines, laboratorial supplies, parenteral nutrition and blood supplies, and other essential health care supplies)?	☐	☐	☐
have established procedures for safely procuring, transporting and storing bottled water and food supplies during an emergency?*	☐	☐	☐
have an effective emergency risk communication plan to reduce risks and impacts for health workers and patients?*	☐	☐	☐
have a contingency plan in place for safe and efficient personnel evacuation (including health staff and patients) before, during and following a flooding or a storm surge?*	☐	☐	☐
have a clear and consistent mechanism for secure evacuation of health workers and patients?*			
have evacuation routes above flood elevation?*	☐	☐	☐
have a plan to transfer critical equipment and medical supplies to another facility or to a safe storage?	☐	☐	☐
implement anti-mosquito breeding measures?	☐	☐	☐
have walls protected and insulated against moisture and mold?	☐	☐	☐
have machine rooms resistant to storm surge damage?	☐	☐	☐
have water-resistant interior construction?	☐	☐	☐
ensure removal of equipment and power supplies from basements and ground floor level to avoid damage from flooding?	☐	☐	☐
have a coordinated mechanism across the health sector in different levels of government, to manage the response and risks of public health emergencies and disasters (including sharing of resources and supplies, transferring of patients, and health workforce support)?*	☐	☐	☐
estimate the possible risks and losses, and adapt to reduce impacts?	☐	☐	☐
(Promotion of new systems and technologies)			
have an information system between the health sector and meteorological services to communicate about storm surge hazards?	☐	☐	☐
have electronic patient health records to make available to other receiving health care facilities in case of evacuation?	☐	☐	☐
have implemented measures to respond to sea-level rise scenarios and threats (e.g. seawater pump stations, floodplain mapping, assessing future sea-level rise impacts)?	☐	☐	☐
have mitigation measures in place to respond to sea-level rise scenarios and threats identified, including engineering, planning, as well as preparedness solutions for the facility and community surroundings (e.g. stormwater pump stations, floodplain mapping, assessing future climate change impacts)?	☐	☐	☐
(Sustainability of health care facility operations)			
review building code design baselines against sea-level rise to assess the risks, impacts and possible loss?	☐	☐	☐
have adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction and response to sea-level rise conditions?	☐	☐	☐
have established partnerships between the facility, community and local authorities to reduce vulnerabilities in the surrounding areas?	☐	☐	☐

SEA-LEVEL RISE	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES			
Does the health care facility,			
have health care coalitions and partnerships with local health care providers for strategic decision-making on health services and clinical resources?	☐	☐	☐
have a route for public transportation which is likely to remain operational during or immediately following a flood event?	☐	☐	☐
have salt-resistant trees and plants?	☐	☐	☐
have trees planted in a secure place that will not block access to the facility or fall on the building in case of land erosion or wave actions?	☐	☐	☐
have a secure storage for hazardous chemicals to avoid their damage or release during an event?*	☐	☐	☐
undertake risk assessments of the supply chain for essential medical and nonmedical products?	☐	☐	☐
have secure access to essential backup services such as sterilization, laundry and cleaning services, via multiple agreements with different facilities to maintain functioning of critical services during or immediately following an event?	☐	☐	☐
have secure access to essential backup food sources via multiple agreements with different vendors and through cooperative agreements with other facilities to maintain functioning of critical services during or immediately following a sea-level rise related event?*	☐	☐	☐
have a coordinated plan with municipal health department heads to ensure appropriate preparations for ongoing sea-level rise?*	☐	☐	☐
have a postflood recovery plan related to sea-level rise for the entire infrastructure (structural and nonstructural elements) of the facility (e.g. clearance, removal and disposal of debris; demolition of critically damaged, or repair of less damaged, structural elements; reposition of equipment and furniture; reassessment of risks)?*	☐	☐	☐
have a plan to consider relocating the facility?*	☐	☐	☐

Note: For WASH and health care waste details see WASH FIT (3).

**For further details see Hospital Safety Index (2).*

IMPACTS CHECKLIST FOR SEA-LEVEL RISE

HEALTH WORKFORCE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Increased risk of indoor mold growth from excess dampness, with impacts on respiratory disease	☐ Possible increased risk of infectious diseases for the health workforce from water and health care waste contamination	☐ Reduction of health workforce functions
☐ Health professionals not able to arrive or depart from the health care facility	☐ High water salinity leading to increased risk of hypertension in the health workforce	☐ Service delivery and programme delays
☐ Loss of work capacity	☐ Minor injuries to health workers requiring short-term medical treatment	☐ Minor injuries to health workers not requiring immediate medical treatment
☐ Increased demand for health care due to infectious and noncommunicable diseases (renal effects, cardiovascular diseases, respiratory diseases) and injuries (electrical shocks, chemical exposure)	☐ Significantly reduced performance capacity needing additional support (local, regional or national)	
☐ Cessation of several programmes or services with possible overflow of patients to other locations	☐ Restrictions to provide health care services and programmes	
	☐ Increased work overload resulting in stress	

WASH AND HEALTH CARE WASTE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Permanent damage to water, wastewater and sewage infrastructure systems	☐ Saltwater intrusion in water and wastewater containment systems leading to reduced capacity for water treatment and distribution	☐ Increased water and wastewater management and repairs due to inundation or erosion
☐ Increased saltwater intrusion into aquifers, resulting in increased salinity of groundwater basins and well water	☐ Limited access to water for drinking and cooking	☐ Shortage of safe water
☐ Water contamination	☐ Reduced volume of stored freshwater	☐ Damage to alternative emergency water sources
☐ No access to drinking water	☐ Reduced capacity to provide disinfection or sterilization processes and hygiene services	☐ Reduced capacity to provide safe cleaning services (floor, toilets, patient rooms, emergency room and other rooms of the facility)
☐ Leakage from septic tanks, sewer systems and instability of storage tanks and pipes	☐ Surface water ingress into septic tanks leading to overflow of effluents into streams, rivers and oceans	☐ Reduced capacity to use laundry and dishwashing machines
☐ Increased corrosion of the water and wastewater drainage system	☐ Risk of sharps containers and specific biological and medical waste bins lost or damaged	☐ Possible damage to emergency water sources
☐ Possible contamination of medical devices, instruments and equipment		
☐ Risk of environmental contamination by biological and chemical hazards		
☐ Loss of water pumping and treatment systems		

ENERGY		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Damage to power lines causing outage ☐ Power failures ☐ Shutdown of cold storage systems ☐ Interruption of health care services which require electricity such as dialysis, oxygen therapy, diagnostic equipment ☐ Disruption of internal and external communication and information systems ☐ Disruption of the fuel supply chain	☐ Disruption of electricity generation and delivery ☐ Reduced capacity to follow boil water advisories ☐ Possible damage to emergency generator or other sources of energy ☐ Reduced capacity to provide critical health care service deliveries such as dialysis, oxygen therapy, diagnosis equipment ☐ Patients need to be transferred to other locations ☐ Loss of vaccines, laboratorial supplies, drugs, pharmaceuticals, milk, parenteral nutrition and blood supplies, and other essential refrigeration-dependent medical supplies	☐ Temporary power supply interruption ☐ Possible delay in restarting power, thereby affecting health care ☐ Reduced capacity to provide cleaning services that need electricity (laundry, dishwashing machines) ☐ No ambient cooling ☐ Loss of food or difficulty in providing food refrigeration ☐ Reduced capacity to provide disinfection services that need electricity

INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Infrastructure destruction (structural and nonstructural; full or parts of the facility) ☐ Building collapse from coastal erosion and material corrosion ☐ Increased water treatment (desalinization process) ☐ Increased maintenance and repair of the facility building ☐ Ongoing facility flooding during high tides ☐ Blocked transport systems and flooded ambulance stations ☐ Blocked building access ☐ Damage to critical medical equipment ☐ Damage to essential supplies (medications, treatments, medical devices, drugs, laboratorial supplies, pharmaceuticals, vaccines, blood, milk, nutritional supplies and other critical supplies) requiring prompt repositioning ☐ Interruption in complex and emergency health care services (surgery, complex treatments, urgent care, blood banks, etc.) ☐ Disruption of health care service delivery and operations, such as ambulatory, immunization, maternity room, pharmacy, medication for chronic diseases, and other primary services ☐ Cessation of services or prolonged service disruption due to loss or damage ☐ Interruption of supply chains ☐ Damage to internal access systems (e.g. elevators, ramps, corridors, garage) ☐ Increased costs of building maintenance ☐ Damage to medical and administration equipment and furniture	☐ Infrastructure damage (structural and nonstructural; full or parts of the facility) ☐ Partial disruption of health care facility functions resulting from coastal erosion or corrosion ☐ Disruption of the food chain due to saline intrusion in agriculture ☐ Damage to road access ☐ Difficulty in transporting patients due to damaged or disabled transportation systems ☐ Reduced capacity to deliver health care services due to damage and reduced access to clinical, laboratorial and medical supplies ☐ Temporary suspension of service deliveries ☐ High demand for cleaning services for the entire facility building, after a flood event ☐ Long-term effect on the environment needing external assistance/interventions ☐ Increased costs from the water desalinization process ☐ Possible replacement of sections of the health facility's building ☐ Increased costs due to demand for repositioning of all damaged or lost medical equipment and devices ☐ Increased demand for providing all necessary essential or critical supplies (medications, treatments, medical devices, drugs, laboratorial supplies, pharmaceuticals, vaccines, milk, parenteral nutritional and blood supplies, and other critical supplies) ☐ Increased costs of recovery of infrastructure, postevent	☐ Localized disruption of services with minor loss and damage ☐ Increase in costs to maintain and repair the facility building and its assets ☐ Damage or loss of documents and medical records ☐ Minor impact on local operations without compromising health care services ☐ Minimal impact on the supply chain ☐ Short-term negative effect on the environment

Sources for tables of vulnerabilities and impacts: (1–3,8,21,41,44–46,49,50).

SEA-LEVEL RISE: PROPOSED ACTIONS TO RESPOND TO THE IDENTIFIED IMPACTS

Health workforce
WASH and health care waste
Energy
Infrastructure, technologies, products and processes

A.4 DROUGHT CHECKLISTS

Drought is defined as a naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems *(22)*. IPCC states that there is medium confidence that some regions of the world have experienced more intense and longer droughts; however it also notes that in some regions, droughts are less frequent, less intense or shorter. There is medium confidence that droughts will intensify in the 21st century in some seasons and areas, due to reduced precipitation and/or increased evapotranspiration *(7)*.

CHECKLIST FOR ASSESSING VULNERABILITY TO DROUGHTS

DROUGHTS		Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)		High	Medium	Low
HEALTH WORKFORCE	**Is the health workforce,**			
	(Human resources)			
	participating in drought, water and climate change adaptation plan and policies?*	☐	☐	☐
	equipped with a plan to identify minimum needs for health workers to ensure operational sufficiency care services?	☐	☐	☐
	equipped with a plan for scheduling outdoor work for cooler time of the day and reducing physical demand during hot days?	☐	☐	☐
	provided with sunscreen, hat and plenty of drinking water for staff carrying out outdoor activities?	☐	☐	☐
	provided with drinking water and stimulated regularly for appropriate water intake?	☐	☐	☐
	(Capacity development)			
	trained to identify health conditions made worse by drought?	☐	☐	☐
	equipped with knowledge, experience, training and resources to manage emergency preparedness plans and response measures to reduce drought risks and impacts at the facility and in the local communities?*	☐	☐	☐
	trained in multihazard assessments?	☐	☐	☐
	trained to manage hazardous chemicals?	☐	☐	☐
	trained on how to treat stored water for human consumption?	☐	☐	☐
	trained or prepared to quantify drought-sensitive diseases taking into account the special drought patterns?	☐	☐	☐
	able to convey protective strategies for public health emergencies, in case of high temperature effects, and water and food contamination to patients, staff and communities?*	☐	☐	☐
	trained to an appropriate standard to maintain the correct level of safety of electrical power supply, in both routine and emergency/disaster situations?*	☐	☐	☐
	(Communication and awareness raising)			
	aware of the different impacts of drought on human health?	☐	☐	☐
	informed of air pollution advisories and warnings?	☐	☐	☐
	prepared with clear messaging about water and food safety during and after a drought?	☐	☐	☐

DROUGHTS		Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)		High	Medium	Low
HEALTH WORKFORCE	**Is the health workforce,**			
	informed on how to use and follow a surveillance system to track health outcomes?	☐	☐	☐
	following guidance on risk assessments to assist in the identification, planning, monitoring and evaluation of risk reduction and adaptation strategies associated with direct and indirect impacts of drought?	☐	☐	☐
	regularly participating in community disaster planning committees to: improve knowledge on how to reduce risks, as well as be prepared and respond to direct and indirect impacts of drought hazard through adaptation measures?*	☐	☐	☐
	following an educational strategy to improve knowledge in the community on the social and economic aspects of drought impacts, and how to reduce health risks and impacts?	☐	☐	☐
	provided with an effective emergency risk communication plan?*	☐	☐	☐
	aware of keeping the facility environment cool (e.g. keep windows that are exposed to the sun closed during the day and open at night when the temperature has dropped; close curtains that receive morning or afternoon sun; turn off nonessential lights and electrical equipment that generate heat; sleeping in a cooler room or use electric fans for some relief if temperatures are below 35°C)?	☐	☐	☐
WASH AND HEALTH CARE WASTE	**Does the health care facility,**			
	(Monitoring and assessment)			
	verify water safety conditions, which include updated risk assessments to map water resources and water supplies for the facility?*	☐	☐	☐
	have an updated plan to map risks to the water and sanitation infrastructure to identify where services could be disrupted from water scarcity?*	☐	☐	☐
	regularly inspect the rainwater harvesting system for damage and contamination?	☐	☐	☐
	have an evaluation system to monitor water drips, leaks and unnecessary flows in bathrooms, laundry facilities, kitchen, etc.; and perform prompt repairs to avoid loss?	☐	☐	☐
	verify safety conditions and proper functioning of all elements of the water distribution system in preparation for drought (e.g. storage tanks, cisterns, valves, pipes and connections, and water disinfection)?*	☐	☐	☐
	have information on the water system installation that ensures lower risk of being contaminated?	☐	☐	☐
	have a water quality monitoring plan for human consumption?	☐	☐	☐
	have a monitoring plan for potable water?*	☐	☐	☐
	(Risk management)			
	have a water management plan to identify water contamination?*	☐	☐	☐
	have a contingency plan for monitoring and reducing contaminant concentrations in the facility water system supplies?	☐	☐	☐
	have a water management system to avoid or reduce vector breeding sites?	☐	☐	☐
	have anti-mosquito breeding measures to avoid vectorborne diseases?	☐	☐	☐
	have a rainwater catchment system with safe water storage?	☐	☐	☐
	have water storage tanks with appropriate covers to prevent contamination?*	☐	☐	☐
	have water storage that is protected from direct sunlight?	☐	☐	☐

DROUGHTS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
WASH AND HEALTH CARE WASTE			
Does the health care facility,			
have chemicals stored away from excessive heat?*	☐	☐	☐
provide sufficient drinking water to staff, patients and visitors?*	☐	☐	☐
have onsite water purification equipment to provide safe drinking water?	☐	☐	☐
have a surveillance system for diseases related to water quality and sanitation?*	☐	☐	☐
(Health and safety regulation)			
have a long-term drought management plan, including the identification of available alternative safe water sources?*	☐	☐	☐
have established procedures for procuring, transporting and safely storing water?*	☐	☐	☐
work with water utility agencies to prevent suspension of services?	☐	☐	☐
have a water safety plan in place, in case of water contamination?	☐	☐	☐
have a plan to conserve and manage water to reduce water usage, specifically in case of prolonged drought?	☐	☐	☐
have a cross-sectoral water management plan to conserve and protect local or alternative water sources?	☐	☐	☐
have a mechanism or regulation to carry out sanitary inspections of alternative forms of water supply (e.g. wells, dams, cisterns, fountains and water trucks), and when necessary, establish a temporary ban on use, until improvements are made to sanitary conditions?	☐	☐	☐
have a contingency plan to ensure effective and timely delivery of safe water during drought and emergencies over the short- and long-term?*	☐	☐	☐
ENERGY			
Does the health care facility,			
(Monitoring and assessment)			
regularly assess its energy system to ensure it can cope with drought conditions?	☐	☐	☐
have an emergency backup generator (including fuel, where relevant) that is able to cover at least all critical service areas and equipment during and after the event?*	☐	☐	☐
periodically check the emergency backup generator (including fuel, where relevant)?*	☐	☐	☐
assess regularly heating, ventilation and air conditioning systems?	☐	☐	☐
assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment?	☐	☐	☐
(Risk management)			
have appliance thermometers in the refrigerator and freezer to determine if food, vaccines and other essential refrigeration-dependent medical supplies are safe?	☐	☐	☐
have adequate daylight to ensure proper visibility during a power outage?	☐	☐	☐
work with energy utility agencies to prevent suspension of electricity services?	☐	☐	☐
have power-operated doors that can be opened manually to permit exit in case of power failure?	☐	☐	☐
have a clear guidance on heat-risk management for the maintenance of critical infrastructure (e.g. air-conditioning, medical devices, computers, diagnostic equipment, boiling water)?*	☐	☐	☐
(Health and safety regulation)			
have an emergency plan for power outages in the short- and long-term?	☐	☐	☐

DROUGHTS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
ENERGY			
Does the health care facility,			
have a plan or regulation to determine ways to reduce overall energy use?	☐	☐	☐
work with energy utility agencies to prevent suspension of electricity services?	☐	☐	☐
have an emergency plan to ensure availability of adequate lighting, communication and information systems, and refrigeration and sterilization equipment during a drought?*	☐	☐	☐
have a plan to evacuate patients to a cooling station if the facility has lost power and has no other source of energy?	☐	☐	☐
have a plan to ensure that the walls and roofs of the facility are insulated?	☐	☐	☐
INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES			
Does the health care facility,			
(Adaptation of current systems and infrastructures)			
have health workforce preparedness and training for periods of extreme drought in place?	☐	☐	☐
perform assessments of drought conditions – current, past trends and future changes – to implement preventive actions?	☐	☐	☐
assess the performance and vulnerabilities of each critical part of the facility (structural and nonstructural elements) that can be affected by hot temperatures?	☐	☐	☐
have a monitoring and early warning system integrated with other areas to manage risks related to drought impacts on the facility?	☐	☐	☐
have a mechanism to rapidly supply or restore water services to the facility?*	☐	☐	☐
conduct ongoing and postdrought evaluations to identify success and weakness to improve preventive measures?	☐	☐	☐
assess the capacity of heating, ventilation and air-conditioning systems to deal with increasing heat?*	☐	☐	☐
have exterior shading devices, trees or other architectural features that mitigate heat and dryness?	☐	☐	☐
have openable windows to provide for ventilation and to maintain habitable conditions?	☐	☐	☐
install reflective white roofs to reduce heat impacts?	☐	☐	☐
have pavements and roofs designed to withstand extreme temperatures or solar radiation?	☐	☐	☐
have a mechanism to filter indoor and ambient air pollutants?	☐	☐	☐
have a system for cooling the environment?	☐	☐	☐
identify vulnerabilities to implement actions to reduce impacts?	☐	☐	☐
stimulate increase of water intake by staff and patients?	☐	☐	☐
store chemicals away from excessive heat?*	☐	☐	☐
have a coordinated team across the health sector with a key stakeholder group including different levels of government to manage the risks of public health emergency related to droughts?	☐	☐	☐
have an effective risk communication plan to communicate clear messages of the danger of heatwaves and dehydration emphasizing health protection as a priority?	☐	☐	☐
(Promotion of new systems and technologies)			
have an information system between the health sector and meteorological services to communicate about the climate hazard?*	☐	☐	☐

DROUGHTS

High: unprepared; unable to respond (Higher risk)
Medium: basic or incomplete preparation; low level of response (Medium risk)
Low: prepared; able to respond (Lower risk)

INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES	Vulnerability level		
Does the health care facility,	High	Medium	Low
have a syndromic surveillance system for drought-related illnesses?	☐	☐	☐
have an assessment plan for identifying vulnerability conditions considering the degree or extent of potential damage or loss in the event of a drought?	☐	☐	☐
have identified capacities, resources and needs to better cope and manage a drought event?	☐	☐	☐
have an established set of procedures to continually evaluate and implement risk management plans to stay responsive to the needs of the facility in ongoing and postdrought events?	☐	☐	☐
ensure information and communication flow between health workforce and policy makers, particularly, during high stress situations and demands created by emergencies?	☐	☐	☐
have trees and plants which are resilient to drought surrounding the facility?	☐	☐	☐
have an information system for tracking and monitoring diseases following drought events?	☐	☐	☐
have measures that improve health performance, based on a history of climate variability in the region or locality?	☐	☐	☐
(Sustainability of health care facility operations)			
have procedures for procuring, transporting and safely storing water supplies?	☐	☐	☐
have a defined and sustained budget as part of core budgeting for emergency preparedness and response to drought risks?	☐	☐	☐
have established partnerships between the facility, community and local authorities to reduce vulnerabilities in the surrounding areas?	☐	☐	☐
have trees and leafy plants near windows to provide natural cooling?	☐	☐	☐
have a plan to conserve and manage water to reduce water usage, specifically in case of prolonged drought?	☐	☐	☐
have a plan for relocating supplies and services in case of outbreaks and epidemics that may overwhelm the facility or increase demand due to severe drought?	☐	☐	☐
have established requirements or provide incentives to encourage water conservation in the facility and also in the communities?	☐	☐	☐
have a coordinated plan with health municipal department heads to ensure appropriate preparations for ongoing drought conditions?*	☐	☐	☐
explore the relationship between social learning and adaptation measures in the face of drought threats to identify and implement the best behavioural responses from successful health facilities?	☐	☐	☐
undertake risk assessments of the supply chain for essential medical and nonmedical products?	☐	☐	☐
have secure access to essential backup food sources via multiple agreements with different vendors and through cooperative agreements with other health care facilities?*	☐	☐	☐

Note: For WASH and health care waste details see WASH FIT (3).

**For further details see Hospital Safety Index (2).*

IMPACTS CHECKLIST FOR DROUGHTS

HEALTH WORKFORCE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Increased threat to the health workforce from infectious disease from water contamination and vector breeding sites ☐ Increased threat to the health workforce resulting in impacts to noncommunicable diseases (cardiovascular, respiratory diseases), from poor air quality and higher temperatures ☐ Drought-related illness to health workers requiring hospitalization ☐ Effects on mental health of staff leading to psychological stress ☐ Interruption of critical programmes or services availability with possible relocation to another facility (municipality or capital) ☐ Reduced performance capacity of health workforce ☐ Increased demand for health care due to drought-related infectious diseases (water-, food- and vector-borne diseases), cardiovascular, kidney and respiratory diseases, cancer (skin, bladder, lung), malnutrition and mental health issues	☐ Increased threat to the health workforce resulting in impacts related to high temperature, low air humidity and less water ingestion ☐ Possible illness to health workers requiring medical treatment ☐ Reduction of health workforce functions ☐ Reduced capacity of the health workforce to deliver health care due to lack of conditions to perform hygiene procedures and services (personal and work-related hygiene) ☐ Reduced productivity ☐ Possible increased risk of dustborne diseases (valley fever, meningococcal meningitis), leading to hospital admissions ☐ Increased risk of mortality associated with drought impacts (cardiopulmonary and respiratory diseases), and increasing demand for services from staff	☐ Drought-related illness among health workers not requiring immediate medical treatment ☐ Service delivery and programme delays ☐ Restrictions to provide health care services and programmes ☐ Reduced capacity for health workforce to performs hygiene procedures compromising safety ☐ Possible reduced capacity and health workforce performance in case of outbreaks

WASH AND HEALTH CARE WASTE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Disruption of the water system supply	☐ Insufficient water availability to provide health care services	☐ Reduced water availability to provide health care services
☐ Shortage or lack of water	☐ Low water quality	☐ Reduced capacity to maintain hygiene of toilets, showers, etc.
☐ Increased water pollution due to pollutant concentration resulting from low flows and reduced water levels (arsenic, iron, manganese, fluoride)	☐ Reduced function of sanitation systems and hygiene practices (flush toilets, showers, sewerage, hand washing, medical procedures)	☐ Reduced capacity to access local agricultural produce
☐ Increased water pollution due to nutrient concentration (phosphorus) resulting from reduced dissolved oxygen levels caused by higher temperatures, and reduced flows that increase phytoplankton activity	☐ Reduced capacity to provide cleaning services (floor, toilets, patient rooms, and other health care facility rooms)	☐ Possible increase in vector breeding sites due to inadequate water storage in the facility or surrounding areas
☐ Increased water contamination by cyanobacterial blooms due to increased temperature	☐ Reduced capacity to provide water for laundry and dishwashing machines	☐ Unable to follow boil water advisories
☐ Water contamination from metals	☐ Reduced capacity to deliver health care services due to water shortage	
☐ Increased water salinity in groundwater resources due to decreased recharge	☐ Reduced capacity to access drinking water for health workforce and patients	
☐ No access to potable water for drinking and cooking	☐ Reduced capacity to provide disinfection or sterilization	
☐ Lack of water availability for washing, cooking and hygiene compromising health service deliveries	☐ Increased dependence on less secure alternative water sources	
☐ Likelihood of contamination of medical devices, instruments and equipment	☐ Lack of safe water to provide complex health care services	
☐ Compromised complex and emergency health care services (surgery, urgent care)	☐ Reduced efficacy of chemicals to treat water	
☐ Compromised routine health care services such as ambulatory, immunization, maternity room, dentistry, and other primary services		
☐ Inadequate wastewater elimination		
☐ Increased rate of broken pipes		

ENERGY		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Power failure ☐ Disruption in use of medical equipments that require electricity ☐ Shutdown of cold storage systems ☐ Interruption of health care services which require electricity such as dialysis, oxygen supplies, diagnosis equipment ☐ Loss of vaccines, laboratorial supplies, drugs, pharmaceuticals and other essential refrigeration-dependent medical supplies ☐ Unable to follow boil water advisories ☐ Disruption of the fuel supply chain ☐ Disruption of energy-dependent water pumping and treatment	☐ Intermittent power delivery ☐ Temporary power supply interruption ☐ Reduced capacity to use medical and diagnostic equipment that require electricity ☐ Disruption of cooling system for medicines, vaccines, and medical and laboratorial supplies ☐ Difficulty to provide critical health care service deliveries such as dialysis, oxygen supplies, diagnostic equipment, causing patient transfers to other health care facilities (municipal or regional) ☐ Reduced capacity to provide cleaning services that need electricity (laundry, dishwashing machines) ☐ Reduced capacity to provide disinfection services that need electricity (autoclave, microwave) ☐ Reduced capacity to boil water	☐ No ongoing compromise of energy supply ☐ No ambient cooling ☐ Loss of food or difficulty in keeping food refrigerated ☐ Interruption of internal access systems (elevators, automatic doors)

INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Damage to vital equipment from power outages ☐ Interruption of health care services delivery and operation ☐ Disruption of internal communication and information systems ☐ Reduced capacity of routine health care services such as ambulatory, immunization, maternity room, dental service, and other primary services (from reduced water supply) ☐ Interruption of diagnostics due to equipment damage ☐ Interruption of water and food supply chains ☐ Increased complex and emergency health care services (dialysis, complex treatments, outbreaks, cardiovascular and respiratory hospitalizations, etc.) ☐ Increased health care costs for attending to all drought-related impacts ☐ Decreased local food security ☐ Disruption of local food supply	☐ Reduced capacity to deliver critical health care services due to water shortage ☐ Reduced capacity to deliver basic health care services ☐ Temporary suspension of service deliveries due to water shortage ☐ Increase in temperature and reduction in air quality within the health care facility ☐ No functioning air conditioning system or electric fans or appropriate window position ☐ Possibility of reduced food supply due to lower access to food production ☐ Increased hospitalization rates requiring extra medical supplies and health workforce ☐ Possibility of higher costs to health care facilities due to lower/reduced food supply and higher prices	☐ Minimal impact on local operations equipment, with no impact on health care service deliveries ☐ Minimal impact on the supply chain ☐ Reduced capacity to provide local food access ☐ Minor impact from high temperatures and reduction in air quality within the facility due to lack of air conditioning or electric fans or appropriate window position

Sources for tables of vulnerabilities and impacts: (1–3,8,21,28,31,42,45–48,51,52).

DROUGHTS: PROPOSED ACTIONS TO RESPOND TO THE IDENTIFIED IMPACTS

Health workforce
WASH and health care waste
Energy
Infrastructure, technologies, products and processes

A.5 HEATWAVE CHECKLISTS

IPCC states that it is very likely that there has been an overall decrease in the number of cold days and nights, and an overall increase in the number of warm days and nights *(7)*. This trend will continue with global average increase in temperature of 1.5 and 2.0°C *(4)*. Moreover, in many regions with sufficient data, there is medium confidence that the length or number of warm spells or heatwaves has increased. Heatwaves can affect the performance of health care workers and can be dangerous to those who work outdoors, such as community health workers. Heatwaves demand more power, potentially generating power outbreaks. Workers and patients need to keep hydrated, resulting in an increased for water demand in the health facility for drinking and for keeping cool.

CHECKLIST FOR ASSESSING VULNERABILITY TO HEATWAVES

HEATWAVES		Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)		High	Medium	Low
HEALTH WORKFORCE	**Is the health workforce,**			
	(Human resources)			
	equipped with a plan to identify and protect health workers at risk of heat stress?	☐	☐	☐
	provided with appropriate clothes (e.g. light, loose-fitting cotton clothes, and when necessary, a hat)?	☐	☐	☐
	provided with sunscreen, hat and plenty of drinking water for staff carrying out outdoor activities?	☐	☐	☐
	provided with safe water during a heatwave event and stimulated regularly for appropriate water intake?	☐	☐	☐
	provided with a cool space or a shower room for staff?	☐	☐	☐
	provided with an information system to manage occupational safety and health in the facility during a heatwave, including rest for staff?	☐	☐	☐
	(Capacity development)			
	trained on public health and climate change hazards, including health impacts related to heatwaves?	☐	☐	☐
	trained to manage hazardous waste (chemical, biological, radiological)?	☐	☐	☐
	prepared and able to follow-up a contingency plan for emerging health workforce heat stress, water- and air-borne diseases, and cardiovascular and respiratory problems?	☐	☐	☐
	able to implement a contingency plan for public health emergencies, in case of high temperature effects, and water and food contamination?	☐	☐	☐
	trained and have specific and clear guidance on actions to reduce heat risk factors for staff?*	☐	☐	☐
	aware of the need for an alternative action plan for the health workforce with outdoor functions to limit their activity to morning and evening hours or reduce their activity demands during the hottest part of the day or try alternate work and rest periods, with rest periods in a cooler area? (more frequent work-rest cycles are better)	☐	☐	☐
	(Communication and awareness raising)			
	aware about impacts of hot temperatures on human health via water quality and quantity (including water- and food-borne diseases) and air quality?	☐	☐	☐
	aware of the type of patients and symptoms expected during a heatwave?	☐	☐	☐

HEATWAVES		Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)		High	Medium	Low
HEALTH WORKFORCE	**Is the health workforce,**			
	informed on how to use and follow a surveillance system to track health outcomes?	☐	☐	☐
	aware of the need to keep hydrated and wear appropriate clothing?	☐	☐	☐
	provided with a community health educational programme to improve community health in the face of heatwave risks?	☐	☐	☐
	aware of keeping the facility environment cool (e.g. keep windows that are exposed to the sun closed during the day and open at night when the temperature has dropped; close curtains that receive morning or afternoon sun; turn off nonessential lights and electrical equipment that generate heat; sleep in a cooler room or use electric fans for some relief if temperatures are below 35°C)?	☐	☐	☐
WASH AND HEALTH CARE WASTE	**Does the health care facility,**			
	(Monitoring and assessment)			
	verify water safety conditions, including updated risk assessments to map water resources and water supplies for the facility?*	☐	☐	☐
	have an evaluation system to monitor its water system or supply before, during and after the event?	☐	☐	☐
	have information on the water system installation that ensures lower risk of being contaminated?	☐	☐	☐
	have a quality monitoring plan for water meant for human consumption?	☐	☐	☐
	have a monitoring plan for potable water?*	☐	☐	☐
	(Risk management)			
	have a water management plan to identify water contamination?	☐	☐	☐
	have onsite water purification equipment to provide safe drinking water?	☐	☐	☐
	provide sufficient drinking-water to staff, patients and visitors?*	☐	☐	☐
	keep drinking water cool or refrigerated where possible for staff, patients and visitors?	☐	☐	☐
	have a contingency plan for monitoring and reducing contaminant concentrations in the facility water system supplies?*	☐	☐	☐
	have water storage protected from direct sunlight?	☐	☐	☐
	have water storage tanks with appropriate covers to protect from excessive heat?	☐	☐	☐
	have chemicals stored away from excessive heat?*	☐	☐	☐
	have health care waste stored away from excessive heat in cool and covered spaces?	☐	☐	☐
	(Health and safety regulation)			
	work with water utility agencies to prevent suspension of services?	☐	☐	☐
	have an alternative source of water supply?*	☐	☐	☐
	have a water safety plan in place, in case of water contamination?	☐	☐	☐
	have a mechanism or regulation to carry out sanitary inspections of water supply, and when necessary establish a temporary ban on use, until improvements are made?	☐	☐	☐
	have a contingency plan to ensure effective and timely delivery of safe water during extreme temperatures and emergencies over the short- and long-term?*	☐	☐	☐
	have a cross-sectoral water management plan to conserve and protect local or alternative water sources?	☐	☐	☐

HEATWAVES

High: unprepared; unable to respond (Higher risk)
Medium: basic or incomplete preparation; low level of response (Medium risk)
Low: prepared; able to respond (Lower risk)

ENERGY	Does the health care facility,	Vulnerability level: High	Medium	Low
	(Monitoring and assessment)			
	regularly assess its energy system to ensure it can cope with heatwave conditions?*	☐	☐	☐
	have an emergency backup generator (including fuel, where relevant) that is able to cover at least all critical service areas and equipment during heatwave events?*	☐	☐	☐
	periodically check the emergency backup generator (including fuel, where relevant), even if rarely used?*	☐	☐	☐
	assess regularly heating, ventilation and air conditioning systems?	☐	☐	☐
	assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment?	☐	☐	☐
	monitor building humidity and if needed adjust the cooling system to control the humidity in operating room areas?	☐	☐	☐
	(Risk management)			
	have a secure place to protect the backup generator (including fuel or battery storage, where relevant) from damage?*	☐	☐	☐
	have appliance thermometers in the refrigerator and freezer to determine if food, vaccines and other essential refrigeration-dependent medical supplies are safe?	☐	☐	☐
	have adequate daylight to ensure proper visibility during power outages?	☐	☐	☐
	have power-operated doors that can be opened manually to permit exit in case of power failure?	☐	☐	☐
	have a clear guidance on heat-risk management for the maintenance of critical infrastructure (air conditioning, medical devices, computers, diagnostic equipment, boiling water, etc.)?*	☐	☐	☐
	(Health and safety regulation)			
	have an emergency plan for power outages in the short- and long-term (during and after the event)?	☐	☐	☐
	have a plan or regulation to determine ways to reduce overall energy use?	☐	☐	☐
	work with energy utility agencies to prevent suspension of electricity services?	☐	☐	☐
	have a management plan for intermittent energy supplies or system failure?	☐	☐	☐
	have an emergency plan to ensure availability of adequate lighting, communication and information systems, and refrigeration and sterilization equipment during the event?*	☐	☐	☐
	have a plan to evacuate patients to a cooling station if the facility has lost power and has no other source of energy?	☐	☐	☐
	ensure that walls and roofs are insulated?	☐	☐	☐

HEATWAVES

High: unprepared; unable to respond (Higher risk)
Medium: basic or incomplete preparation; low level of response (Medium risk)
Low: prepared; able to respond (Lower risk)

INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES	Vulnerability level		
Does the health care facility,	High	Medium	Low
(Adaptation of current systems and infrastructures)			
provide greater advocacy on health workforce education to cover heatwave risks and responses?	☐	☐	☐
have preparedness and training for periods of extreme heat?	☐	☐	☐
assess the performance and vulnerabilities of each critical part of the facility (structural and nonstructural elements) that can be affected by hot temperatures?	☐	☐	☐
assess the heating, ventilation and air-conditioning systems for capacity to deal with increasing heat and humidity?*	☐	☐	☐
install reflective white roofs to reduce heat impacts?	☐	☐	☐
install green roofs to mitigate heat impacts?	☐	☐	☐
have pavements and roofs designed to withstand extreme temperatures or solar radiation?	☐	☐	☐
have light coloured paving on parking areas and walkways around the facility?	☐	☐	☐
review building code design baselines against extreme temperatures to ascertain inventory risks?*	☐	☐	☐
identify vulnerabilities to estimate the possible loss and implemented actions to reduce impacts?	☐	☐	☐
have exterior shading devices, resilient trees or other architectural features that mitigate heat?	☐	☐	☐
have windows that can be operated to provide for ventilation and maintain habitable and operational conditions?	☐	☐	☐
have a system for cooling the environment?	☐	☐	☐
provide an extra medical supply in case of increased demand for treatment of heat stress?	☐	☐	☐
stimulate increase of water intake by staff and patients?	☐	☐	☐
have insulated loft and cavity walls?	☐	☐	☐
have a plan for arranging for extra staffing for emergency support services?*	☐	☐	☐
store chemicals away from excessive heat?*	☐	☐	☐
have a monitoring and early warning system integrated with other areas to manage risks related to heatwave impacts on the facility?*	☐	☐	☐
have an effective emergency risk communication plan to communicate clear messages of the danger of heatwaves, emphasizing health protection as a priority?	☐	☐	☐
(Promotion of new systems and technologies)			
receive meteorological information on the likelihood of forthcoming hot weather?*	☐	☐	☐
have a syndromic surveillance system for heat-related illnesses?	☐	☐	☐
have an updated training programme for the health workforce to detect and track climate change-related human heat stress?	☐	☐	☐
have a long-term strategy for reducing heat, such as through building insulation?	☐	☐	☐
perform risk assessments to assist with adaptation measures for heatwaves?*	☐	☐	☐
have an information system for tracking and monitoring of diseases following heatwave events?	☐	☐	☐

HEATWAVES		Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)		High	Medium	Low
INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES	**Does the health care facility,**			
	have measures that improve health performance, based on a history of climate variability in the region or locality?	☐	☐	☐
	perform evaluations to predict heatwave conditions 1–5 days in advance?	☐	☐	☐
	coordinate public broadcasts of information about the anticipated timing, severity and duration of heatwave conditions in its surrounding communities?	☐	☐	☐
	(Sustainability of health care facility operations)			
	have a defined and sustained budget as part of core budgeting for emergency preparedness and response to heatwaves?	☐	☐	☐
	improve adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction and response?	☐	☐	☐
	assess the length of time people can remain in a place before it gets overheated, requiring evacuation to another facility?	☐	☐	☐
	have a thermal stress device to assess temperature and identify heat warning environment?	☐	☐	☐
	have trees and leafy plants near windows to provide natural cooling?	☐	☐	☐
	explore the relationship between social learning and adaptation measures in the face of heatwave threats to identify and implement the best behavioural responses from successful health facilities?	☐	☐	☐
	have a coordinated plan with health municipal department heads to ensure appropriate preparations for ongoing heatwave conditions?*	☐	☐	☐

Note: For WASH and health care waste details see WASH FIT (3).

**For further details see Hospital Safety Index (2).*

IMPACTS CHECKLIST FOR HEATWAVES

HEALTH WORKFORCE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Danger of life-threatening heat stroke ☐ Increased likelihood of heat stress effects (heat exhaustion and heat stroke) ☐ Increased threat to staff with pre-existing health conditions such as heart conditions, cardiovascular diseases, diabetes, lung diseases, respiratory diseases, fluid/electrolyte disorders and some neurological disorders ☐ Increase in number of respiratory diseases due to elevated ozone levels ☐ Loss of work capacity and reduced productivity ☐ Increased workforce absenteeism ☐ Increased hospital admissions and emergency services overwhelming health workers	☐ Increased heat stress effects (heat syncope, heat cramps) ☐ Increased threat to health workforce due to individual level risk factors (age, sex, culture, body weight; fitness; behaviour; drug treatment; body acclimatization) ☐ Excessive heat exposure resulting in effects related to cardiovascular and renal systems, and dehydration ☐ Diseases requiring medical treatment, specifically for those with pre-existing health conditions such as asthma, COPD, respiratory tract infections, diabetes, heart conditions, renal conditions ☐ Significantly reduced performance capacity ☐ Increased heat affecting day and nocturnal conditions that heighten health workforce exposures	☐ Increased thirst and headaches ☐ Increase in infectious disease cases among the health workforce from water and food contamination ☐ Reduction of health workforce functions

WASH AND HEALTH CARE WASTE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Increased water demand ☐ Water source contamination ☐ Shortage of safe water ☐ No access to drinking water in the premises ☐ Reduced effectiveness of chemicals used for water treatment	☐ Reduced capacity to provide sanitation and hygiene services (floor, toilets, patient rooms, emergency room and other health care facility rooms) ☐ Reduced capacity to provide water for drinking and cooking ☐ Reduced capacity to use laundry and dishwashing machines	☐ Reduced function of sanitation systems and hygiene practices (flush toilets, showers, sewerage, treatment, hand washing, medical procedures, etc.) ☐ Increased demand for drinking water from health workers engaged in outdoor activities

ENERGY		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Increased demand for energy consumption ☐ Power outages ☐ Disruption of medical equipment and storage of medicines, vaccines and other essential refrigeration-dependent medical supplies ☐ Loss of vaccines, laboratorial supplies, drugs, pharmaceuticals and other essential refrigeration-dependent medical supplies ☐ Reduced capacity to use critical facility machines (medical devices) ☐ Disruption of the fuel supply chain ☐ Disruption of energy-dependent water pumping and treatment	☐ Power shortages ☐ Intermittent access to electricity causing interruption of health care services ☐ Difficulty in providing health care services such as dialysis, oxygen supplies, diagnostic equipment ☐ Patients needing to be transported to other health care facilities ☐ Reduced capacity to provide cleaning and disinfection services that require electricity (laundry, dishwashing machines)	☐ No ambient cooling ☐ Loss of food or difficulty in keeping food refrigerated ☐ Difficulty in providing thermal comfort, affecting health workers and patients ☐ Unable to follow boil water alerts ☐ Loss of water pumping and treatment systems

INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Damage to medical and laboratorial equipment and devices ☐ Damage to communication and information systems ☐ Increased number of patients presenting with infectious diseases, cardiovascular and respiratory diseases; increasing demand for health care ☐ Increase in complex and emergency health care services ☐ Increased electricity demand ☐ Increased demand for drinking water ☐ Increased costs for providing all necessary measures to keep staff and infrastructures safe ☐ Damage to water pipes from heat ☐ High humidity in operating rooms resulting in cancellation of surgeries	☐ Increased hospitalization rates requiring extra medical supplies and health workforce ☐ Increased demand for cooling areas and rest areas for staff ☐ Increased demand for adaptation measures and plans to reduce heat effects on health workers and the health care facility ☐ Insufficient supplies, including fans and air conditioning units ☐ Increased risk of damage to pharmaceuticals	☐ Increased demand for conducting coordinated strategies to ensure the implementation of measures with other sectors ☐ Overwhelmed health care services

Sources for tables of vulnerabilities and impacts: (2,3,8,21,33,41,44–47,52–55).

HEATWAVES: PROPOSED ACTIONS TO RESPOND TO THE IDENTIFIED IMPACTS

Health workforce
WASH and health care waste
Energy
Infrastructure, technologies, products and processes

A.6 WILDFIRE CHECKLISTS

Wildfires are defined as any uncontrolled and nonprescribed combustion or burning of plants in a natural setting (such as a forest, grassland, brush land or tundra), which consumes natural fuels and spreads based on environmental conditions (such as wind, topography and temperature) *(24)*. Wildfires can be associated with droughts, extreme temperatures and wind, making their combined impacts stronger (multihazard events).

CHECKLIST FOR ASSESSING VULNERABILITY TO WILDFIRES

WILDFIRES		Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)		High	Medium	Low
HEALTH WORKFORCE	**Is the health workforce,**			
	(Human resources)			
	equipped with an alternative action plan for the health workforce with outdoor functions to avoid or limit their outdoor activity to avoid smoke and ash exposure (e.g. focusing on only performing high priority tasks, with workers' protection measures in place)?	☐	☐	☐
	equipped with a plan to identify and protect health workers at risk of smoke and ash exposure, and heat stress?	☐	☐	☐
	prepared with clear guidance on actions to reduce heat and respiratory risk factors for staff, and find alternative human resources?	☐	☐	☐
	provided with a cool space and a shower room to offer cooling options for staff?	☐	☐	☐
	provided with special care assistance to treat eye and skin irritation, diseases related to hot temperatures, air pollution and ash and smoke exposure, as well as for mental stress, and chronic respiratory and cardiovascular diseases?	☐	☐	☐
	equipped with a contingency plan for limiting workers' smoke and ash exposure, including postponing or shortening time spent outdoors, relocating workers or rescheduling work tasks to areas or times of the day that are smoke-free or have less smoke; as well as encouraging and ensuring workers take frequent breaks inside clean air spaces (e.g. enclosed structures or vehicles with windows closed and in recirculating air mode)?	☐	☐	☐
	prepared with clear messages on reduction measures for short- and long-term exposures to indoor and outdoor air pollution and smoke (e.g. providing cleaner air spaces; using respirator masks; reducing outdoor activities; setting air conditioners to recirculation mode where safe; avoiding the use of exhaust fans in the kitchen, bathroom, clothes dryer and other facility rooms with exhaust fans)?	☐	☐	☐
	provided with adequate personal protective equipment, especially for cleaners (respirator masks (fitting N-95 respirator#), leather gloves, safety glasses or goggles, clothes (long-sleeved shirts and long pants), and shoes with rugged soles)?*	☐	☐	☐
	(Capacity development)			
	trained in public health climate change matters related to wildfire impacts on human health?	☐	☐	☐
	trained to an appropriate standard to maintain the correct level of safety of electrical power supply, in both routine and emergency/disaster situations?*	☐	☐	☐
	prepared and trained on a contingency plan for rapid increase in health workforce respiratory and cardiovascular problems, increased temperatures, and smoke and ash exposures?	☐	☐	☐

WILDFIRES	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
HEALTH WORKFORCE			
Is the health workforce,			
provided with a mechanism to learn about air pollution advisories and warnings, including air quality monitoring information?	☐	☐	☐
equipped with knowledge, experience, training and resources to manage emergency preparedness and response measures to reduce wildfire risks and impacts?	☐	☐	☐
(Communication and awareness raising)			
aware about the potential risks and impacts of wildfire on human health due to poor air quality?	☐	☐	☐
aware about keeping the facility environment cool where possible (e.g. close windows and doors; seal large gaps as much as possible; close curtains that receive morning or afternoon sun; turn off nonessential lights and electrical equipment; sleep or rest in a cooler room)?	☐	☐	☐
provided with guidance to perform risk assessments (including vulnerabilities and exposures) to support the identification, planning, monitoring and evaluation of risk reduction and adaptation strategies to reduce direct and indirect impacts of wildfires?	☐	☐	☐
aware that to prevent overheating they must use cool compresses, misting, showers and drink plenty of water?	☐	☐	☐
aware of appropriate strategies to reduce smoke exposure during evacuation, when necessary because of danger from fires?	☐	☐	☐
aware of wearing tight-fitting respirators to filter ash particles from the air to protect lungs (e.g. N95 respirator mask#), particularly for cleaners and outdoor workers?	☐	☐	☐
aware of wearing gloves, long-sleeved shirts, long pants, shoes, socks and goggles to avoid skin contact (e.g. contact with wet ash can cause chemical burns or skin irritation), particularly among cleaners?	☐	☐	☐
aware of having to change shoes and clothing before leaving a clean-up site to avoid taking ash offsite?	☐	☐	☐
aware of not bringing food or eating at the affected site (and keeping food in a sealed container) and washing hands well before eating?	☐	☐	☐
# Note: surgical masks and one-strap dust masks will not protect lungs.			
WASH AND HEALTH CARE WASTE			
Does the health care facility,			
(Monitoring and assessment)			
have information on water system installation, such as deep tubewells and pipe materials that ensure low risk of contamination?	☐	☐	☐
verify water safety conditions, which include updated risk assessments to map water resources and water supplies for the facility?*	☐	☐	☐
monitor the water distribution system for fire-related pollutants?	☐	☐	☐
map risks to water and sanitation infrastructures to identify where services could be disrupted by wildfires and water scarcity?	☐	☐	☐
have a quality monitoring plan for potable water?*	☐	☐	☐
(Risk management)			
have direct communication with water providers to ensure that water supply is safe to drink?	☐	☐	☐
have a water management plan to identify water contamination?*	☐	☐	☐

WILDFIRES		Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)		High	Medium	Low
WASH AND HEALTH CARE WASTE	have water treatment equipment and materials in sufficient quantity to provide potable water?	☐	☐	☐
	Does the health care facility,			
	have a contingency plan for monitoring and reducing contaminant concentrations in the facility's water supply system?	☐	☐	☐
	keep drinking water cool or refrigerated where possible for staff, patients and visitors?	☐	☐	☐
	provide sufficient drinking water for staff, patients and visitors?*	☐	☐	☐
	have water storage tanks with appropriate covers to protect from excessive heat?*	☐	☐	☐
	have chemicals stored away from excessive heat?	☐	☐	☐
	(Health and safety regulation)			
	have a water management plan to protect the water supply and alternative water sources from contamination by wildfire particles?	☐	☐	☐
	work with water utility agencies to prevent suspension of services?	☐	☐	☐
	have an alternative source of water supply?*	☐	☐	☐
	have additional water treatment and storage capacity to account for interruption, quality and quantity?	☐	☐	☐
	have a quality monitoring plan for water meant for human consumption?	☐	☐	☐
	have a contingency plan to ensure effective and timely delivery of safe water during a wildfire and emergencies over the short- and long-term?*	☐	☐	☐
	have a cross-sectoral water management plan to conserve and protect local or alternative water sources?	☐	☐	☐
ENERGY	**Does the health care facility,**			
	(Monitoring and assessment)			
	regularly assess its energy system to ensure it can cope with conditions of heat?*	☐	☐	☐
	have an emergency backup generator (including fuel, where relevant) that is able to cover at least all critical service areas and equipment during and after the event?*	☐	☐	☐
	periodically check the emergency backup generator (including fuel, where relevant)?*	☐	☐	☐
	assess heating, ventilation and air conditioning ductwork pipes to ensure good functioning to cope with wildfire impacts?*	☐	☐	☐
	assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment?	☐	☐	☐
	(Risk management)			
	have a secure place to protect the backup generator (including fuel or battery storage, where relevant) from fire?*	☐	☐	☐
	have appliance thermometers in the refrigerator and freezer to determine if food, vaccines and other essential refrigeration-dependent medical supplies are safe?	☐	☐	☐
	have adequate daylight to ensure proper visibility during power outages?	☐	☐	☐
	have power-operated doors that can be opened manually to permit exit in case of an emergency?	☐	☐	☐

WILDFIRES	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
ENERGY			
Does the health care facility,			
have a clear guidance to alert staff on safety measures, (e.g. never restore power when the power is off, until a professional inspects and ensures the integrity of the electrical system; do not use electrical equipment that has been exposed to heat from a fire until checked by an electrician; use extreme caution when equipment is moved near overhead power lines; do not stand or work in areas with thick smoke (smoke hides electrical lines and equipment)?	☐	☐	☐
have a clear guidance on heat-risk management for the maintenance of critical infrastructure (e.g. air conditioning, medical devices, computers, diagnostic equipment, boiling water)?*	☐	☐	☐
(Health and safety regulation)			
have an emergency plan for power outages in the short- and long-term?	☐	☐	☐
have a plan or regulation to determine ways to reduce overall energy use?	☐	☐	☐
work with energy utility agencies to prevent suspension of electricity services?			
have a generator backup or renewable energy sources (e.g. solar, wind power, small-scale hydroelectric power plants) that can be used for water pumping?	☐	☐	☐
have an emergency plan to ensure availability of adequate lighting, communication and information systems, and refrigeration and sterilization equipment during a wildfire?*	☐	☐	☐
have a plan to evacuate patients to a cooling station if the facility has lost power and has no other sources of energy?	☐	☐	☐
INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES			
Does the health care facility,			
(Adaptation of current systems and infrastructures)			
work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning and implementation?	☐	☐	☐
provide advocacy on health workforce education to cover climate change wildfire risks and responses?	☐	☐	☐
have a monitoring and early warning system integrated with other areas to manage risk reduction?*	☐	☐	☐
have an indoor air quality contingency plan in place for hazard-reduction burning, before the start of the fire season, as well as during and after a wildfire to assist in planning and decision-making?	☐	☐	☐
in their annual planning consider how climate risks may change in the future?	☐	☐	☐
have a mechanism in place to filter indoor and ambient air pollutants?	☐	☐	☐
review building code design baselines against wildfire, wind speeds, high temperature, smoke to assess each risk?	☐	☐	☐
map the location of the building relative to wildfire hazards?	☐	☐	☐
assess the performance and vulnerabilities of each critical part of the facility (structural and nonstructural elements) that can be affected by high temperatures and smoke from wildfire hazards?	☐	☐	☐
utilize the assessed information as a basis to plan and prioritize measures to reduce risk impact?	☐	☐	☐
have a coordinated mechanism across the health sector at different levels of government, to manage the responses and risks of public health emergencies and disasters (including sharing of resources and supplies, transferring of patients, and health workforce support)?*	☐	☐	☐

WILDFIRES

High: unprepared; unable to respond (Higher risk)
Medium: basic or incomplete preparation; low level of response (Medium risk)
Low: prepared; able to respond (Lower risk)

INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES	Vulnerability level		
Does the health care facility,	**High**	**Medium**	**Low**
have a safe space within or external to the facility for the storage and stockpiling of additional supplies, considering ease of access, security, temperature, ventilation, light and smoke exposure and humidity?	☐	☐	☐
have a contingency plan in place for safe and efficient personnel evacuation (including health staff and patients)?*	☐	☐	☐
have a plan to transfer critical equipment and medical supplies to another place or to a cool storage to avoid or reduce damage?	☐	☐	☐
regularly monitor air quality (temperature and humidity), especially during and after wildfire exposures?	☐	☐	☐
have available appropriate air filters in indoor working areas to reduce overall smoke and dust exposure?	☐	☐	☐
assess if the filters of the heating, ventilating and air conditioning systems are not dirty, damaged, dislodged or leaking around the edges, before the wildfire season and during smoke events to ensure necessary repairs and appropriate maintenance?*	☐	☐	☐
have appropriate portable air cleaners to reduce indoor particle levels?	☐	☐	☐
have appropriate ceiling fans or portable fans for room cooling?	☐	☐	☐
have a management plan for the use of personal protective equipment for wildfires in the medical stockpile?	☐	☐	☐
maintain partnerships with key partners and stakeholders (e.g. air quality agencies, local health providers, health departments, fire department, land management agencies, and others) for effective wildfire response and recovery?	☐	☐	☐
(Promotion of new systems and technologies)			
have an information system between the health sector and meteorological services, and other relevant sectors, to communicate about the risks of wildfires, or hazard-reduction burning, and expected number of hot and smoky days?*	☐	☐	☐
monitor information alerts from local announcements, air quality forecasts, and changing smoke conditions?	☐	☐	☐
have emergency plan and procedures in place related to wildfire effects (such as hot temperature, air pollution, smoke, ash) on the facility,?	☐	☐	☐
have reliable communication and information systems to facilitate measures to avoid or reduce impacts from wildfire hazard?*	☐	☐	☐
have established, clear and consistent knowledge transfer procedures in case of a public health emergency?*	☐	☐	☐
have an established plan to review, evaluate and catalogue risks related to wildfires for the health care facility supply chain?*	☐	☐	☐
have a calibrated carbon monoxide alarm with a digital display and battery backup function to identify air contamination?	☐	☐	☐
(Sustainability of health care facility operations)			
offer a pleasant cool and protected environment that can avoid any kind of stress from high temperatures and smoke?	☐	☐	☐
have adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction and response?	☐	☐	☐

WILDFIRES	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
Does the health care facility,			
have established partnerships between the facility, community and local authorities to reduce vulnerabilities in the surrounding areas?	☐	☐	☐
store chemical materials away from excessive heat or wildfires?*	☐	☐	☐
have arrangements to transfer patients to temporary safe shelters?*	☐	☐	☐
assess the length of time people (including health workforce and patients) can remain in place before evacuating?	☐	☐	☐
have a clean-up plan with appropriate measures to avoid contamination and stir up ash in the air (e.g. store in plastic bags or other containers to prevent stirring up; avoid washing ash into storm drains; use a high-efficiency particulate air vacuum to clean dusty surfaces; avoid stirring up or sifting through ash)?	☐	☐	☐
have a trained and prepared team or a dedicated person for occupational health and safety, to manage hazards (e.g. providing respirator masks that are appropriate for the hazard and work situation; medical evaluation for safe respirator use; fit testing for tight-fitting respirators; training on topics such as how to use and maintain respirator masks; and programme evaluation)?	☐	☐	☐
have a secure plan to ensure continuity of the facility's supply and delivery chain?	☐	☐	☐
have a safe location for fuel storage systems (e.g. gas, gasoline, diesel) or other protection measures in place?*	☐	☐	☐

Note: For WASH and health care waste details see WASH FIT (3).

**For further details see Hospital Safety Index (2).*

IMPACTS CHECKLIST FOR WILDFIRES

HEALTH WORKFORCE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ High risk of disease or death from chronic respiratory and cardiovascular diseases ☐ Life-threatening or serious harm and injuries from burnt and unstable structures ☐ Increased risk of heat-related illnesses, including heat exhaustion, heat stroke and death ☐ Diseases requiring hospitalization or medical treatment specifically for those with pre-existing health conditions such as asthma, chronic pulmonary obstructive disease, diabetes, heart conditions and other cardiovascular diseases ☐ Loss of work capacity due to smoke, ash and high temperature ☐ Cessation of all programmes or service availability flowing to other locations ☐ Increased demand for medical visits or hospitalization for lung and heart diseases ☐ Effects on mental health of staff ☐ Health professionals are unable to arrive or depart from the facility building due to fire threat	☐ Increased threat to the health workforce resulting in physical injuries or intoxications from air pollution (smoke and ash, and from chemicals released into the air from burning of structures) ☐ Increased impacts of noncommunicable diseases (cardiovascular diseases, respiratory diseases), especially among pregnant women, older health workers and outdoor workers ☐ Increased threat of exposure to dust, ash and other products during clean-up operations, resulting in impacts on eyes, nose or skin irritation, coughing and other health effects ☐ Cessation of some programmes or service availability ☐ Significantly reduced performance capacity of the health workforce ☐ Reduced availability and capacity of health services ☐ Health workforce shortage due to reduced, or lack, of transport	☐ Minor injuries to health workers not requiring immediate medical treatment ☐ Increased discomfort to health workers and patients due to air pollution and higher temperatures ☐ Difficulty or interruption in delivering services, including primary care services at home ☐ Emotional stress and mental and physical fatigue ☐ Reduction of health workforce functions

WASH AND HEALTH CARE WASTE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Degradation of water quality from forested catchment areas ☐ Disruption of the water system supply ☐ Shortage of safe water ☐ Possible interruption of water pumping due to power outages ☐ Increased demand for water causing water shortage ☐ Water contamination (from wildfire ash, dead animals, fire retardants, or damaged water pipes) ☐ Reduced capacity to use medical and laboratorial equipment that require potable water	☐ Possible degradation of drinking water treatment plants ☐ Likely unsafe water supply ☐ Reduced function of sanitation systems and hygiene practices ☐ Reduced capacity to use laundry and dishwashing machines ☐ Reduced capacity for accessing water for drinking and cooking ☐ Increased dependence on less safe water sources ☐ Damage to plastic pipes lying close to the surface	☐ Increased demand for drinking water for health workers, especially for those that have outdoor activities ☐ Changes in demand of water use ☐ Minor disruption of health care deliveries

ENERGY		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Interruption of power (if electricity supplies are deliberately disconnected for safety reasons, or as a direct result of the fire) ☐ Interruption of medical procedures that rely on electricity, such as dialysis, intensive care rooms, laboratories, oxygen therapy, radiotherapy, imaging and diagnostic equipment) ☐ Disruption of safe storage of medicines, vaccines and other essential refrigeration-dependent medical supplies ☐ Loss of medical and laboratorial supplies, vaccines, pharmaceuticals, milk, blood bank supplies, and other essential refrigeration-dependent medical supplies ☐ Disruption of fuel supply chain ☐ Disruption of energy-dependent water pumping and treatment	☐ Intermittent access to electricity leading to damage of medical and laboratorial equipment and devices ☐ Loss of alternative energy sources (such as power generators) ☐ Threats to stored fuels ☐ Increased demand for energy consumption from air conditioning ☐ Reduced capacity to provide health care that relies on electricity, such as dialysis equipment, intensive treatment rooms, laboratorial rooms, oxygen therapy, radiotherapy, imaging and diagnostic equipment ☐ Reduced capacity to use critical medical devices ☐ Increased general demand for energy consumption ☐ Increased energy use and costs	☐ Difficulty to provide thermal control causing increasing discomfort to health workers and patients ☐ Loss of food or difficulty in keeping food refrigerated ☐ Reduced capacity to use medical devices that rely on energy ☐ Possible downed/damaged power poles with potentially energized power lines, increasing the risk of electrocution ☐ Reduced capacity to provide cleaning and disinfection services that require electricity (laundry, dishwashing machines, autoclave, microwave) ☐ Difficulty following boil water alerts

INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Fire damage to the premises ☐ Interruption of the supply chain for essential medical and laboratorial supplies ☐ Damage to medical and laboratorial equipment and devices (refrigeration of vaccines and some medications, sterilization processes, diagnosis and therapy equipment) ☐ Damage to communication and information systems ☐ Increase in cardiovascular and respiratory problems, burns, and complex emergencies, overwhelming the capacity of the facility ☐ Increasing indoor air contamination from smoke, threatening the health of patients and staff	☐ Increased hospitalization rates requiring extra medical treatment, supplies and health workforce ☐ Possible indoor air pollution ☐ Possible indoor higher temperature ☐ Increased demand for medication dispensations for respiratory problems (asthma, bronchitis, chest pain, COPD, respiratory infections and cardiovascular diseases) ☐ Increased hospitalization rates requiring extra medical supplies and health workforce ☐ Increased demand for cooling areas and rest areas for staff	☐ Increased demand for conducting coordinated strategies with health departments, other sectors, fire department and volunteers ☐ Increased demand for adaptation measures and plans to reduce heat effects, and smoke and ash exposure to the facility ☐ Increased costs for providing safety measures ☐ Disruption of food supplies ☐ Melted roadways disrupting transportation access ☐ Interruption of the supply chain including fans and air conditioning units

Sources for tables of vulnerabilities and impacts: (1–3,21,32,38,41,44,46,56,57).

WILDFIRES: PROPOSED ACTIONS TO RESPOND TO THE IDENTIFIED IMPACTS

Health workforce
WASH and health care waste
Energy
Infrastructure, technologies, products and processes

A.7 COLD WAVE CHECKLISTS

As the climate warms up, with expected increases of up to 4.5°C in some areas and a global temperature increase of 1.5°C, there is a decrease in cold days and nights and cold extremes in general *(4,7)*. Nevertheless, some countries and areas within countries experience unusual cold waves (as recently reported in Nepal *(58)*).

CHECKLIST FOR ASSESSING VULNERABILITY TO COLD WAVES

COLD WAVES		Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)		High	Medium	Low
HEALTH WORKFORCE	**Is the health workforce,**			
	(Human resources)			
	equipped with a plan to identify and protect health workers at risk of cold waves impacts?	☐	☐	☐
	provided with appropriate clothes during cold snaps (e.g. warm, windproof and waterproof clothes, thermal underwear, boots)?	☐	☐	☐
	provided with a warm resting place?	☐	☐	☐
	provided with an information system to manage occupational safety and health in the facility during a cold wave?	☐	☐	☐
	equipped with a plan with rescheduled activities regarding outdoor activities?	☐	☐	☐
	(Capacity development)			
	trained on public health and cold wave risk factors?	☐	☐	☐
	trained on risk factors related to heating (e.g. carbon monoxide poisoning from certain heating appliances)?			
	prepared and able to follow up a contingency plan for increasing health workforce cardiovascular stresses and respiratory problems?	☐	☐	☐
	able to implement a contingency plan for public health emergency, in case of exposure to excessive cold temperatures?	☐	☐	☐
	trained on actions to reduce personal levels of cardiac workload risk factors for staff?	☐	☐	☐
	able to manage peak electricity demand?	☐	☐	☐
	(Communication and awareness raising)			
	aware of the risk factors of patients and symptoms expected during a cold wave?	☐	☐	☐
	informed on how to use and follow a surveillance system to track health effects from cold exposure?	☐	☐	☐
	aware of the need to wear appropriate clothing (ensuring that head, nose, mouth, neck, hands and feet are covered properly; wearing appropriate boots that keep feet warm and prevent from slipping and falling; using several layers of clothing and ensuring the top one is windproof and waterproof), specifically for outdoor activities?	☐	☐	☐
	aware of avoiding getting their clothes wet?	☐	☐	☐
	provided with a community health educational programme to improve community health in the face of cold wave risks (including homeless, alcohol and drug addicts and other persons who may spend long periods of time outdoors)?	☐	☐	☐

COLD WAVES	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
HEALTH WORKFORCE			
Is the health workforce,			
aware of the need for an alternative action plan for the health workforce with outdoor responsibilities to reduce or avoid activity during excessive cold?	☐	☐	☐
aware of the need to take breaks in a warm place that is sheltered from wind and snowfall, when needing to stay outdoors for long periods of time?	☐	☐	☐
aware of the factors that can increase impacts on health (e.g. smoking and drinking alcohol may lower the body temperature leading to hypothermia; some medications can make people more sensitive to cold; certain diseases can be aggravated from cold temperatures, such as heart diseases, lung diseases, malnutrition)?	☐	☐	☐
WASH AND HEALTH CARE WASTE			
Does the health care facility,			
(Monitoring and assessment)			
verify water safety conditions, which include updated risk assessments to map water resources and water supplies for the facility?*	☐	☐	☐
have an evaluation system to monitor its water system or supply before, during and after an event?	☐	☐	☐
have information on water system installation that ensures lower risk of freezing?	☐	☐	☐
(Risk management)			
have a water management plan to identify water contamination?	☐	☐	☐
provide sufficient drinking water to staff, patients and visitors?*	☐	☐	☐
(Health and safety regulation)			
have an alternative source of water supply?*	☐	☐	☐
have a water safety plan in place, in case of freezing waters?	☐	☐	☐
have a contingency plan to ensure effective and timely delivery of safe water during extreme cold temperatures and emergencies over the short- and long-term?*	☐	☐	☐
have a cross-sectoral water management plan to conserve and protect local or alternative water sources?	☐	☐	☐
ENERGY			
Does the health care facility,			
(Monitoring and assessment)			
regularly assess its energy system to ensure that it can cope with cold wave conditions?	☐	☐	☐
have an emergency backup generator (including fuel, where relevant) that is able to cover at least all critical service areas and equipment during cold wave events?*	☐	☐	☐
check the emergency backup generator (including fuel, where relevant), prior to cold waves to ensure its capacity to work in freezing conditions?	☐	☐	☐
regularly assess whether the heating system can cope with unexpected cold temperatures?	☐	☐	☐
assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment?	☐	☐	☐
monitor the heating system to control the functioning of all critical medical equipment?	☐	☐	☐

COLD WAVES

High: unprepared; unable to respond (Higher risk)
Medium: basic or incomplete preparation; low level of response (Medium risk)
Low: prepared; able to respond (Lower risk)

		Vulnerability level		
		High	Medium	Low
ENERGY	**Does the health care facility,**			
	(Risk management)			
	have a secure place to protect the backup generator (including fuel or battery storage, where relevant) from damage?*	☐	☐	☐
	have power-operated doors that can be opened manually to permit exit in case of power failure?	☐	☐	☐
	have a clear guidance on cold-risk management for the maintenance of critical infrastructures (such as heating systems, medical devices, computers, diagnostic equipment, boiling water)?*	☐	☐	☐
	(Health and safety regulation)			
	have an emergency plan for power outages in the short- and long-term (during and after the event)?	☐	☐	☐
	have a plan or regulation to determine ways to reduce overall energy use?	☐	☐	☐
	work with energy utility agencies to prevent suspension of electricity services?	☐	☐	☐
	have a management plan for intermittent energy supplies or system failure?	☐	☐	☐
	have an emergency plan to ensure availability of adequate lighting, communication and information systems, and refrigeration and sterilization equipment during the event?*	☐	☐	☐
	have a plan to evacuate patients to a heating station or other health care centre if the facility has lost power and has no other source of energy?	☐	☐	☐
	ensure that walls and roofs are insulated?	☐	☐	☐
INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES	**Does the health care facility,**			
	(Adaptation of current systems and infrastructures)			
	provide advocacy on health workforce education to cover cold wave risks and responses?	☐	☐	☐
	have preparedness and training for periods of extreme cold exposure?	☐	☐	☐
	assess the performance and vulnerabilities of each critical part of the facility (structural and nonstructural elements) that can be affected by cold temperatures?	☐	☐	☐
	perform necessary and appropriate maintenance work to prepare the facility for winter or severe cold temperatures?	☐	☐	☐
	ensure that the rooms are well ventilated, when using an auxiliary heating system, such as oil-burning furnaces, wood-burning fireplaces, wood-burning stoves, propane heaters generators?	☐	☐	☐
	review building code design baselines against extreme cold temperatures?	☐	☐	☐
	identify vulnerabilities to estimate possible losses and implement actions to reduce impacts from extreme cold or freezing temperatures?	☐	☐	☐
	have caulked windows and doors to prevent cold air from coming in?	☐	☐	☐
	have insulated loft and cavity walls?	☐	☐	☐
	provide sufficient and necessary materials to supporting staff in outdoor activities, when necessary (e.g. in the case of vehicle breakdown having bottled water, food, blankets, cell phone and charger, shovel, snow brush, traction aids and medication)?	☐	☐	☐

COLD WAVES	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES			
Does the health care facility,			
have access to extra medical supplies in case of increased demand for treatment of cold effects?	☐	☐	☐
have a plan for arranging extra staff or emergency support services?*	☐	☐	☐
store chemicals away from excessive cold?	☐	☐	☐
have an effective emergency risk communication plan to communicate clear messages of the danger of cold waves, emphasizing health protection as a priority?	☐	☐	☐
(Promotion of new systems and technologies)			
receive meteorological information and warnings on the likelihood of forthcoming extreme cold weather conditions?*	☐	☐	☐
have a syndromic surveillance system for cold-related diseases?	☐	☐	☐
have a long-term strategy for reducing cold effects, such as through building insulation?	☐	☐	☐
perform risk assessments to assist with adaptation measures for cold waves?*	☐	☐	☐
have an information system for tracking and monitoring diseases following cold wave events?	☐	☐	☐
have measures that improve health performance, based on a history of climate variability in the region or locality?	☐	☐	☐
coordinate public broadcasts of information about anticipated timing, severity and duration of cold wave conditions in its surrounding communities?	☐	☐	☐
(Sustainability of health care facility operations)			
have a defined and sustained budget as part of core budgeting for emergency preparedness and response to cold waves?	☐	☐	☐
assess the length of time people can remain in a place without heating systems (or in case of failure), before requiring evacuation to another facility?	☐	☐	☐
explore the relationship between social learning and adaptation measures in the face of cold wave threats to identify and implement the best behavioural responses from successful health facilities?	☐	☐	☐
have adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction and response?	☐	☐	☐
have a coordinated plan with local health department teams to ensure appropriate preparations for ongoing cold wave conditions?*	☐	☐	☐

Note: For WASH and health care waste details see WASH FIT (3).

**For further details see Hospital Safety Index (2).*

IMPACTS CHECKLIST FOR COLD WAVES

HEALTH WORKFORCE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Life-threatening risks from exposure to excessive cold ☐ Cold exposure resulting in hypothermia ☐ Increased likelihood of cardiac workload (heart diseases), respiratory infections (influenza) and respiratory chronic conditions (asthma) ☐ Loss of work capacity and reduced productivity affecting the health of patients ☐ Increased workforce absenteeism ☐ Increased hospital admissions and emergency services overwhelming health workers	☐ Increased likelihood of diseases to the health workforce through exposure to outdoor activities ☐ Diseases requiring medical treatment, specifically for those with pre-existing chronic health conditions such as heart diseases, respiratory diseases (asthma, chronic bronchitis, emphysema), diabetes and certain neurological disorders ☐ Significantly reduced performance capacity ☐ Increased difficulty in accessing the health care facility due to freezing conditions	☐ Increased threat to the health workforce due to individual-level risk factors (age, pre-existing chronic health conditions, smoking, body acclimatization, reduced mobility) ☐ Reduction of health workforce functions

WASH AND HEALTH CARE WASTE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Increased likelihood of water pipes bursting ☐ Increased likelihood of water freezing ☐ Loss of water pressure ☐ No access to drinking water in the premises ☐ Defaulting delivery care services due to lack of water access ☐ Disruption of water pumping and treatment systems	☐ Increased likelihood of water shortage ☐ Reduced capacity to provide sanitation and hygiene services ☐ Reduced capacity to provide sterilization, laundry and dishwashing services ☐ Reduced effectiveness of water treatment chemicals ☐ Reduced capacity for waste collection, storage and transport	☐ Reduced capacity to provide water for drinking and cooking ☐ Reduced functioning of sanitation systems and hygiene practices (flush toilets, showers, sewerage, treatment, hand washing, medical procedures)

ENERGY		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Increased demand for energy consumption ☐ Power outages ☐ Increased likelihood of disruption of medical equipment and storage of medicines, vaccines and other essential refrigeration-dependent medical supplies ☐ Increased likelihood of disruption of the fuel supply chain ☐ Disruption of energy-dependent water pumping and treatment systems ☐ Disruption of internal heating systems ☐ Disruption of communication and information systems	☐ Power shortages ☐ Difficulty in providing health care services ☐ Patients have to be transported to other health care facilities ☐ Reduced capacity to use critical facility equipment (medical devices) ☐ Reduced capacity to provide cleaning and disinfection services that require electricity (sterilization, laundry, dishwashing machines) ☐ Increased likelihood of loss of vaccines, laboratorial supplies, drugs, pharmaceuticals and other essential refrigeration-dependent medical supplies	☐ Difficulty in keeping food refrigerated ☐ Difficulty in providing thermal comfort, affecting health workers and patients ☐ Unable to follow boil water alerts

INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Damage to medical and laboratorial equipment and devices ☐ Interruption of complex and emergency health care services (surgery, complex treatments, urgent care) ☐ Increased likelihood of disruption of communication and information systems ☐ Increased number of patients presenting with cardiovascular and respiratory diseases, frostbite and hypothermia ☐ Increased demand for emergency health care services ☐ Increased electricity demand ☐ Damage to water pipes from cold exposure ☐ Disruption of health care facility access ☐ Difficult to transport patients and staff due to disabled transportation systems (ambulance, home assistance care, patient transportation)	☐ Increased hospitalization rates requiring extra medical supplies and health workforce ☐ Increased demand for heating devices ☐ Difficult transportation access interrupting supply chain ☐ Increased demand for adaptation measures and plans to reduce cold effects on health workers and the health care facility ☐ Disruption of supplies including that of heating units ☐ Breakdown of routine health care services such as ambulatory, immunization, maternity room, pharmacy, medication for chronic diseases, dental, and other primary services ☐ Interruption of diagnosis due to equipment damage	☐ Increased demand for conducting coordinated strategies to ensure the implementation of measures with other sectors ☐ Overwhelmed health services ☐ Increased costs for providing all necessary measures to keep staff, patients and technologies safe

Sources for tables of vulnerabilities and impacts: (2,3,8,35,37,40,44–46,55).

COLD WAVES: PROPOSED ACTIONS TO RESPOND TO THE IDENTIFIED IMPACTS

Health workforce
WASH and health care waste
Energy
Infrastructure, technologies, products and processes

REFERENCES

1. WHO Guidance for climate-resilient and environmentally sustainable health care facilities. Geneva: World Health Organization; 2020 (https://www.who.int/publications/i/item/climate-resilient-and-environmentally-sustainable-health-care-facilities, accessed 2 February 2021).
2. Hospital safety index: guide for evaluators. 2nd ed. Safe Hospitals Initiative. Geneva: World Health Organization and Washington DC: Pan American Health Organization; 2015 (https://apps.who.int/iris/bitstream/handle/10665/258966/9789241548984-eng.pdf, accessed 2 February 2021).
3. 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 2 February 2021).
4. Annex I: Glossary. Matthews JBR (ed.). In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Masson-Delmotte V, Zhai P, Pörtner H-O, Roberts D, Skea J, Shukla PR, et al. (eds.). Geneva: Intergovernmental Panel on Climate Change; 2018:541–60 (https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_AnnexI_Glossary.pdf, accessed 2 February 2021).
5. 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, accessed 2 February 2021).
6. Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction. United Nations General Assembly. Seventy-first session. United Nations Office for Disaster Risk Reduction; 2016 (https://www.preventionweb.net/files/50683_oiewgreportenglish.pdf, accessed 2 February 2021).
7. Managing the risks of extreme events and disasters to advance climate change adaptation. Special Report of the Intergovernmental Panel on Climate Change. Field CB, Barros V, Stocker TF, Qin D, Dokken DJ, Ebi KL, et al. (eds.). Cambridge: Cambridge University Press; 2012:582 pp. (https://www.ipcc.ch/report/managing-the-risks-of-extreme-events-and-disasters-to-advance-climate- change-adaptation/, accessed 2 February 2021).
8. 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, accessed 2 February 2021).
9. Haines A, Ebi K. The imperative for climate action to protect health. N Engl J Med. 2019;380:263–73.
10. Common ground between the Paris Agreement and the Sendai Framework. Climate change adaptation and disaster risk reduction. Organisation for Economic Co-operation and Development iLibrary [website] (https://www.oecd-ilibrary.org/sites/3edc8d09-en/index.html?itemId=/content/publication/3edc8d09-en, accessed 2 February 2021).
11. Sendai Framework for Disaster Risk Reduction 2015–2030. Geneva: United Nations Office for Disaster Risk Reduction; 2015;32pp (https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030, accessed 2 February 2021).

12. The Paris Agreement. United Nations Framework Convention on Climate Change. New York: United Nations; 2015 (https://unfccc.int/sites/default/files/english_paris_agreement.pdf, accessed 2 February 2021).

13. The 17 Goals. Sustainable Development. Department of Economic and Social Affairs. United Nations [website] (https://sdgs.un.org/goals, accessed 2 February 2021).

14. Summary for policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Masson-Delmotte V, Zhai P, Pörtner H-O, Roberts D, Skea J, Shukla PR, et al. (eds.). Geneva: Intergovernmental Panel on Climate Change; 2018:3–24 (https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf, accessed 2 February 2021).

15. WMO Statement on the State of the Global Climate in 2019. WMO-No 1248. Geneva: World Meteorological Organization; 2020 (https://library.wmo.int/doc_num.php?explnum_id=10211, accessed 2 February 2021).

16. Streletskiy DA, Suter LJ, Shiklomanov N, Porfiriev BN, Eliseev DO. Assessment of climate change impacts on buildings, structures and infrastructure in the Russian regions on permafrost. Environ Res Lett. 2019;14:. https://iopscience.iop.org/article/10.1088/1748-9326/aaf5e6, accessed 2 February 2021).

17. Smith KR, Woodward A, Campbell-Lendrum D, Chadee DD, Honda Y, Liu Q, et al. Human health: impacts, adaptation, and co-benefits. 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; 2014:709–54 (https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap11_FINAL.pdf, accessed 2 February 2021).

18. Health emergency and disaster risk management framework. Geneva: World Health Organization; 2019 (https://apps.who.int/iris/bitstream/handle/10665/326106/9789241516181-eng.pdf?sequence=1&isAllowed=y, accessed 2 February 2021).

19. Hazard definition and classification review. Technical Report. Geneva: United Nations Office for Disaster Risk Reduction; 2020 (https://www.undrr.org/publication/hazard-definition-and-classification-review, accessed 2 February 2021).

20. Water, sanitation and hygiene. Water-related diseases. Cyanobacterial toxins. World Health Organization [website] (https://www.who.int/water_sanitation_health/diseases-risks/diseases/cyanobacteria/en/, accessed 2 February 2021).

21. 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-%20eng.pdf;jsessionid=F4B5E121316C78D4BAB1C92FB4971F75?sequence=1, accessed 2 February 2021).

22. Reporting glossary for the 2017–2018 UNCCD reporting process. Performance review and assessment of implementation system. Seventh reporting process. Bonn: United Nations Convention to Combat Desertification; 2016 (https://prais.unccd.int/sites/default/files/helper_documents/1-Glossary_EN.pdf, accessed 2 February 2021).

23. Climate change 2014: Synthesis report. Core Writing Team, Pachauri RK, Meyer LA (eds.). Geneva: Intergovernmental Panel on Climate Change; 2014:151 pp. https://www.ipcc.ch/site/assets/uploads/2018/05/SYR_AR5_FINAL_full_wcover.pdf, accessed 2 February 2021).

24. EM-DAT. The International Disaster Database. Centre for Research on the Epidemiology of Disasters [website] (https://www.emdat.be/index.php, accessed 2 February 2021).

25. Mauri M, Elli T, Caviglia G, Uboldi G, Azzi M. RAWGraphs: A visualisation platform to create open outputs. In: Proceedings of the 12th Biannual Conference on Italian SIGCHI Chapter. New York: Association for Computing Machinery; 2017:1–5.

26. Managing climate extremes and disasters in the health sector: Lessons from the IPCC SREX Report. Cape Town: Climate & Development Knowledge Network; 2012 (https://cdkn.org/wp-content/uploads/2012/10/SREX-lessons-for-health-sector.pdf, accessed 2 February 2021).

27. Marchigiani R, Gordy S, Cipolla J, Adams RC, Evans DC, Stehly C, et al. Wind disasters: A comprehensive review of current management strategies. Int J Crit Illn Inj Sci. 2013;3(2):130–142.

28. Stanke C, Kerac M, Prudhomme C, Medlock J, Murray V. Health effects of drought: a systematic review of the evidence. Version 1. PLoS Curr. 2013 June 5; 5: ecurrents.dis.7a2cee9e980f91ad7697b570bcc4b004. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3682759/, accessed 14 February 2021).

29. Floods and health: Fact sheets for health professionals. Copenhagen: World Health Organization Regional Office for Europe; 2014 (https://www.euro.who.int/__data/assets/pdf_file/0016/252601/Floods-and-health-Fact-sheets-for-health-professionals.pdf, accessed 2 February 2021).

30. Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization; 2014 (https://apps.who.int/iris/bitstream/handle/10665/134014/9789241507691_eng.pdf, accessed 2 February 2021).

31. Wilhite DA, Sivakumar MVK, Pulwarty R. Managing drought risk in a changing climate: The role of national drought policy. Weather Clim Extrem. 2014;3:4–13.

32. Natural hazards: Public health considerations. Sydney: NSW Ministry of Health; 2014 (https://www.health.nsw.gov.au/emergency_preparedness/Publications/natural-hazards.pdf, accessed 2 February 2021).

33. Heatwaves and health: guidance on warning-system development. Geneva: World Meteorological Organization/World Health Organization; 2015 (https://www.who.int/globalchange/publications/WMO_WHO_Heat_Health_Guidance_2015.pdf, accessed 2 February 2021).

34. McMichael AJ. Extreme weather events and infectious disease outbreaks. Virulence 2015;6 (6):543–7.

35. Seltenrich N. Between extremes: Health effects of heat and cold. Environ Health Perspect. 2015;123(11):A275–A279.

36. Lu L, Gong P. Climate change and human infectious diseases: A synthesis of research findings from global and spatio-temporal perspectives. Environ Int. 2017;103:99–108 (https://www.sciencedirect.com/science/article/pii/S0160412016309758, accessed 2 February 2021).

37. Añel JA, Fernández-González M, Labandeira X, López-Otero X, De la Torre L. Impact of cold waves and heat waves on the energy production sector. Atmosphere 2017;8:209 (https://doi.org/10.3390/atmos8110209, accessed 2 February 2021).

38. Xu R, Yu P, Abramson MJ, Johnston FH, Samet JH, Bell ML, et al. Wildfires, global climate change, and human health. N Engl J Med 2020;383:2173–81.

39. Roa L, Velin L, Tudravu J, McClain CD, Bernstein A, Meara JG. Climate change: challenges and opportunities to scale up surgical, obstetric, and anaesthesia care globally. Lancet Planet Health 2020;4:e538–43.

40. The effects of cold temperatures on health. Canada: Government of Quebec. Health and environment [website] (https://www.quebec.ca/en/health/advice-and-prevention/health-and-environment/the-effects-of-cold- temperatures-on-health/, accessed 2 February 2021).

41. Safe hospitals: prepared for emergencies and disasters. Disaster Risk Management for Health Fact Sheets; Global Platform: May, 2011. World Health Organization, United Kingdom Health Protection Agency and partners (https://www.who.int/hac/events/drm_fact_sheet_safe_hospitals.pdf, accessed 2 February 2021).

42. Guenther, R, Balbus J. Primary protection: Enhancing health care resiliency 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%20final2%202014%20Web.pdf, accessed 2 February 2021).

43. Healthy, resilient, and sustainable communities after disasters: Strategies, opportunities, and planning for recovery. Washington DC: The National Academies Press; 2015 (https://www.ncbi.nlm.nih.gov/books/NBK316532/pdf/Bookshelf_NBK316532.pdf, accessed 2 February 2021).

44. Curtis S, Fair A, Wistow J, Val DV, Oven K. Impact of extreme weather events and climate change for health and social care systems. Environ Health. 2017;16:128 (https://ehjournal.biomedcentral.com/articles/10.1186/s12940-017-0324-3, accessed 2 February 2021).

45. Communicating risk in public health emergencies: A WHO guideline for emergency risk communication (ERC) policy and practice. Geneva: World Health Organization; 2017 (https://apps.who.int/iris/bitstream/handle/10665/259807/9789241550208-eng.pdf?sequence=2, accessed 2 February 2021).

46. Smart hospital toolkit. A practical guide for hospital administrators, health disaster coordinators, health facility designers, engineers and maintenance staff to achieve Smart Health Facilities by conserving resources, cutting costs, increasing efficiency in operations and reducing carbon emissions. Green checklist. Washington DC: Pan American Health Organization; 2017. (https://www.paho.org/disasters/index.php?option=com_docman&view=download&category_slug=smart-hospitals-toolkit&alias=2495-smart-hospitals-toolkit-2017-5&Itemid=1179&lang=en, accessed 2 February 2021).

47. Moulton AD, Schramm PJ. Climate change and public health surveillance: Toward a comprehensive strategy. J Public Health Manag Pract. 2017;23(6): 618–26.

48. Food and water safety during power outages and floods. Silver Spring: U.S. Food and Drug Administration [website] (https://www.fda.gov/food/buy-store-serve-safe-food/food-and-water-safety-during-power-outages-and-floods, accessed 2 February 2021).

49. Sea-level rise, climate change and health. Oakland: Public Health Institute/Center for Climate Change and Health: 2016 (https://climatehealthconnect.org/wp-content/uploads/2016/09/SeaLevelRise.pdf, accessed 2 February 2021).

50. Siebentritt M. Understanding sea-level rise and climate change, and associated impacts on the coastal zone. CoastAdapt Information Manual 2. Gold Coast: National Climate Change Adaptation Research Facility; 2016 (https://coastadapt.com.au/sites/default/files/information-manual/IM02_Understanding_sea_level_rise.pdf, accessed 2 February 2021).

51. Hagenlocher M, Meza I, Anderson CC, Min A, Renaud FG, Walz Y, et al. Drought vulnerability and risk assessments: state of the art, persistent gaps, and research agenda. Environ Res Lett. 2019;14:083002 (https://iopscience.iop.org/article/10.1088/1748-9326/ab225d/pdf, accessed 2 February 2021).

52. Cherng ST, Cangemi I, Trostle JA, Remais J, Eisenberg JNS. Social cohesion and passive adaptation in relation to climate change and disease. Glob Environ Change. 2019;58:101960 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7448570/, accessed 2 February 2021).

53. Heat-health action plans: guidance. Matthies F, Bickler G, Marin NC, Hales S (eds.). Copenhagen: World Health Organization Regional Office for Europe; 2008 (https://www.who.int/publications/i/item/heat-health-action-plans, accessed 2 February 2021).

54. Public health advice on preventing health effects of heat: New and updated information for different audiences. Copenhagen: World Health Organization Regional Office for Europe; 2011 (https://www.who.int/publications/i/item/public-health-advice-on-preventing-health-effects-of-heat, accessed 2 February 2021).

55. Abat C, Chaudet H, Rolain J-M, Colson P, Raoult D. Traditional and syndromic surveillance of infectious diseases and pathogens. Int J Infect Dis. 2016;48:22–8.

56. Wildfire smoke factsheet: protect yourself form ash. U.S. Environmental Protection Agency; 2018. EPA-452/F-18–004 (https://www.scribd.com/document/476160317/Protect-Yourself-From-Ash-Factsheet, accessed 2 February 2021).

57. Wildfire smoke: a guide for public health officials. Revised 2019. Washington: U.S. Environmental Protection Agency; Atlanta: Centers for Diseases Control and Prevention; 2019, EPA-452/R-19–901 (https://www.airnow.gov/sites/default/files/2020-06/wildfire-smoke-guide-revised-2019.pdf, accessed 2 February 2021).

58. Climate and health country profile 2015 – Nepal. Geneva: World Health Organization; 2015 (https://apps.who.int/iris/bitstream/handle/10665/246135/WHO-FWC-PHE-EPE-15.27-eng.pdf, accessed 2 February 2021).

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/