# Climate change health vulnerability and adaptation assessment (VAA) for sound management of climate change-related health risks in Uganda

**Study report**

**Submitted to:**

Ministry of Health


| **Lead investigators** | |
|---|---|
| Dr. John Bosco Isunju | Department of Disease Control and Environmental Health |
| Dr. Justine N. Bukenya | Department of Community Health and Behavioural Sciences |
| Dr. Victoria Masembe | Makerere University |
| Tonny Ssekamatte | Department of Disease Control and Environmental Health |
| Didacus B. Namanya | Environmental Health Department, Ministry of Health |
| Dr. Philip Nyenje | Makerere University College of Engineering |
| **Other investigators** | |
| Nakalembe Doreen | Department of Disease Control and Environmental Health |
| Bridget Nagawa Tamale | Department of Disease Control and Environmental Health |
| Aisha Nalugya | Department of Disease Control and Environmental Health |


**November 2023**

## Table of Contents

## List of Figures

## List of Tables

## Acronyms and Abbreviations

| | |
|---|---|
| **COP** | Conference of Parties |
| **DFID** | Department for International Development |
| **EHD** | Environmental Health Department MoH |
| **FY** | Financial Year |
| **HSDP** | Health Sector Development Plan |
| **MoH** | Ministry of Health |
| **SDGs** | Sustainable Development Goals |
| **UBOS** | Uganda Bureau of Statistics |
| **UDHS** | Uganda Demographic Health Survey |
| **UN** | United Nations |
| **UNFCCC** | The United Nations Framework Convention on Climate Change |
| **VAA** | Vulnerability and Adaptation Assessment |
| **WB** | World Bank |
| **WHO** | World Health Organization |

## Definitions

| | |
|---|---|
| **Adaptation** | Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. |
| **Adaptive capacity** | The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, take advantage of opportunities, or cope with consequences. |
| **Climate** | Climate characterizes the average weather conditions for a particular location over a long period of time (usually 30 years) |
| **Climate Change** | Climate change refers to changes in the earth's climate, especially the gradual rise in temperature caused by high levels of carbon dioxide and other gases |
| **Climate change hazard** | Process, phenomenon or human activity that may cause loss of life, injury or other health impact, property damage, social or economic disruption, or environmental degradation. |
| **Coping measures** | Short-term and immediate practices during a crisis that are oriented towards survival |
| **Disaster** | A disaster is a serious disruption, occurring over a relatively short time, of the functioning of a community or a society involving widespread human, material, economic or environmental loss and impacts, which exceeds the ability of the affected community or society to cope using its resources. |
| **Hazard** | Potential occurrence of a natural or human-induced physical event, trend or physical impact that may cause loss of life, injury, other health impact, or damage to or loss of property, infrastructure, livelihoods, service provision, ecosystems or environmental resources. |
| **Mitigation** | Mitigation measures are those actions that are taken to reduce the effect of climate change by focusing on the causes of climate change |
| **Public health risks** | Climate change affects social and environmental determinants of health including clean air, safe drinking water, sufficient food and secure shelter as well as increasing the prevalence of water-borne diseases. These are associated with noticeable possible health impacts**.** |
| **Resilience** | Resilience is the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. |
| **Risk** | Is the possibility of losing something of value |
| **Risk assessment** | Qualitative or quantitative scientific estimation of risks |
| **Vulnerability** | The inability to resist a hazard or to respond when a disaster has occurred |

# 1. Introduction and background

## 1.1 Introduction

Climate change is described as a change in climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which in addition to natural climate variability observed overcomes comparable time periods (GOU 2021, Climate Change Act). According to WHO (2002), McMichael et al. (2003), Confalonieri et al. (2007), WHO (2009) and WHO (2013), climate change is adversely affecting the health of populations around the world, and the greatest impacts are in low-income countries. Without proper mitigation and adaptation, climate change poses environmental and health risks to the general public and communities, especially in the developing world (World Bank, 2018). Adverse effects are observed as changes in the physical environment or bio-data that have significant harmful effects on the composition, resilience or productivity of natural and managed ecosystems or the operation of the socio-economic systems or human health and welfare (GOU 2021, Climate Change Act). Climate change health impacts can be grouped into 1) Direct impacts, such as those arising from damages and illness due to increased frequency and severity of extreme weather events. 2) Environmental system mediated impacts, such as rising air pollution and changing patterns of vector-, food- and water-borne diseases. 3) Socially mediated effects that occur via the effect of climate change on social and human systems, such as health effects resulting from undernutrition, occupational heat stress and mental illness, as well as potential increases in population displacement, slowing of economic growth and poverty aggravation (WHO 2015:2).

There is also a risk of displacement of populations, destruction of property and sources of livelihood pushing people into poverty and its vicious cycle of ill health and loss of wellbeing (Black et al., 2011); World Bank, 2016). As population pressure builds, there is increased interaction between humans and animals/birds. This interaction is contributing to an increasing prevalence of pandemics/epidemics such as Avian/human influenza, Ebola, Marburg and more recently COVID-19 viral diseases.

Climate change health impacts include; reductions in air quality from smog and smoke resulting in air pollution-related diseases such as asthma, chronic obstructive airway diseases, cardiovascular diseases, and allergic ailments. Other diseases of concern include vector, food and water-borne diseases such as Malaria, Rift Valley Fever, Crimean Congo Viral Disease, Cholera, and Dysentery (World Bank, 2018) (WHO, 2018) (Robine, 2008) (Zhou G, 2004) (World Bank, 2016). Current literature also indicates that extreme temperatures have negative consequences on the environment, ecosystem, and human health. With recent increases in global temperatures, there has been a rise in the burden of heat-related illnesses, with a disproportionate impact on low- and middle income countries (Hasan et al. 2021) Lessons learned during the implementation of the avian and human influenza preparedness and response project revealed that limited use of preventive measures during food production, processing, handling, vending/retailing contribute to significant food contamination and subsequent transmission of infections (World Bank, 2014).

The most affected groups include; young children, the elderly, pregnant women, people with chronic illness, people with disabilities, individuals that work outdoors and the less privileged, e.g, the poor, remotely-located indigenous people, refugees [12356]. Climate change-related adverse events are stressful causing mental illnesses such as anxiety, depression, suicide and post-traumatic stress disorders (Guiney, 2012, Lin et al., 2008). In the health sector, climate change-related events such as storms, floods and heat waves can disrupt service delivery and if not addressed can negate previous

achievements or overwhelm the current capacity of the sector to respond (Mcmichael AJ, 2006); Pilkey OH, 2004).

Globally, climate change is recognized by the Sustainable Development Goals (SDG13) calling for climate action. At the regional level, an East –African policy for addressing climate change was put in place in 2009 by heads of states at their 11th summit that took place in Arusha, Tanzania. Nationally, Uganda is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and under this framework participates in the annual Conferences of Parties (COPs). The current National Development Plan III and the National Climate change Policy 2015, highlight the need to tackle climate change by all sectors and GOU went ahead to enact the Climate Change Act 2021.

## 1.2 Background

Uganda is already experiencing the effects of climate change in form of increasing rainfall, changing patterns of rainfall, droughts, and warming up of places like Kabale, Kisoro and Nwoya, therefore, increasing cases of malaria (Environmental Alert, 2007) [MoH, 2016/17 HMIS data]. The country is experiencing impacts of vector-borne diseases such as malaria, rift valley fever, anthrax, Marburg, Crimean Congo Virus disease, measles and Rubella. Droughts are putting the country at an increased risk of anthrax and floods occurring due to heavy rains are accelerating outbreaks of cholera and other related diseases. The health sector has run short of resources to respond to the increasing numbers of outbreaks occurring concurrently (FY 2017/18 data from disease surveillance division at the Ugandan MoH). A total of 45 outbreaks were registered in the country in FY 2017/18 affecting 24 districts. The outbreaks affected a total of about 6,000 people out of whom about 80 (1.3%) died. The districts of Amudat, Arua, Buikwe, Hoima, Isingiro, Kagadi, Kakumiro, Kampala, Kasese, Kiboga, Kiruhura, Kween Kyankwanzi, Kyegegwa, Mityana, Nakaseke and Tororo are especially vulnerable to outbreaks of Cholera, Rift Valley Fever, Crimean Congo Viral disease, Marburg and anthrax. These districts have a total of 7,276,200 people at risk of suffering from outbreaks.

Recent national assessments in developed countries show that there is still low but progressively increasing awareness among local communities and climate and health experts about climate change as an issue of global concern (Afrobarometer, 2022). There are however very few studies done to explore the views of health professionals in the developing world. A review of existing strategic documents for the health sector in Uganda such as the health sector development plan (HSDP) shows that climate change has not been prioritized and as result, programs lack provisions that address climate change-related adaptation mechanisms (MoH, HSDP 2015 – 2020). One of the key challenges of climate change planning in the health sector in Uganda is the lack of a full national vulnerability assessment that would act as a basis for developing an informed health national adaptation plan.

Major environmental impacts include; extreme heat waves and wildfires, substantial precipitation; drought; failure in water catchment resulting in increased water and food scarcity; rising sea levels; ocean acidification; infrastructural damage; loss of biodiversity; deforestation, floods and landslides (Hepworth and Goulden, 2008).

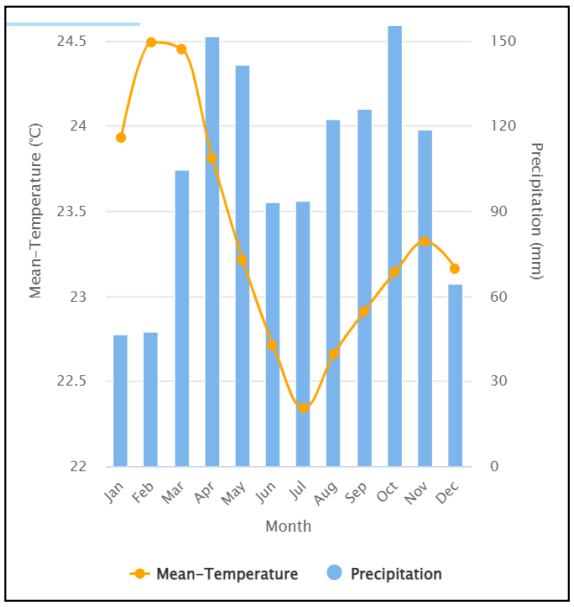
The government of Uganda passed a National Climate Change Act 2021 (MWE, 2021). The Act recommends several priorities for health sector adaptation to climate change and these include; assessing the impacts of climate change on health; establishing adaptive mechanisms and early warning systems for diseases related to climate change; conducting vulnerability assessment of the health sector to climate change impacts; developing a system for collection, management, storage and dissemination of health information; conducting surveillance of disease outbreaks and providing rapid responses to control of epidemics. The joint statement was signed by ministers of health of the WHO African region Yamoussoukro, Cote d'Ivoire 29th August to 2nd September 2011 ***[resolution AFR/RC61/R2 on the***

***Framework for Public Health Adaptation to climate change].*** The priorities are also aligned to the UN Framework Convention [Decision CP16 of the UNFCCC COP 16], on climate change which requires countries to integrate climate change-related issues within their national plans and budgets, the Kyoto protocol and Millennium Development Goals (MDGs).

## 2. Statement of the problem, justification and conceptual framework

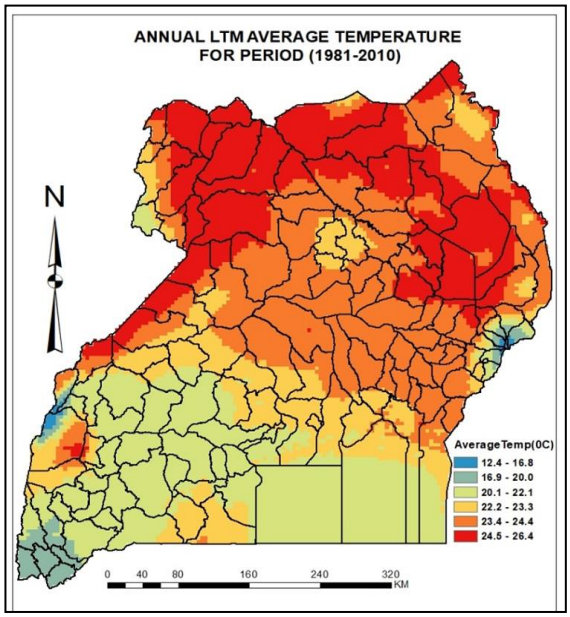
### 2.1 Statement of the problem

Climate-sensitive preventable diseases dominate Uganda's disease burden. The 2021/22 annual health sector performance report puts malaria as the leading condition among all OPD diagnoses for all ages, accounting for 32.1% of all OPD attendances. This is followed by cough or cold (no pneumonia) at 20.4%. The duo are among the known climate-sensitive diseases (MoH, 2022). Rising temperatures and more frequent extreme weather events like heavy rains, drought, wind storms, and heat and cold waves can cost lives, directly increase transmission and spread of diseases, and undermine the environmental determinants of health, including clean air, water, sufficient food, and secure shelter (MoH, 2016:44). Further, such environment related negative outcomes can potentially deter the country's efforts towards growth and economic transformation through different pathways such as eroding of the country's financial and human resources, reduction in food production and the availability of potable water among others (NPA, NDPIII, 2020).




Monthly climatology of mean-temperature and precipitation in Uganda from 1991-2020

Source: *The World Bank Group, 2021*




Annual long-term mean average temperature for period (1981-2010)

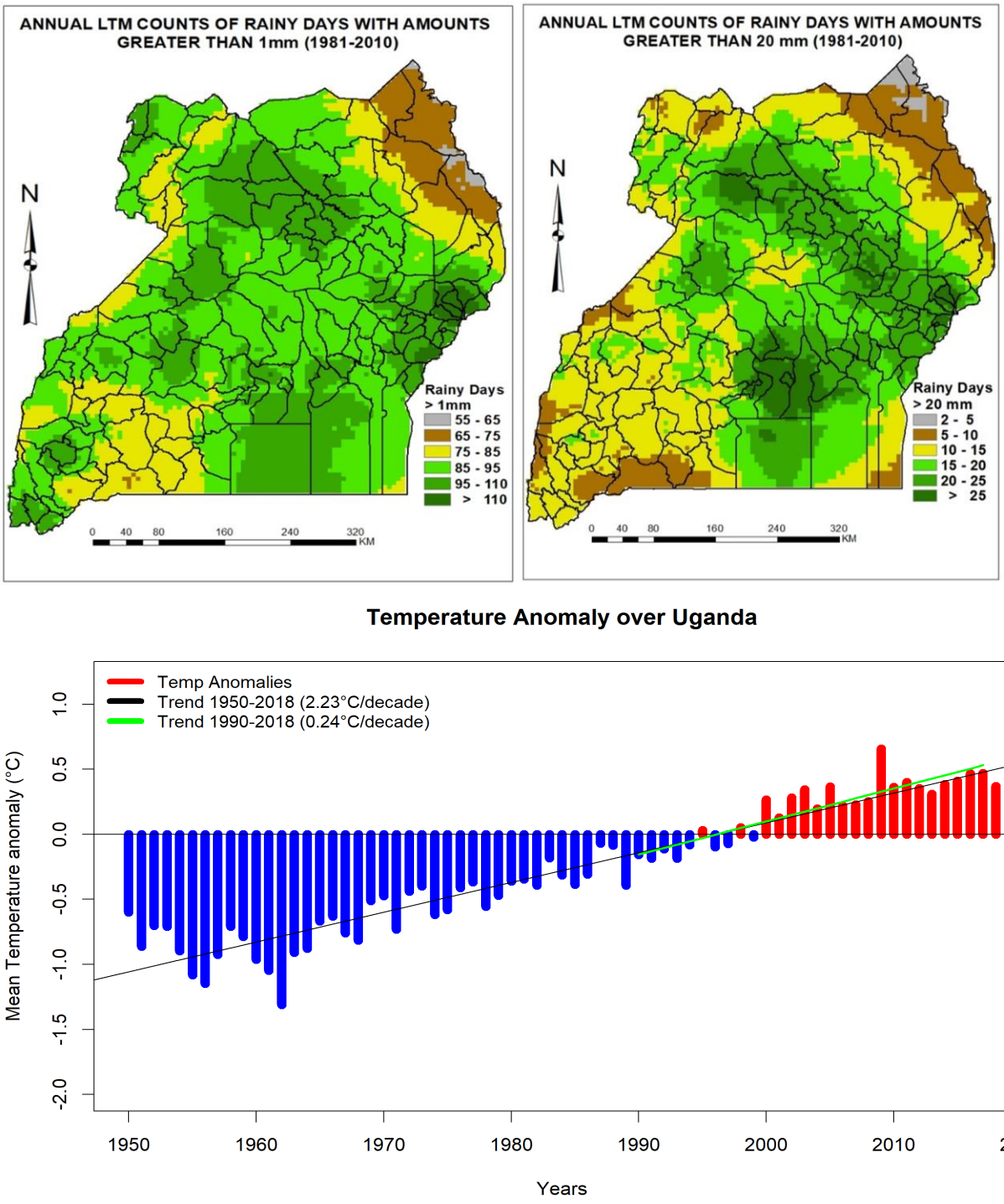



*Figure 1: Climatology of mean-temperature and precipitation in Uganda*

According to the World Bank's estimates, around 200,000 Ugandans have been impacted annually by weather-related disasters for the past two decades (World Bank, 2021). This number includes the recent climate related hazards, such as the flooding in Kasese and along the Nile valley; the landslides in the Mt. Elgon and Rwenzori regions; and droughts in the cattle corridor region. The changes are mainly affecting the lives of the most vulnerable populations including; children, women, the elderly the

disabled, the poor, remotely-located indigenous peoples and refugees. If not addressed, the burden of the disease will continue stressing the already stretched health system. At the same time, the health sector faces a challenge of competing needs in tackling climate change concerns. There has also been noted inadequate technical and financial resources as well as limited awareness among health managers and health workers. Furthermore, there is a lack of tailored coordination and communication mechanisms between the sector, local governments and communities affecting the ability to mitigate and control emerging threats from climate change in time.

The country however has several ongoing activities related to preparedness under emergencies, for example, multi-sectoral disaster preparedness committees in place, there is provision within the MoH structures for task forces to handle health emergencies and staff are catered for (public health and environmental officers, epidemiologists, communication specialists, laboratory technicians and case management teams. The teams are however not well oriented on climate change and how it is related to health, for example, changes in disease epidemiology are surprising to teams both in geographical locations but also in numbers. Districts level structures especially lack adequate capacity and are failing to cope.

The problems outlined underpin the need for conducting a health climate change vulnerability and adaptation assessment (VAA), in order to quantify the issues, and link that quantification to potential health system adaptation solutions. Therefore, the VAA will inform the development of the Health National Adaptation Plan (H-NAP).

## 2.2 Justification

Climate change is already having significant effects on human health. Districts in the cattle corridor (e.g., Amudat, Isingiro, Kakumiro, Kiboga, Kiruhura, Nakasongola and Nakaseke among others) are particularly at high risk and will be better protected through the implementation of strategic interventions. Other districts located in mountainous regions of Uganda including Kasese, Bundibugyo, Ntoroko in the Rwenzori, Mbale, Bududa, Manafwa, Sironko, Bulambuli, Kapchorwa in Elgon and Kisoro, Kabale, Rukiga, Rubanda, Kanungu and Rukungiri are prone to landslides and flooding (Namanya et al. 2021). The health systems in Uganda if strengthened to adapt, survive and recover from climate change-induced emergencies can be in a better position to cope with the situation (Environmental Alert, 2007; World Bank, 2018, Namanya et al, 2021). Building capacities of health workers and other stakeholders will go a long way in improving their competencies to cope and adapt to climate change (Namanya et al 2021). Improving leadership skills among health managers and improving coordination will help in aligning stakeholders to a common vision focusing on the need to prioritize climate change preparedness and response e.g. in the context of floods, frequent outbreaks, breakdown in infrastructure, sanitation, and waste management. Strengthening joint surveillance among health workers, environmental officers and members of the community will improve timeliness in the detection of threats and responding to emerging outbreaks. Establishing/strengthening robust monitoring and evaluation will help in documenting changing patterns in health and environmental risks and their outcomes and will help planners in better targeting their interventions. Strengthening linkages between the health system and communities will help in harnessing the indigenous knowledge and existing expertise in a situation where many health events are happening as a result of climate change. There is a strong need to prioritize a health systems approach to strengthen country preparedness in the context of climate change. The H-NAP will help to propose potential solutions to the challenges identified, will thus contribute increasing the resilience of the health system to climate change.

## 2.3 Conceptual framework

The vulnerability of the health sector to climate shocks can be due to factors such as the baseline climate, including the expected magnitude and frequency of extreme weather events, and geographical circumstances (World Health Organization, 2021b). Population vulnerability is also a function of the effectiveness and coverage of the health system and related institutions, reflected in the quality of policies and programmes such as surveillance and control programmes, and baseline morbidity and mortality conditions (World Health Organization, 2021b). Population characteristics such as demographic structure, prevalence of pre-existing medical conditions, and acquired factors such as immunity and genetic factors are important baseline vulnerability conditions. Other demographic and socioeconomic factors, including population density, social capital and distribution of resources, also play a critical role in determining vulnerability, often interacting with biological factors such as nutritional status that lead to differences in the ability to adapt or respond to exposures or early phases of illness. The end result of vulnerability is climate-sensitive health risks such as injury and mortality from extreme weather events, respiratory illnesses, zoonoses and malnutrition among others (Fig 2).

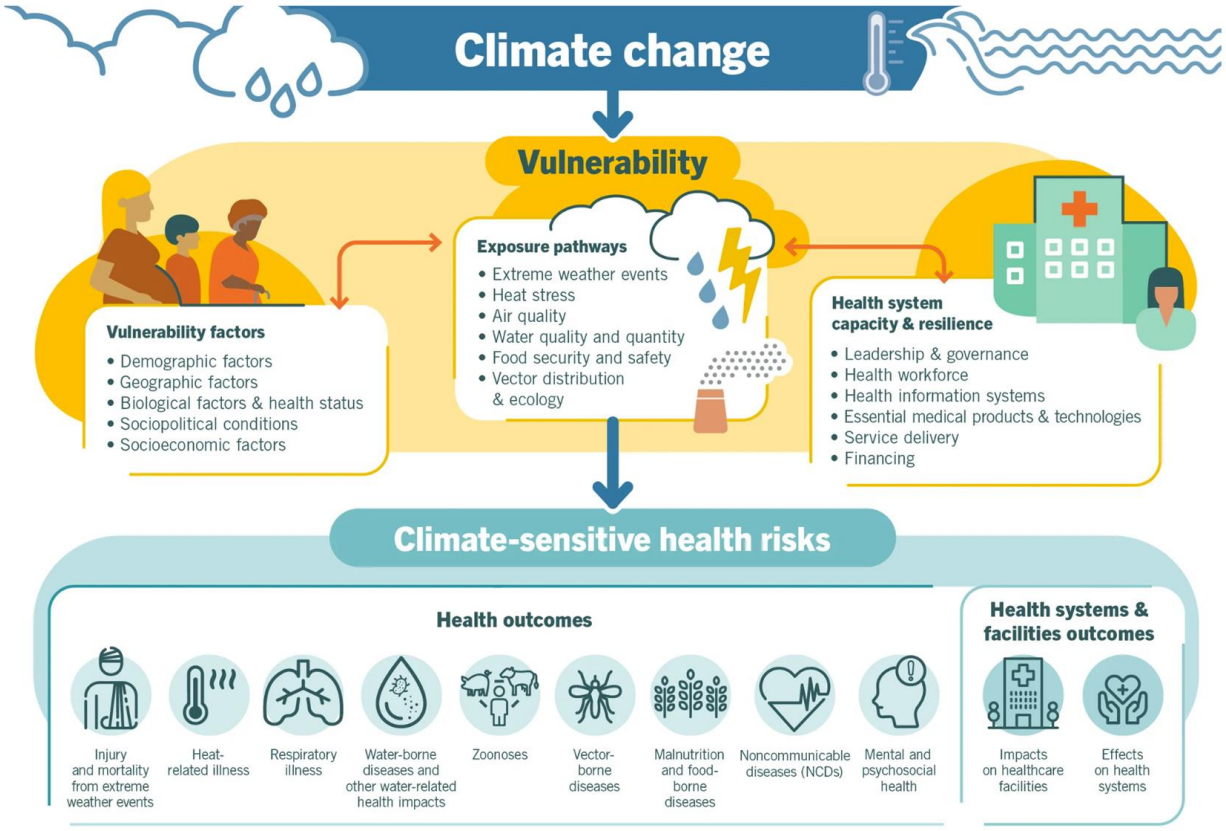



***Figure 2: Conceptual framework for climate-sensitive health risks (adapted from (World Health Organization, 2021b))***

## 2.4 Research questions

1. What is the extent of climate-change related risks (present and future risks) on the health sector in Uganda?
2. What are the potential impacts (present and future) of climate change on the health sector in Uganda?
3. What are the current risks of climate-sensitive diseases and health outcomes in Uganda?
4. What policies, programmes and adaptation mechanisms should be prioritized to effectively mitigate, adapt and respond to climate change-related risks and impacts in the health sector in Uganda?
5. How should monitoring and evaluation of mitigation, adaptation and response measures to climate-change related risks and impacts on the health sector in Uganda be done?

## 3. Study objectives

**General objective**

To conduct a national health climate change vulnerability and adaptation assessment to identify health risk factors and gaps for sound management of climate change-related health risks in Uganda

**Specific objectives**

1. To describe and quantify climate-change related risks (present and future risks) on the health sector in Uganda
2. To describe and quantify the potential impacts (present and future) of climate change on the health sector in Uganda
3. To describe current risks of climate-sensitive diseases and health outcomes in Uganda
4. To identify policies, programmes and adaptation mechanisms that should be prioritized to effectively mitigate, adapt and respond to climate change-related risks and impacts in the health sector in Uganda
5. To explore how monitoring and evaluation of mitigation, adaptation and response measures to climate-change related risks and impacts on the health sector in Uganda should be done
6. To use evidence from objectives 1-5 to inform the development of a National Health Adaptation Plan (H-NAP) for effective mitigation, adaptation and response to climate change in the health sector.

# 4. Methodology

## 4.1 Study area

Uganda is located in East Africa and lies across the equator, about 800 kilometres inland from the Indian Ocean. It lies between 10 29' South and 40 12' North latitude, 290 34 East and 350 0' East longitude. The country is landlocked, bordered by Kenya in the East; South Sudan in the North; the Democratic Republic of Congo in the West; Tanzania in the South; and Rwanda in the South West. It has a total area of 241,551 square kilometres, of which the land area covers 200,523 square kilometres (UBOS, 2016). According to the most recent estimates, Uganda's population is projected at 44.2 million people (UBOS, 2022), a population density of 173 persons per square kilometres (UBOS, 2018) and an average population growth rate of 3.0% (UBOS, 2016). Uganda like the rest of the world and more particularly the Least Developed Countries with the least capacity to adapt, is vulnerable to the negative impacts of climate change. It is a threat to its fragile ecosystems, people's livelihoods and ultimately the national economic development efforts. The proposed study was conducted in 43 districts, selected purposively and located in fifteen (15) regions across Uganda. The selection of districts was based on past occurrence of health hazards such as droughts, storms, floods, extreme temperatures. Selected districts for the study are shown in Figure 3.

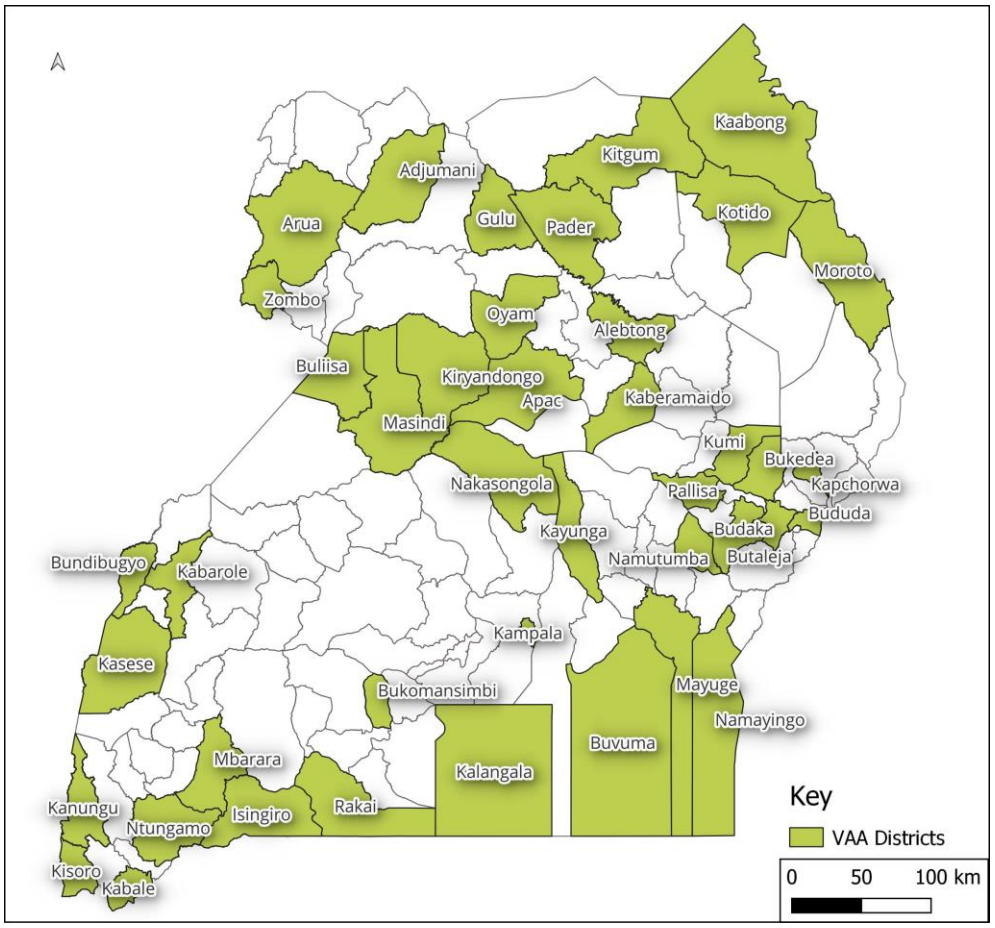



*Figure 3: Map of Uganda showing the study districts*

## 4.2 Study design

A healthcare facility-based crossectional study was used. Both qualitative and quantitative data collection methods were adopted.

## 4.3 Sample size estimation

A healthcare facility-based crossectional study was implemented. A sample of health facilities was selected to participate in the study. Selection of Health facilities was based on all those facilities, from the 43 selected districts, that reported into the Health Management Information System (DHIS2) in 2021, including health Centre IIs, Health Centre IIIs, Health Centre IVs and Hospitals. In addition, all regional referral hospitals (RRHs) WERE surveyed for a total of 15 RRHs. Selection was done using Yamane's formula for sample size calculation equation 1 (Yamane, 1967)

Equation 1 $$n_0 = \frac{N}{1 + N(e)^2}$$

where $n_0$ is the sample size, N (see column for reporting health facilities plus VHTs per region) is the population size and e (equal to 5%) is the level of precision. The sample size $n_0$ from equation 1, is adjusted with equation 2 since the population of Health Facilities is finite.

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}}$$

This gave a sample size of **726 health facilities** divided by health facility levels as indicated in the table 2 below. No separate sample was drawn for villages, but rather, the health unit management committees (HUMIC) at the HF represented/respondedon behalf of the community where the health facility was located.

**Table 2: Sample size of HFs to interview**

| Region | District | # of Govt and PNFP Facilities | Sample Size | Sample size by HF Level | | | |
|---|---|---|---|---|---|---|---|
| | | | | Hospitals | HCIVs | HCIIIs | HCIIs |
| Acholi | Gulu | 22 | 12 | 0 | 1 | 5 | 6 |
| | Kitgum | 34 | 17 | 2 | 1 | 7 | 7 |
| | Pader | 39 | 20 | 0 | 2 | 8 | 10 |
| Ankole | Isingiro | 50 | 26 | 0 | 4 | 10 | 12 |
| | Mbarara | 30 | 16 | 2 | 4 | 5 | 5 |
| | Ntungamo | 43 | 22 | 1 | 4 | 7 | 10 |
| Bugisu | Kapchorwa | 25 | 13 | 1 | 1 | 5 | 6 |
| | Mbale | 40 | 20 | 2 | 4 | 7 | 7 |
| | Sironko | 31 | 16 | 0 | 2 | 7 | 7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bukedi | Budaka | 16 | 9 | 0 | 1 | 6 | 2 |
| | Butaleja | 25 | 13 | 2 | 1 | 5 | 5 |
| | Pallisa | 22 | 12 | 1 | 0 | 5 | 6 |
| Bunyoro | Buliisa | 15 | 8 | 1 | 2 | 2 | 3 |
| | Kiryandongo | 24 | 13 | 1 | 1 | 5 | 6 |
| | Masindi | 41 | 21 | 1 | 3 | 8 | 9 |
| Busoga | Mayuge | 45 | 23 | 1 | 3 | 8 | 11 |
| | Namayingo | 31 | 16 | 0 | 1 | 7 | 8 |
| | Namutumba | 32 | 16 | 0 | 1 | 7 | 8 |
| Kampala | Kampala | 86 | 41 | 10 | 5 | 13 | 13 |
| Karamoja | Kaabong | 27 | 14 | 1 | 3 | 4 | 6 |
| | Kotido | 22 | 12 | 1 | 4 | 3 | 4 |
| | Moroto | 19 | 10 | 1 | 3 | 3 | 3 |
| Kigezi | Kabale | 60 | 30 | 2 | 4 | 8 | 16 |
| | Kanungu | 53 | 26 | 2 | 2 | 8 | 14 |
| | Kisoro | 44 | 22 | 2 | 3 | 8 | 9 |
| Lango | Alebtong | 19 | 10 | 0 | 1 | 4 | 5 |
| | Apac | 19 | 10 | 1 | 0 | 4 | 5 |
| | Oyam | 33 | 17 | 1 | 1 | 5 | 10 |
| North Central | Buvuma | 14 | 8 | 0 | 1 | 2 | 5 |
| | Kayunga | 29 | 15 | 1 | 2 | 5 | 7 |
| | Nakasongola | 35 | 18 | 1 | 2 | 7 | 8 |
| South Central | Bukomansimbi | 19 | 10 | 0 | 1 | 6 | 3 |
| | Kalangala | 22 | 12 | 0 | 2 | 4 | 6 |
| | Rakai | 44 | 22 | 1 | 0 | 8 | 13 |
| Teso | Bukedea | 14 | 8 | 0 | 1 | 3 | 4 |
| | Kaberamaido | 13 | 7 | 1 | 0 | 2 | 4 |
| | Soroti | 15 | 8 | 0 | 1 | 3 | 4 |
| Tooro | Bundibugyo | 29 | 15 | 1 | 3 | 5 | 6 |
| | Kabarole | 27 | 14 | 1 | 3 | 4 | 6 |
| | Kasese | 107 | 50 | 3 | 6 | 16 | 25 |
| West Nile | Adjumani | 43 | 22 | 1 | 2 | 8 | 11 |
| | Arua | 42 | 22 | 2 | 4 | 8 | 8 |
| | Zombo | 19 | 10 | 1 | 1 | 3 | 5 |
| **Total** | | | **726** | **49** | **91** | **258** | **328** |

## 4.4 Sampling

We used multi-stage cluster random sampling techniques to distribute the sample size of health facilities (HFs). We used probability proportionate to size sampling (PPS) to distribute the sample size of health facilities across the regions, using the number of health facilities reported in DHIS2 in 2021 and the number of villages per region, as the basis for this distribution. A random sample of HFs per district by level (Hospital, HCIV, HCIII and HCII) was, thendrawn using PPS to get a representative sample. In the situation where there was a regional referral hospital among the selected districts, this was automatically included in the sub-sample of hospitals. Likewise, VHTs were sampled across the 15 regions using PPS based on the number of villages per district. We interviewed selected facilities; targeting the health facility in charge and the selected villages; taking one VHT to interview per village.

## 4.5 Implementation mechanism

In line with the WHO (2013) guidelines for doing VAA, we proposed to conduct a series of activities. These activities included;

a) conducting full national climate change health vulnerability
b) conducting climate change health impacts assessment,
c) conducting climate change adaptation assessment
d) generating a National Health Plan for climate change.
e) producing an iterative process for monitoring and management of health risks associated with climate change

## 4.6 Approach

The WHO (2013) methodological approach was used to design and implement a baseline vulnerability and adaptation assessment protocol. A comparison was made between desired situation and the findings of the assessment (gap analysis) and based on identified gaps, interventional plans were developed by respective sectors. Details of the approach are provided in the guide WHO (2013) *Protecting Health from Climate Change: Vulnerability and Adaptation Assessment*.

## 4.7 Study procedure

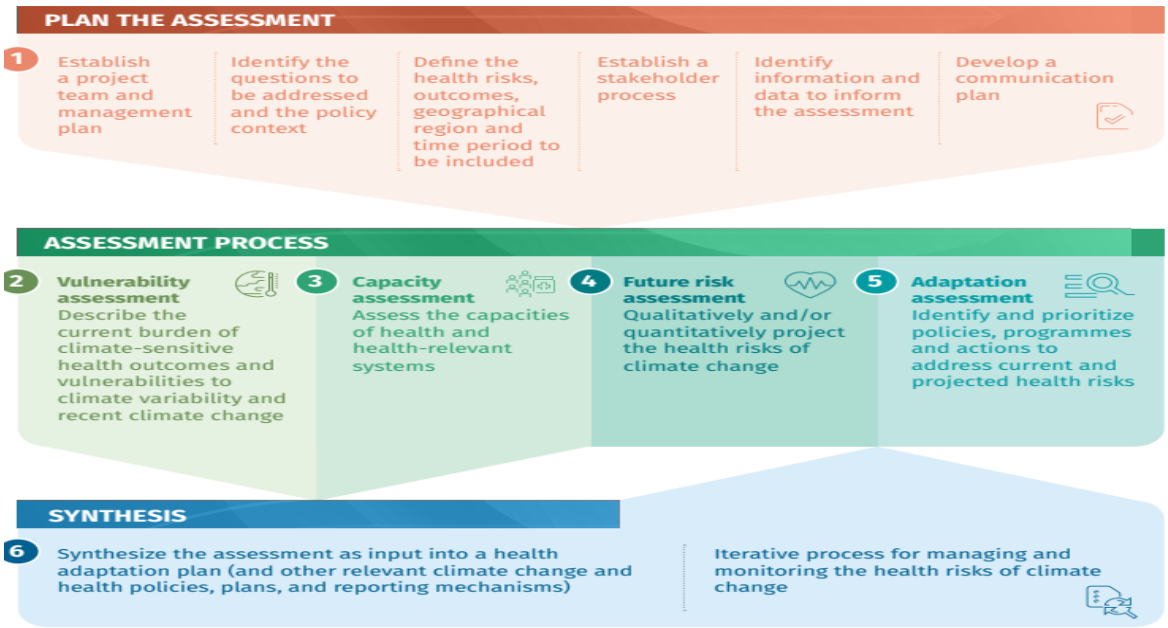



***Figure 4: Conducting a climate change and health vulnerability and adaptation assessment***

Based on the WHO 2013 Guidelines for conducting climate change Vulnerability and Adaptation

### *4.7.1 The VAA assessment*

This started with

a) Establishing a project team and management plan: MaKSPH identified the technical staff in key research areas and constituted a project team using the core competencies required to execute project assignments as the basis.

b) Identifying health risks across geographical regions and health outcomes of interest: Data was reviewed from various sources including literature review, meteorological data, climate change preparedness and impact reports, DHIS2 and related databases, previous strategic plans and performance review reports and where there are data gaps, new data was collected to get a clear picture. In addition, key actors on climate change in the health sector and beyond were consulted on priority risks, geographical regions and health outcomes of interest. Two stakeholder engagement workshops are envisaged, i.e., one national stakeholder workshop to discuss preliminary findings from the VAA, and another national stakeholder workshop for consensus building on the H-NAP.

c) Identifying the questions to be addressed and steps to be used: Consultative meetings that were held in "b" above were also be used to agree on questions that were addressed by the investigations. The questions were drafted putting into consideration the objectives of the assessment.

d) Identifying the policy context for assessment: To identify the policy context for the assessment, global guiding documents on climate change were reviewed focusing on recommended policies, strategies and guiding principles for countries. Through literature search and key informant interviews with national and regional stakeholders, investigators narrowed down the policy context for assessment. Exiting policy documents in the country were especially be scrutinized for guidance in prioritization.

e) Establishing stakeholder processes and developing communication plans:

f) The above steps evolved into the actual vulnerability and adaptation assessment involving:

g) collecting and analysing data on the current burden of disease and health protection

h) establishing future impacts i.e. changing burden without climate change and projected health impacts of climate change

i) recommending priorities for climate change adaptation including identifying and selecting additional interventions and ascertaining resources and barriers to implementation.

j) These processes produced a comprehensive VAA report that informed the development of the Health National Adaptation Plan.

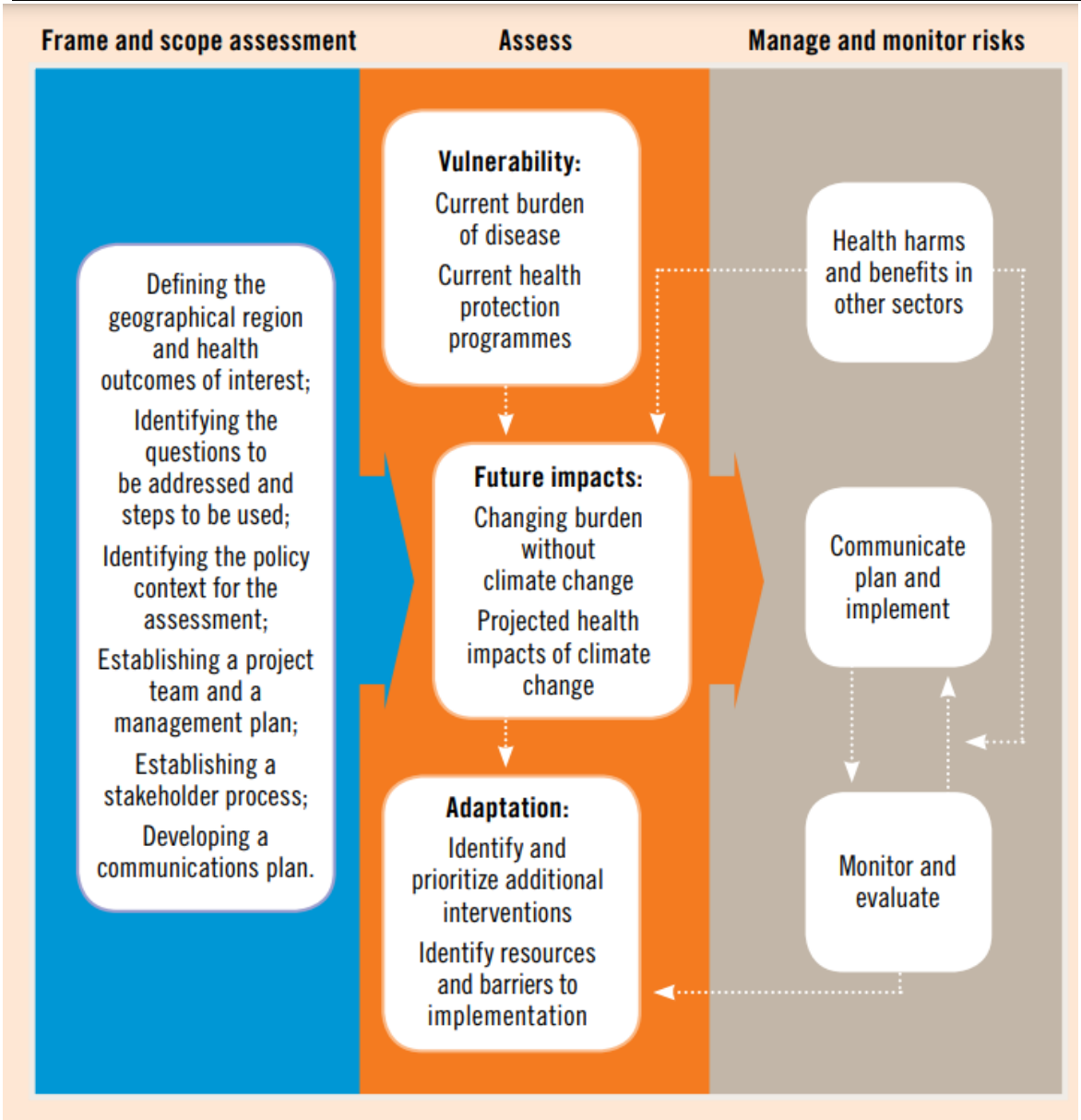



*Figure 5: Vulnerability and Adaptation Assessment (WHO, 2013)*

The stages illustrated above are further described in the document *WHO (2013) Protecting health from climate change: Vulnerability and Adaptation Assessment*, pg. 14 – 52

### *4.7.2 Development of a Health National Adaptation Plan.*

To develop the national Action plan, the following steps will be undertaken**.**

1) **Step One**. Setting goals and objectives of the plan. This will be undertaken in a consultative manner through key informative interviews with identified stakeholders by MaKSPH and MOH. Criteria will be developed upon which the goals and objectives will be evaluated for instance, based on the health development plan, and international commitments such as SDGs among others.

2) **Step Two**: Building concession on the shape and scope/priorities of the plan (what should be in and out, the role of each actor among others)

3**) Step three**: Collation of all existing evidence and new evidence, and identifying any missing evidence that needed to be brought to the discussion to inform the plan.

4) **Step Four:** Conduct a stakeholder's workshop to discuss preliminary findings

The main objective of this workshop will be to assess and verify information collected during the landscape review, spatial maps and preliminary interviews. The workshop will be used to confirm initial thinking and directions and identify additional resources and stakeholders that should be part of the overall assessment. MakSPH will work closely with the Ministry of Health and other government partners to identify and invite relevant stakeholders to the workshop.

The key participants for this workshop will include technical staff, such as department directors in the ministries of health, environment, and agriculture (for example Ministry of Health, Ministry of Water and Environment, Ministry of Energy and Mineral Development; national climate change team; emergency and disaster risk management team; hydrometeorological agencies; and others, as well as the heads of vector-borne disease and other control programs; Civil society (community representatives, NGOs); academia/researchers; International agencies such as WHO and UN Development Programme (UNDP) country office and Development organizations and donors active in protecting population health, or in adapting to climate change.

5) **Step Five:** Estimating the costs of actions and of inaction to protect health based on different scenarios.

6) **Step Six:** Producing a monitoring and evaluation plan for monitoring climate change events and processes

7) **Step Seven:** Deliberations with stakeholders for consensus on the final plan

## 4.8 Data collection methods and tools

### *4.8.1 Quantitative*

#### 4.8.1.1 *Structured questionnaire*

This study adopted the checklists used by WHO to assess checklists to assess vulnerabilities in health care facilities in the context of climate change(World Health Organization, 2021a). A structured questionnaire was used to obtain data from each study healthcare facility. The questionnaire was used to assess the capacity to predict and respond to the impacts of climate change. In addition, it was used to evaluate the existing processes of responding to climate change-related disasters. A total of 726 health facilities were assessed for vulnerability to several climate change hazards including floods, storms, rising water levels, drought, heat waves, and cold waves

### *4.8.2 Qualitative*

#### 4.8.2.1 *National level and regional level interviews*

To better understand the challenges and opportunities that climate-related shocks and stresses present for specific populations, communities, and health systems, a research team from MaKSPH conductedinterviews with key informants at the ministry of health, ministerial departments and other government and non-government agencies including the humanitarian and donor organization in the area of disaster management. The humanitarian organizations to be interviewed included WHO, OXFAM, UNDP, UNHCR, International Committee of the Red Cross, UNICEF, UNFPA, Word Bank and UN Women. Interviewees included technical staff, such as department directors in the ministries of health, environment, and agriculture (for example Ministry of Health, Ministry of Water and Environment, Ministry of Energy and Mineral Development; national climate change team; emergency and disaster risk management team; hydrometeorological agencies; and others, as well as the heads of vector-borne

disease and other control programs; Civil society (community representatives, NGOs); academia/researchers; International agencies such as WHO and UN Development Programme (UNDP) country office and Development organizations and donors active in protecting population health, or in adapting to climate change.

The interviews focused on 1) perceived climate change priorities of interest to the national level leaders and managers, 2) availability and functionality of a national climate change steering committee, 3) availability of policies and guidelines that a favourable environment for reducing vulnerabilities to climate change hazards and resulting outcomes, 4) mandate, the roles and responsibilities of the institutions and collaborations with the health sector, 5) systems in place to address climate change, 6) monitoring and evaluations systems, in place and their functionality as well as key indicators, 7) communication and information sharing, 8) availability of strategies and operational plans and levels of implementation of the plans, 9) capacity building plans, 10) preparedness and readiness of actors at various levels to respond, 11) resources allocation, 12)efforts in place to foster adaptation to climate change, and the extent to which global recommendations have been adopted/adapted. This qualitative assessment provided a glimpse of the extent to which current policies and programs managed the risks. At regional level, interviews were conducted with resource persons including meteorological officers, departments responsible for environmental courses in sitting Universities, directors of regional referral Hospitals, surveillance officers, members of disaster preparedness and response committees, civil society organizations and community groups with a special interest in climate change.

#### 4.8.2.2 *Field/ site visits*

Field visits aided by photography enabled the research team to gain a deeper understanding of risks to health systems by visiting locations that could be considered hotspots of vulnerability (existing and projected) and provide a good representation of challenges and achievements. Field visits helped in the identification of the contextual risk factors (e.g. flood zones, location/ terrain) that increase vulnerability to climate change related events. Photography was used to document evidence of the contextual risk factors. The field visits also provided an opportunity for obtaining information about the current capacity to cope with significant weather-related events, such as flooding, drought or landslides. Conversely, the field visits helped the national risk and capacity assessment team to assess the existing gaps with regard to response to the health risks. These visits were informed by the priority climate-sensitive health risks identified, the modifications suggested to health adaptation policies and programs, and other issues raised during the workshop.

#### 4.8.2.3 *Focus Group Discussions (FGDs)*

FGDs aided by an interview guide were used to explore knowledge of climate change, and associated risks, impacts, existing mitigation measures and suggestions for improving response to climate change hazards. Twenty FGDs were conducted. These were distributed equally across the study regions. Each FGD comprised of 6-10 participants and were conducted by an interviewer aided by a note taker. FGD participants included Community Health Workers (also known as VHTs) and members of health unit management committees and the discussions took place at healthcare facilities. FGD participants were purposively selected with the help of the healthcare facility in-charges and were expected to be attached to the study healthcare facility at the time of the study. We ensured that the FGDs were homogeneous in nature which allowed the reconstruction of collective ways of thinking, or even formation of groupthink phenomenon over various topics (Woźniak, 2014).

## 4.9 Study variables

### 4.9.1 Measurement of vulnerability

Vulnerability to climate change-related hazards was assessed by evaluating various components of healthcare facilities (i.e., health workforce; WASH and health care waste services; energy services; infrastructure, technologies, products and processes), and assigning scores to each component based on the items listed within them. The scores for individual items contributed to the total score for each component, and the overall vulnerability score for each hazard was calculated based on the cumulative scores of all components. Vulnerability was classified as 1) **High** if a healthcare facility was unprepared or unable to respond, 2) **Medium** if the HCF has basic or incomplete preparation and 3) **Low** if the HCF was prepared and able to respond. The table below shows the total score per component.

| For each item, responses was range from High =2; Medium =1; Low =0 | | | |
|---|---|---|---|
| **Hazard** | **Component** | **Total items** | **Total score** |
| **FLOODS** | **HEALTHWORK FORCE** | | |
| | Human resources | 9 | 18 |
| | Capacity development | 9 | 18 |
| | Communication and awareness raising | 9 | 18 |
| | ***Sub-total*** | **27** | **54** |
| | **WASH AND HEALTHCARE WASTE** | | |
| | Monitoring and assessment | 8 | 16 |
| | Risk management | 13 | 26 |
| | Health and safety regulation | 7 | 14 |
| | ***Sub-total*** | | **56** |
| | **ENERGY SERVICES** | | |
| | Monitoring and assessment | 5 | 10 |
| | Risk management | 5 | 10 |
| | Health and safety regulation | 5 | 10 |
| | ***Sub-total*** | | **30** |
| | **INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS, PROCESSES** | | |
| | Adaptation of current systems and infrastructures | 35 | 70 |
| | Promotion of new systems and technologies | 10 | 20 |
| | Sustainability of healthcare facility operations | 12 | 24 |
| | ***Sub-total*** | | **114** |
| **STORM** | **HEALTHWORK FORCE** | | |
| | Human resources | 9 | 18 |
| | Capacity development | 10 | 20 |
| | Communication and awareness raising | 7 | 14 |
| | ***Sub-total*** | | **52** |
| | **WASH AND HEALTHCARE WASTE** | | |
| | Monitoring and assessment | 6 | 12 |
| | Risk management | 11 | 22 |
| | Health and safety regulation | 5 | 10 |
| | ***Sub-total*** | | **44** |
| | **ENERGY SERVICES** | | |
| | Monitoring and assessment | 5 | 10 |
| | Risk management | 5 | 10 |
| | Health and safety regulation | 5 | 10 |
| | ***Sub-total*** | | **30** |
| | **INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS, PROCESSES** | | |

| | | | |
|---|---|---|---|
| | Adaptation of current systems and infrastructures | 40 | 80 |
| | Promotion of new systems and technologies | 9 | 18 |
| | Sustainability of healthcare facility operations | 12 | 24 |
| | ***Sub-total*** | | **122** |
| **DROUGHT** | **HEALTHWORK FORCE** | | |
| | Human resources | 5 | 10 |
| | Capacity development | 8 | 16 |
| | Communication and awareness raising | 9 | 18 |
| | ***Sub-total*** | | **44** |
| | **WASH AND HEALTHCARE WASTE** | | |
| | Monitoring and assessment | 8 | 16 |
| | Risk management | 11 | 22 |
| | Health and safety regulation | 8 | 16 |
| | ***Sub-total*** | | **54** |
| | **ENERGY SERVICES** | | |
| | Monitoring and assessment | 5 | 10 |
| | Risk management | 5 | 10 |
| | Health and safety regulation | 6 | 12 |
| | ***Sub-total*** | | 32 |
| | **INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS, PROCESSES** | | |
| | Adaptation of current systems and infrastructures | 18 | 36 |
| | Promotion of new systems and technologies | 9 | 18 |
| | Sustainability of healthcare facility operations | 11 | 22 |
| | ***Sub-total*** | | **76** |
| **HEATWAVE** | **HEALTHWORK FORCE** | | |
| | Human resources | 6 | 12 |
| | Capacity development | 6 | 12 |
| | Communication and awareness raising | 6 | 12 |
| | ***Sub-total*** | | 36 |
| | **WASH AND HEALTHCARE WASTE** | | |
| | Monitoring and assessment | 5 | 10 |
| | Risk management | 9 | 18 |
| | Health and safety regulation | 6 | 12 |
| | ***Sub-total*** | | **40** |
| | **ENERGY SERVICES** | | |
| | Monitoring and assessment | 6 | 12 |
| | Risk management | 5 | 10 |
| | Health and safety regulation | 7 | 14 |
| | ***Sub-total*** | | **36** |
| | **INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS, PROCESSES** | | |
| | Adaptation of current systems and infrastructures | 20 | 40 |
| | Promotion of new systems and technologies | 9 | 18 |
| | Sustainability of healthcare facility operations | 7 | 14 |
| | ***Sub-total*** | | **72** |

### *4.9.2 Measurement of health workforce climate change related impacts*

Impacts on human resource: The impacts of the different climate change-related hazards were classified as major, moderate or minor. Flood events that lead to 1) deaths or life-threatening injuries or illness (e.g. drowning, hypothermia and infectious diseases, such as diarrhoeal diseases, leptospirosis, cholera,

vector borne diseases), 2) health professionals not being able to arrive at or depart from the health care facility, 3) large loss of work capacity, 4) cessation of critical programmes or services, 5) significant reduction in performance capacity of health workforce, 6) effects on mental health of staff due to disaster trauma, loss of a family member, friends or patients, 7) increased demand for health services from infectious diseases (water-, food- and vector-borne diseases), animal bites (including poisonous animals), respiratory infections, zoonotic diseases, (rodent borne diseases such as, hantavirus pulmonary syndrome, leptospirosis), noncommunicable diseases, electrical shock and toxic chemicals exposure and 8) increased health workforce overload and stress wre classified as major. Impacts were classified as moderate if they lead to 1) serious harm, injury or illness requiring hospitalization or medical treatment, 2) health professionals having difficulty in arriving at or departing from the health care facility, 3) a reduction in health workforce functions, 4) restrictions to provide services and programmes, 5) healthcare providers' inability to provide adequate care to patients, 6) increased work overload along with stress, and healthcare facility overcrowding. Low impact climate change-related hazards were those that lead to 1) minor injuries to health workers, not requiring immediate medical treatment, 2) difficulty in providing usual treatment and medication, 3) reduced primary services at home for communities, and 4) service delivery and programme delays.

### *4.9.3 Measurement of WASH and healthcare waste climate change related impacts*

The impacts of different climate change-related hazards on WASH (Water, Sanitation, and Hygiene) and healthcare waste services in healthcare facilities were assessed and classified as major, moderate, or minor levels of impact. For each climate change-related hazard, such as flood events, the potential impacts on WASH and healthcare waste services were evaluated based on specific criteria. The impacts for floods were categorized as follows: Major Impact if there is 1) Disruption of wastewater and sewage systems, 2) water contamination 3) shortage of safe water, 4) unable to provide hygiene services 5) Damage to waste storage causing environmental contamination by biological and chemical hazards, 6) Lost sharps containers and hazardous waste bins, 7) Damage to emergency water sources, 8) Toilets unavailable, and 9) Disruption of wastewater and sewage systems. Moderate impacts on WASH and healthcare waste included; Temporary water supply interruption, Reduced capacity to provide safe water for drinking or cooking, Reduced capacity to provide disinfection or sterilization processes, Cross-contamination from damages to sewage system, Reduced water quality as animal faeces and sewage get washed into surface water, and reduced capacity to maintain waste collection and treatment. Minor impacts included Reduced capacity to access drinking water, Reduced capacity to use toilets, showers, etc, Reduced capacity to use laundry and dishwashing machines, Reduced capacity to provide cleaning services (floor, toilets, patient rooms, emergency rooms), Heavy sediment and pollution loads make treatment ineffective and Possible rodent infestation around rubbish binsMeasurement of energy related impacts.

### *4.9.1 Measurement of energy services climate change related impacts*

The impacts of the different climate change-related hazards on energy services was classified as major, moderate or minor. Flood events that was lead to 1) Power failure, 2) shutdown of cold storage systems, 3) interruption in providing health care services that require electricity such as dialysis, oxygen therapy, diagnosis equipment, 4) loss of vaccines, laboratorial supplies, drugs, parenteral nutrition and blood supplies, pharmaceuticals, food supply, and other essential refrigeration- dependent medical supplies, 5) damage to emergency generator or other sources of energy, 6) disruption of the fuel supply chain, 7) disruption of energy-dependent water pumping and treatment systems was classified as major impact. Moderate impacts on energy was include; 1) temporary power supply interruption, 2) difficulty in providing critical health care service deliveries (dialysis, oxygen therapy, diagnosis equipment), causing patients to be evacuated to other health facilities, 3) reduced capacity to provide services that need

electricity (laundry, dishwashing machines, etc.) and 4) reduced capacity to provide disinfection services that need electricity (autoclave, microwave, water boiler). Minor impacts was include flood events that lead to; 1) no ambient cooling, 2) loss of food or difficulty in refrigerating food and reduced capacity to follow boil water advisories.

### *4.9.2 Measurement of infrastructure, technologies, and products climate change related impacts*

The impacts of different climate change-related hazards on infrastructures, technologies, products and processes in healthcare facilities were assessed and classified as major, moderate, or minor levels of impact. For each climate change-related hazard, such as flood events, the potential impacts were evaluated based on specific criteria. The impacts for floods are categorized as follows: Major Impact if there is, 1) flood damage or destruction of structural components (full or parts of the facility), 2) partial destruction by floods causing land erosion, 3) blocked transport systems and flooded ambulance stations, 4) damage to building access, 5) damage to machine room, 6) damage to critical equipment, 7) damage of internal and external communication and information systems, 8) loss or damage of health care facility essential supplies (medications, medical devices, drugs, laboratorial supplies, blood, pharmaceuticals, vaccines) 9) interruption of complex and emergency health care services (surgery, complex treatments, urgent care) 10) disruption of health care services delivery and operation, 11) cessation of services or prolonged disruption of services due to loss or damage, 12) breakdown of routine health care services (such as ambulatory, immunization, maternity room, pharmacy, medication for chronic diseases, dental, and other primary services), 13) interruption of diagnosis due to equipment damage, 14) contamination of medical devices, instruments and equipment, 15) interruption of supply chains, 16) long-term effect on the environment needing external assistance/interventions, 17) damage to internal transportation systems (elevators, ramps, corridors), and 18) increased immediate and long-term costs to recover from damage. Moderate impacts of floods on infrastructures, technologies, products and processes was include 1) disruption to communication and information systems and assets, 2) damage to road, disrupting access to health care facility 3) difficulty in transporting patients due to damaged or disabled transportation systems, 4) reduced capacity to deliver health care services due to damage and reduced supplies, 5) temporary suspension of service deliveries, 6) damage to paper medical record storage, 7) reduced capacity to access clinical and laboratorial supplies, 8) increased hospitalization rates requiring extra medical supplies and health workforce, 9) high demand for cleaning services in all facility buildings after flood event requiring extra personal protective equipment, 10) increased demand in costs for repairing or buying damaged or lost medical equipment and devices, needed for short-term recovery, and 11) increased costs due to necessary post flood repairs. Impact was classified as minor impacts if floods led to, 1) localized disruption of services with minor loss and damage, 2) damage or loss to health care facility documents and records, 3) no lasting effects on the external health care facility environment, 4) minimal impact on local operations and equipment that do not compromise health care service deliveries, 5) minimal impact on the supply chain, which can continue to support health care facility needs, 6) possible mold, indoor and outdoor, requiring special cleaning-up or essential personal protective equipment for cleaners and 7) increased demand for providing cleaning and disinfection supplies.

### *4.9.3 Vulnerability assessment*

Analysis of vulnerability and impact assessment data collected from health facilities was done using WHO checklists provided in the document titled “Checklists to assess vulnerabilities in health care facilities in the context of climate change”. The checklists classified vulnerabilities of health facilities to each climate change hazard as red or high risk (unprepared; unable to respond), yellow or medium risk

(basic or incomplete preparation; and green or low level of response and low risk (prepared; able to respond). Hazards affecting vulnerable health facilities were mapped against affected sub-counties, districts and regions and DHIS2 data was analyzed to relate hazards that happened in the past to disease trends correlating to periods when each hazard happened.

| HEALTH WORKFORCE | | |
|---|---|---|
| LEVEL OF IMPACT | | |
| **MAJOR** | **MODERATE** | **MINOR** |
| ☐ Increased threat to the health workforce from infectious disease from water contamination and vector breeding sites<br>☐ Increased threat to the health workforce resulting in impacts to noncommunicable diseases (cardiovascular, respiratory diseases), from poor air quality and higher temperatures<br>☐ Drought-related illness to health workers requiring hospitalization<br>☐ Effects on mental health of staff leading to psychological stress<br>☐ Interruption of critical programmes or services availability with possible relocation to another facility (municipality or capital)<br>☐ Reduced performance capacity of health workforce<br>☐ 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<br>☐ Possible illness to health workers requiring medical treatment<br>☐ Reduction of health workforce functions<br>☐ 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)<br>☐ Reduced productivity<br>☐ Possible increased risk of dustborne diseases (valley fever, meningococcal meningitis), leading to hospital admissions<br>☐ 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<br>☐ Service delivery and programme delays<br>☐ Restrictions to provide health care services and programmes<br>☐ Reduced capacity for health workforce to performs hygiene procedures compromising safety<br>☐ Possible reduced capacity and health workforce performance in case of outbreaks |

*Figure 6: Checklist for impact assessment for drought*

### *4.9.4 Health risk and impact assessments*

The **HRA** included the identification of potential climate hazards linked to specific processes within the health sector, the identification and appraisal of existing control measures, and a semi-quantitative risk assessment. During the assessment, we based on self-reports and the literature to describe how the different climate hazards **impacted** the health sector. Once the potential impact pathways on the health sector were identified, literature providing evidence for the direction and magnitude of the potential health impacts was reviewed and reference added. At this point, the **Impact Level (IL)** (ranging from insignificant to catastrophic) and the **Likelihood or Frequency** (LoF) of the hazardous event occurring was determined for each of the identified climate hazards. In order to determine the likelihood or frequency of occurrence, the mitigation potential (i.e. the combination of technical effectiveness and acceptability of the proposed control measure) were considered. The combination of the likelihood or frequency of occurrence and the level of impact results were used to calculate the Risk score (RS). (RS =

IL x LoF; low risk: <6; moderate risk: 7–12; high risk: 13–32; and very high risk: ≥32). The HRA was based on the modified Delphi approach (Rowe and Wright, 1999), which was also used by Winkler et al. (2015) to undertake a health risk assessment of waste reuse business models proposed for Kampala. The Delphi technique is recommended for use in judgment and forecasting situations in which pure model-based statistical methods are not practicable. During the assessment, the research assistants guided the healthcare managers (one per healthcare facility) to make individual/ independent assessments to facilitate agreement on the final ranking.

| **IMPACT LEVEL (I)** | | |
|---|---|---|
| **Category** | **Score** | **Description** |
| **Insignificant** | **1** | No health consequences anticipated and no impact on normal operations |
| **Minor impact** | **2** | Impact not resulting in any perceivable or measurable health effect; easily manageable disruptions to operation; no rise in complaints anticipated |
| **Moderate impact** | **4** | Impact resulting in minor disability (e.g. fever, headache, diarrhoea, small injuries) or unease (e.g. noise, malodours); may lead to complaints or minor community annoyance; operations may be disrupted for short duration |
| **Major impact** | **8** | Impact resulting in moderate disability (e.g. acute intoxication, malaria, injury) or minor disability of long duration; may lead to legal complaints and major community concerns; operations could be significantly affected by the impact |
| **Catastrophic impact** | **16** | Impact resulting in severe disability, chronic disease or even loss of life; major investigation by regulator with prosecution are likely; can lead to complete failure of system |
| **LIKELIHOOD or FREQUENCY (LoF)** | | |
| **Category** | **Score** | **Description** |
| **Very unlikely** | **1** | In consideration of the technical effectiveness and local acceptability of proposed control measures, it is very unlikely that exposure to the health hazard will occur (odds: <5%). Frequency: once every 5 years |
| **Unlikely** | **2** | In consideration of the technical effectiveness and local acceptability of proposed control measures, it is unlikely that exposure to the health hazard will occur (odds: 5–40%). Frequency: once a year |
| **Possible** | **3** | In consideration of the technical effectiveness and local acceptability of proposed control measures, it is possible that exposure to the health hazard will occur (odds: 41-60%). Frequency: once a month |
| **Likely** | **4** | In consideration of the technical effectiveness and local acceptability of proposed control measures, it is likely that exposure to the health hazard will occur (odds: 61-95%). Frequency: once a week |
| **Almost certain** | **5** | In consideration of the technical effectiveness and local acceptability of proposed control measures, it is almost certain that exposure to the health hazard will occur (odds: >95%). Frequency: once a day |

*Figure 7: Definition of impact level, and likelihood for the HRA*

| Risk score: (RS) = (IL) x (LoF)<br>Very high risk >32<br>High risk 13–32<br>Moderate risk 7–12<br>Low risk <6 | | IMPACT LEVEL (IL) | | | | |
|---|---|---|---|---|---|---|
| | | Insignificant (1) | Minor impact (2) | Moderate impact (4) | Major impact (8) | Catastrophic impact (16) |
| LIKELIHOOD or FREQUNCY (LoF) | Very unlikely (1) | 1 | 2 | 4 | 8 | **16** |
| | Unlikely (2) | 2 | 4 | 8 | **16** | **32** |
| | Possible (3) | 3 | 6 | 12 | **24** | **48** |
| | Likely (4) | 4 | 8 | **16** | **32** | **64** |
| | Almost certain (5) | 5 | 10 | **20** | **40** | **80** |

*Figure 8: Semi-quantitative assessment matrix*

**Health Impact assessment (HIA)**

Impact assessment was done using hazard by hazard checklists from WHO. Dimensions for analysis included Impacts on, the health workforce, water, sanitation and health care waste management, energy and infrastructure, technologies, products and processes. Impacts were classified by facility as major, moderate or minor. Facility data were aggregated to establish the proportions of health facilities in each category of impact. Data were also be disaggregated by region, level of health facility and by ownership (public versus private). Figure 4 is an example of a checklist for impact assessment for drought. The impact assessment aimed at establishing the potential impacts of climate hazards on the health sector at community level under the assumption that the control measures proposed by the HRA were deployed. This included consideration of both potential health benefits (reduced healthcare provider absence) and adverse health impacts (the destruction of healthcare facility infrastructure). A literature analysis was used to provide evidence for the direction and magnitude of the potential health impacts. During the impact assessment, a semi-quantitative risk assessment was undertaken to characterise the nature (positive or negative) and magnitude (minor to major) of the climate hazards. For this purpose, the **Impact Level (IL)** (ranging from major negative impact to major positive impact), the LoF of the impact to occur and the estimated **number of people affected (PA)** was determined for each of the identified potential impact on the health sector. ***Assumption:*** The total number of people affected was assumed to be equivalent to the catchment population of the healthcare facility. The combination of the IL with the LoF and the estimated number of people affected resulted in the magnitude of the impact on the health sector (Magnitude = IL x LoF x PA; low positive impact: 0–4; moderate positive impact: 10–4,499; high positive impact: ≥4,500; low negative impact: 0– - 4; moderate negative impact: -10– -4,499; and high negative impact: ≤-4,500. The rating for the HIA was based on the modified Delphi approach used by Rowe and Wright (1999).

| IMPACT LEVEL (IL) | | |
|---|---|---|
| **Category** | **Score** | **Description** |
| **Major positive impact** | **1** | Impact reduces incidence of diseases or injury, resulting in severe disability, chronic disease or even loss of life |
| **Moderate positive impact** | **0.5** | Impact reduces incidence of diseases or injury, resulting in moderate disability that may require hospitalisation (e.g. acute intoxication, malaria, injury) or minor disability of long duration |
| **Minor positive impact** | **0.1** | Impact reduces incidence of disease or injury, resulting in minor disability of short duration (e.g. acute diarrhoea, acute respiratory infection) that does not require hospitalization |
| **Insignificant** | **0** | Impact not resulting in any perceivable or measurable health effect |
| **Minor negative impact** | **-0.1** | Impact increases incidence of diseases or injury, resulting in minor disability of short duration (e.g. acute diarrhoea, acute respiratory infection) that does not require hospitalization |
| **Moderate negative impact** | **-0.5** | Impact increases incidence of diseases or injury, resulting in moderate disability that may require hospitalisation (e.g. acute intoxication, malaria, injury) or minor disability of long duration |
| **Major negative impact** | **-1** | Impact increases incidence of diseases or injury, resulting in severe disability, chronic disease or even loss of life |
| **PEOPLE AFFECTED (PA)** | | |
| **Category** | **Score** | **Description** |
| **Individual cases** | **1** | A few individuals are concerned by the impact (e.g. road traffic accidents) |
| **Specific population** | **100** | A relatively small specific population group is concerned by the impact (e.g. people living in proximity to an operation) |
| **Medium population group** | **1,000** | A medium size population group is concerned by the impact (e.g. people living downstream a river that may be contaminated by an operation) |
| **Large population group** | **10,000** | A large population group is concerned by the impact (e.g. consumers of a widely used product of an operation) |
| **Major population group** | **100,000** | A major population group is concerned by the impact (e.g. a small city that will gain access to safe drinking water) |
| **LIKELIHOOD or FREQUENCY (LoF)** | | |
| **Category** | **Score** | **Description** |
| **Very unlikely** | **0.05** | It is very unlikely that the impact will occur (odds: <5%). Frequency: once every 5 years |
| **Unlikely** | **0.3** | It is unlikely that the impact will occur (odds: 5–40%). Frequency: once a year |
| **Possible** | **0.5** | It is possible that the impact will occur (odds: 41-60%). Frequency: once a month |
| **Likely** | **0.7** | It is likely that the impact will occur (odds: 61-95%). Frequency: once a week |
| **Almost certain** | **0.95** | It is almost certain that the impact will occur (odds: >95%). Frequency: once a day |

*Figure 9: Definition of impact level and likelihood for the HIA (adapted from Winkler et al. (2010))*

| | | | PEOPLE AFFECTED (PA) | | | | |
|---|---|---|---|---|---|---|---|
| | | | Individual cases | Specific population | Medium population group | Large population group | Major population |
| | | | 1 | 100 | 1,000 | 10,000 | 100,000 |
| IMPACT LEVEL (IL) | Major positive impact | 1 | 0.05 | 30 | 500 | 7,000 | 95,000 |
| | Moderate positive impact | 0.5 | 0.03 | 15 | 250 | 3,500 | 47,500 |
| | Minor positive impact | 0.1 | 0.01 | 3 | 50 | 700 | 9,500 |
| | Insignificant | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Minor negative impact | -0.1 | -0.01 | -3 | -50 | -700 | -9,500 |
| | Moderate negative impact | -0.5 | -0.03 | -15 | -250 | -3,500 | -47,500 |
| | Major negative impact | -1 | -0.05 | -30 | -500 | -7,000 | -95,000 |
| | | | 0.05 | 0.3 | 0.5 | 0.7 | 0.95 |
| | | | Very unlikely | Unlikely | Possible | Likely | Almost certain |
| | | | LIKELIHOOD or FREQUENCY (LoF) | | | | |

*Figure 10: Impact assessment matrix [adapted from Winkler et al. (2010)]*

## 4.10 Eligibility

All healthcare facilities in the study districts (as determined by the sample estimates) were studied. For the qualitative component, we conducted interviews with only those individuals who were involved in either climate change related work or the delivery of healthcare services. Only VHTs at the reference healthcare facilitie who had been residents for atleast three years and consented to participate were included in the sample. Three years were considered adequate for observing weather patterns in the areas where the healthcare facilities were located.

Healthcare facilities whose managers declined to participate were excluded. VHTs who are sick or mentally unsound were also excluded from our sample.

## 4.11 Data management and analysis plan

A digital questionnaire was preloaded on mobile devices such as phones and tablets, and data collected using the KoboCollect mobile application. The questionnaire was designed with appropriate skip patterns and validation criteria to enable accurate data capture. During data collection, research assistants were required to upload the data daily to the cloud server for quality control purposes. Upon submission, data was downloaded into the Microsoft Excel program for cleaning. Data cleaning involved the removal of unwanted or duplicate observations from the dataset (de-duplication), fixing structural errors such as typos, or incorrect capitalization, filtering unwanted outliers, handle missing data, and validation. Common inconsistencies were communicated to field teams through their supervisors to ensure that caution was taken to avoid future errors. To avoid loss of data, datasets were backed up at the end of each data collection day on a central computer and another copy on a flash drive was kept with the data supervisor. After all, data had been collected and entered, it was transferred to Stata for analysis. STATA version 16.0 was used for analyses. Descriptive statistics such as, means and standard deviations, and medians, and interquartile range were used to summarize continuous data while frequencies and proportions were used to summarize data.

### *4.11.1 Qualitative data*

All qualitative interviews was conducted in English. All the interviews were tape-recorded to reduce recall bias by the researcher. The audio files were then be transcribed verbatim. All transcripts were

categorized and coded using the ATLAS ti software. Thereafter, themes were developed and summarized using a data master sheet. The information generated from the different KIs was triangulated to give more meaning to the study findings. Thematic content analysis was used to analyse the transcripts. To ensure the reliability of the coding frame, intercoder or interrater assessments was undertaken during the analysis. Intercoder reliability stems from interrelated coding and this looks at the consistency, reliability, transparency and validity of relevant codes, themes, concepts and words. To ensure reliability of the coding process, two qualitative experts independently developed a standardised codebook with its definitions, which was afterwards discussed to facilitate deliberations on the codes, emerging themes and subthemes (Cliodhna O'Connor, 2020, Daniel Tunner, 2022). This process facilitated robustness of the coding frame and its application. Intercoder reliability was calculated using a percent agreement between coefficient indices, which is a common statistical approach in measuring codes and themes (Cliodhna O'Connor, 2020). These percentage agreements, including disagreements, were calculated manually to allow for multiple coding of datasets. Intercoder reliability is useful for thematic and content analysis in qualitative methodology, not only reflections and interpretations but also for trustworthiness and quantifying diverse empirical data. Moreover, this data analysis tool is also systematic to avoid duplications, identify limitations and define conceptual relations. Intercoder reliability is also useful for other researchers to replicate the study and consider other interpretations and knowledge fields (Niek Mouter, 2012).

## 4.12 Quality assurance and quality control procedures

Research assistants (RAs) were recruited from a well-established network of RAs that have participated in successful research projects. All RAs were trained on the research protocol and ethical issues surrounding the study to ensure quality data collection. The consultant only recruited RAs who were well conversant with English and a local language likely to be used by some study participants. The researcher, together with the RAs conducted a pre-test of the quantitative data collection tools. This was aimed at enabling the RAs to familiarize themselves with the data collection tools and also correct any errors if discovered. The pre-test activity was conducted in a district that was not be included in the final sample. In addition, the researcher instituted a data quality control system which included review and editing of data from the field to ensure completeness. The quality control (QC) team conducted a sample of re-interviews to ensure consistency and accuracy of the data. To ensure quality quantitative data entry, the data entry screen was designed with skips and restrictions to ensure quality data entry. Double data entry was also be carried out to further minimize possible errors. On the other hand, the consultant ensured that qualitative data was collected by experienced qualitative researchers with sound competencies in probing and eliciting information from the study participants.

## 4.13 Methods matrix

| Objective | Data collection method and tools | Sample size | Respondents | Analysis plan |
|---|---|---|---|---|
| To describe and quantify climate-change related risks (present and future risks) on the health sector in Uganda<br><br>To describe and quantify the potential impacts (present and future) of climate change on the health sector in Uganda | Structured questionnaire preloaded on KoboCollect mobile data collection application. Adopted the checklists used by WHO to assess vulnerabilities in healthcare facilities in the context of climate change. We was focus on the different components of the healthcare facility including; the health workforce, WASH and healthcare waste, energy, and infrastructure, technologies, products, and processes | 726 HCFs | Healthcare facility managers | Descriptive statistics (frequencies and proportions) was performed to summarize data |
| | Field visits | 726 HCFs | | |
| | Hazard Identification template | 726 HCFs | | |
| | Focus group discussions using an FGD guide | 20 | VHTs and members of health unit management committeess | Thematic content analysis was used to analyse the transcripts. ATLAS ti 23.0 was aid the analysis. |
| To describe current risks of climate-sensitive diseases and health outcomes in Uganda | Data abstraction form | 43 districts/726 healthcare facilities | Source: HMIS data | Descriptive statistics |
| To identify policies, programmes, and adaptation mechanisms that should be prioritized to effectively mitigate, adapt, and respond to climate change-related risks and impacts in the health sector in Uganda | Key informant interviews (KIs) using a KI interview guide. | 30 KIIs | • Officials from relevant government ministries and departments (MOH, MWE, MAAIF, national climate change team; emergency and disaster risk management team; hydrometeorological agencies; and others, as well as the heads of vector-borne disease and other | Thematic content analysis was used to analyse the transcripts. ATLAS ti 23.0 was aid the analysis. |

| | | | | |
|---|---|---|---|---|
| | | | control programs)<br>• Technical staff of non-government agencies and humanitarian organizations<br>• Academia/researchers<br>• Civil society (community representatives) | |
| To explore how monitoring and evaluation of mitigation, adaptation, and response measures to climate-change-related risks and impacts on the health sector in Uganda should be done | Key informant interviews (KIIs) using a KI interview guide. | 30 KIIs | • Officials from relevant government ministries and departments (MOH, MWE, MAAIF, national climate change team; emergency and disaster risk management team; hydrometeorological agencies; and others, heads of vector-borne disease and other control programs)<br>• Technical staff of NGOs and humanitarian organizations<br>• Academia/researchers<br>• Civil society (community representatives) | Thematic content analysis was used to analyse the transcripts. ATLAS ti 23.0 was aid the analysis. |

## 4.14 Validation and dissemination of study findings

### 4.14.1.1 *Hold a vision-building workshop to develop recommendations and prepare a summary report*

The vision-building workshop will provide an avenue for discussing the climate-associated health impacts and opportunities for mitigating the impact of climate change. During the same workshop, the key stakeholders will develop recommendations and prepare a summary report. The report will provide a comprehensive account of the latest in climate and health information in the country. It will detail impacts, opportunities, a systems assessment, and recommendations for actions and investments. In addition, it will incorporate factors such as the likelihood and timing of the threat, competing demands, windows of opportunity based on current and planned projects and investments, and stakeholder concerns and preferences.

### 4.14.1.2 *Present and validate report findings and recommendations*

The report is anticipated to provide a comprehensive overview of the latest climate and health information in the country, summarizing risks and opportunities, assessing systems, and recommending actions and investments. This stage will bring together participants in the launch and vision-building workshops with decision-makers and other stakeholders to present the findings of the diagnostic and discuss priority recommendations. The validation workshop is expected to result in agreed priorities and next steps to increase resilience and low-carbon growth in the context of the capacity of health systems and barriers and constraints to investments.

## 4.15 Community engagement plan

This study was conceptualized after consultation with the Ministry of Health, which has the mandate to manage the health sector. Aside, other key players such as the Ministry of Water and Environment, the private sector, and the communities served, especially by healthcare facilities in the high-risk zones for climate shocks were consulted. During the implementation of the study, the village health team and members of the health unit management committees were involved in the mobilization of study participants in order to increase their participation in the study. Furthermore, VHTs with a minimum of a diploma were involved in the data collection process thus creating a sense of ownership of the study findings. Also, VHTs, healthcare facility managers, and the district health managers were involved in the validation of study findings, and review of policy briefs to ensure that all their problems are fronted to the policymakers.

## 4.16 Ethical considerations

Ethical approval wasobtained from Makerere University School of Public Health Research Ethics Committee (HDREC) and the Uganda National Council for Science and Technology (UNCST). Permission to interview the district managers and other stakeholders was obtained from the relevant employers. Informed written consent was obtained from all study participants.

# 5 RESULTS

## 5.1 Characteristics of the study Healthcare Facilities (HCFs)

### 5.1.1 Level of Healthcare facility

About 45.8% were health centre IIIs, 40.9% were health centre IIs, 8.7% were health centre IVs, 4.3% were general hospitals and only 0.3% were regional referral hospitals (Fig 2)

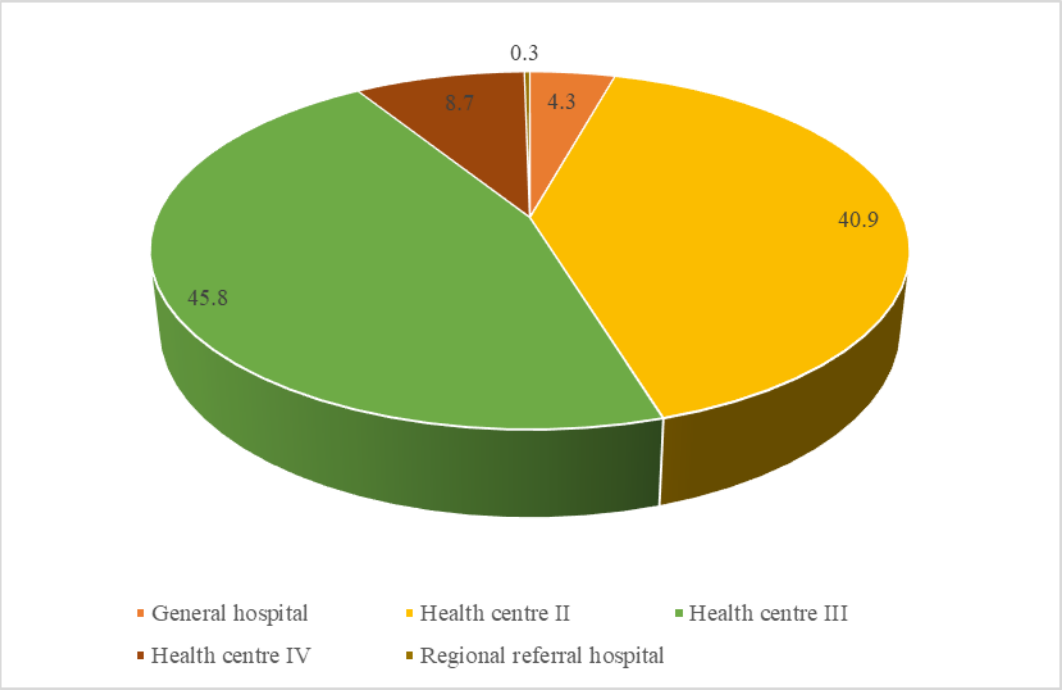



*Figure 11: Level of healthcare facility*

### 5.1.2 Ownership of the facility

Almost all, 90.4% of the healthcare facilities were owned by the government, 9.2% were private not for profit and 0.4% were private for profit (Fig 3)

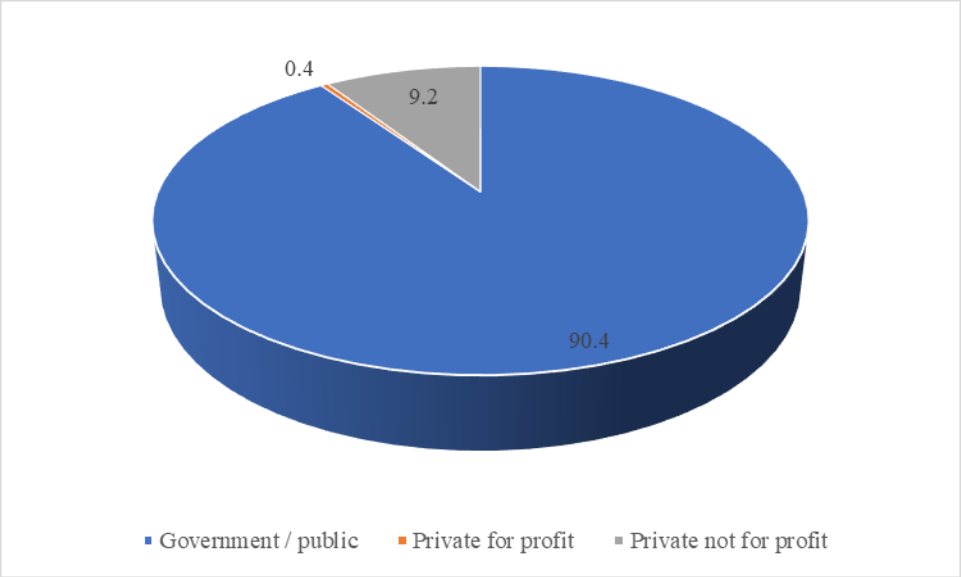



*Figure 12: Ownership of the facility*

### 5.2 Exposure to Climate Change related hazards in Healthcare Facilities in Uganda

Nearly half, 47.6% of the HCFs were exposed to drought, 39.7% were exposed to floods, 31.1% were exposed to storms, 12.0% were exposed to water level rise, 11.7% were exposed to landslides, 8.9% were exposed to lightening, 2.0% were exposed to heat wave and 0.1% were exposed to a cold wave. (Figure 1).

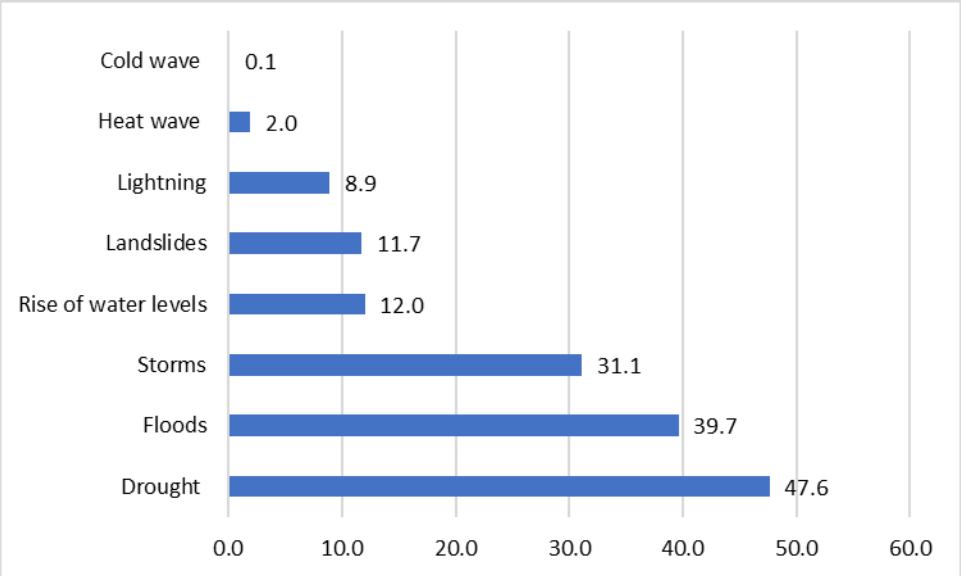



*Figure 13: Hazards or exposure present at the healthcare facility*

## 5.3 Vulnerability to drought

### 5.3.1 Vulnerability of the health workforce to drought

More than half (58.1%) of the HCFs were classified as highly vulnerable due to non-participation of the health workforce in adaptation plans and policies. A significant proportion (60.4%) of the HCFs did not provide their workforce with sunscreen, hat, and plenty of drinking water for carrying out outdoor work, demonstrating high vulnerability to drought. Nearly half (49.3%) showed high vulnerability, lacking provisions for drinking for their workforce. Over half (56.0%) had high vulnerability since their HCWs lacked training to identify health conditions worsened by drought. A significant portion (61.6%) exhibited high vulnerability, because their staff lacked knowledge and resources for emergency preparedness. (Table 2).

***Table 1: Vulnerability of the health workforce to drought among healthcare facilities in Uganda***

| **WORKFORCE** | **Vulnerability level** | | |
|---|---|---|---|
| | **High** | **Medium** | **Low** |
| ***Vulnerability scale: 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)*** | | | |
| **The health workforce** | | | |
| **Human Resource** | | | |
| Participates in drought, water, and climate change adaptation plans and policies | 198 (58.1) | 98 (28.7) | 45 (13.2) |
| Equipped with a plan to identify minimum needs for health workers to ensure operational | 178 (52.2) | 109 (32.0) | 54 (15.8) |
| Equipped with a plan for scheduling outdoor work for cooler times of the day and reducing | 201 (58.9) | 90 (26.4) | 50 (14.7) |
| Provided with sunscreen, hat, and plenty of drinking water for staff carrying out outdoor | 206 (60.4) | 93 (27.3) | 42 (12.3) |
| Provided with drinking water and stimulated regularly for appropriate water intake | 168 (49.3) | 113 (33.1) | 60 (17.6) |
| **Capacity Development** | | | |
| Trained to identify health conditions made worse by drought | 191 (56.0) | 91 (26.7) | 59 (17.3) |
| Equipped with knowledge, experience, training, and resources to manage emergency preparedness plans and response measures to reduce drought risks and impacts | 210 (61.6) | 94 (27.6) | 37 (10.9) |
| Trained in multi-hazard assessments | 243 (71.3) | 72 (21.1) | 26 (7.6) |
| Trained to manage hazardous chemicals | 192 (56.3) | 97 (28.4) | 52 (15.2) |
| Trained on how to treat stored water for human consumption | 114 (33.4) | 116 (34.0) | 111 (32.6) |
| Trained or prepared to quantify drought-sensitive diseases considering the special drought patterns | 187 (54.8) | 112 (32.8) | 42 (12.3) |
| 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 | 175 (51.3) | 123 (36.1) | 43 (12.6) |
| Trained to an appropriate standard to maintain the correct level of safety of electrical power supply, in both routine and emergency/disaster situations | 217 (63.6) | 87 (25.5) | 37 (10.9) |
| **Communication and awareness-raising** | | | |
| Aware of the different impacts of drought on human health | 73 (21.4) | 162 (47.5) | 106 (31.1) |
| Informed of air pollution advisories and warnings | 144 (42.2) | 131(38.4) | 66 (19.4) |
| Prepared with clear messaging about water and food safety | 137 (40.2) | 148 (43.4) | 56 (16.4) |

| | | | |
|---|---|---|---|
| during and after a drought | | | |
| Informed on how to use and follow a surveillance system to track health outcomes | 125 (36.7) | 124 (36.4) | 92 (27.0) |
| 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 associated with direct and indirect impacts of drought | 185 (54.3) | 123 (36.1) | 33 (9.7) |
| 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 | 204 (59.8) | 101 (29.6) | 36 (10.6) |
| 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 | 178 (52.2) | 119(34.9) | 44 (12.9) |
| Provided with an effective emergency risk communication plan | 228 (66.9) | 75 (22.0) | 38 (11.1) |
| 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) | 97 (28.4) | 123 (36.1) | 121 (35.5) |
| **Monitoring and assessment** | | | |
| Verifies water safety conditions, which include updated risk assessments to map water resources and water supplies for the facility | 126 (37.0) | 132 (38.7) | 83 (24.3) |
| Has an updated plan to map risks to the water and sanitation infrastructure to identify where services could be disrupted from water scarcity | 163 (47.8) | 112 (32.8) | 66 (19.4) |
| Regularly inspects the rainwater harvesting system for damage and contamination | 117 (34.3) | 119 (34.9) | 105 (30.8) |
| Has an evaluation system to monitor water drips, leaks and unnecessary flows in bathrooms, laundry facilities, kitchen, etc.; and perform prompt repairs to avoid losses avoid loss | 129 (37.8) | 112 (32.8) | 100 (29.3) |
| Verifies safety conditions and proper functioning of all elements of the water distribution system in preparation for drought valves, pipes and connections, and water disinfection) | 132 (38.7) | 127 (37.2) | 82 (24.0) |
| Has information on the water system installation that ensures lower risk of being contaminated | 121 (35.5) | 138 (40.5) | 82 (24.0) |
| Has a water quality monitoring plan for human consumption | 162 (47.5) | 108 (31.7) | 71 (20.8) |
| Has a monitoring plan for potable water | 178 (52.2) | 110 (32.3) | 53 (15.5) |

### 5.3.2 Vulnerability of the WASH component to drought

Nearly half (44.6%) of healthcare facilities demonstrated high vulnerability due to the absence of a water management plan to identify water contamination. More than half (53.7%) showed high vulnerability, lacking a contingency plan for monitoring and reducing contaminant concentrations. Over one-third (36.7%) demonstrated high vulnerability, storing chemicals without protection from excessive heat. More than half (54.3%) were highly vulnerable, lacking onsite water purification equipment. A significant majority (61.0%) of healthcare facilities exhibited high vulnerability, lacking a long-term drought management plan. Over 61.6% showed high vulnerability, lacking established procedures for water procurement, transport, and safe storage. Nearly 60% (59.2%) showed high

vulnerability, lacking a contingency plan for the delivery of safe water during drought and emergencies. (Table 3).

**Table 2: Vulnerability of the WASH component to drought among healthcare facilities in Uganda**

| WATER, SANITATION, AND HEALTHCARE WASTE; | Vulnerability level | | |
|---|---|---|---|
| | High | Medium | Low |
| ***Vulnerability scale: 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)*** | | | |
| **The health care facility** | | | |
| **Risk Management** | | | |
| Has a water management plan to identify water contamination | 152 (44.6) | 125 (36.7) | 64 (18.8) |
| Has a contingency plan for monitoring and reducing contaminant concentrations in the facility water system supplies | 183 (53.7) | 105 (30.8) | 53 (15.5) |
| Has a water management system to avoid or reduce vector breeding sites | 139 (40.8) | 107 (31.4) | 95 (27.9) |
| Has anti-mosquito breeding measures to avoid vector-borne diseases | 98 (28.7) | 123 (36.1) | 120 (35.2) |
| Has a rainwater catchment system with safe water storage | 107 (31.4) | 105(30.8) | 129 (37.8) |
| Has water storage tanks with appropriate covers to prevent contamination | 94 (27.6) | 105 (30.8) | 142 (41.6) |
| Has water storage that is protected from direct sunlight | 142 (41.6) | 86 (25.2) | 113 (33.1) |
| Has chemicals stored away from excessive heat | 125 (36.7) | 86 (25.2) | 130 (38.1) |
| Provides sufficient drinking water to staff, patients, and visitors | 101 (29.6) | 132 (38.7) | 108 (31.7) |
| Has onsite water purification equipment to provide safe drinking water | 185 (54.3) | 78 (22.9) | 78 (22.9) |
| Has a surveillance system for diseases related to water quality and sanitation | 100 (29.3) | 132 (38.7) | 109 (32.0) |
| **Health and Safety Regulations** | | | |
| Has a long-term drought management plan, including the identification of available alternative safe water sources | 208 (61.0) | 93 (27.3) | 40 (11.7) |
| Has established procedures for procuring, transporting, and safely storing water | 210 (61.6) | 88 (25.8) | 43 (12.6) |
| Works with water utility agencies to prevent suspension of services | 188 (55.1) | 89 (26.1) | 64 (18.8) |
| Has a water safety plan in place, in case of water contamination | 188 (55.1) | 107 (31.4) | 46 (13.5) |
| Has a plan to conserve and manage water to reduce water usage, specifically in case of prolonged drought | 156 (45.7) | 118 (34.6) | 67 (19.6) |
| Has a cross-sectoral water management plan to conserve and protect local or alternative water sources | 186 (54.5) | 108 (31.7) | 47 (13.8) |
| Has 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 | 149 (43.7) | 106 (31.1) | 86 (25.2) |
| Has a contingency plan to ensure effective and timely | 202 (59.2) | 89 (26.1) | 50 (14.7) |

| | | | |
|---|---|---|---|
| delivery of safe water during drought and emergencies over the short- and long-term | | | |

### 5.3.3 Vulnerability of the energy component to drought

Nearly half (44.3%) of HCFs were classified as highly vulnerable due to irregular assessments of their energy system's ability to cope with drought conditions. A significant majority (73.0%) demonstrated high vulnerability, lacking adequate emergency backup generator coverage for critical service areas during and after events. Similarly, a considerable majority (72.7%) exhibited high vulnerability by not regularly checking their emergency backup generators. Over 57.8% were vulnerable because they did not have an emergency plan for power outages in the short- and long-term (Table 4).

**Table 3: Vulnerability of the energy component to drought**

| **ENERGY** | **Vulnerability level** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Monitoring and Assessment** | | | |
| **The health care facility** | **High** | **Medium** | **Low** |
| Regularly assesses its energy system to ensure it can cope with drought conditions | 151 (44.3) | 119 (34.9) | 71 (20.8) |
| HCF has 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 | 249 (73.0) | 37 (10.9) | 55 (16.1) |
| Periodically checks the emergency backup generator (including fuel, where relevant) | 248 (72.7) | 37 (10.9) | 56 (16.4) |
| Assesses regularly heating, ventilation and air conditioning systems | 185 (54.3) | 90 (26.4) | 66 (19.4) |
| Assesses whether renewable energy (if available, such as solar) is sufficient to power critical equipment | 121 (35.5) | 122 (35.8) | 98 (28.7) |
| **Risk Management** | | | |
| Has appliance thermometers in the refrigerator and freezer to determine if food, vaccines and other essential refrigeration-dependent medical supplies are safe | 55 (16.1) | 53 (15.5) | 233 (68.3) |
| Has adequate daylight to ensure proper visibility during a power outage | 62 (18.2) | 66 (19.4) | 213 (62.5) |
| Works with energy utility agencies to prevent suspension of electricity services | 169 (49.6) | 89 (26.1) | 83 (24.3) |
| Has power-operated doors that can be opened manually to permit exit in case of power failure | 205 (60.1) | 34 (10.0) | 102 (29.9) |
| Has a clear guidance on heat-risk management for the maintenance of critical infrastructure | 211 (61.9) | 82 (24.0) | 48 (14.1) |
| **Health and safety regulations** | | | |
| Has an emergency plan for power outages in the short- and long-term | 197 (57.8) | 87 (25.5) | 57 (16.7) |
| Has a plan or regulation to determine ways to reduce overall energy use | 175 (51.3) | 111 (32.6) | 55 (16.1) |
| Works with energy utility agencies to prevent suspension of electricity services | 185 (54.3) | 82 (24.0) | 74 (31.7) |
| Has an emergency plan to ensure availability of adequate lighting, communication and information systems, and refrigeration and sterilization equipment during a drought | 139 (40.8) | 128 (37.5) | 74 (21.7) |
| Has a plan to evacuate patients to a cooling station if the | 245 (71.8) | 59 (17.3) | 37 (10.9) |

| | | | |
|---|---|---|---|
| facility has lost power and has no other source of energy | | | |
| Has a plan to ensure that the walls and roofs of the facility are insulated | 194 (56.9) | 82 (24.0) | 65 (19.1) |

### 5.3.4 Vulnerability of infrastructure, technologies, production and processes to drought

A significant majority (75.1%) demonstrated high vulnerability since the health workforce was not prepared and trained for periods of extreme drought. About 70.4% of the HCFs were highly vulnerable since they were unable to perform assessments of drought conditions and implement preventive actions. More than half, 57.8% of the HCFs were highly vulnerable since they did not assess the performance and vulnerabilities of each critical part of the facility (structural and nonstructural elements) that can be affected by hot temperatures. Around 71% (71.0%) showed high vulnerability, lacking a monitoring and early warning system for drought impacts. Over 72.1% showed high vulnerability, lacking a mechanism to filter indoor and ambient air pollutants. (Table 5)

*Table 4: Vulnerability of infrastructure, technologies, production and processes to drought*

| **INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES:** | **Vulnerability level** | | |
|---|---|---|---|
| ***Vulnerability scale: 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** |
| **Adaptation of current systems and infrastructures** | | | |
| **The health care facility** | | | |
| Has health workforce preparedness and training for periods of extreme drought in place | 256 (75.1) | 64 (18.8) | 21 (6.2) |
| Performs assessments of drought conditions – current, past trends and future changes – to implement preventive actions | 240 (70.4) | 82 (24.0) | 19 (5.6) |
| Assesses the performance and vulnerabilities of each critical part of the facility (structural and nonstructural elements) that can be affected by hot temperatures | 197 (57.8) | 104 (30.5) | 40 (11.7) |
| Has a monitoring and early warning system integrated with other areas to manage risks related to drought impacts on the facility | 242 (71.0) | 72 (21.1) | 27 (7.9) |
| Has a mechanism to rapidly supply or restore water services to the facility | 183 (53.7) | 98 (28.7) | 60 (17.6) |
| Conducts ongoing and post drought evaluations to identify success and weakness to improve preventive measures | 232 (68.0) | 90 (26.4) | 19 (5.6) |
| Assesses the capacity of heating, ventilation and air-conditioning systems to deal with increasing heat | 204 (59.8) | 91 (26.7) | 46 (13.5) |
| Has exterior shading devices, trees or other architectural features that mitigate heat and dryness | 102 (29.9) | 132 (38.7) | 107 (31.4) |
| Has openable windows to provide for ventilation and to maintain habitable conditions | 47 (13.8) | 90 (26.4) | 204 (59.8) |
| Installs reflective white roofs to reduce heat impacts | 178 (52.2) | 82 (24.0) | 81 (23.8) |
| Has pavements and roofs designed to withstand extreme temperatures or solar radiation | 167 (49.0) | 111 (32.6) | 63 (18.5) |
| Has a mechanism to filter indoor and ambient air pollutants | 246 (72.1) | 63 (18.5) | 32 (9.4) |
| Has a system for cooling the environment | 241 (70.7) | 70 (20.5) | 30 (8.8) |
| Identifies vulnerabilities to implement actions to reduce impacts | 214 (62.8) | 98 (28.7) | 29 (8.5) |
| Stimulates increase of water intake by staff and patients | 122 (35.8) | 141 (41.3) | 78 (22.9) |

| | | | |
|---|---|---|---|
| Stores chemicals away from excessive heat | 94 (27.6) | 109 (32.0) | 138 (40.5) |
| Has 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 drought | 173 (50.7) | 112 (32.8) | 56 (16.4) |
| Has an effective risk communication plan to communicate clear messages of the danger of heatwaves and dehydration emphasizing health protection as a priority | 184 (54.0) | 109 (32.0) | 48 (14.1) |
| **Promotion of new systems and technologies** | | | |
| Has an information system between the health sector and meteorological services to communicate about the climate hazard | 248 (72.7) | 69 (20.2) | 24 (7.0) |
| Has a syndromic surveillance system for drought-related illnesses | 196 (57.5) | 101 (29.6) | 44 (12.9) |
| Have an assessment plan for identifying vulnerability conditions considering the degree or extent of potential damage or loss in the event of a drought | 233 (68.3) | 79 (23.2) | 29 (8.5) |
| Has identified capacities, resources and needs to better cope and manage a drought event | 239 (70.1) | 81 (23.8) | 21 (6.2) |
| Has 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 post drought events post drought events | 236 (69.2) | 85 (24.9) | 20 (5.9) |
| Ensure information and communication flow between health workforce and policy makers, particularly, during high stress situations and demands created by emergencies | 154 (45.2) | 133 (39.0) | 54 (15.8) |
| Has trees and plants which are resilient to drought surrounding the facility | 78 (22.9) | 129 (37.8) | 134 (39.3) |
| Has an information system for tracking and monitoring diseases following drought events | 135 (39.6) | 124 (36.4) | 82 (24.0) |
| Has measures that improve health performance, based on a history of climate variability in the region or locality | 185 (54.3) | 113 (33.1) | 43 (12.6) |
| **Sustainability of Healthcare facility Operations** | | | |
| Has procedures for procuring, transporting and safely storing water supplies | 175 (51.3) | 113 (33.1) | 53 (15.5) |
| Has a defined and sustained budget as part of core budgeting for emergency preparedness and response to drought risks | 248 (72.7) | 74 (21.7) | 19 (5.6) |
| Has established partnerships between the facility, community and local authorities to reduce vulnerabilities in the surrounding areas | 160 (46.9) | 129 (37.8) | 52 (15.2) |
| Has trees and leafy plants near windows to provide natural cooling | 113 (33.1) | 131 (38.4) | 97 (28.4) |
| Has a plan to conserve and manage water to reduce water usage, specifically in case of prolonged drought | 139 (40.8) | 145 (42.5) | 57 (16.7) |
| Has 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 | 207 (60.7) | 104 (30.5) | 30 (8.8) |
| Has established requirements or provided incentives to encourage water conservation in the facility and also in the communities | 209 (61.3) | 98 (28.7) | 34 (10.0) |

| | | | |
|---|---|---|---|
| Has a coordinated plan with health municipal department heads to ensure appropriate preparations for ongoing drought conditions | 222 (65.1) | 93 (27.3) | 26 (7.6) |
| Explores the relationship between social learning and adaptation measures in the face of drought threats to identify and implement the best behavioral responses from successful health facilities | 212 (62.2) | 108 (31.7) | 21 (6.2) |
| Undertakes risk assessments of the supply chain for essential medical and nonmedical products | 150 (44.0) | 129 (37.8) | 62 (18.2) |
| Has secure access to essential backup food sources via multiple agreements with different vendors and through cooperative agreements with other healthcare facilities | 252 (73.9) | 65 (19.1) | 24 (7.0) |

## 5.4 Vulnerability to storms

### 5.4.1 Vulnerability of the health workforce to storms

More than three quarters, 83.0% (185/223) of the HCFs were highly vulnerable to storms because their workforce was unprepared with a post-storm employee recovery assistance programme according to staff needs.
(Table 11).

***Table 5: Vulnerability of the health workforce to storms***

| **WORKFORCE** | **Vulnerability level** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Human Resource** | | | |
| **The health workforce** | High | Medium | Low |
| Provided with programs for supporting staff with regards to mental health, injuries, medical treatment and related support measures | 108 (48.4) | 91 (40.8) | 24 (10.8) |
| 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 | 15 0(67.3) | 48 (21.5) | 25 (11.2) |
| Prepared with a contingency plan for accessing additional health workforce to strengthen performance capacity | 146 (65.5) | 65 (29.1) | 12 (5.4) |
| Provided with an information system to manage occupational safety and health in the facility during a storm | 126 (56.5) | 69 (30.9) | 28 (12.6) |
| Provided with a post-storm employee recovery assistance program according to staff needs | 185 (83.0) | 23 (10.3) | 15 (6.7) |
| Equipped with a coordinated plan, including volunteers on stand-by, to assist during an emergency or to support health professionals | 156 (70.0) | 44 (19.7) | 23 (10.3) |
| Provided with full personal protective equipment, especially for clean-up crews (including waterproof safety boots, goggles, work gloves and masks) | 66 (29.6) | 98 (43.9) | 59 (26.5) |
| Provided with safe water and food during an event | 131 (58.7) | 65 (29.1) | 27 (12.1) |
| **Capacity Development** | | | |
| Trained on public health and climate change hazards, including health impacts related to different kinds of storms | 171 (76.7) | 41 (18.4) | 11 (4.9) |

| | | | |
|---|---|---|---|
| Equipped with knowledge, experience, training and resources to manage storm risk reduction at the facility and in the local communities | 168 (75.7) | 41 (18.5) | 13 (5.9) |
| Engaged in the development of plans and responses to storm risks | 168 (75.3) | 39 (17.5) | 16 (7.2) |
| Prepared and able to implement risk reduction actions to protect themselves | 125 (56.1) | 80 (35.9) | 18 (8.1) |
| Equipped with a contingency plan for continuing to provide services at other facilities or in the local communities (primary health care), if necessary | 122 (54.7) | 74 (33.2) | 27 (12.1) |
| Trained to manage hazardous chemicals in emergency situations | 151 (67.7) | 43 (19.3) | 29 (13.0) |
| Trained in multi-hazard assessments | 169 (76.5) | 37 (16.7) | 15 (6.8) |
| Trained to maintain correct level of water quality controls in an emergency or disaster situations | 171 (77.0) | 36 (16.2) | 15 (6.7) |
| Trained to an appropriate standard to maintain the correct level of safety of electrical power supply, in both routine and emergency/disaster situations | 168 (76.4) | 37 (16.8) | (6.8)15 |
| Trained to detect posttraumatic stress disorder among staff to take prompt action | 105 (47.1) | 90 (40.4) | 28 (12.6) |
| **Communication and awareness-raising** | | | |
| Provided with a safe internal communication system, especially in emergency situations | 99 (45.0) | 78 (35.4) | 43 (19.5) |
| Aware of contingency plans for accessing and leaving the facility during flood and strong wind emergencies, and health workforce transportation | 156 (70.6) | 52 (23.5) | 13 (5.9) |
| 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 | 142 (64.5) | 66 (30.0) | 12 (5.4) |
| Prepared with clear messaging about water and food safety during and after a storm | 128 (57.9) | 72 (32.6) | 21 (9.5) |
| Prepared with clear messaging, and staff trained on exit and evacuation routes that are clearly marked and free of obstacles to enable emergency evacuation | 163 (73.8) | 44 (19.9) | 14 (6.3) |
| Equipped with a community health educational Programme to assist the community in reducing vulnerability to storm impacts | 120 (53.8) | 78 (35.0) | 25 (11.2) |
| Equipped with a community health educational Programme to improve community health in the face of storm risks | 110 (49.3) | 87 (39.0) | 25 (11.2) |
| **Monitoring and assessment** | | | |
| Assess the capacity of the existing stormwater management system, to ensure adequacy for anticipated 50- or 100-year storm events today | 171 (77.7) | 42(19.1) | 7 (3.2) |
| Verify water safety conditions, including updated risk assessments to map water resources and water supplies for the facility | 102 (45.9) | 85 (38.3) | 35 (15.8) |
| Regularly assess its sanitation systems for any possible damage in the event of storms and severe winds | 71 (32.1) | 114 (51.6) | 36 (16.3) |
| Have information on water system installation that ensures lower risk of contamination | 73 (33.2) | 98 (33.2) | 49 (33.2) |

| | | | |
|---|---|---|---|
| Have a water quality monitoring plan for drinking water during and after the event | 108 (48.9) | 83 (37.6) | 30 (13.6) |
| Monitor sewer overflows to fix pumps in advance of a storm and after the event | 129 (64.5) | 47 (23.5) | 24 (12.0) |

### 5.4.2 Vulnerability of WASH to storms

Majority, 75.6% of the HCFs were highly vulnerable to storms since they lacked a stormwater management system able to cope with storm-caused floods. Nearly two-thirds, 62.7% did not have a schedule for emptying latrines in advance of storms to avoid overflows and 59.9% did not have an assessment plan that mapped risks to WASH infrastructure to identify where services could be disrupted during storms, floods and landslides. (Table 6).

***Table 6: Vulnerability of WASH to storms among healthcare facilities in different regions of Uganda***

| **WATER, SANITATION, AND HEALTHCARE WASTE;** | **Vulnerability levels** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Risk Management**<br>**The healthcare facility** | **High** | **Medium** | **Low** |
| Have a storm water management system able to cope with storm-caused floods | 167 (75.6) | 43 (19.5) | 11 (5.0) |
| Have a storm water management system to avoid standing water near the facility | 132 (59.2) | 65 (29.1) | 26 (11.7) |
| Store hazardous chemicals, radioactive and biological wastes in a safe place and on a level above the ground floor | 110(51.6) | 59 (27.7) | 44 (20.7) |
| Have a schedule for emptying latrines in advance of storms to avoid overflows | 136 (62.7) | 48 (22.1) | 33 (15.2) |
| Have water storage tanks supported and anchored to resist strong winds and rainfall | 72 (32.7) | 63 (28.6) | 85 (38.6) |
| Have a safe system for waste disposal after a storm | 95 (43.2) | 87 (39.5) | 38 (17.3) |
| Have an established safe management approach to health care waste transport (including hazardous waste) during and after a storm | 126 (56.8) | 62 (27.9) | 34 (15.3) |
| Have onsite water purification equipment to provide safe drinking water | 116 (52.5) | 56 (25.3) | 49 (22.2) |
| Have non return valves installed on water supply pipes to prevent backflows, in case of flooding | 124 (59.9) | 44 (21.3) | 39 (18.8) |
| Have a surveillance system for diseases related to water | 71 (32.0) | 76 (34.2) | 75(33.8) |

| | | | |
|---|---|---|---|
| quality and sanitation | | | |
| Provide appropriate covers for water storage tanks to prevent damage and water contamination | 65 (30.7) | 82(38.7) | 65 (30.7) |
| **Health and Safety Regulations** | | | |
| Have an assessment plan that maps risks to water and sanitation infrastructures to identify where services could be disrupted during storms, floods and landslides | 133 (59.9) | 74 (33.3) | 15 (6.8) |
| Have an emergency water supply plan | 118 (53.4) | 65 (29.4) | 38 (17.2) |
| Have the 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 | 123 (56.7) | 69 (31.8) | 25 (11.5) |
| Have a contingency plan to ensure effective and timely delivery of safe water during extreme temperatures and emergencies over the short- and long-term | 133 (59.9) | 61 (27.5) | 28 (12.6) |
| Have an emergency plan for maintenance and restoration of waste management systems | 112 (50.2) | 80 (35.9) | 31 (13.9) |

### 5.4.3 Vulnerability of the energy component to storms

Vulnerability was assessed based on monitoring and assessment; risk management; and health and safety regulations. Close to half, 49.1% of the HCFs were highly vulnerable to storms since they were unprepared to assess their energy system to ensure that it could cope with storm events and minimize their impacts, 22.6% had a medium vulnerability to storms since they had basic daylight to ensure proper visibility during a power outage, and 65.1% were highly vulnerable to storms since they lacked an emergency plan for power outages in the short- and long-term (before, during and after a storm). Over 78% of the HCFs did not periodically check their emergency backup generators (including fuel, where relevant) (Table 13).

**Table 7: Vulnerability of the energy component to storms**

| ENERGY | Vulnerability levels | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Monitoring and Assessment** | **High** | **Medium** | **Low** |
| **The health care facility** | | | |
| Regularly assess its energy system to ensure that it can cope with storm events and minimize their impacts | 109 (49.1) | 74 (33.3) | 39 (17.6) |
| 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 | 145 (79.7) | 13 (7.1) | 24 (13.2) |
| Periodically check emergency backup generators (including fuel, where relevant) | 128 (78.0) | 12 (7.3) | 24 (14.6) |
| Identify priority areas within the facility which would require emergency power when needed | 82 (37.6) | 76 (34.9) | 60 (27.5) |
| Assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment | 74 (34.1) | 88 (40.6) | 55 (25.3) |
| **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 | 118 (70.2) | 22 (13.1) | 28 (16.7) |
| Have appliance thermometers in the refrigerator and freezer to determine if food, vaccines and other essential refrigeration-dependent medical supplies are safe | 37 (17.0) | 45 (20.6) | 136 (62.4) |
| Have adequate daylight to ensure proper visibility during a power outage | 28 (12.7) | 50 (22.6) | 143 (64.7) |
| Have power-operated doors that can be opened manually to permit exit during power failure | 83 (52.9) | 22 (14.0) | 52 (33.1) |
| Have a clear guidance to alert staff on safety measures | 142 (65.4) | 47 (21.7) | 28 (12.9) |
| **Health and safety regulation** | | | |
| Have an emergency plan for power outages in the short- and long-term (before, during and after a storm) | 142 (65.1) | 51 (23.4) | 25 (11.5) |
| Work with energy utility agencies to prevent suspension of electricity services | 111 (55.0) | 56 (27.7) | 35 (17.3) |
| Have a management plan for intermittent energy supplies or | 133 (62.1) | 51 (23.8) | 30 (14.0) |

| | | | |
|---|---|---|---|
| system failure | | | |
| Have a plan or regulation to determine ways to reduce overall energy use | 126 (58.3) | 63 (29.2) | 27 (12.5) |
| Have an emergency plan to ensure the availability of adequate lighting, communication, and information systems, as well as refrigeration and sterilization equipment during a storm | 106 (48.8) | 77 (35.5) | 34 (15.7) |

### 5.4.4 Vulnerability of infrastructure, technologies, production and processes to storms

Vulnerability was assessed based on adaptation of current systems and infrastructures; and promotion of new systems and technologies and sustainability of healthcare facility operations. About 56.8% of the HCFs were highly vulnerable to storms since they were unable to provide knowledge, experience and resources to reduce disaster risk related to storms. About 40.5% of the HCFs were highly vulnerable to storms since they were unable to work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning and implementation. About 67.1% of the HCFs were highly vulnerable to storms since they were unable to conduct climate risk and vulnerability assessments for all facility sectors to identify risk scenarios, vulnerabilities and the facility's response capacity. Over 76.0% of the HCFs were highly vulnerable to storms since they did not have a monitoring and early warning system to manage and reduce the risks of storm related health effects (Table 14)

**Table 8: Vulnerability of infrastructure, technologies, production and processes to storms**

| **INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES** | **Vulnerability levels** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Adaptation of current systems and infrastructures** | **High** | **Medium** | **Low** |
| **The health care facility** | | | |
| Have knowledge, experience (considering previous damages) and resources (including human, material, financial, supplies chain and logistics) to reduce disaster risk related to storms | 126 (56.8) | 74 (33.3) | 22 (9.9) |
| Work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning and implementation | 90 (40.5) | 99 (44.6) | 33 (14.9) |
| Conduct climate risk and vulnerability assessments for all facility sectors to identify risk scenarios, vulnerabilities and the facility's response capacity | 149 (67.1) | 58 (67.1) | 15 (67.1) |
| Have a monitoring and early warning system to manage and reduce the risks of storm related health effects | 168 (76.0) | 37 (76.0) | 16 (76.0) |
| Utilize the assessed information as a basis to plan and prioritize measures to reduce risk impact | 129 (59.7) | 70 (32.4) | 17 (7.9) |
| In their annual planning consider how climate risks may change in the future | 149 (67.1) | 56 (25.2) | 17 (7.7) |
| Have resources available to adopt risk reduction measures on the building and its infrastructure, technologies, products and processes | 153 (68.9) | 56 (25.2) | 13 (5.9) |
| Regularly update these assessments, considering emerging scientific information | 160 (73.7) | 46 (21.2) | 11 (5.1) |
| 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 | 92 (41.3) | 90 (40.4) | 41 (18.4) |

| | | | |
|---|---|---|---|
| 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 | 100 (44.8) | 78 (35.0) | 45 (20.2) |
| Have an effective emergency risk communication plan to reduce risks and impacts for health workers and patients | 115 (51.8) | 82 (36.9) | 25 (11.3) |
| Have a contingency plan in place for safe and efficient personnel evacuation (including health staff and patients) before, during and following a storm | 153 (69.9) | 52 (23.7) | 14 (6.4) |
| Have a plan to transfer critical equipment and medical supplies to another health care facility or to a secure storage | 113 (51.6) | 74 (33.8) | 32 (14.6) |
| 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 | 116 (53.0) | 66 (30.1) | 37 (16.9) |
| 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 | 144 (65.2) | 56 (25.3) | 21 (9.5) |
| Have a mechanism for providing prompt maintenance and repair of equipment required for essential services | 106 (48.0) | 86 (38.9) | 29 (13.1) |
| 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 | 147 (67.7) | 42 (19.4) | 28 (12.9) |
| Have established procedures or plans for procuring, transporting and storing bottled water and food supplies during an emergency | 165 (76.0) | 35 (16.1) | 17 (7.8) |
| 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 | 119 (54.1) | 67 (30.5) | 34 (15.5) |
| Assess the performance and vulnerabilities of each critical part of the facility (structural and nonstructural elements) that can be affected by storm hazards | 100 (44.8) | 94 (42.2) | 29 (13.0) |
| Calculate possible losses and implement measures to reduce impacts | 129 (57.8) | 75 (33.6) | 19 (8.5) |
| Have a plan to house staff at the health care facility if shelter in place is required (sleeping rooms, food, water) | 102 (45.9) | 79 (35.6) | 41 (18.5) |
| Have roof drainage systems and adequate capacity in the event of excessive rainfall | 74 (33.3) | 84 (37.8) | 64 (28.8) |
| Have roofs that are leak-proof and insulated | 75 (33.6) | 78 (35.0) | 70 (31.4) |
| Have safe roofing designed to withstand wind velocity of 175-250 kph (e.g. In a high intensity tropical storm) | 94 (42.3) | 91 (41.0) | 37 (16.7) |
| Have rooftop structures and equipment which have been reviewed for anticipated storm and high wind speeds | 131 (58.7) | 60 (26.9) | 32 (14.3) |
| Have machine rooms that are resistant to flooding or high wind/rooftop damage | 146 (69.5) | 39 (18.6) | 25 (11.9) |
| Have stairwell construction fortified against high-wind events | 141 (74.6) | 32 (16.9) | 16 (8.5) |
| Have measures in place to remove mosquito breeding sites | 53 (23.8) | 99 (44.4) | 71 (31.8) |
| Have glass walls, doors and windows able to resist basic wind speeds up to 200-250 kph | 101 (46.8) | 76 (35.2) | 39 (18.1) |
| Have laminated or protected glass windows to prevent risk of shattering during a lightning event | 111 (51.2) | 72 (33.2) | 34 (15.7) |
| Have leak proof windows and doors with wind protection devices | 107 (48.6) | 72 (32.7) | 41 (18.6) |

| | | | |
|---|---|---|---|
| Have walls that are protected and insulated against moisture and mold | 87 (39.2) | 79 (35.6) | 56 (25.2) |
| Ensure removal of equipment and power supplies from basements and ground floor level to avoid damage from flooding | 103 (50.0) | 69 (33.5) | 34 (16.5) |
| Have health care agreements with other health care providers for additional health services and clinical resources | 105 (47.5) | 79 (35.7) | 37 (16.7) |
| 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) | 88 (39.6) | 92 (41.4) | 42 (18.9) |
| Have a plan on continuity of operational processes during a storm and for building back better through training and workshops | 135 (61.4) | 71 (32.3) | 14 (6.4) |
| Conduct site and building maintenance procedures that include specifications on how the weather may affect the safety and continued functioning of the facility | 133 (59.9) | 68 (30.6) | 21 (9.5) |
| 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 | 100 (45.2) | 83 (37.6) | 38 (17.2) |
| Have an established poststorm recovery plan for all infrastructure (structural and nonstructural elements) of the facility | 176 (80.0) | 34 (15.5) | 10 (4.5) |
| Have an information system between the health sector and meteorological services to communicate about climate hazards | 170 (78.0) | 39 (17.9) | 9 (4.1) |

**Storm checklist on INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES**

| **INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS, AND PROCESSES: The health care facility** | **Vulnerability levels** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Promotion of new systems and technologies** | **High** | **Medium** | **Low** |
| **The healthcare facility** | | | |
| Have an established plan to review, evaluate, and catalog climate risks related to storms for the healthcare facility location | 184 (83.3) | 30 (13.6) | 7 (3.2) |
| Have an established plan to review, evaluate, and catalog risks related to storms for the healthcare facility supply chain | 174 (78.4) | 43 (19.4) | 5 (2.3) |
| Have an established, clear, and consistent knowledge transfer procedure in case of a public health emergency | 142 (63.7) | 61 (27.4) | 20 (9.0) |
| Have electronic patient health records available to other receiving facilities in case of evacuation | 156 (71.9) | 41 (18.9) | 20 (9.2) |
| Ensure information and communication flow between the health workforce and policymakers, particularly during high-stress situations and demands created by emergencies | 77 (34.5) | 10 2(45.7) | 44 (19.7) |
| Have information and communication systems safely secured with backup arrangement (via cloud, satellite) to satisfy the facility's demand | 160 (73.4) | 41 (18.8) | 17 (7.8) |
| Have an information system for tracking and monitoring diseases following storm events | 98 (43.9) | 80 (35.9) | 45 (20.2) |
| Have more than one access route, especially if the | 107 (48.0) | 59 (26.5) | 57 (25.6) |

| | | | |
|---|---|---|---|
| facility is critical to higher demand following a storm event | | | |
| Review building code design baselines against storm, lightning, wind speeds, and rainfall volumes, and map each risk | 170 (76.6) | 39 (17.6) | 13 (5.9) |
| **Sustainability of Healthcare facility Operations** | | | |
| Have a defined and sustained budget as part of core budgeting for emergency preparedness and response, including for storm hazards | 180 (81.4) | 32 (14.5) | 9 (4.1) |
| Improve adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction and response | 158 (71.2) | 53 (23.9) | 11 (5.0) |
| Have trees planted in a secure place that will not block access to the facility or fall on the building during an event | 49 (22.1) | 102 (45.9) | 71 (32.0) |
| Have established partnerships between the facility, community and local authorities to identify and reduce vulnerabilities in the surrounding areas | 80 (35.9) | 94 (42.2) | 49 (22.0) |
| Have an access route for public transportation which is likely to remain operational during or immediately following a storm event | 80 (36.0) | 70 (31.5) | 72 (32.4) |
| Have a secure storage for critical chemicals and materials to avoid their damage or release during or following a storm event | 123 (55.4) | 64 (28.8) | 35 (15.8) |
| 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) | 92 (41.4) | 81 (36.5) | 49 (22.1) |
| Undertake risk assessments of the supply chain for essential medical and nonmedical products | 103 (46.2) | 81 (36.3) | 39 (17.5) |
| Have a secure plan to ensure continuity of the facility's supply and delivery chain | 72 (32.3) | 80 (35.9) | 71 (31.8) |
| Have secure access to essential backup services such as sterilization, laundry, and cleaning services, via multiple agreements with different facilities to maintain the functioning of critical services during or immediately following a storm event | 119 (54.3) | 59 (26.9) | 41 (18.7) |
| Have secure access to essential backup food sources via multiple agreements with different vendors and through cooperative agreements with other healthcare facilities to maintain the functioning of critical services | 151 (70.9) | 44 (20.7) | 18 (8.5) |

## 5.5 Vulnerability to floods

### 5.5.1 Vulnerability of the health workforce to floods

Vulnerability was assessed based on human resources; capacity development; communication and awareness raising; and monitoring and assessment. Close to half, 48.7% of the HCFs were highly vulnerable to floods since the health workforce was unable to be provided with programmes for supporting staff with regard to mental health, injuries, medical treatment and related support

measures. About 56.9% of the HCFs were highly vulnerable to floods since the health workforce was unable to be equipped with an emergency plan for shift relay or replacement of health professionals to ensure that staff get adequate rest. About 61.5% of the HCFs were highly vulnerable to floods since the health workforce as unable to be prepared with a contingency plan for accessing additional health workforce to strengthen performance capacity. More than half, 55.3% of the HCFs were highly vulnerable since the health workforce was unable to be provided with an information system to manage occupational safety and health in the facility during a flood to strengthen performance capacity (Table 20).

**Table 9: Flood checklist for assessing vulnerabilities on workforce**

| **WORKFORCE** | **Vulnerability levels** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Human resource** The health workforce is | **High** | **Medium** | **Low** |
| Provided with programmes for supporting staff with regard to mental health, injuries, medical treatment and related support measures | 138 (48.7) | 112 (39.6) | 33 (11.7) |
| Equipped with an emergency plan for shift relay or replacement of health professionals to ensure that staff get adequate rest | 161 (56.9) | 89 (31.4) | 33 (11.7) |
| Prepared with a contingency plan for accessing additional health workforce to strengthen performance capacity | 174 (61.5) | 76 (26.9) | 33 (11.7) |
| Provided with an information system to manage occupational safety and health in the facility during a flood to strengthen performance capacity | 157 (55.3) | 94 (33.1) | 33 (11.6) |
| Equipped with an emergency plan to protect health workers from multiple biological and chemical hazards | 170 (59.9) | 85 (29.9) | 28 (9.9) |
| Provided with a post-flood employee recovery assistance program according to staff needs | 222 (79.3) | 40 (14.3) | 18 (6.4) |
| Equipped with a coordinated plan, including volunteers on standby, to assist during an emergency or to support health professionals | 199 (71.1) | 56 (20.0) | 25 (8.9) |
| The healthcare workforce is provided with full personal protective equipment, especially for clean-up crews (including waterproof safety boots, goggles, work gloves and masks) | 90 (31.9) | 131 (46.5) | 61 (21.6) |
| The healthcare workforce is provided with safe water and food during a flood event | 166 (59.1) | 75 (26.7) | 40 (14.2) |
| **Capacity development** | | | |
| The healthcare workforce is trained on public health and climate change hazards including health impacts related to floods | 214 (75.6) | 51 (18.0) | 18 (6.4) |
| The healthcare workforce is equipped with knowledge, experience, training and resources to manage flood risk reduction at the facility and in the local communities | 195 (68.7) | 72 (25.4) | 17 (6.0) |

| | | | |
|---|---|---|---|
| The healthcare workforce is engaged in the development of plans and responses to flood risk | 201 (71.3) | 66 (23.4) | 15 (5.3) |
| The healthcare workforce is prepared and able to implement risk-reduction actions to protect themselves | 172 (60.6) | 90 (31.7) | 22 (7.7) |
| The health care workforce is prepared with a contingency plan for additional health workforce to strengthen performance capacity | 185 (65.8) | 75 (26.7) | 21 (7.5) |
| The health care workforce is prepared with a contingency plan for continuing to provide services at other facilities or in the local communities (primary health care), if necessary | 153 (53.9) | 94 (33.5) | 34 (12.1) |
| The healthcare workforce is trained to detect posttraumatic stress disorder among staff to take prompt action | 156 (54.9) | 90 (31.7) | 38 (13.4) |
| The healthcare workforce is trained to manage hazardous chemicals in emergency situations | 188 (66.2) | 64 (22.5) | 30 (10.6) |
| The health care workforce is trained to an appropriate standard to maintain the correct level of safety of electrical power supply, in both routine and emergency/disaster situations | 202 (72.1) | 58 (20.7) | 20 (7.1) |
| **Communication and awareness-raising** | | | |
| The healthcare workforce is provided with a safe internal communication system, especially in emergency situations | 137 (48.8) | 100 (35.6) | 44 (15.7) |
| The healthcare workforce is informed on how to use and follow a surveillance system to track health outcomes | 87 (30.7) | 120 (42.4) | 76 (26.9) |
| The healthcare workforce is aware of contingency plans for accessing and leaving the facility during flood emergencies, and health workforce transportation | 195 (68.9) | 64 (22.6) | 24 (8.5) |
| The healthcare workforce is 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 | 165 (58.5) | 98 (34.8) | 19 (6.7) |
| The healthcare workforce is prepared with clear messaging about water and food safety during and after a flood | 166 (58.5) | 85 (29.9) | 33 (11.6) |
| The healthcare workforce is prepared with clear messaging, and staff trained on exit and evacuation routes that are clearly marked and free of obstacles to enable emergency evacuation) | 202 (71.6) | 57 (20.2) | 23 (8.2) |
| The healthcare workforce is equipped with a flood plan or programme with clear instructions on how to proceed during flood emergency situations | 214 (75.6) | 51 (18.0) | 18 (6.4) |
| The healthcare workforce is equipped with a community health educational programme to assist the community in reducing vulnerabilities to flood impacts | 157 (55.5) | 99 (35.0) | 27 (9.5) |

| | | | |
|---|---|---|---|
| The healthcare workforce is equipped with a community health educational programme to improve community health in the face of flood risks | 152 (53.7) | 97 (34.3) | 34 (12.0) |

### 5.5.2 Vulnerability of water, sanitation and healthcare waste to floods

Vulnerability was assessed based on risk management; and health and safety regulations. About 60.5% of the HCFs were highly vulnerable to floods since they were unprepared to have an updated assessment plan to map risks to the sanitation infrastructure in place and to identify where services could be disrupted by floods. About 46.5% of the HCFs were highly vulnerable to floods since they were unprepared to verify water safety conditions, including updated risk assessments to map water resources and water supplies. About 55.4% of the HCFs were highly vulnerable to floods since they were unprepared to have a quality monitoring plan for drinking water during and after the event. About 37.3% of the HCFs were highly vulnerable to floods since they were unprepared to regularly assess their sanitation system for any possible damage in the event of flooding. About 44.9% of the HCFs were highly vulnerable to floods since they were unprepared to 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 (Table 21).

**Table 10: Flood checklist for assessing vulnerabilities on water, sanitation and healthcare waste**

| **WATER, SANITATION AND HEALTHCARE WASTE** | **Vulnerability levels** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Monitoring and assessment** | **High** | **Medium** | Low |
| Healthcare facilities have an updated assessment plan to map risks to the sanitation infrastructure in place and to identify where services could be disrupted by floods | 170 (60.5) | 82 (29.2) | 29 (10.3) |
| Healthcare facilities verify water safety conditions, including updated risk assessments to map water resources and water supplies for the facility | 131 (46.5) | 100 (35.5) | 51 (18.1) |
| Healthcare facilities have a quality monitoring plan for drinking water during and after the event | 157 (55.4) | 83 (29.3) | 43 (15.2) |
| Healthcare facilities regularly assess their sanitation system for any possible damage in the event of flooding | 106 (37.3) | 118 (41.5) | 58 (20.4) |
| Healthcare facilities monitor sewer overflows in order to fix pumps in advance of the flood season | 152 (60.3) | 64 (25.4) | 36 (14.3) |
| Healthcare facilities 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 | 124 (44.9) | 103 (37.3) | 49 (17.8) |
| Healthcare facilities have information on water system installation that ensures a lower risk of contamination | 113 (40.4) | 110 (39.3) | 57 (20.4) |
| The healthcare facilities conduct a waste audit to reduce waste as much as possible | 136 (48.6) | 87 (31.1) | 54 (19.3) |
| **Risk Management** | | | |
| Healthcare facilities have a natural floodwater infiltration system to reduce the risk of facility flooding | 192 (68.6) | 52 (18.5) | 36 (12.9) |
| Healthcare facilities have anti-mosquito breeding measures | 91 (32.2) | 113 (39.9) | 79 (27.9) |
| Healthcare facilities have scheduled for emptying latrines in | 171 (60.2) | 72 (25.4) | 33 (11.6) |

| | | | |
|---|---|---|---|
| advance of the flood season to avoid overflows | | | |
| Healthcare facilities have safe healthcare waste storage place | 76 (26.9) | 110 (38.9) | 97 (34.3) |
| Healthcare facilities have safe waste disposal systems before, during and after floods | 118 (41.8) | 90 (31.9) | 74 (26.2) |
| Healthcare facilities have established a safe management approach to healthcare waste transport (including hazardous waste) in case of floods | 169 (60.1) | 77 (27.4) | 35 (12.5) |
| Healthcare facilities have chemical, radioactive and biological hazardous waste stored in a safe place and on a level above the ground floor | 166 (62.4) | 69 (25.9) | 31 (11.7) |
| Healthcare facilities have water storage tanks appropriately covered to prevent access or contamination, and safety located for flooding events | 88 (31.3) | 86 (30.6) | 107 (38.1) |
| Healthcare facilities have a site water purification equipment to provide safe drinking water | 161 (57.7) | 61 (21.9) | 57 (20.4) |
| Healthcare facilities have nonreturn valves installed on water supply pipes to prevent backflows | 142 (50.9) | 63 (22.6) | 58 (20.4) |
| Healthcare facilities have waste pits that are able to withstand flood events | 138 (50.0) | 79 (28.6) | 59 (21.4) |
| Healthcare facilities have a surveillance system for diseases related to water quality and sanitation | 68 (23.9) | 129 (45.4) | 87 (30.6) |
| Healthcare facilities keep waste sealed in rubbish bins to avoid rodents | 61 (21.6) | 112 (39.7) | 109 (38.7) |
| **Health and safety regulation** | | | |
| Healthcare facilities have an emergency water supply plan | 169 (59.7) | 62 (21.8) | 52 (18.4) |
| Healthcare facilities have 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 | 160 (56.9) | 77 (27.4) | 44 (15.7) |
| Healthcare facilities have a water safety plan in place, in case of water contamination | 166 (58.7) | 68 (24.0) | 49 (17.3) |
| Healthcare facilities have a mechanism or regulation to carry out sanitary inspections of water supply, and when necessary, establish a temporary ban on the use, until improvements are made | 135 (47.9) | 97 (34.4) | 50 (17.7) |
| Healthcare facilities have a contingency plan to ensure effective and timely delivery of safe water during floods and emergencies over the short- and long-term | 195 (69.6) | 60 (21.4) | 25 (8.9) |
| Healthcare facilities have a plan to provide and maintain adequate cleaning and disinfection supplies (such as chlorine, filters or other water treatment technology, and rapid water testing kit)for water safety | 126 (45.0) | 111 (39.6) | 43 (15.4) |
| Healthcare facilities have an emergency plan for the maintenance and restoration of waste management systems | 151 (53.5) | 94 (33.3) | 37 (13.1) |

### 5.5.3 Vulnerability of energy to floods

Vulnerability was assessed based on monitoring and assessment; risk management; and health and safety regulations. About 56.7% of the HCFs had a high vulnerability to drought since they were unprepared to regularly assess their energy systems to ensure that they can cope with flood events.

More than three quarters, 76.4% of the HCFs were highly vulnerable to floods since they were unprepared to regularly 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. About 72.7% of the HCFs were highly vulnerable to floods since they were unprepared to periodically check emergency backup generators (including fuel, where relevant). About 37.0% of the HCFs were highly vulnerable to floods since they were unprepared to assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment (Table 22).

**Table 11: Flood checklist for assessing vulnerabilities in energy**

| **ENERGY** | **Vulnerability levels** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Monitoring and assessment** | **High** | **Medium** | **Low** |
| Healthcare facilities regularly assess their energy systems to ensure that they can cope with flood events | 156 (56.7) | 91 (33.1) | 28 (9.9) |
| Healthcare facilities regularly 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 | 188 (76.4) | 28 (11.4) | 30 (12.2) |
| Healthcare facilities periodically check emergency backup generators (including fuel, where relevant) | 160 (72.7) | 34 (15.5) | 26 (11.8) |
| Healthcare facilities assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment | 102 (37.0) | 110 (39.9) | 65 (23.6) |
| Healthcare facilities identify priority areas within the facility which would require emergency power during and after a flood event | 109 (38.7) | 103 (36.5) | 70 (24.8) |
| **Risk Management** | | | |
| Healthcare facilities have a secure place to protect the backup generator (e.g. an elevated place; including fuel or battery storage, where relevant) from flood waters | 149 (67.1) | 41 (18.5) | 32 (14.4) |
| Healthcare facilities have adequate daylight to ensure proper visibility during a power outage including fuel or battery storage, where relevant) from flood waters | 56 (20.1) | 97 (34.9) | 128 (46.0) |
| Healthcare facilities have power-operated doors that can easily be opened manually to permit exit in case of power failure | 118 (54.6) | 35 (16.2) | 63 (29.2) |
| Healthcare facilities have appliance thermometers in the refrigerator and freezer to determine if food, vaccines and other essential refrigeration-dependent medical supplies are safe | 50 (18.1) | 64 (23.1) | 163 (58.8) |
| Healthcare facilities have 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) | 153 (55.4) | 77 (27.9) | 46 (16.7) |
| **Health and safety regulation** | | | |

| | | | |
|---|---|---|---|
| Healthcare facilities have an emergency plan for power outages in the short- and long-term (before, during and after a flood | 169 (60.4) | 70 (25.0) | 41 (14.6) |
| Healthcare facilities work with energy utility agencies to prevent the suspension of electricity services | 157 (58.4) | 63 (23.4) | 49 (18.2) |
| Healthcare facilities have a management plan for intermittent energy supplies or system failure | 157 (56.3) | 80 (28.7) | 42 (15.1) |
| Healthcare facilities have a plan or regulation to determine ways to reduce overall energy use | 147 (51.8) | 87 (30.6) | 46 (16.2) |
| Healthcare facilities have an emergency plan to ensure the availability of adequate lighting, communication and information systems, and refrigeration and sterilization equipment during a flood | 148 (52.5) | 89 (31.8) | 41 (14.6) |

### 5.5.4 Vulnerability of the infrastructure, technologies, production and processes to floods

Vulnerability was assessed based on adaptation of current systems and infrastructures; and promotion of new systems and technologies and sustainability of healthcare facility operations. About 56.2% of the HCFs were highly vulnerable to floods since they didn't have the knowledge, experience (considering previous damages) and resources (including human, material, financial, supplies chain and logistics) to manage flood risk reduction prepared and trained for periods of extreme drought. About 59.2% of the HCFs were highly vulnerable to floods since they were unable to provide greater advocacy on health workforce education to cover climate change risks and responses. About 37.0% of the HCFs were highly vulnerable to floods since they were unable to work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning and implementation. About 70.1% of the HCFs were highly vulnerable since they were unable to conduct climate risk and vulnerability assessments for all facility sectors to identify risk scenarios, vulnerabilities and the facility's response capacity (Table 23).

**Table 12: Flood checklist for assessing vulnerabilities in infrastructure, technologies production and processes**

| **INFRASTRUCTURE, TECHNOLOGIES, PRODUCTION AND PROCESSES** | **Vulnerability levels** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Adaptation of current systems and infrastructures** | **High** | **Medium** | **Low** |
| Healthcare facilities have the knowledge, experience (considering previous damages) and resources (including human, material, financial, supplies chain and logistics) to manage flood risk reduction | 159 (56.2) | 106 (37.5) | 18 (6.4) |
| Healthcare facilities provide greater advocacy on health workforce education to cover climate change risks and responses | 168 (59.2) | 93 (32.7) | 23 (8.1) |
| Healthcare facilities work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning and implementation | 105 (37.0) | 148 (52.1) | 31 (10.9) |
| Healthcare facilities conduct climate risk and vulnerability assessments for all facility sectors to identify risk | 199 (70.1) | 74 (26.1) | 11 (3.9) |

| | | | |
|---|---|---|---|
| scenarios, vulnerabilities and the facility's response capacity | | | |
| Healthcare facilities utilize the assessed information as a basis to plan and prioritize measures to reduce risk impact | 157 (56.1) | 102 (36.4) | 21 (7.5) |
| Healthcare facilities in their annual planning consider how climate risks may change in the future | 168 (59.4) | 91 (32.1) | 24 (8.5) |
| Healthcare facilities have resources available to adopt risk reduction measures on the building and its infrastructure, technologies, products and processes | 186 (65.5) | 82 (28.9) | 16 (5.6) |
| Healthcare facilities regularly update these assessments, considering emerging scientific information | 199 (71.1) | 67 (23.9) | 14 (5.0) |
| Healthcare facilities 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 | 97 (34.2) | 130 (45.8) | 57 (20.1) |
| Healthcare facilities evaluate the condition and safety of structural and non-structural elements impacted by previous exposure to flood | 138 (49.8) | 102 (36.8) | 37 (13.4) |
| Healthcare facilities have a safe location for critical services and equipment in a flood emergency situation | 180 (63.8) | 73 (25.9) | 29 (10.3) |
| Healthcare facilities have a safety plan to prevent medical and laboratory equipment supplies, and food packages from being exposed to flood waters | 142 (50.2) | 94 (33.2) | 47 (16.6) |
| Healthcare facilities 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 | 153 (55.6) | 75 (27.3) | 47 (5.1) |
| Healthcare facilities have an effective emergency risk communication plan to reduce risks and impacts for health workers and patients | 145 (51.2) | 98 (34.6) | 40 (14.1) |
| Healthcare facilities have a contingency plan in place for safe and efficient personnel evacuation (including health staff and patients) before, during and following a flood | 190 (67.1) | 74 (26.1) | 19 (6.7) |
| Healthcare facilities have a clear and consistent mechanism for secure evacuation of health workers and patients | 184 (64.8) | 80 (28.2) | 20 (7.0) |
| Healthcare facilities have a plan to transfer critical equipment and medical supplies to another healthcare facility or to a secure storage | 152 (53.5) | 90 (31.7) | 42 (14.8) |
| Healthcare facilities 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 | 163 (57.8) | 98 (34.8) | 21 (7.4) |
| Healthcare 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 | 175 (61.6) | 78 (27.8) | 27 (9.6) |
| Healthcare facilities have a mechanism for providing prompt maintenance and repair of equipment required for essential services | 128 (45.1) | 117 (41.2) | 39 (13.7) |

| | | | |
|---|---|---|---|
| Healthcare facilities 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 | 156 (55.5) | 89 (31.7) | 36 (12.8) |
| Healthcare facilities have walls protected and insulated against moisture and mould | 108 (38.3) | 101 (35.8) | 73 (25.9) |
| Healthcare facilities assess the performance and vulnerabilities of each critical part of the facility (structural and non-structural elements) that can be affected by floods | 127 (44.7) | 110 (38.7) | 47 (16.5) |
| Healthcare facilities have measures to remove mosquito breeding sites | 60 (21.2) | 118 (41.8) | 104 (36.9) |
| Healthcare facilities have roof drainage systems for rainfall | 71 (25.1) | 107 (37.8) | 105 (37.1) |
| Healthcare facilities have rooftop structures and equipment revised for anticipated increased rainfall | 121 (42.9) | 87 (30.9) | 73 (25.9) |
| Healthcare facilities have roofs that are leak-proof and insulated | 96 (34.1) | 98 (34.9) | 87 (40.0) |
| Healthcare facilities have machine rooms that are resistant to flooding or rooftop damage | 154 (60.1) | 61 (23.8) | 41 (16.0) |
| Healthcare facilities ensure the removal of equipment and power supplies from basements and ground floor levels to avoid damage from flooding | 131 (48.2) | 81 (29.8) | 60 (22.1) |
| Healthcare facilities 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) | 133 (47.5) | 110 (39.3) | 37 (13.2) |
| Healthcare facilities have established procedures for procuring, and safely transporting and storing medical devices, pharmaceuticals, vaccines, laboratory supplies, parenteral nutrition and blood supplies, and other essential medical supplies | 129 (46.1) | 91 (32.5) | 60 (21.4) |
| Healthcare facilities have established procedures or plans for procuring, transporting and storing bottled water and food supplies during an emergency | 182 (66.4) | 71 (25.9) | 21 (7.7) |
| Healthcare facilities 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 | 148 (52.7) | 91 (32.0) | 42 (14.8) |
| Healthcare facilities have a plan to house staff at the healthcare facility if shelter is required (sleeping areas, food, water | 116 (41.6) | 104 (37.3) | 59 (21.1) |
| Healthcare facilities have an established post-flood recovery plan for all infrastructure facilities (structural and non-structural elements | 211 (75.4) | 52 (18.6) | 17 (6.1) |
| **Promotion of new systems and technologies** | | | |
| Healthcare facilities conduct the promotion of new | 133 (60.2) | 62 (28.1) | 26 (11.8) |

| | | | |
|---|---|---|---|
| systems and technologies | | | |
| Healthcare facilities have an information system between the health sector and meteorological services to communicate about climate hazards | 202 (71.6) | 60 (21.3) | 20 (7.1) |
| Healthcare facilities have an established plan to review, evaluate and catalogue climate risks related to floods for the healthcare facility's location | 213 (75.3) | 53 (18.7) | 17 (6.0) |
| Healthcare facilities have an established plan to review, evaluate and catalogue risks related to floods for the healthcare facility's supply chain | 204 (71.8) | 60 (21.1) | 20 (7.1) |
| Healthcare facilities have electronic patient health records to make available to other receiving healthcare facilities, in case of evacuation | 187 (69.0) | 57 (21.0) | 27 (10.0) |
| Healthcare facilities have information and communication systems safely secured with backup arrangements (via cloud, satellite) to satisfy the facility's demand | 195 (67.5) | 61 (22.0) | 21 (7.6) |
| Healthcare facilities ensure information and communication flow between the health workforce and policymakers, particularly during high-stress situations and demands created by emergencies | 128 (45.2) | 116 (50.0) | 39 (13.8) |
| Healthcare facilities have an established, clear and consistent knowledge transfer procedure for a public health emergency | 148 (52.3) | 108 (38.2) | 27 (9.5) |
| Healthcare facilities have identified capacities, resources and needs to better cope with and manage floods | 190 (67.4) | 75 (26.6) | 17 (6.0) |
| Healthcare facilities perform site and building maintenance procedures that include specifications on how the weather may affect the safety and continued functioning of the facility | 168 (59.6) | 90 (31.9) | 24 (8.5) |
| Healthcare facilities have an information system for tracking and monitoring diseases following flood events | 118 (41.8) | 119 (41.2) | 45 (16.0) |
| **Sustainability of healthcare facility operations** | | | |
| Healthcare facilities have adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction and response | 163 (57.8) | 99 (35.1) | 20 (7.1) |
| Healthcare facilities have partnerships established between the facility, community and local authorities to reduce vulnerabilities in the surrounding areas | 115 (40.5) | 134 (47.2) | 35 (12.3) |
| Healthcare facilities have secure storage for hazardous chemicals to avoid their damage or release during a flood event | 155 (55.4) | 79 (28.2) | 46 (16.4) |
| Healthcare facilities have a defined and sustained budget as part of core budgeting for emergency preparedness and response to flood events | 224 (79.2) | 44 (15.5) | 15 (5.3) |
| Healthcare facilities have an access route for public transportation which is likely to remain operational during or immediately following a flood event | 145 (51.4) | 79 (28.0) | 58 (20.6) |
| Healthcare facilities review building code design baselines against rainfall volumes, and map each risk | 194 (68.8) | 64 (22.7) | 24 (8.5) |

| | | | |
|---|---|---|---|
| Healthcare facilities have trees planted in a secure place that will not block access to the facility or fall on the building during an event | 67 (23.7) | 111 (39.2) | 105 (37.1) |
| Healthcare facilities have estimates of the consumption (such as the amount used per week) of essential medical, pharmaceutical, nutritional and laboratory supplies, personal protective equipment, food, etc., using the most likely flood scenario | 117 (41.7) | 101 (36.1) | 62 (22.1) |
| Healthcare facilities undertake risk assessments of the supply chain for essential medical and nonmedical products | 115 (40.6) | 120 (42.4) | 48 (17.0) |
| Healthcare facilities have a secure plan to ensure continuity of the facility's supply and delivery chain | 100 (35.5) | 111 (39.4) | 71 (25.2) |
| Healthcare facilities have secure access to essential backup services, such as sterilization, laundry and cleaning services, via multiple agreements with different facilities to maintain the functioning of critical services | 146 (53.5) | 84 (30.8) | 43 (15.8) |
| Healthcare facilities have secure access to essential backup food sources via multiple agreements with different vendors, and through cooperative agreements with other facilities to maintain the functioning of critical services | 198 (72.5) | 58 (21.2) | 17 (6.2) |

## 5.6 Vulnerability to water level rise

### 5.6.1 Vulnerability of the health workforce to water level rise

Vulnerability was assessed based on human resources; capacity development; communication and awareness raising; and monitoring and assessment. About 27.9% of the HCFs were highly vulnerable to rise of water levels since the health workforce was unprepared to be aware of the potential risks of water-level rise to the health care facility and to themselves. About 62.8% of the HCFs were highly vulnerable to water-level rise since the health workforce was unprepared to be equipped with a programme for assistance for mental health, injuries, medical treatment. About 66.3% of the HCFs were highly vulnerable to rise of water levels since the healthcare workforce was unprepared to be protected from impacts of water level rise surges. About 65.1% of the HCFs were highly vulnerable to rise of water level rise since the health workforce was unprepared to be equipped with an emergency plan to protect health workers from multiple biological and chemical hazards. About 39.5% of the HCFs were highly vulnerable to rise of water rise since the health workforce was unprepared to be provided with full personal protective equipment, especially, for clean-up crews (Table 29).

**Table 13: Water level rise checklist for assessing vulnerabilities on workforce**

| **WORKFORCE** | **Vulnerability levels** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Human resource** | **High** | **Medium** | Low |
| The healthcare workforce is aware of the potential risks of water-level rise to the health care facility and to themselves | 24 (27.9) | 35 (40.7) | 27 (31.4) |

| | | | |
|---|---|---|---|
| The healthcare workforce is equipped with a programme for assistance for mental health, injuries, medical treatment, etc | 54 (62.8) | 22 (25.6) | 10 (11.6) |
| The healthcare workforce is protected from impacts of storm surges | 57 (66.3) | 20 (23.3) | 9 (10.5) |
| The healthcare workforce is equipped with an emergency plan to protect health workers from multiple biological and chemical hazards | 56 (65.1) | 26 (30.2) | 4 (4.7) |
| The healthcare workforce is provided with full personal protective equipment, especially, for clean-up crews (including waterproof safety boots, goggles, work gloves and masks) | 34 (39.5) | 30 (34.9) | 22 (25.6) |
| Capacity development | | | |
| The healthcare workforce is equipped with knowledge, experience, training and resources to manage risks and to be prepared to address actions to reduce impacts from water-level rise | 49 (57.0) | 32 (37.2) | 5 (5.8) |
| The healthcare workforce is prepared and able to implement risk reduction actions and recover better than before the event | 50 (58.1) | 28 (32.6) | 8 (9.3) |
| The healthcare workforce is trained on public health climate change issues related to effects of water-level rise on human health | 62 (72.1) | 19 (22.1) | 5 (5.8) |
| The healthcare workforce is trained to manage hazardous chemicals in emergency situations | 51 (59.3) | 30 (34.9) | 5 (5.8) |
| The healthcare workforce is engaged in the development of plans and responses to water-level rise and storm surge risks | 60 (69.8) | 22 (25.6) | 4 (4.7) |
| The healthcare workforce is prepared and able to implement risk reduction actions for protecting themselves | 43 (50.0) | 33 (38.4) | 10 (11.6) |
| The healthcare workforce is prepared with contingency plan for storm surges and floods | 61 (70.9) | 19 (22.1) | 6 (7.0) |
| The healthcare workforce is trained to maintain the correct level of water safety, quality control, and treatment supplies, in both routine and water-level rise-related events | 56 (65.1) | 24 (27.9) | 6 (7.0) |
| The healthcare workforce is trained in multiphaser assessments | 60 (69.8) | 23 (26.7) | 3 (3.5) |
| The healthcare workforce is trained to an appropriate standard to maintain the correct level of safety of electrical power supply, in both routine and emergency/disaster situations | 67 (77.9) | 14 (16.3) | 5 (5.8) |
| The healthcare workforce is trained to detect posttraumatic stress disorder among staff to take prompt action | 48 (55.8) | 29 (33.7) | 9 (10.5) |
| **Communication and awareness raising** | | | |
| The healthcare workforce is provided with an established information system for managing occupational safety and health in emergency situations | 37 (43.0) | 36 (41.9) | 13 (15.1) |
| The healthcare workforce is regularly participating in community disaster planning committees to: improve knowledge on how to reduce risks, be prepared and respond to water-level rise risks, and recover better than before through adaptation measures | 45 (52.3) | 34 (39.5) | 7 (8.1) |
| The healthcare workforce is provided with a contingency plan for continuing to provide services at other facilities or in communities (primary health care), if necessary | 43 (50.0) | 30 (34.9) | 13 (15.1) |
| The healthcare workforce is prepared with clear messaging | 45 (52.3) | 31 (36.0) | 10 (11.6) |

| | | | |
|---|---|---|---|
| about water and food safety during and after a storm surge event | | | |
| The healthcare workforce is informed on how to reduce risks and vulnerabilities to flood and storm surge events resulting from water-level rise | 50 (58.1) | 27 (31.4) | 9 (10.5) |

### 5.6.2 Vulnerability of the WASH component to water level rise

Vulnerability was assessed based on risk management; and health and safety regulations. About 64.0% of the HCFs were highly vulnerable to water level rise since they were unable to have an updated assessment plan to map risks to the water and sanitation infrastructure in place to identify where services could be disrupted from water-level rise. About 43.0% of the HCFs were highly vulnerable since they were unable to regularly assessed its sanitation system for any possible damage from water-level rise impacts. Nearly two thirds, 59.3% of the HCFs were highly vulnerable since they were unable to have an evaluation system to monitor its water system or supply before, during, and after a storm surge event (Table 30).

**Table 14: Water level rise checklist for assessing vulnerabilities on water, sanitation and healthcare waste**

| **WATER, SANITATION AND HEALTHCARE WASTE** | **Vulnerability levels** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Monitoring and assessment** | **High** | **Medium** | **Low** |
| Healthcare facilities have an updated assessment plan to map risks to the water and sanitation infrastructure in place to identify where services could be disrupted from water-level rise | 55 (64.0) | 23 (26.7) | 8 (9.3) |
| Healthcare facilities have regularly assessed its sanitation system for any possible damage from water-level rise impacts | 37 (43.0) | 35 (40.7) | 14 (16.3) |
| Healthcare facilities have an evaluation system to monitor its water system or supply before, during, and after a water-level rise surge event | 51 (59.3) | 29 (33.7) | 6 (7.0) |
| Healthcare facilities have a contingency plan for monitoring and reducing contaminant concentrations in the facility's water supply system | 46 (53.5) | 33 (38.4) | 7 (8.1) |
| Healthcare facilities regularly verify safety conditions and proper functioning of all elements of the water distribution system as early action for water-level rise (e.g. storage tanks, cisterns, valves, pipes and connections, and water disinfection) | 46 (53.5) | 26 (30.2) | 14 (16.3) |
| Healthcare facilities have a water quality monitoring plan for human consumption | 43 (50.0) | 33 (38.4) | 10 (11.6) |
| **Risk management** | | | |

| | | | |
|---|---|---|---|
| Healthcare facilities have a mechanism to protect freshwater sources around the facility from all types of contamination, including saline intrusion | 44 (51.2) | 23 (26.7) | 19 (22.1) |
| Healthcare facilities have a safe water and wastewater management system for water-level rise impacts, including standing water near the facility | 50 (58.1) | 26 (30.2) | 10 (11.6) |
| Healthcare facilities store waste in a safe place to avoid release in case of flooding | 38 (44.2) | 27 (31.4) | 21 (24.4) |
| Healthcare facilities store hazardous chemical, radioactive and biological waste in a safe place and on a level above the ground floor | 46 (53.5) | 19 (22.1) | 21 (24.4) |
| Healthcare facilities have a schedule for emptying latrines regularly and in advance of flooding from high tides to avoid overflows | 50 (58.1) | 22 (25.6) | 14 (16.3) |
| Healthcare facilities have safe waste disposal of debris after a high tide event | 43 (50.0) | 31 (36.0) | 12 (14.0) |
| Healthcare facilities have an established safe management approach for health care waste transport (including hazardous waste) during and after a flood event due to water-level rise | 48 (55.8) | 29 (33.7) | 9 (10.5) |
| Healthcare facilities provide appropriate covers for water storage tanks to prevent damage, water contamination and saline water intrusion in case of flooding related to water-level rise | 43 (50.0) | 24 (27.9) | 19 (22.1) |
| Healthcare facilities have nonreturn valves installed in water supply pipes to prevent backflows, in case of flooding | 55 (64.0) | 20 (23.3) | 11 (12.8) |
| Healthcare facilities build waste pits to withstand flood events | 51 (59.3) | 23 (26.7) | 12 (14.0) |
| Healthcare facilities have onsite water purification equipment to provide safe drinking water | 52 (60.5) | 26 (30.2) | 8 (9.3) |
| **Health and safety regulations** | | | |
| Healthcare facilities have an alternative water source to supply the facility | 33 (38.4) | 23 (26.7) | 30 (34.9) |
| Healthcare facilities have a water safety plan in place, in case of water contamination | 50 (58.1) | 20 (23.3) | 16 (18.6) |
| Healthcare facilities 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 | 40 (46.5) | 31 (36.0) | 15 (17.4) |
| Healthcare facilities have a contingency plan to ensure effective and timely delivery of safe water during floods and emergencies over the short- and mid-term | 49 (57.0) | 27 (31.4) | 10 (11.6) |
| Healthcare facilities have a coordinated cross-sectoral water management plan to protect local or alternative water sources | 44 (51.2) | 29 (33.7) | 13 (15.1) |

### 5.6.3 Vulnerability of the energy component to water-level rise

About 67.9% of the HCFs were highly vulnerable to rise of water levels since they were unprepared to regularly assess its energy system to ensure that it can cope with water-level rise events. About 73.3% of the HCFs were highly vulnerable since they were unprepared to 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. About 71.4% of the HCFs were highly vulnerable since they unprepared to periodically check the emergency backup generator (including fuel, where relevant). About 36.9% of the HCFs were highly vulnerable since they were unprepared to assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment. About 68.1% of the HCFs were highly vulnerable since they were unprepared have a secure place to protect the backup generator (Table 31).

**Table 15: Water level rise checklist for assessing vulnerabilities on energy**

| **ENERGY** | **Vulnerability level** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Monitoring and assessment** | **High** | **Medium** | **Low** |
| Healthcare facilities regularly assess its energy system to ensure that it can cope with water-level rise events | 55 (67.9) | 13 (16.0) | 13 (16.0) |
| Healthcare facilities 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 | 55 (73.3) | 8 (10.7) | 12 (16.0) |
| Healthcare facilities periodically check the emergency backup generator (including fuel, where relevant) | 50 (71.4) | 10 (14.3) | 10 (14.3) |
| Healthcare facilities assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment | 31 (36.9) | 28 (33.3) | 25 (29.8) |
| **Risk management** | | | |
| Healthcare facilities have a secure place to protect the backup generator (e.g. an elevated place; including fuel or battery storage, where relevant) from damage | 47 (68.1) | 14 (20.3) | 8 (11.6) |
| Healthcare facilities have appliance thermometers in the refrigerator and freezer to determine if food, vaccines and other essential refrigeration-dependent medical supplies are safe | 22 (27.2) | 19 (23.5) | 40 (49.4) |
| Healthcare facilities have adequate daylight to ensure proper visibility during power outage | 25 (29.8) | 20 (23.8) | 39 (46.4) |
| Healthcare facilities have power-operated doors that can be opened manually to permit exit in case of power failure | 31 (52.1) | 14 (19.7) | 20 (28.2) |
| Healthcare facilities have a safety backup for telecommunication and information systems (e.g. via cloud and satellite) | 61 (76.3) | 13 (16.3) | 6 (7.5) |
| Healthcare facilities 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) | 51 (60.7) | 25 (29.8) | 8 (9.5) |

| Health and safety regulation | | | |
|---|---|---|---|
| Healthcare facilities have an emergency plan for power outages in the short- and long-term (before, during and after a water-level rise flood event) | 61 (71.8) | 14 (16.5) | 10 (11.8) |
| Healthcare facilities work with energy utility agencies to prevent suspension of electricity services | 49 (60.5) | 20 (24.7) | 12 (14.8) |
| Healthcare facilities have a management plan for intermittent energy supplies or system failure | 52 (61.2) | 23 (27.1) | 10 (11.8) |
| Healthcare facilities have a plan or regulation to determine ways to reduce overall energy use | 48 (55.8) | 26 (30.2) | 12 (14.0) |
| Healthcare facilities have an emergency plan to ensure availability of adequate lighting, communication and information systems, as well as refrigeration and sterilization equipment during a water level rise | 50 (58.8) | 24 (28.2) | 11 (12.9) |

### 5.6.4 Vulnerability of infrastructure, technologies, products and processes to water level rise

About 79.8% of the HCFs were highly vulnerable since they were unprepared to provide health workforce training to cover climate change risks and responses regarding water-level rise. About 74.1% of the HCFs were highly vulnerable since they were unprepared to have monitoring and early warning system integrated with other areas to manage and reduce risks from storm surges and floods related to water-level rise. About 58.8% of the HCFs were highly vulnerable since they were umprepared to have knowledge, experience (considering previous damages) and resources (including human, material, financial, supplies chain and logistics) to manage risks from water-level rise (Table 32).

**Table 16: Water level rise checklist for assessing infrastructure, technologies, products and processes**

| INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES | Vulnerability levels | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Adaptation of current systems and infrastructures** | **High** | **Medium** | **Low** |
| Healthcare facilities provide health workforce training to cover climate change risks and responses regarding water-level rise | 67 (79.8) | 15 (17.9) | 2 (2.4) |
| Healthcare facilities have a monitoring and early warning system integrated with other areas to manage and reduce risks from storm surges and floods related to water-level rise | 63 (74.1) | 18 (21.2) | 4 (4.7) |
| Healthcare facilities have knowledge, experience (considering previous damages) and resources (including human, material, financial, supplies chain and logistics) to manage risks from water-level rise | 50 (58.8) | 30 (35.3) | 5 (5.9) |
| Healthcare facilities work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning and implementation | 37 (43.0) | 38 (44.2) | 11 (12.8) |
| Healthcare facilities map the facility's location relative to water-level rise hazards | 48 (55.8) | 27 (31.4) | 11 (12.8) |

| | | | |
|---|---|---|---|
| Healthcare facilities assess the performance and vulnerabilities of each critical part of the facility (structural and non-structural elements) that can be affected by water-level rise hazards | 52 (60.5) | 25 (29.1) | 9 (10.5) |
| Healthcare facilities 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 routes for other healthcare facilities, logistics and supply chain for medical and laboratory supplies, drinking water, food and other supplies) | 55 (64.7) | 36 (30.6) | 4 (4.7) |
| Healthcare facilities in their annual planning consider how climate risks may change in future | 63 (75.0) | 16 (19.0) | 5 (6.0) |
| Healthcare facilities have resources available to adopt risk reduction measures to the facility and its infrastructure, technologies, products and processes | 64 (75.3) | 12 (14.1) | 9 (10.9) |
| Healthcare facilities regularly update these assessments, considering emerging scientific information | 58 (68.2) | 24 (28.2) | 3 (3.5) |
| Healthcare facilities 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 water-level rise impacts | 44 (51.2) | 30 (34.9) | 12 (14.0) |
| Healthcare facilities evaluate the condition and safety of structural and non-structural elements impacts resulting from previous exposure to water-level rise event | 49 (57.6) | 26 (30.6) | 10 (11.8) |
| Healthcare facilities 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 | 59 (70.2) | 18 (21.4) | 7 (8.3) |
| Healthcare facilities have funding to protect the facility and vulnerable assets from water-level rise | 66 (78.6) | 13 (15.5) | 5 (6.0) |
| Healthcare facilities have an evacuation plan to transfer critical medical, laboratory and administration equipment to another healthcare facility or to safety storage or location in a storm surge emergency situation. | 61 (73.5) | 14 (16.9) | 8 (9.6) |
| Healthcare facilities have established procedures for safely procuring, transporting and storing medical supplies (medical devices, pharmaceuticals, vaccines, laboratory supplies, parenteral nutrition and blood supplies, and other essential healthcare supplies) | 48 (56.5) | 19 (22.4) | 18 (21.2) |
| Healthcare facilities have established procedures for safely procuring, transporting and storing bottled water and food supplies during an emergency | 55 (64.7) | 22 (25.9) | 8 (9.4) |
| Healthcare facilities have an effective emergency risk communication plan to reduce risks and impacts for health workers and patients | 59 (68.6) | 19 (22.1) | 8 (9.3) |
| Healthcare facilities have a contingency plan in place for safe and efficient personnel evacuation (including health staff and patients) before, during and following a water rise level | 57 (67.1) | 21 (24.7) | 7 (8.2) |
| Healthcare facilities have a clear and consistent mechanism for secure evacuation of health workers and patients | 63 (73.3) | 18 (20.9) | 5 (5.8) |
| Healthcare facilities have evacuation routes above flood | 60 (70.6) | 19 (22.4) | 6 (7.1) |

| | | | |
|---|---|---|---|
| elevation | | | |
| Healthcare facilities have a plan to transfer critical equipment and medical supplies to another facility or to a safe storage | 52 (61.2) | 21 (24.7) | 12 (14.1) |
| Healthcare facilities implement anti-mosquito breeding measures | 32 (37.6) | 30 (35.3) | 23 (27.1) |
| Healthcare facilities have walls protected and insulated against moisture and mould | 49 (57.6) | 20 (23.5) | 16 (18.8) |
| Healthcare facilities have machine rooms resistant to storm surge damage | 56 (68.3) | 15 (18.3) | 11 (13.4) |
| Healthcare facilities have water-resistant interior construction | 48 (57.1) | 24 (28.6) | 12 (14.3) |
| Healthcare facilities ensure the removal of equipment and power supplies from basements and ground floor levels to avoid damage from flooding | 46 (56.1) | 25 (30.5) | 11 (13.4) |
| Healthcare facilities have a coordinated mechanism across the health sector at 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) | 51 (62.2) | 19 (23.2) | 12 (14.6) |
| Healthcare facilities estimate the possible risks and losses and adapt to reduce impacts | 50 (61.0) | 25 (30.5) | 7 (8.5) |
| **Promotion of new systems technologies** | | | |
| Healthcare facilities have an information system between the health sector and meteorological services to communicate about storm surge hazards | 53 (66.3) | 23 (28.8) | 4 (5.0) |
| Healthcare facilities have electronic patient health records to make available to other receiving healthcare facilities in case of evacuation | 50 (64.1) | 6 (7.7) | 22 (28.2) |
| Healthcare facilities have implemented measures to respond to water-level rise scenarios and threats (e.g. water pump stations, floodplain mapping, assessing future water-level rise impacts) | 63 (74.1) | 20 (23.5) | 2 (2.4) |
| Healthcare facilities have mitigation measures in place to respond to water-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) | 59 (69.4) | 23 (27.1) | 3 (3.5) |
| **Sustainability of healthcare facility operations** | | | |
| Healthcare facilities review building code design baselines against water-level rise to assess the risks, impacts, and possible loss | 57 (67.1) | 25 (29.4) | 3 (3.5) |
| Healthcare facilities have adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction, and response to water-level rise conditions | 60 (70.6) | 23 (27.1) | 2 (2.4) |
| Healthcare facilities have established partnerships between the facility, community, and local authorities to reduce vulnerabilities in the surrounding areas | 41 (47.7) | 34 (39.5) | 11 (12.8) |
| Healthcare facilities have healthcare coalitions and partnerships with local healthcare providers for strategic decision-making on health services and clinical resources | 41 (47.7) | 35 (40.7) | 10 (11.6) |

| | | | |
|---|---|---|---|
| Healthcare facilities have a route for public transportation that is likely to remain operational during or immediately following a flood event | 48 (56.5) | 25 (29.4) | 12 (14.1) |
| Healthcare facilities have salt-resistant trees and plants | 52 (65.0) | 21 (26.3) | 7 (8.8) |
| Healthcare facilities 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 | 32 (38.1) | 28 (33.3) | 24 (28.6) |
| Healthcare facilities have secure storage for hazardous chemicals to avoid their damage or release during an event | 48 (55.8) | 24 (27.9) | 14 (16.3) |
| Healthcare facilities undertake risk assessments of the supply chain for essential medical and nonmedical products | 39 (45.3) | 29 (33.7) | 18 (20.9) |
| Healthcare facilities have secure access to essential backup services such as sterilization, laundry and cleaning services, via multiple agreements with different facilities to maintain the functioning of critical services during or immediately following an event | 46 (55.4) | 24 (28.9) | 13 (15.7) |
| Healthcare facilities have secure access to essential backup food sources via multiple agreements with different vendors and through cooperative agreements with other facilities to maintain the functioning of critical services during or immediately following an event | 55 (67.1) | 19 (23.2) | 8 (9.8) |
| Healthcare facilities have a coordinated plan with municipal health department heads to ensure appropriate preparations for the ongoing water-level rise | 55 (66.3) | 23 (27.7) | 5 (6.0) |
| Healthcare facilities have a post-flood recovery plan related to water-level rise for the entire infrastructure (structural and non-structural elements) of the facility (e.g. clearance, removal and disposal of debris; demolition of critically damaged, or repair of less damaged, structural elements; repositioning of equipment and furniture; reassessment of risks) | 61 (72.6) | 15 (17.9) | 8 (9.5) |
| Healthcare facilities have a plan to consider relocating the facility | 66 (82.5) | 8 (10.0) | 6 (7.5) |

## 5.7 Vulnerability to landslides

### 5.7.1 Vulnerability of the health workforce to landslides

About 55.4% of the HCFs were highly vulnerable since the health workforce were unable to be provided with programs for supporting staff with regard to mental health, injuries, medical treatment and related support measures. About 69.9% of the HCFs were highly vulnerable since the health workforce were unable to be equipped with an emergency plan for shift relay or replacement of health professionals to ensure that staff get adequate rest. About 75.9% of the HCFs were highly vulnerable since the health workforce were unable to be prepared with a contingency plan for accessing additional health workforce to strengthen performance capacity (Table 56).

**Table 17: Vulnerability of the health workforce to landslides**

| **WORKFORCE** | **Vulnerability level** |
|---|---|
| ***Vulnerability scale: 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)*** | |

| Human Resource | High | Medium | Low |
|---|---|---|---|
| The health workforce is provided with programs for supporting staff with regard to mental health, injuries, medical treatment and related support measures | 46 (55.4) | 30 (36.4) | 7 (8.4) |
| The health workforce is equipped with an emergency plan for shift relay or replacement of health professionals to ensure that staff get adequate rest | 58 (69.9) | 14 (16.9) | 11 (13.3) |
| The heath workforce is prepared with a contingency plan for accessing additional health workforce to strengthen performance capacity | 63 (75.9) | 17 (20.8) | 3 (3.6) |
| The health workforce is provided with an information system to manage occupational safety and health in the facility during a landslide | 57 (68.7) | 23 (27.7) | 3 (3.6) |
| The health workforce is equipped with an emergency plan to protect health workers from multiple biological and chemical hazards | 52 (62.7) | 26 (31.3) | 5 (6.0) |
| The health workforce is provided with a post-landslide employee recovery assistance Programme according to staff needs | 74 (90.2) | 6 (7.3) | 2 (2.44) |
| The health workforce is equipped with a coordinated plan. including volunteers on standby, to assist during an emergency or to support health professionals | 55 (66.3) | 21 (25.3) | 7 (8.4) |
| The health workforce is provided with full personal protective equipment. especially for clean-up crews (including waterproof safety boots. goggles, work gloves and masks) | 28 (34.2) | 40 (48.8) | 14 (17.1) |
| The health workforce is provided with safe water and food during a landslide event | 52 (64.2) | 21 (25.9) | 8 (9.9) |
| **Capacity development** | | | |
| The health workforce is trained on public health and climate change hazards Including health impacts related to landslides | 65 (78.3) | 13 (15.7) | 5 (6.0) |
| The health workforce is equipped with knowledge, experience, training and resources to manage landslide risk reduction at the facility and in the local communities | 63 (75.1) | 16 (19.3) | 4 (4.8) |
| The health workforce is engaged in the development of plans and responses to landslide risks | 67 (80.7) | 13 (15.7) | 3 (3.6) |
| The health workforce is prepared and able to implement risk-reduction actions to protect themselves | 53 (63.9) | 28 (33.7) | 2 (2.4) |
| The health workforce is prepared with a contingency plan for additional health workforce to strengthen performance capacity | 67 (80.7) | 12 (14.5) | 4 (4.8) |
| The health workforce is prepared with a contingency plan for continuing to provide services at other facilities or in the local communities (primary health care), if necessary | 48 (57.8) | 31 (37.4) | 4 (4.8) |
| The health workforce is trained to detect posttraumatic stress disorder among staff to take prompt action | 39 (47.0) | 40 (48.2) | 4 (4.8) |
| The health workforce is trained to manage hazardous chemicals in emergency situations of a landslide | 62 (74.7) | 18 (21.7) | 3 (3.6) |
| The health workforce is trained to an appropriate standard to maintain the correct level of safety of electrical power supply, in both routine and emergency/disaster situations | 70 (84.3) | 10 (12.1) | 3 (3.6) |
| **Communication and awareness raising** | | | |
| The health workforce is provided with a safe internal | 49 (59.0) | 26 (31.3) | 8 (9.6) |

| | | | |
|---|---|---|---|
| communication system, especially in emergency situations | | | |
| The health workforce is informed on how to use and follow a surveillance system to track health outcomes | 33 (39.8) | 31 (37.4) | 19 (22.9) |
| The health workforce is aware of contingency plans for accessing and leaving the facility during landslide emergencies, and health workforce transportation | 58 (70.7) | 15 (18.3) | 9 (11.0) |
| The health workforce regularly participates in community disaster planning committees to: improve knowledge of how to reduce risks. be prepared and respond to landslides, and recover better than before through adaptation measures | 59 (71.1) | 19 (22.9) | 5 (6.0) |
| The health workforce is prepared with clear messaging about water and food safety during and after landslides | 54 (65.1) | 25 (30.1) | 4 (4.8) |
| The health workforce is prepared with clear messaging, and staff trained on exit and evacuation routes that are clearly marked and free of obstacles to enable emergency evacuation | 68 (81.9) | 15 (18.1) | 0 (0.0) |
| The health workforce is equipped with a landslide plan or Programme with clear instructions on how to proceed during landslide emergency situations | 70 (85.4) | 10 (12.2) | 2 (2.4) |
| The health workforce is equipped with a community health educational Programme to assist the community in reducing vulnerabilities to landslide impacts | 49 (59.0) | 29 (35.0) | 5 (6.0) |
| The health workforce is equipped with a community health educational Programme to improve community health in the face of a landslide | 50 (60.2) | 25 (30.1) | 8 (9.6) |

### 5.7.2 Vulnerability of the WASH component to landslides

About 65.5% of the HCFs were highly vulnerable since they were unable to verify water safety conditions. including updated risk assessments to map water resources and water supplies for the facility. About 71.1% of the HCFs were highly vulnerable since they were unable to have a quality monitoring plan for drinking water during and after the landslide event. About 53.6% of the HCFs were highly vulnerable since they were unable to regularly assess their sanitation system for any possible damage in the event of a landslide (Table 57).

**Table 18: Vulnerability of the WASH component to landslides**

| **WATER, SANITATION AND HEALTHCARE WASTE** | **Vulnerability level** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Monitoring and assessment** | **High** | **Medium** | **Low** |
| The health care facility verifies water safety conditions. including updated risk assessments to map water resources and water supplies for the facility | 55 (65.5) | 25 (29.8) | 4 (4.8) |
| The healthcare facility has a quality monitoring plan for drinking water during and after the landslide event | 59 (71.1) | 19 (22.9) | 5 (6.0) |
| The healthcare facility regularly assesses its sanitation system for any possible damage in the event of a landslide | 45 (53.6) | 31 (36.9) | 8 (9.5) |
| The healthcare facility monitors sewer overflows in order | 47 (75.8) | 12 (19.4) | 3 (4.8) |

| | | | |
|---|---|---|---|
| to fix pumps in advance of the landslide season | | | |
| The healthcare facility regularly verifies safety conditions and proper functioning of all elements of the water distribution system, including storage tanks, cisterns, valves, pipes and connections and water disinfection | 44 (55.0) | 23 (28.8) | 13 (16.3) |
| The healthcare facility has information on water system installation that ensures lower risk of contamination | 45 (54.9) | 27 (32.9) | 10 (12.2) |
| The healthcare facility conducts a waste audit to reduce waste as much as possible | 42 (50.6) | 24 (28.9) | 17 (20.5) |
| **Risk management** | | | |
| The healthcare facility has anti-mosquito breeding measures | 18 (21.4) | 29 (34.5) | 37 (44.1) |
| The healthcare facility has a schedule for emptying latrines in advance of the landslide season to avoid over flows | 58 (72.5) | 14 (17.5) | 8 (10.0) |
| The healthcare facility has a safe health care waste storage | 26 (31.3) | 31 (37.4) | 26 (31.3) |
| The healthcare facility has a safe waste disposal system before, during and after a landslide | 36 (43.9) | 25 (30.5) | 21 (25.6) |
| The healthcare facility has an established safe management approach to health care waste transport (including hazardous waste) in case of Landsides | 57 (68.7) | 18 (21.7) | 8 (9.6) |
| The healthcare facility has chemical, radioactive and biological hazardous waste stored in a safe place and on a level above the ground floor | 50 (67.6) | 16 (21.6) | 8 (10.8) |
| The healthcare facility has water storage tanks appropriately covered to prevent access or contamination, and safety located for landslide events | 29 (36.3) | 25 (31.3) | 26 (32.5) |
| The healthcare facility has an onsite water purification equipment to provide safe drinking water | 42 (50.6) | 29 (34.9) | 12 (14.5) |
| The healthcare facility has a non-return valve installed on the water supply pipes to prevent backflows | 51 (68.9) | 12 (16.2) | 11 (14.9) |
| The healthcare facility has waste pits able to withstand landslide events | 48 (57.1) | 20 (23.8) | 16 (19.1) |
| The healthcare facility has a surveillance system for diseases related to water quality and sanitation | 22 (26.2) | 35 (41.7) | 27 (32.1) |
| The healthcare facility has a keep waste sealed in rubbish bins to avoid rodents | 18 (21.4) | 28 (33.3) | 38 (45.2) |
| **Health and safety regulation** | | | |
| The health care facility has an emergency water supply plan | 56 (66.7) | 19 (22.6) | 9 (10.7) |
| The health care facility has 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 | 54 (65.0) | 21 (25.3) | 8 (9.6) |
| The health care facility has a water safety plan in place, in case of water contamination | 49 (58.3) | 25 (29.8) | 10 (11.9) |
| The health care facility has 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 | 41 (48.8) | 31 (36.9) | 12 (14.3) |
| The health care facility has a contingency plan to ensure | 64 (76.2) | 15 (17.9) | 5 (96.0) |

| | | | |
|---|---|---|---|
| effective and timely delivery of safe water during landslides and emergencies over the short- and long-term | | | |
| The health care facility has 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 | 39 (46.4) | 25 (29.8) | 20 (23.8) |
| The health care facility has an emergency plan for maintenance and restoration of waste management systems | 55 (65.5) | 22 (26.2) | 7 (8.3) |

### 5.7.3 Vulnerability of the energy component to landslides

About 68.0% of the HCFs were highly vulnerable since they were unable to regularly assesses their energy system to ensure that it can cope with landslide events. About 82.8% of the HCFs were highly vulnerable since they were unable to 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 landslide event (Table 58).

**Table 19: Vulnerability of the energy component to landslides**

| **ENERGY** | **Vulnerability level** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Monitoring and assessment** | **High** | **Medium** | **Low** |
| The healthcare facility regularly assesses its energy system to ensure that it can cope with landslide events | 53 (68.0) | 13 (16.7) | 12 (15.4) |
| The health care facility has 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 landslide event | 53 (82.8) | 4 (6.3) | 7 (10.9) |
| The healthcare facility periodically checks emergency backup generators (including fuel, where assess whether renewable energy (If available. such as solar) | 39 (76.5) | 7 (13.7) | 5 (9.8) |
| The health care facility identifies priority areas within the facility which would require emergency power during and after a landslide event | 28 (35.0) | 33 (41.3) | 19 (23.8) |
| **Risk management** | | | |
| The health care facility has a secure place to protect the backup generator (e.g., an elevated place; including fuel or battery storage. where relevant) from landslide waters | 39 (73.58) | 8(15.09) | 6 (11.32) |
| The health care facility has adequate daylight to ensure proper visibility during a power outage | 13 (15.9) | 33 (40.2) | 36 (43.9) |
| The health care facility has power-operated doors that can easily be opened manually to permit exit in case of power failure | 31 (59.6) | 9 (17.3) | 12 (23.1) |
| The health care facility has appliance thermometers in the refrigerator and freezer to determine if food, vaccines and other essential refrigeration-dependent medical supplies are safe | 23 (28.4) | 15 (18.5) | 43 (53.1) |

| | | | |
|---|---|---|---|
| The health care facility has a clear guidance to alert staff on safety measures e.g never restore power | 49 (64.5) | 17 (22.4) | 10 (13.2) |
| **Health and safety regulation** | | | |
| The health care facility has an emergency plan for power outages in the short- and long-term (before, during and after a landside) | 56 (69.1) | 19 (23.5) | 6 (7.4) |
| The health care facility has work with energy utility agencies to prevent the suspension of electricity services | 56 (76.7) | 12 (16.4) | 5 (6.6) |
| The health care facility has a management plan for intermittent energy supplies or system failure | 52 (65.0) | 17 (21.3) | 11 (13.8) |
| The health care facility has a plan or regulation to determine ways to reduce overall energy use | 53 (67.0) | 13 (16.5) | 13 (16.5) |
| The health care facility has an emergency plan to ensure availability of adequate lighting, communication and Information systems, and refrigeration and sterilization equipment during a landslide | 54 (67.5) | 18 (22.5) | 8 (10.0) |

### 5.7.4 Vulnerability of infrastructure, technologies, products and processes to landslides

About 69.9% of the HCFs were highly vulnerable since they were unable to have knowledge, experience (considering previous damages), and resources (including, material, financial, supplies chain, and logistics) to manage landslide risk reduction. About 69.1% of the HCFs were highly vulnerable since they were unable to provide greater advocacy on health workforce education to cover climate change risks and responses. About 41.7% of the HCFs were highly vulnerable since they were unable to work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning, and implementation (Table 59).

**Table 20: Vulnerability of infrastructure, technologies, products and processes to landslides**

| **Infrastructure, technologies, products, and processes** | **Vulnerability level** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Adaptation of current systems and infrastructures** | **High** | **Medium** | **Low** |
| Healthcare facilities have the knowledge, experience (considering previous damages), and resources (including, material, financial, supplies chain, and logistics) to manage landslide risk reduction | 58 (69.9) | 22 (26.5) | 3 (3.6) |
| Healthcare facilities provide greater advocacy on health workforce education to cover climate change risks and responses | 58 (69.1) | 22 (26.2) | 4 (4.8) |
| Healthcare facilities work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning, and implementation | 35 (41.7) | 41 (48.8) | 8 (9.5) |

| | | | |
|---|---|---|---|
| Healthcare facilities conduct climate risk and vulnerability assessments for all facility sectors to identify risk scenarios, vulnerabilities, and the facility's response capacity | 62 (73.8) | 17 (20.2) | 5 (6.0) |
| Healthcare facilities utilize the assessed information as a basis to plan and prioritize measures to reduce risk impact | 57 (67.9) | 25 (29.8) | 2 (2.4) |
| Healthcare facilities in their annual planning consider how climate risks may change in the future | 58 (69.0) | 24 (28.6) | 2 (2.3) |
| Healthcare facilities have resources available to adopt risk reduction measures on the building and its infrastructure, technologies, products, and processes | 61 (73.5) | 18 (21.5) | 4 (4.8) |
| Healthcare facilities regularly update these assessments, considering emerging scientific information | 70 (83.3) | 12 (14.3) | 2 (3.4) |
| Healthcare facilities 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 landslide impacts | 37 (44.0) | 32 (38.1) | 15 (17.9) |
| Healthcare facilities evaluate the condition and safety of structural and non-structural elements impacted by previous exposure to landslide | 48 (57.1) | 27 (32.1) | 9 (10.7) |
| Healthcare facilities have a safe location for critical services and equipment in a landslide emergency situation | 64 (77.1) | 13 (15.7) | 6 (7.2) |
| Healthcare facilities have a safety plan to prevent medical and laboratory equipment supplies, and food packages to be exposed to landslide waters | 54 (67.5) | 22 (27.5) | 4 (5.0) |
| Healthcare facilities have procedures to store food and bottled water on shelves that will be safely out of the way of contaminated water in case of a landslide | 56 (71.8) | 13 (16.7) | 9 (11.5) |
| Healthcare facilities have an effective emergency risk communication plan to reduce risks and impacts for health workers and patients | 61 (73.5) | 18 (21.7) | 4 (4.8) |
| Healthcare facilities have a contingency plan in place for safe and efficient personnel evacuation (including staff and patients) before, during and following a landslide | 65 (77.4) | 16 (19.0) | 3 (3.6) |
| Healthcare facilities have a clear and consistent mechanism for secure evacuation of health workers and patients | 67 (80.7) | 14 (16.9) | 2 (2.4) |
| Healthcare facilities have a plan to transfer critical equipment and medical supplies to another healthcare | 56 (66.7) | 21 (25.0) | 7 (8.3) |

| | | | |
|---|---|---|---|
| facility or to a secure storage | | | |
| Healthcare facilities explore the relationship between social learning and adaptation measures in the face of landslide threats to identify and implement the best behavioral responses from successful health facilities | 60 (72.3) | 20 (24.1) | 3 (3.6) |
| Healthcare facilities have evaluation tools (e.g. forms) to identify damages and minimum needs in terms of health workers and medical supplies to ensure the continuous functioning of services | 64 (76.2) | 11 (13.1) | 9 (10.7) |
| Healthcare facilities have a mechanism for providing prompt maintenance and repair of equipment required for essential services | 58 (69.0) | 16 (19.0) | 10 (11.9) |
| Healthcare facilities 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 | 62 (74.7) | 17 (20.5) | 4 (4.8) |
| Healthcare facilities have walls protected and insulated against moisture and mould | 34 (40.5) | 31 (36.9) | 19 (22.6) |
| Healthcare facilities assess the performance and vulnerabilities of each critical part of the facility (structural and non-structural elements) that can be affected by a landslide | 48 (57.1) | 31 (36.9) | 5 (6.0) |
| Healthcare facilities have measures to remove mosquito breeding sites | 17 (20.2) | 32 (38.1) | 35 (41.7) |
| Healthcare facilities have roof drainage systems for rainfall | 28 (33.3) | 25 (29.8) | 31 (36.9) |
| Healthcare facilities have rooftop structures and equipment revised for anticipated increased rainfall | 44 (52.4) | 15 (17.9) | 25 (29.8) |
| Healthcare facilities have roofs that are leak-proof and insulated | 35 (42.2) | 21 (25.3) | 27 (32.5) |
| Healthcare facilities have machine rooms that are resistant to landslide or rooftop damage | 56 (76.7) | 8 (11.0) | 9 (12.3) |
| Healthcare facilities 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 | 51 (61.5) | 21 (25.3) | 11 (13.3) |
| Healthcare facilities have established procedures for procuring, safely transporting, and storing medical devices, pharmaceuticals, vaccines, laboratory | 44 (55.0) | 26 (32.5) | 10 (12.5) |

| | | | |
|---|---|---|---|
| supplies, parenteral nutrition and blood supplies, and other essential medical supplies | | | |
| Healthcare facilities have established procedures or plans for procuring, transporting, and storing bottled water and food supplies during an emergency | 62 (78.5) | 13 (16.5) | 4 (5.1) |
| Healthcare facilities 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 | 50 (60.2) | 24 (28.9) | 9 (10.8) |
| Healthcare facilities have a plan to house staff at the healthcare facility if shelter is required (sleeping areas, food, water) | 42 (50.6) | 27 (32.5) | 14 (16.9) |
| Healthcare facilities have an established post-landslide recovery plan for all infrastructure facilities (structural and non-structural elements) | 68 (81.0) | 13 (15.5) | 3 (3.6) |

**Landslide checklist on infrastructure, technologies, products and processes**

| **Infrastructure, technologies, products and processes** | **Vulnerably level** | | |
|---|---|---|---|
| **Promotion of new systems and technologies** | | | |
| ***Vulnerability scale: 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)*** | | | |
| **The healthcare facility has** | **High** | **Medium** | **Low** |
| Promotion of new systems and technologies | 48 (71.6) | 13 (19.4) | 6 (9.0) |
| Healthcare facilities have an information system between the health sector and meteorological services to communicate about climate hazards | 68 (81.9) | 12 (14.5) | 3 (3.6) |
| Healthcare facilities have an established plan to review, evaluate, and catalogue climate risks related to landslides for the healthcare facility's location | 69 (83.1) | 13 (15.7) | 1 (1.2) |
| Healthcare facilities have an established plan to review, evaluate and catalogue risks related to landslides for the healthcare facility's supply chain | 67 (80.7) | 13 (15.7) | 3 (3.6) |
| Healthcare facilities have electronic patient health records to make available to others receiving healthcare facilities, in case of evacuation | 59 (74.7) | 12 (15.2) | 8 (10.1) |
| Healthcare facilities have information and communication systems safely secured with backup arrangements (via cloud, satellite) to satisfy the facility's demand | 63 (81.8) | 8 (10.4) | 6 (7.8) |
| Healthcare facilities ensure information and communication flow between the health workforce and policymakers, particularly during high-stress situations and demands created by emergencies | 41 (50.0) | 30 (36.6) | 11 (13.4) |
| Healthcare facilities have an established, clear, and consistent knowledge transfer procedure for public health emergency | 56 (67.5) | 23 (27.7) | 4 (4.8) |

| | | | |
|---|---|---|---|
| Healthcare facilities have identified capacities, resources, and needs to better cope and manage landslides | 61 (73.5) | 19 (22.9) | 3 (3.6) |
| Healthcare facilities perform site and building maintenance procedures that include specifications on how the weather may affect the safety and continued functioning of the facility | 60 (72.3) | 18 (21.7) | 5 (6.0) |
| Healthcare facilities have an information system for tracking and monitoring diseases following landslide events | 37 (44.6) | 33 (39.8) | 13 (15.7) |

| **Infrastructure, technologies, products and processes** | **High** | **Medium** | **Low** |
|---|---|---|---|
| **Sustainability of healthcare facility operations** | | | |
| have adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction, and response | 60 (72.3) | 18 (21.7) | 5 (6.0) |
| have partnerships established between the facility, community, and local authorities to reduce vulnerabilities in the surrounding areas | 35 (42.1) | 35 (42.2) | 13 (15.7) |
| have secure storage for hazardous chemicals to avoid their damage or release during a landslide event | 57 (69.5) | 17 (20.7) | 8 (9.8) |
| Healthcare facilities have a defined and sustained budget as part of core budgeting for emergency preparedness and response to landslide events | 69 (83.1) | 12 (14.5) | 2 (2.4) |
| Healthcare facilities have an access route for public transportation which is likely to remain operational during or immediately following a landslide event | 46 (55.4) | 17 (20.4) | 20 (24.1) |
| Healthcare facilities review building code design baselines against rainfall volumes, and map each risk | 61 (73.5) | 18 (21.7) | 4 (4.9) |
| Healthcare facilities have trees planted in a secure place that will not block access to the facility or fall on the building during an event | 25 (30.1) | 31 (37.4) | 27 (32.5) |
| Healthcare facilities have estimates of the consumption (such as the amount used per week) of essential, pharmaceutical, nutritional, and laboratorial supplies, personal protective equipment, food, etc., using the most likely landslide scenario | 43 (52.4) | 24 (29.3) | 15 (18.3) |
| Healthcare facilities undertake risk assessments of the supply chain for essential medical and nonmedical products | 45 (54.2) | 27 (32.5) | 11 (13.3) |
| Healthcare facilities have a secure plan to ensure the continuity of the facility's supply and delivery chain | 41 (49.4) | 23 (27.7) | 19 (22.9) |

## 5.8 Vulnerability to heat waves

### 5.8.1 Vulnerability of the health workforce to heat waves

About 57.1% of the HCFs were highly vulnerable to heat waves since the health workforce were not equipped with a plan to identify and protect health workers at risk of heat stress. About 78.6% of the HCFs were highly vulnerable since the health workforce were unable to be provided with appropriate clothes (e.g., light, loose-fitting cotton clothes, and when necessary, a hat). About 78.6% of the HCFs were highly vulnerable since the health workforce were unable to be provided with

sunscreen, hats and plenty of drinking water for staff carrying out outdoor activities. About 50.0% of the HCFs were highly vulnerable since the health workforce were unable to be provided with safe water during a heatwave event and stimulated regularly for appropriate water (Table 38).

**Table 21: Vulnerability of the health workforce to heat waves**

| **HEALTH WORKFORCE** | **Vulnerability level** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Human resource** | **High** | **Medium** | **Low** |
| The health workforce is equipped with a plan to identify and protect health workers at risk of heat stress | 8 (57.1) | 4 (28.6) | 2 (14.3) |
| The health workforce is provided with appropriate clothes (e.g., light, loose-fitting cotton clothes, and when necessary, a hat) | 11 (78.6) | 2 (14.3) | 1 (7.1) |
| The health workforce is provided with sunscreen, hats and plenty of drinking water for staff carrying out outdoor activities | 11 (78.6) | 2 (14.3) | 1 (7.1) |
| The health workforce is provided with safe water during a heatwave event and stimulated regularly for appropriate water intake | 7 (50.0) | 5 (35.7) | 2 (14.3) |
| The health workforce is provided with a cool space or a shower room for staff | 9 (64.3) | 3 (21.4) | 2 (14.3) |
| The health workforce is provided with an information system to manage occupational safety and health in the facility during a heatwave, including rest for staff | 8 (57.1) | 4 (28.6) | 2 (14.3) |
| The health workforce is provided with an information system to manage occupational safety and health in the facility during a heatwave, including rest for staff | 8 (57.1) | 5 (35.7) | 1 (7.1) |
| **Capacity development** | | | |
| The health workforce is trained to manage hazardous waste (chemical, biological, radiological) | 4 (28.6) | 4 (28.6) | 6 (42.9) |
| The health workforce is trained on public health and climate change hazards, including health impacts related to heatwaves | 10 (71.4) | 4 (28.6) | 0 (0.0) |
| The health workforce is 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 | 10 (71.4) | 2 (14.3) | 2 (14.3) |
| The health workforce is able to implement a contingency plan for public health emergencies, in case of high temperature effects, and water and food contamination | 10 (71.4) | 2 (14.3) | 2 (14.3) |
| The health workforce is trained and has specific and clear guidance on actions to reduce heat risk factors for staff | 10 (71.4) | 4 (28.6) | 0 (0.0) |
| The health workforce is 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) | 11 (78.6) | 2 (14.3) | 1 (7.1) |
| **Communication and awareness-raising** | | | |
| The health workforce is aware about the impacts of hot temperatures on human health via water quality and quantity (including water- and food-borne diseases) and air quality | 3 (21.4) | 7 (50.0) | 4 (28.6) |
| The health workforce is aware of the type of patients and symptoms expected during a heatwave | 7 (50.0) | 3 (21.4) | 4 (28.6) |

| | | | |
|---|---|---|---|
| The health workforce is informed on how to use and follow a surveillance system to track health outcomes | 7 (50.0) | 4 (28.6) | 3 (21.4) |
| The health workforce is aware of the need to keep hydrated and wear appropriate clothing | 4 (28.6) | 4 (28.6) | 6 (42.9) |
| The health workforce is provided with a community health educational programme to improve community health in the face of heatwave risks | 8 (57.1) | 4 (28.6) | 2 (14.3) |
| The health workforce is 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) | 5 (35.7) | 6 (42.9) | 3 (21.4) |

## Vulnerability of the WASH component to heat waves

About 42.9% of the HCFs were highly vulnerable to heat waves since they were unable to verify water safety conditions, including updated risk assessments to map water resources and water supplies for the facility. About 64.3% of the HCFs were highly vulnerable since they were unable to have an evaluation system to monitor their water system or supply before, during and after the event. About 42.9% of the HCFs were highly vulnerable since they were unable to have information on the water system installation that ensures lower risk of being contaminated. About 50.0% of the HCFs were highly vulnerable since they were unable to have a quality monitoring plan for water meant for human consumption. About 71.4% of the HCFs were highly vulnerable since they were unable to have a monitoring plan for potable water. About 50.0% of the HCFs were highly vulnerable since they were unable to have a water management plan to identify water contamination (Table 39)

**Table 22: Heat wave checklist for assessing vulnerabilities on water, sanitation and healthcare waste**

| **WATER, SANITATION AND HEALTHCARE WASTE** | **Vulnerability level** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Monitoring and assessment** | **High** | **Medium** | Low |
| The healthcare facilities verify water safety conditions, including updated risk assessments to map water resources and water supplies for the facility | 6 (42.9) | 5 (35.7) | 3 (21.4) |
| Healthcare facilities have an evaluation system to monitor their water system or supply before, during and after the event | 9 (64.3) | 3 (21.4) | 2 (14.3) |
| Healthcare facilities have information on the water system installation that ensures lower risk of being contaminated | 6 (42.9) | 5 (35.7) | 3 (21.4) |
| Healthcare facilities have a quality monitoring plan for water meant for human consumption | 7 (50.0) | 5 (35.7) | 2 (14.3) |
| Healthcare facilities have a monitoring plan for potable water | 10 (71.4) | 3 (21.4) | 1 (7.1) |
| Healthcare facilities have a water management plan to identify water contamination | 7 (50.0) | 2 (14.3) | 5 (35.7) |
| **Risk Management** | | | |

| | | | |
|---|---|---|---|
| Healthcare facilities have onsite water purification equipment to provide safe drinking water | 9 (64.3) | 3 (21.4) | 2 (14.3) |
| The healthcare facilities provide sufficient drinking water to staff, patients and visitors | 2 (14.3) | 8 (57.1) | 4 (28.6) |
| Healthcare facilities keep drinking water cool or refrigerated where possible for staff, patients and visitors | 9 (69.2) | 2 (15.4) | 2 (15.4) |
| Healthcare facilities have a contingency plan for monitoring and reducing contaminant concentrations in the facility water system supplies | 9 (64.3) | 4 (28.6) | 1 (7.1) |
| Healthcare facilities have water storage protected from direct sunlight | 6 (42.9) | 5 (35.7) | 3 (21.4) |
| Healthcare facilities have water storage tanks with appropriate covers to protect from excessive heat | 6 (42.9) | 4 (28.6) | 4 (28.6) |
| Healthcare facilities have chemicals stored away from excessive heat | 6 (46.2) | 4 (30.8) | 3 (23.1) |
| Healthcare facilities have healthcare waste stored away from excessive heat in cool and covered spaces | 6 (42.9) | 3 (21.4) | 5 (35.7) |
| **Health and safety regulation** | | | |
| Healthcare facilities work with water utility agencies to prevent suspension of services | 8 (57.1) | 3 (21.4) | 3 (21.4) |
| Healthcare facilities have an alternative source of water supply | 4 (28.6) | 5 (35.7) | 5 (35.7) |
| Healthcare facilities have a water safety plan in place, in case of water contamination | 8 (57.1) | 4 (28.6) | 2 (14.3) |
| Healthcare facilities have a mechanism or regulation to carry out sanitary inspections of water supply, and when necessary, establish a temporary ban on the use, until improvements are made | 5 (35.7) | 3 (21.4) | 6 (42.9) |
| Healthcare facilities have a contingency plan to ensure effective and timely delivery of safe water during extreme temperatures and emergencies over the short- and long-term | 7 (50.0) | 3 (21.4) | 4 (28.6) |
| Healthcare facilities have a cross-sectoral water management plan to conserve and protect local or alternative water sources | 9 (64.3) | 1 (7.1) | 4 (28.6) |

### 5.8.2 Vulnerability of WASH and healthcare waste to heat waves

About 42.9% of the HCFs were highly vulnerable to heat waves since they were unable to verify water safety conditions, including updated risk assessments to map water resources and water supplies for the facility. About 64.3% of the HCFs were highly vulnerable since they were unable to have an evaluation system to monitor their water system or supply before, during and after the event. About 42.9% of the HCFs were highly vulnerable since they were unable to have information on the water system installation that ensures lower risk of being contaminated. About 50.0% of the HCFs were highly vulnerable since they were unable to have a quality monitoring plan for water meant for human consumption. About 71.4% of the HCFs were highly vulnerable since they were unable to have a monitoring plan for potable water. About 50.0% of the HCFs were highly vulnerable since they were unable to have a water management plan to identify water contamination (Table 39)

**Table 23: Vulnerability of WASH and healthcare waste to heat waves**

| WATER, SANITATION AND HEALTHCARE WASTE | Vulnerability level |
|---|---|

| ***Vulnerability scale: 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)*** | | | |
|---|---|---|---|
| **Monitoring and assessment** | **High** | **Medium** | Low |
| The healthcare facilities verify water safety conditions, including updated risk assessments to map water resources and water supplies for the facility | 6 (42.9) | 5 (35.7) | 3 (21.4) |
| Healthcare facilities have an evaluation system to monitor their water system or supply before, during and after the event | 9 (64.3) | 3 (21.4) | 2 (14.3) |
| Healthcare facilities have information on the water system installation that ensures lower risk of being contaminated | 6 (42.9) | 5 (35.7) | 3 (21.4) |
| Healthcare facilities have a quality monitoring plan for water meant for human consumption | 7 (50.0) | 5 (35.7) | 2 (14.3) |
| Healthcare facilities have a monitoring plan for potable water | 10 (71.4) | 3 (21.4) | 1 (7.1) |
| Healthcare facilities have a water management plan to identify water contamination | 7 (50.0) | 2 (14.3) | 5 (35.7) |
| **Risk Management** | | | |
| Healthcare facilities have onsite water purification equipment to provide safe drinking water | 9 (64.3) | 3 (21.4) | 2 (14.3) |
| The healthcare facilities provide sufficient drinking water to staff, patients and visitors | 2 (14.3) | 8 (57.1) | 4 (28.6) |
| Healthcare facilities keep drinking water cool or refrigerated where possible for staff, patients and visitors | 9 (69.2) | 2 (15.4) | 2 (15.4) |
| Healthcare facilities have a contingency plan for monitoring and reducing contaminant concentrations in the facility water system supplies | 9 (64.3) | 4 (28.6) | 1 (7.1) |
| Healthcare facilities have water storage protected from direct sunlight | 6 (42.9) | 5 (35.7) | 3 (21.4) |
| Healthcare facilities have water storage tanks with appropriate covers to protect from excessive heat | 6 (42.9) | 4 (28.6) | 4 (28.6) |
| Healthcare facilities have chemicals stored away from excessive heat | 6 (46.2) | 4 (30.8) | 3 (23.1) |
| Healthcare facilities have healthcare waste stored away from excessive heat in cool and covered spaces | 6 (42.9) | 3 (21.4) | 5 (35.7) |
| **Health and safety regulation** | | | |
| Healthcare facilities work with water utility agencies to prevent suspension of services | 8 (57.1) | 3 (21.4) | 3 (21.4) |
| Healthcare facilities have an alternative source of water supply | 4 (28.6) | 5 (35.7) | 5 (35.7) |
| Healthcare facilities have a water safety plan in place, in case of water contamination | 8 (57.1) | 4 (28.6) | 2 (14.3) |
| Healthcare facilities have a mechanism or regulation to carry out sanitary inspections of water supply, and when necessary, establish a temporary ban on the use, until improvements are made | 5 (35.7) | 3 (21.4) | 6 (42.9) |
| Healthcare facilities have a contingency plan to ensure effective and timely delivery of safe water during extreme temperatures and emergencies over the short- and long-term | 7 (50.0) | 3 (21.4) | 4 (28.6) |

| | | | |
|---|---|---|---|
| Healthcare facilities have a cross-sectoral water management plan to conserve and protect local or alternative water sources | 9 (64.3) | 1 (7.1) | 4 (28.6) |

### 5.8.3 Vulnerability of the energy component to heat waves

About 64.3% of the HCFs were highly vulnerable to heat waves since they were unable to assess their energy system to ensure they can cope with heatwave conditions. About 78.6% of the HCFs were highly vulnerable since they were unable to 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. About 77.0% of the HCFs were highly vulnerable since they were unable to periodically check the emergency backup generator (including fuel, where relevant), even if rarely used (Table 40).

**Table 24: Vulnerability of the energy component to heat waves**

| **ENERGY** | **Vulnerability level** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Monitoring and assessment** | **High** | **Medium** | **Low** |
| HCFs regularly assess their energy system to ensure they can cope with heatwave conditions | 9 (64.3) | 4 (28.6) | 1 (7.1) |
| HCFs 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 | 11 (78.6) | 1 (7.1) | 2 (14.3) |
| HCFs periodically check the emergency backup generator (including fuel, where relevant), even if rarely used | 10 (77.0) | 1 (7.7) | 2 (15.4) |
| HCFs assess regularly heating, ventilation and air conditioning systems | 10 (77.0) | 2 (14.3) | 1 (7.7) |
| HCFs assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment | 6 (46.2) | 5 (38.5) | 2 (15.4) |
| HCFs monitor building humidity and if needed adjust the cooling system to control the humidity in operating room areas | 11 (78.6) | 1 (7.1) | 2 (14.3) |
| **Risk management** | | | |
| HCFs have a secure place to protect the backup generator (including fuel or battery storage, where relevant) from damage | 7 (50.0) | 1 (7.1) | 6 (42.9) |
| HCFs have appliance thermometers in the refrigerator and freezer to determine if food, vaccines and other essential refrigeration-dependent medical supplies are safe | 2 (15.4) | 3 (23.1) | 8 (61.5) |
| HCFs have adequate daylight to ensure proper visibility during power outages | 4 (30.8) | 2 (15.4) | 7 (53.8) |
| HCFs have power-operated doors that can be opened manually to permit exit in case of power failure | 6 (60.0) | 2 (16.7) | 4 (33.3) |
| **Health and Safety** | | | |
| HCFs have an emergency plan for power outages in the short- and long-term (during and after the event) | 11 (84.6) | 1 (7.7) | 1 (7.7)) |
| HCFs work with energy utility agencies to prevent suspension of electricity services | 8 (61.5) | 3 (23.1) | 2 (15.4) |

| | | | |
|---|---|---|---|
| HCFs have a management plan for intermittent energy supplies or system failure | 10 (71.4) | 3 (21.4) | 1 (7.1) |
| HCFs have an emergency plan to ensure the availability of adequate lighting, communication and information systems, and refrigeration and sterilization equipment during the event | 9 (64.3) | 4 (28.6) | 1 (7.1) |
| HCFs have a plan to evacuate patients to a cooling station if the facility has lost power and has no other source of energy | 11 (78.6) | 1 (7.1) | 2 (14.3) |

### 5.8.4 Vulnerability of infrastructure, technologies, products and processes to heat waves

About 71.4% of the HCFs were vulnerable since they were unable to provide greater advocacy on health workforce education to cover heatwave risks and responses. About 85.7% of the HCFs were vulnerable to heat waves since they were unable to have preparedness and training for periods of extreme heat. About 50.0% of the HCFs were vulnerable since they were unable to assess the performance and vulnerabilities of each critical part of the facility (structural and non-structural elements) that can be affected by hot temperatures (Table 41).

**Table 25: Vulnerability of infrastructure, technologies, products and processes to heat waves**

| **INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES** | **Vulnerability level** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Adaptation of current system and infrastructure** | High | Medium | Low |
| Healthcare facilities provide greater advocacy on health workforce education to cover heatwave risks and responses | 10 (71.4) | 2 (14.3) | 2 (14.3) |
| Healthcare facilities have preparedness and training for periods of extreme heat | 12 (85.7) | 1 (7.1) | 1 (7.1) |
| Healthcare facility assess the performance and vulnerabilities of each critical part of the facility (structural and non-structural elements) that can be affected by hot temperatures | 7 (50.0) | 4 (28.6) | 3 (21.4) |
| Healthcare facilities assess the heating, ventilation and air-conditioning systems for capacity to deal with increasing heat and humidity | 6 (46.2) | 5 (38.5) | 2 (15.4) |
| Healthcare facilities install reflective white roofs to reduce heat impacts | 11 (78.6) | 1 (7.1) | 2 (14.3) |
| Healthcare facilities install green roofs to mitigate heat impacts | 12 (85.7) | 0 (0.0) | 2 (14.3) |
| Healthcare facilities have pavements and roofs designed to withstand extreme temperatures or solar radiation | 9 (64.3) | 5 (35.7) | 0 (0.0) |
| Healthcare facilities have light-coloured paving on parking areas and walkways around the facility | 12 (85.7) | 0 (0.0) | 2 (14.3) |
| Healthcare facilities review building code design baselines against extreme temperatures to ascertain inventory risks | 10 (71.4) | 2 (14.3) | 2 (14.3) |
| Healthcare facilities identify vulnerabilities to estimate the possible loss and implement actions to reduce impacts | 11 (78.6) | 2 (14.3) | 1 (7.1) |
| Healthcare facilities have exterior shading devices, resilient trees or other architectural features that mitigate heat | 8 (61.5) | 3 (23.1) | 2 (15.4) |
| Healthcare facilities have windows that can be operated to | 4 (30.8) | 4 (30.8) | 5 (38.5) |

| | | | |
|---|---|---|---|
| provide ventilation and maintain habitable and operational conditions | | | |
| Healthcare facilities have a system for cooling the environment | 9 (64.3) | 2 (14.3) | 3 (21.4) |
| Healthcare facilities provide an extra medical supply in case of increased demand for the treatment of heat stress | 8 (57.1) | 3 (21.4) | 3 (21.4) |
| Healthcare facilities stimulate the increase of water intake by staff and patients | 5 (35.7) | 3 (21.4) | 6 (42.9) |
| Healthcare facilities have insulated loft and cavity walls | 10 (71.4) | 3 (21.4) | 1 (7.1) |
| Healthcare facilities store chemicals away from excessive heat | 5 (35.7) | 3 (21.4) | 6 (42.9) |
| Healthcare facilities have a plan for arranging for extra staffing for emergency support services | 12 (85.7) | 1 (7.1) | 1 (7.1) |
| Healthcare facilities have a monitoring and early warning system integrated with other areas to manage risks related to heatwave impacts on the facility | 11 (78.6) | 2 (14.3) | 1 (7.1) |
| Healthcare facilities have an effective emergency risk communication plan to communicate clear messages of the danger of heatwaves, emphasizing health protection as a priority | 9 (64.3) | 3 (21.4) | 2 (14.3) |
| Promotion of new systems and technologies | | | |
| Healthcare facilities receive meteorological information on the likelihood of forthcoming hot weather | 13 (92.9) | 1 (7.1) | 0 (0.0) |
| Healthcare facilities have a syndromic surveillance system for heat-related illnesses | 10 (76.9) | 2 (15.4) | 1 (7.7) |
| Healthcare facilities have an updated training programme for the health workforce to detect and track climate change-related human heat stress | 12 (85.7) | 1 (7.1) | 1 (7.1) |
| Healthcare facilities have a long-term strategy for reducing heat, such as through building insulation | 12 (85.7) | 2 (14.3) | 0 (0.0) |
| Healthcare facilities perform risk assessments to assist with adaptation measures for heatwaves | 12 (85.7) | 2 (14.3) | 0 (0.0) |
| Healthcare facilities have an information system for tracking and monitoring diseases following heatwave events | 10 (71.4) | 2 (14.3) | 2 (14.3) |
| Healthcare facilities have measures that improve health performance, based on a history of climate variability in the region or locality | 11 (78.6) | 1 (7.1) | 2 (14.3) |
| Healthcare facilities perform evaluations to predict heatwave conditions 1–5 days in advance | 13 (92.9) | 1 (7.1) | 0 (0.0) |
| Healthcare facilities coordinate public broadcasts of information about the anticipated timing, severity and duration of heatwave conditions in its surrounding communities | 12 (85.7) | 2 (14.3) | 0 (0.0) |
| **Sustainability of healthcare facility operations** | | | |
| Healthcare facilities have a defined and sustained budget as part of core budgeting for emergency preparedness and response to heatwaves | 12 (85.7) | 2 (14.3) | 0 (0.0) |
| Healthcare facilities improve adaptive governance capacity regarding evaluation and measures for risk identification, | 11 (78.6) | 2 (14.3) | 1 (7.1) |

| | | | |
|---|---|---|---|
| risk reduction and response | | | |
| Healthcare facilities assess the length of time people can remain in a place before it gets overheated, requiring evacuation to another facility | 10 (71.4) | 2 (14.3) | 2 (14.3) |
| Healthcare facilities have a thermal stress device to assess temperature and identify heat warning environment | 11 (78.6) | 2 (14.3) | 1 (7.1) |
| Healthcare facilities have trees and leafy plants near windows to provide natural cooling | 4 (30.8) | 6 (46.2) | 3 (23.1) |
| Healthcare facilities 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 | 11 (78.6) | 1 (7.1) | 2 (14.3) |
| Healthcare facilities have a coordinated plan with health municipal department heads to ensure appropriate preparations for ongoing heatwave conditions | 11 (78.6) | 1 (7.1) | 2 (14.3) |

## 5.9 Vulnerability to lightening

### 5.9.1 Vulnerability of the health workforce to lightening

About 52.5% of the HCFs were highly vulnerable to lightening since the workforce were unable to be provided with programs for supporting staff with regards to mental health, injuries, medical treatment and related support measures. About 57.6% of the HCFs were highly vulnerable since the workforce were unable to be provided 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 lightning event. About 61.3% of the HCFs were highly vulnerable since the health workforce were unable to be prepared with a contingency plan for accessing additional health workforce to strengthen performance capacity. About 59.7% of the HCFs were highly vulnerable since the health workforce was unable to be prepared with an information system to manage occupational safety and health in the facility during a lightning event (Table 46).

**Table 26: Lightening checklist for assessing vulnerabilities on workforce**

| **WORKFORCE** | **Vulnerability level** | | |
|---|---|---|---|
| ***Vulnerability scale: 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*** | | | |
| **Human resources** | **High** | **Low** | **Medium** |
| **The health workforce** | | | |
| Provided with programs for supporting staff with regards to mental health, injuries, medical treatment and related support measures | 32 (52.5) | 3 (4.9) | 26 (42.6) |
| 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 | 34 (57.6) | 4 (6.7) | 21(35.6) |

| | | | |
|---|---|---|---|
| severe lightning event | | | |
| Prepared with a contingency plan for accessing additional health workforce to strengthen performance capacity | 38 (61.3) | 3 (4.8) | 21 (33.9) |
| Provided with an information system to manage occupational safety and health in the facility during a lightning event | 37 (59.7) | 5 (8.1) | 20 (32.3) |
| Equipped with an emergency plan to protect health workers from multiple physical and biological hazards | 38 (62.3) | 2 (3.3) | 21 (34.4) |
| Provided with a post-lightning employee recovery assistance program according to staff needs | 52 (83.9) | 1 (1.6) | 9 (14.5) |
| Equipped with a coordinated plan, including volunteers on stand-by, to assist during an emergency or to support health professionals | 46 (75.4) | 5 (8.2) | 10 (16.4) |
| Provided with full personal protective equipment, especially for clean-up crews (including waterproof safety boots, goggles, work gloves and masks) | 25 (39.1) | 14 (21.9) | 25 (39.1) |
| Provided with safe water and food during a lightning event | 35 (56.5) | 13 (21.0) | 14 (22.6) |
| **Capacity development** | | | |
| Trained on public‹ health and climate change hazards, including health Impacts related to different kinds of lightning | 47 (73.4) | 2 (3.1) | 15 (23.4) |
| Equipped with knowledge, experience, training and resources to manage lightning risk reduction at the facility and in the local communities | 40 (62.5) | 3 (4.7) | 21 (32.8) |
| Engaged in the development of pians and responses to lightning risks | 50 (79.4) | 2 (3.2) | 11 (17.5) |
| Prepared and able to implement risk reduction actions for protecting themselves | 40 (62.5) | 3 (4.7) | 21 (32.8) |
| Equipped with a contingency plan for continuing to provide services at other facilities or in the local communities (primary health care), if necessary | 39 (60.9) | 5 (7.8) | 20 (31.3) |
| Trained in multi-hazard assessments | 51 (79.7) | 3 (4.7) | 10 (15.6) |
| Trained to maintain correct level of water quality controls in an emergency or disaster situations | 49 (76.6) | 6 (9.4) | 9 (14.1) |
| Trained to an appropriate standard to maintain the correct level of safety of electrical power supply. in both routine and power supply. in both routine and emergency/disaster | 46 (71.9) | 4 (6.3) | 14 (21.9) |

| | | | |
|---|---|---|---|
| situations | | | |
| Trained to detect posttraumatic stress disorder among staff to take prompt action | 33 (51.6) | 5 (7.8) | 26 (40.6) |
| **Communication and awareness raising** | | | |
| Provided with a safe internal communication system, especially in emergency situations | 28 (43.8) | 6 (9.4) | 30 (46.9) |
| Aware of contingency plans for accessing and leaving the facility during flood and strong wind emergencies, and health workforce transportation | 45 (71.4) | 1 (1.6) | 17 (27.0) |
| Regularly participating in community disaster planning committees to: improve knowledge on how to reduce risks. be prepared and respond to lightning hazards, and recover better than before through adaptation measures | 44 (68.8) | 00 (0.0) | 20 (31.3) |
| Prepared with clear messaging about water and food safety during and after a lightning event | 42 (65.6) | 1 (1.6) | 21 (32.8) |
| Prepared with clear messaging, and staff trained on exit and evacuation routes that are clearly marked and free of obstacles to enable emergency evacuation | 41 (65.1) | 3 (4.8) | 19 (30.7) |
| Equipped with a community health educational programme to assist the community in reducing vulnerability to lightning impacts | 38 (59.4) | 5 (7.8) | 21 (32.8) |
| Equipped with a community health educational programme to improve community health in the face of lightning risks | 42 (65.6) | 4 (6.3) | 18 (28.1) |

### 5.9.2 Vulnerability of the water, sanitation and healthcare waste to lightening

About 37.1% of the HCFs were highly vulnerable since they did not verify water safety conditions, including updated risk assessments to map water resources and water supplies for the facility. About 42.9% of the HCFs were highly vulnerable since they were unable to regularly assess its sanitation systems for any possible damage in the event of lightning and severe winds. About 41.3% of the HCFs were highly vulnerable since they were unable to have information on water system installation that ensures lower risk of contamination (Table 48).

**Table 27: Lightning checklist for assessing vulnerability on water, sanitation and healthcare waste**

| **WATER, SANITATION AND HEALTH CARE WASTE** | **Vulnerability level** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Monitoring and assessment** | **High** | **Low** | **Medium** |

| **The healthcare facility** | | | |
|---|---|---|---|
| Verify' water safety conditions, including updated risk assessments to map water resources and water supplies for the facility | 23 (37.1) | 12 (19.4) | 27 (43.6) |
| Regularly assess its sanitation systems for any possible damage in the event of lightning and severe winds | 27 (42.9) | 15 (23.8) | 21 (33.3) |
| Have information on water system installation that ensures lower risk of contamination | 26 (41.3) | 11 (17.5) | 26 (41.3) |
| Have a water quality monitoring plan for drinking water during and after a lightning event | 35 (57.4) | 6 (9.8) | 20 (32.8) |
| Monitor sewer overflows to fix pumps in advance of a lightning and after the event | 32 (68.1) | 5 (10.6) | 10 (21.3) |
| **Risk management** | | | |
| Store hazardous chemicals. radioactive and biological wastes in a safe place and on a level above the ground floor | 22 (39.3) | 19 (33.9) | 15 (26.8) |
| Have a schedule for emptying latrines in advance of lightning to avoid overflows | 28 (49.1) | 11 (19.3) | 18 (31.6) |
| Have water storage tanks supported and anchored to resist strong winds and rainfall | 19 (30.7) | 25 (40.3) | 18 (29.0) |
| Have a safe system for waste disposal after a lightning | 24 (38.7) | 12 (19.4) | 26 (41.9) |
| Have an established safe management approach to health care waste transport (including hazardous waste) during and after a lightning event | 32 (50.8) | 8 (12.7) | 23 (36.5) |
| Have onsite water purification equipment to provide safe drinking water | 36 (61 0) | 9 (15.3) | 14 (23.7) |
| Have a surveillance system for diseases related to water quality and sanitation | 23 (36.5) | 19 (30.2) | 21 (33.3) |
| **Health and safety** | | | |
| Have an assessment plan that maps risks to water and sanitation infrastructures to identify where services could be disrupted during lightning events | 39 (62.9) | 5 (8.1) | 18 (29.0) |
| Have an emergency water supply plan | 37 (58.7) | 11 (17.5) | 15 (23.8) |
| Have a plan to verify safety conditions and proper functioning of all elements of water distribution system, including storage tanks. cisterns, valves, pipes and connections, as well as water disinfection to avoid or reduce Impacts from a storm | 37 (58.7) | 8 (12.7) | 18 28.6) |

| | | | |
|---|---|---|---|
| Have a contingency plan to ensure effective and timely delivery of safe water during extreme temperatures and emergencies over the short- and long-term | 39 (62.9) | 4 (6.5) | 19 (30.7) |
| Have an emergency plan for maintenance and restoration of waste management systems | 38 (61.3) | 9 (14.5) | 15 (24. 2) |

### 5.9.3 Vulnerability of energy to lightening

About 59.4% of the HCFs were highly vulnerable since they were unable to assess its energy system to ensure that it can cope with lightning events and minimize their impacts (e.g., solar photovoltaic panels, either rooftop or ground mounted). About 73.2% of the HCFs were highly vulnerable since they were unable to have 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. About 66.0% of the HCFs were highly vulnerable since they were unable to Periodically check emergency backup generators (including fuel, where relevant) (Table 49).

**Table 28: Lightning checklist for assessing vulnerabilities on energy**

| **ENERGY** | **Vulnerability level** | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Monitoring and assessment** | **High** | **Low** | **Medium** |
| **The healthcare facility** | | | |
| Regularly assess its energy system to ensure that it can cope with lightning events and minimize their impacts (e.g., solar photovoltaic panels, either rooftop or ground mounted) | 38 (59.4) | 7 (10.9) | 19 (29.7) |
| 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 | 41 (73.2) | 8 (14.3) | 7 (12.5) |
| Periodically check emergency backup generators (including fuel, where relevant) | 31 (66.0) | 8 (17.0) | 8 (17.0) |
| Identify priority areas within the facility which would require emergency power when needed | 24 (39.3) | 16 (26.2) | 21 (34.4) |
| Assess whether renewable energy (if available. such as solar) is sufficient to power critical equipment | 21 (33.9) | 14 (22.6) | 27 (43.6) |
| **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 | 27 (60.0) | 8 (17.8) | 10 (22.2) |

| | | | |
|---|---|---|---|
| damage | | | |
| Have appliance thermometers in the refrigerator and freezer to determine if food, vaccines, and other essential refri8eration-dependent medical supplies are safe | 13 (21.3) | 31 (50.8) | 17 (27.9) |
| Have adequate daylight to ensure proper visibility during a power outage | 13 (20.6) | 36 (57.1) | 14 (22.2) |
| Have power-operated doors that can be opened manually to permit exit during power failure | 27 (62.8) | 9 (20.9) | 7 (16.3) |
| 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 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) | 37 (59.7) | 8 (12.9) | 17 (27.4) |
| Have an emergency plan for power outages in the short- and long-term (before, during and after a lightening) | 44 (69.8) | 7 (11.1) | 12 (19.1) |
| Work with energy utility agencies to prevent suspension of electricity services | 34 (56.7) | 9 (15.0) | 17 (28.3) |
| Have a management plan for intermittent energy supplies or system failure | 37 (60.7) | 8 (13.1) | 16 (26.2) |
| Have a plan or regulation to determine ways to reduce overall energy use | 34 (54.8) | 7 (11.3) | 21 (33.9) |
| Have an emergency plan to ensure the availability of adequate lighting, communication. and information systems. as well as refrigeration and sterilization equipment during a lightning event | 34 (54.8) | 9 (14.5) | 19 (30.7) |

### 5.9.4 Vulnerability of infrastructure, technologies, products and processes to lightening

About 60.3% of the HCFs were highly vulnerable since they were unable to have knowledge, experience (considering previous damages) and resources (including human, material, financial, supplies chain and logistics) to reduce disaster risk related to lightening. About 68.3% of the HCFs were highly vulnerable since they were unable to work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning and implementation. About 74.6% of the HCFs were vulnerable since they were unable to conduct climate risk and vulnerability assessments for all facility sectors to identify risk scenarios, vulnerabilities and the facility's response capacity. About 74.6% of the HCFs were vulnerable since they were unable to have a monitoring and early warning system to manage and reduce the risks of storm related health effects (Table 50).

**Table 29: Lightning checklist on infrastructure, technologies, products and processes**

| INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES | Vulnerability level | | |
|---|---|---|---|
| ***Vulnerability scale: 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)*** | | | |
| **Adaptation of current systems and infrastructures** | **High** | **Low** | **Medium** |
| **The healthcare facilities** | | | |
| Have knowledge, experience (considering previous damages) and resources (including human, material, financial, supplies chain and logistics) to reduce disaster risk related to lightening | 38 (60.3) | 7 (11.1) | 18 (28.6) |
| Work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning and implementation | 33 (52.4) | 5 (7.9) | 25 (39.7) |
| Conduct climate risk and vulnerability assessments for all facility sectors to identify risk scenarios, vulnerabilities and the facility's response capacity | 43 (68.3) | 3 (4.8) | 17 (27.0) |
| Have a monitoring and early warning system to manage and reduce the risks of storm related health effects | 47 (74.6) | 2 (3.2) | 14 (22.2) |
| Utilize the assessed information as a basis to plan and prioritize measures to reduce risk impact | 34 (54.8) | 5 (8.1) | 23 (37.1) |
| In their annual planning consider how climate risks may change in the future | 43 (68.3) | 5 (7.9) | 15 (23.8) |
| Have resources available to adopt risk reduction measures on the building and infrastructure, technologies, products and processes | 40 (64.5) | 3 (4.8) | 19 (30.7) |
| Regularly update these assessments, considering emerging scientific information | 45 (71.4) | 2 (3.2) | 16 (25.4) |
| Havea 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) | 23 (37.1) | 14 (22.6) | 25 (40.3) |
| Evaluate the condition and safety of structural and non-structural elements of facility, impacted by previous exposures to storms or similar hazards | 29 (46.8) | 4 (6.5) | 29 (46.8) |

| | | | |
|---|---|---|---|
| Have an effective emergency risk communication plan to reduce risks and impacts for health workers and patients | 43 (68.3) | 4 (6.4) | 16 (25.4) |
| Havea contingency plan in place for safe and efficient personnel evacuation (including health staff and patients) before, during and following a lightening | 47 (74.6) | 5 (7.9) | 11 (17.5) |
| Have a plan to transfer critical equipment and medical supplies to another health care facility or to a secure storage | 37 (62.7) | 5 (8.5) | 17 (28.8) |
| 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 | 33 (54.1) | 10 (16.4) | 18 (29.5) |
| 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 | 33 (54.1) | 5 (8.2) | 23 (37.7) |
| Have a mechanism for providing prompt maintenance and repair of equipment required for essential services | 33 (54.1) | 5 (8.2) | 23 (37.7) |
| Have procedures to store food and bottled water on shelves that will be safely out of the way of contaminated water in case of lightening | 38 (63.3) | 1 (1.7) | 21 (35.0) |
| Have established procedures or plans for procuring, transporting and storing bottled water and food supplies during an emergency | 45 (73.8) | 2 (3.3) | 14 (23.0) |
| 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 | 22 (36.7) | 15 (25.0) | 23 (38.3) |
| Assess the performance and vulnerabilities of each critical part of the facility (structural and non-structural elements) that can be affected by lightning hazards | 32 (51.6) | 5 (8.1) | 25 (40.3) |
| Calculate possible losses and implement measures to reduce impacts | 35 (56.5) | 4 (6.5) | 23 (37.1) |
| Have a plan to house staff at the health care facility if shelter in place is required (sleeping rooms, food, water) | 25 (41.0) | 15 (24.6) | 21 (34.4) |
| Have roof drainage systems and adequate capacity in the event of excessive rainfall | 19 (29.7) | 19 (29.7) | 26 (40.6) |
| Have roofs that are leak-proof and insulated | 21 (33.3) | 23 (36.5) | 19 (30.2) |
| Have safe roofing designed to withstand wind velocity of 175-Z5o kph (e.g., in a high intensity tropical listening) | 28 (44.4) | 11 (17.5) | 24 (38.1) |

| | | | |
|---|---|---|---|
| Have rooftop structures and equipment which have been reviewed for anticipated storm and high wind speeds | 29 (46.0) | 13 (20.6) | 21 (33.3) |
| Have machine rooms that are resistant to lightening or high wind/rooftop damage | 39 (65.0) | 6 (10.0) | 15 (25.0) |
| Have stairwell construction fortified against high-wind events | 33 (63.5) | 6 (11.5) | 13 (25.0) |
| Have measures in place to remove mosquito breeding sites | 18 (29.0) | 21 (33.9) | 23 (37.1) |
| Have glass walls, doors and windows able to resist basic wind speeds up to 200-250 kph | 24 (40.7) | 11 (18.6) | 24 (40.7) |
| Have laminated or protected glass windows to prevent risk of shattering during a storm | 29 (47.5) | 12 (19.7) | 20 (32.8) |
| Have leak proof windows and doors with lightening protection devices | 34 (56.7) | 5 (8.3) | 21 (35.0) |
| Have walls that are protected against lightening | 27 (42.9) | 8 (12.7) | 28 (44.4) |
| ensure removal of equipment and power supplies from basements and ground floor level to avoid damage from lightening | 31 (51.7) | 7 (11.7) | 22 (36.7) |
| have health care agreements with other health care providers for additional health services and clinical resources | 27 (42.9) | 8 (12.7) | 28 (444) |
| Have a coordinated mechanism across the health sector in different levels of government, to manage the response end risks of public health emergencies and disasters (including sharing of resources and supplies, transferring of patients, and health workforce support) | 29 (46.0) | 8 (12.7) | 26 (41.3) |
| Have a plan on continuity of operational processes during a lightening and for building a beck better through training and workshops | 39 (62.9) | 6 (9.7) | 17 (27.4) |
| Conduct site and building maintenance procedures that include specifications on how the weather may affect the safety and continued functioning of the facility | 36 (56.3) | 4 (6.3) | 24 (37.5) |
| 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 humidly | 34 (54.0) | 4 (6.4) | 25 (39.7) |
| Have an established post storm recovery plan for all infrastructure (structural and non-structural elements) of the facility | 51 (79.7) | 2 (3.1) | 11 (17.2) |
| **Promotion of new systems and technologies** | | | |

| | | | |
|---|---|---|---|
| Have an information system between the health sector and meteorological services to communicate about climate hazards | 43 (71.7) | 7 (11.7) | 10 (16.7) |
| Have an established plan to review, evaluate, and catalogue climate risks related to lightening for the health care facility location | 48 (76.2) | 2 (3.2) | 13 (20.6) |
| Have an established plan to review, evaluate and catalogue risks related to lightening for the health care facility supply chain | 48 (77.4) | 2 (3.2) | 12 (19.4) |
| have an established, clear and consistent knowledge transfer procedure in case of a public health emergency | 40 (63.5) | 3 (4.8) | 20 (31.8) |
| Have electronic patient health records made available to other receiving facilities in cases of evacuation | 40 (66.7) | 3 (5.0) | 17 (28.3) |
| Ensure information and communication flow between the health workforce and policymakers, particularly during high-stress situations and demands created by emergencies | 27 (42.9) | 5 (7.9) | 31 (49.2) |
| Have information and communication systems safely secured with backup arrangement (via cloud, satellite) to satisfy the facility's demand | 36 (59.0) | 3 (4.9) | 22 (36.1) |
| Have an information system for tracking and monitoring diseases following lightening events | 38 (61.3) | 4 (6.5) | 20 (32.3) |
| Have more than one access route, especially if the facility is critical to higher demand following a lightening event | 27 (43.6) | 17 (27.4) | 18 (29.0) |
| **Sustainability of health care facility operations** | | | |
| Review building code design baselines against storm. wind speeds. rainfall volumes, and map each risk | 43 (70.5) | 3 (4.9) | 15 (24.6) |
| Have defined and sustained budget as part of core budgeting for emergency preparedness and response. including for lightening hazards | 50 (79.4) | 2 (3.2) | 11 (17.5) |
| Improve adaptive governance capacity regarding evaluation and measures for risk identification. risk reduction and response | 44 (69.8) | 2 (3.2) | 17 (27.0) |
| Have trees planted in a secure place that will not block access to the facility or fall to the building during an event | 19 (30.7) | 16 (25.8) | 27 (43.6) |
| Have established partnerships between the facility, community and local authorities to identify and reduce vulnerabilities in the surrounding areas | 27 (43.6) | 5 (8.1) | 30 (48.4) |
| Have an access route for public transportation which is likely to remain operational during or immediately following a lightning | 21 (33.3) | 19 (30.2) | 23 (36.5) |

| | | | |
|---|---|---|---|
| event | | | |
| Have a secure storage for critical chemicals and materials to avoid their damage or release during or following a lightening event | 30 (49.2) | 7 (11.5) | 24 (39.3) |
| 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 llightening impact | 29 (47.5) | 10 (16.4) | 22 (36.1) |
| Undertake risk assessments of the supply chain for essential medical and nonmedical products | 29 (46.0) | 10 (15.9) | 24 (38.1) |
| Have a secure plan to ensure continuity of the facility's supply and delivery chain | 27 (43.6) | 12 (19.4) | 23 (37.1) |
| 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 lightning event | 34 (55.7) | 9 (14.8) | 18 (29.5) |
| Have secure access to essential backup food sources via multiple agreement with different vendors and through cooperative agreements with other health care facilities to maintain functioning of critical services | 45 (75.0) | 5 (8.3) | 10 (16.7) |

## 5.10 Impacts of climate change on different HCF components

Of the HCFs that had ever experienced a drought, more than three quarters (76.5%) observed impacts on the health workforce, 73.6% had observed impacts on WASH and health care, and 32.6% had possible impacts with changed conditions on infrastructure, technologies, products, and processes. Over 79.6% of the HCFs that had ever experienced floods had observed impacts on the health workforce, 71.1% had observed impacts on WASH and health care waste, and 68.0% had possible impacts with changed conditions on infrastructure, technologies, products, and processes. More than three quarters, 75.6% of the HCFs that had ever experienced rise of water levels had observed impacts on the health workforce, 73.3% had observed impacts on WASH and health care waste, and 53.5% had possible impacts with changed conditions on infrastructure, technologies, products, and processes. About 71.4% of the HCFs that had ever experienced landslides had observed impacts on the health workforce, 75.0% had observed impacts on WASH and health care, and 70.2% had possible impacts with changed conditions on infrastructure, technologies, products, and processes

***Table 30: Proportion of healthcare facilities that have observed the impacts of climate change related hazards on the different HCF components***

| **HCF component** | **Proportion of HCFs impacted** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Drought** | **Floods** | **Storms** | **Water level** | **Heat** | **Lightening** | **Landslides** |

| | n (%) | n (%) | n (%) | rise n (%) | waves n (%) | n (%) | n (%) |
|---|---|---|---|---|---|---|---|
| **Health workforce** | 261 (76.5) | 226 (79.6) | 160 (71.7) | 65 (75.6) | 11 (78.6) | 29 (46.8) | 60 (71.4) |
| **WASH and healthcare waste** | 251 (73.6) | 202 (71.1) | 142 (63.7) | 63 (73.3) | 5 (35.7) | 16 (25.8) | 63 (75.0) |
| **Energy services** | 106 (31.1) | 161 (56.7) | 142 (63.7) | 46 (53.5) | 0 (0.0) | 32 (51.6) | 35 (41.7) |
| **Infrastructure, technologies, products, and processes** | 151 (44.3) | 193 (68.0) | 157 (70.4) | 65 (75.6) | 9 (64.3) | 34 (54.8) | 59 70.2) |

### 5.10.1 Impacts of drought on health workforce

More than half, 56.8% of HCFs reported an increased threat to the health workforce due to infectious diseases resulting from water contamination and breeding sites for vectors, 31.0% reported drought-related illnesses among health workers, necessitating hospitalization and 31.6% of HCFs reported adverse effects on the mental health of health workers, leading to psychological stress. More than a quarter, 28.5% of HCFs reported valid interruptions in critical programs or services availability, with a possible need for relocation to alternative facilities, 53.8% reported a reduced performance capacity of the health workforce during drought conditions, and 64.7% reported an increased demand for health care services due to drought-related infectious diseases. More than half, 56.4% of HCFs reported service delivery and program delays during drought conditions, 55.5% reported a reduced capacity for the health workforce to perform hygiene procedures, compromising safety during drought conditions and 57.1% of healthcare facilities reported a possible reduced capacity and performance of the health workforce in the case of disease outbreaks during drought conditions. (Table 6).

***Table 31: Impacts of droughts on Health workforce in healthcare facilities in Uganda***

| Impact | Yes | No | Don't know |
|---|---|---|---|
| Increased threat to the health workforce from infectious diseases from water contamination and vector breeding sites | 191 (56.8) | 143 (42.6) | 2 (0.6) |
| Increased threat to the health workforce resulting in impacts to non-communicable diseases (cardiovascular, respiratory diseases), from poor air quality and higher temperatures | 174 (51.1) | 155 (46.1) | 7 (2.1) |
| Drought-related illness to health workers requiring hospitalization | 104 (31.0) | 224 (66.9) | 7 (2.1) |
| Effects on mental health of staff leading to psychological stress | 106 (31.6) | 218 (65.1) | 11 (3.3) |
| Valid Interruption of critical programs or services availability with possible relocation to another facility | 95 (28.5) | 232 (69.7) | 6 (1.8) |
| Reduced performance capacity of health workforce | 180 (53.8) | 152 (45.5) | 2 (0.6) |
| Increased demand for health care due to drought-related infectious diseases (water-, food- and vector-borne | 216 (64.7) | 113 (33.8) | 5 (1.5) |
| Increased threat to the health workforce resulting in impacts related to high temperature, low air humidity and less water ingestion | 178 (53.1) | 152 (45.8) | 2 (0.6) |
| Possible illness to health workers requiring medical treatment | 175 (51.9) | 157 (46.6) | 5 (1.5) |

| | | | |
|---|---|---|---|
| Reduction of health workforce functions | 174 (51.9) | 159 (47.5) | 2 (0.6) |
| 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) | 178 (53.3) | 153 (45.8) | 3 (0.9) |
| Reduced productivity | 185 (55.1) | 144 (42.9) | 7 (2.1) |
| Possible increased risk of dust-borne diseases (valley fever, meningococcal meningitis), leading to hospital admissions | 162 (48.6) | 163 (48.9) | 9 (2.4) |
| Increased risk of mortality associated with drought impacts (cardiopulmonary and respiratory diseases), and increasing demand for services from staff | 120 (36.0) | 208 (62.5) | 5 (1.5) |
| Drought-related illness among health workers not requiring immediate medical treatment | 173 (51.6) | 157 (46.9) | 5 (1.5) |
| Service delivery and program delays | 190 (56.4) | 144 (42.7) | 3 (0.9) |
| Restrictions to provide healthcare services and programs | 125 (37.5) | 207 (62.2) | 1 (0.3) |
| Reduced capacity for the health workforce to perform hygiene procedures compromising safety | 186 (55.5) | 147 (43.9) | 2 (0.6) |
| Possible reduced capacity and health workforce performance in case of outbreaks | 192 (57.1) | 142 (42.3) | 2 (0.6) |

### 5.10.2 Impacts of other hazards on health workforce

**Storms**: More than a tenth (22%) of the HCFs reported death and life-threatening impacts on health workers as a result of storms, 30.0% experienced a reduction in work capacity, 45.3% reported significantly reduced performance, requiring additional support, 59.2% reported increased demand for healthcare services, leading to work overload and 60.1% reported adverse effects on mental health. Nearly half, 41.7% reported that health professionals were unable to arrive or depart from the facility, 56.5% reported a reduction in health workforce functions and 73.1% reported delays in service delivery and programs as a result of storms. **Floods**: In contrast, 40.8% reported life-threatening impacts on health workers as a result of floods, 38.4% experienced a reduction in work capacity, 47.5% faced interruptions in critical programs or services, 48.2% reported significantly reduced performance, requiring additional support, 66.9% reported increased demand for healthcare services, leading to work overload, 68.0% reported adverse effects on mental health, 49.6% reported health professionals were unable to arrive or depart from the facility, and over 80.3% reported delays in service delivery and programs. **Landslides**: Only 21.4% of the HCFs reported life-threatening impacts on health workers as a result of landslides, 32.1% experienced a reduction in work capacity, 39.3% faced interruptions in critical programs or services, 60.7% reported increased demand for healthcare services, leading to work overload, 82.1% reported adverse effects on mental health, 82.1% reported that health professionals were unable to arrive or depart from the facility, 57.1% reported a reduction in health workforce functions and 78.6% reported delays in service delivery and programs.

***Table 32: Impacts of other hazards on Health Workforce in healthcare facilities in Uganda***

| Impacts | Hazards | | | | | |
|---|---|---|---|---|---|---|
| | **Storms n (%)** | **Floods n (%)** | **Landslides n (%)** | **Water level rise n (%)** | **Heat waves n (%)** | **Lightening n (%)** |
| Deaths, life-threatening injuries or illness among health workers | 49 (22.0) | 116 (40.8) | 6 (21.4) | N/A | | 11 (17.2) |
| Loss of work capacity | 67 (30.0) | 109 (38.4) | 9 (32.1) | 40 (50.0) | 6 (42.9) | 14 (21.9) |
| Cessation of critical programs or service availability with possible overflow to other locations | 74 (33.2) | 135 (47.5) | 11 (39.3) | 46 (57.5) | | 19 (29.7) |
| Significantly reduced performance capacity of health workforce; needing additional support (local, regional or national) | 101 (45.3) | 137 (48.2) | 11 (39.3) | N/A | 6 (42.9) | 21 (32.8) |
| Increased health care demand for infectious diseases, animal bites, non-communicable diseases, and toxic chemicals exposure, increasing health workforce overload and availability | 132 (59.2) | 190 (66.9) | 17 (60.7) | 49 (61.3) | N/A | 33 (51.6) |
| Increased work overload with stress | 134 (60.1) | 193 (68.0) | 23 (82.1) | 51 (63.8) | N/A | 35 (54.7) |
| Serious harm, injury or illness causing hospitalization and medical treatment | 55 (24.7) | 90 (31.7) | 7 (25.0) | N/A | N/A | 22 (34.4) |
| Health professionals not able to arrive at or depart from the healthcare facility | 93 (41.7) | 141 (49.6) | 23 (82.1) | 41 (51.3) | N/A | 17 (26.6) |
| Reduction of health workforce functions | 126 (56.5) | 182 (64.1) | 16 (57.1) | 49 (61.3) | 4 (30.8) | 26 (40.6) |
| Restrictions to the provision of some healthcare services and programs | 127(57.0) | | 12 (42.9) | 41 (51.3) | N/A | 25 (39.1) |
| Effects on mental health due to disaster trauma resulting in diminishing ability to provide adequate care to patients | 72 (32.3) | 109 (38.4) | N/A | N/A | N/A | 24 (37.5) |
| Increased respiratory diseases from dust storms/dust lightening | 125 (56.1) | N/A | N/A | N/A | N/A | 20 (31.3) |
| Minor injuries to health workers requiring minimal or short-term medical treatment | 90 (40.4) | 139 (48.9) | 14 (50.0) | 47 (58.8) | N/A | 23 (35.9) |
| Difficulty in providing medications and primary healthcare services to the communities | 130 (58.3) | 148 (52.1) | 12 (42.9) | N/A | N/A | 27 (42.2) |
| Reduced functioning of health workers if the facility lacks a plan to respond to overcrowding of patients and visitors | 120 (53.8) | N/A | N/A | N/A | N/A | 24 (37.5) |
| Service delivery and program delays | 163(73.1) | 228 (80.3) | 22 (78.6) | 53 (66.3) | N/A | 31 (48.4) |
| Restrictions to provide services and programmes | N/A | 149 (52.5) | N/A | N/A | N/A | N/A |
| Unable to provide adequate care to patients | N/A | 164 (57.7) | 17 (60.7) | N/A | N/A | N/A |
| Increased work overload along with stress | N/A | 190 (66.9) | N/A | N/A | N/A | N/A |
| Facilities overcrowding | N/A | 165 (58.1) | 15 (53.6) | N/A | N/A | N/A |
| Increased infectious disease cases among health workers from water and | N/A | 148 (52.1) | 12 (42.9) | 54 (67.5) | 5 (38.5) | N/A |

| | | | | | | |
|---|---|---|---|---|---|---|
| healthcare waste contamination | | | | | | |
| Reduced primary healthcare services in communities | N/A | 193 (68.0) | 21 (75.0) | N/A | N/A | N/A |
| Increased risk of indoor mould growth from excess dampness, with impacts on respiratory disease | N/A | N/A | N/A | 49 (61.3) | N/A | N/A |
| High water salinity leads to an increased risk of hypertension in the health workforce | N/A | N/A | N/A | 30 (37.5) | N/A | N/A |
| Significantly reduced performance capacity needing additional support | N/A | N/A | N/A | 42 (52.5) | N/A | N/A |
| Danger of life-threatening heat stroke | N/A | N/A | N/A | N/A | 3 (21.4) | N/A |
| Increased likelihood of heat stress effects (heat exhaustion and heat stroke) | N/A | N/A | N/A | N/A | 3 (25.0) | N/A |
| 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 | N/A | N/A | N/A | N/A | 4 (28.6) | N/A |
| Increase in the number of respiratory diseases due to elevated ozone levels | N/A | N/A | N/A | N/A | 6 (42.9) | N/A |
| Increased workforce absenteeism | N/A | N/A | N/A | N/A | 3 (21.4) | N/A |
| Increased hospital admissions and emergency services overwhelming health workers | N/A | N/A | N/A | N/A | 4 (28.6) | N/A |
| Increased heat affecting day and nocturnal conditions that heighten health workforce exposures | N/A | N/A | N/A | N/A | 5 (35.7) | N/A |
| Diseases requiring medical treatment, specifically for those with pre-existing health conditions such as asthma, COPD, respiratory tract infections, diabetes, heart conditions, renal conditions | N/A | N/A | N/A | N/A | 5 (38.5) | N/A |
| Excessive heat exposure results in effects related to cardiovascular and renal systems, and dehydration | N/A | N/A | N/A | N/A | 5 (38.5) | N/A |
| Increased heat stress effects (heat syncope, heat cramps) | N/A | N/A | N/A | N/A | 3 (23.1) | N/A |
| Increased thirst and headaches | N/A | N/A | N/A | N/A | 7 (53.8) | N/A |

*N/A: Indicator not assessed for that hazard*

### 5.10.3 Impacts of the hazards on WASH and healthcare waste

**Floods:** Over 62.3% reported severe damage to water supply, 54.2% experienced severe disruption of wastewater and sewage systems, 74.6% reported large-scale water contamination reported contamination, 69.7% experienced shortage of safe water, and 56.3% experienced inability to provide sanitation and hygiene services. Nearly half, 45.1% experienced damage to emergency water sources and 47.2% faced reduced capacity for disinfection due to floods. Over 59.9% reported reduced capacity to provide safe water for drinking or cooking, 64.4% reported reduced water quality and 53.5% reported rodent infestation. **Storms:** About 32.3% of the HCFs experienced overflow of storm water and wastewater containment systems leading to surpassing the capacity of water treatment and distribution systems, 39.0% reported severe damage to water supply system and infrastructure, 29.1% experienced severe

disruption of wastewater and sewage systems, and 38.6% had large-scale water contamination. About 55.6% of the HCFs experienced shortage of safe water, 37.2% had no access to drinking water, 42.6% experienced inability to provide sanitation and hygiene services and 46.2% reported damage to waste storage causing environmental contamination from biological and chemical hazards. **Landslides:** About 71.4% of the HCFs had damage to water supply and storage infrastructure, 46.4% had disruption of waste water and sewage systems, 85.7% had water contamination, 78.6% had shortage of safe water, 60.7% had unable to provide hygiene services and 50.0% had damage to waste storage causing environmental contamination by biological and chemical hazards, 17.9% had lost sharps containers and hazardous waste bins and 42.9% had damage to emergency water sources. **Drought:** About 66.9% of HCFs had a disrupted water system supply, 76.8% had shortage or lack of water, 53.1% had increased water pollution due to pollutant concentration resulting from low flows and reduced water levels (arsenic, iron, manganese, fluoride), 39.9% had 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 and 40.1% had increased water contamination by cyanobacterial blooms due to increased temperature.

***Table 33: Impact of hazards on WASH and healthcare waste management in healthcare facilities in Uganda***

| **Impact** | **Hazard** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Floods n (%)** | **Storms n (%)** | **Water level rise n (%)** | **Land slides n (%)** | **Drought n (%)** | **Heat waves n (%)** | **Lightening n (%)** |
| Severe damage to water supply and storage infrastructure | 177 (62.3) | 87 (39.0) | N/A | 20 (71.4) | N/A | N/A | 18 (28.1) |
| Overflow of storm water and wastewater containment systems surpassing the capacity of water treatment and distribution systems | N/A | 72 (32.3) | N/A | N/A | N/A | N/A | N/A |
| Severe disruption of wastewater and sewage systems | 154 (54.2) | 65 (29.1) | 33 (41.3) | 13 (46.4) | N/A | N/A | 13 (20.3) |
| Large-scale water contamination | 212 (74.6) | 86 (38.6) | 58 (72.5) | 24 (85.7) | N/A | 4 (28.6) | 12 (18.8) |
| Shortage of safe water | 198 (69.7) | 124 (55.6) | 51 (63.8) | 22 (78.6) | 261 (76.8) | 10 (71.4) | 14 (21.9) |
| Unable to provide sanitation and hygiene services | 160 (56.3) | 95 (42.6) | | 17 (60.7) | N/A | 4 (28.6) | 12 (18.8) |
| Damage to waste storage causing environmental contamination by biological and chemical hazards | 157 (55.3) | 103 (46.2) | 103(46.2) | 14 (50.0) | N/A | N/A | N/A |
| Sharps containers and specific biological and medical bins damaged, potentially releasing hazardous materials | 86 (30.3) | 65 (29.1) | 37 (46.3) | 5 (17.9) | N/A | N/A | 15 (23.4) |
| Damage to emergency water sources | 128 (45.1) | 94 (42.2) | 49 (61.3) | 12 (42.9) | N/A | N/A | 18 (28.1) |
| Temporal water supply interruption | 163 (57.4) | N/A | N/A | 20 (71.4) | N/A | N/A | |
| Reduced capacity to provide safe water for drinking or cooking | 170 (59.9) | 99 (44.4) | 51 (63.8) | 19 (67.9) | N/A | 6 (42.9) | 13 (20.3) |
| Reduced capacity to provide disinfection or sterilization processes | 134 (47.2) | N/A | 46 (57.5) | 11 (39.3) | N/A | N/A | N/A |
| Cross-contamination from damages to the sewage system | 132 (46.5) | 55(24.7) | N/A | 13 (46.4) | N/A | N/A | N/A |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Reduced water quality as animal faeces and sewage get washed into surface water | 183 (64.4) | N/A | N/A | 20 (71.4) | N/A | N/A | N/A |
| Reduced capacity to maintain waste collection and treatment systems | 165 (58.1) | N/A | N/A | 16 (57.1) | N/A | N/A | N/A |
| Reduced capacity to access drinking water | 177 (62.3) | N/A | N/A | 23 (82.1) | N/A | N/A | 11 ((17.2) |
| Reduced capacity to use toilets, showers, etc. | 142 (50.0) | N/A | N/A | 13 (46.4) | N/A | N/A | 16 (25.0) |
| Reduced capacity to use laundry and dishwashing machines | 88 (31.0) | 67 (30.0) | 35 (43.8) | 3 (10.7) | N/A | 7 (50.0) | |
| Reduced capacity to provide cleaning services for facility rooms | 150 (52.8) | 111(49.8) | 46 (57.5) | 19 (67.9) | N/A | N/A | 24 (37.5) |
| Heavy sediment and pollution loads making treatment ineffective | 121 (42.6) | 76 (34.1) | N/A | 15 (53.6) | N/A | N/A | 14 (21.9) |
| Possible rodent infestation around rubbish bins | 152 (53.5) | N/A | N/A | 13 (46.4) | N/A | N/A | |
| Heavy rainfall risks the flushing of pathogens into water sources | N/A | 130 (58.3) | | N/A | N/A | N/A | |
| Increased risk of contamination of medical devices, instruments and equipment, and other medical supplies | N/A | 84 (37.7) | 38 (47.5) | N/A | N/A | N/A | 19 (29.7) |
| Increased health workforce infections from water and health care waste contamination | N/A | 81 (36.3) | N/A | N/A | N/A | N/A | 15 (23.4) |
| Reduced functioning of sanitation systems and hygiene practices (flush toilets, showers, sewerage, treatment, hand washing, medical procedures, etc.) | N/A | 96 (43.0) | N/A | N/A | N/A | 3 (23.1) | 16 (25.0) |
| Increased nutrient loads | N/A | 66 (29.6) | N/A | N/A | N/A | N/A | 12 (18.8) |
| Possible overflow of effluents into streams and rivers if surface water enters septic tanks | N/A | 88 (39.5) | N/A | N/A | N/A | N/A | 14 (21.9) |
| Increased possibility of contamination of groundwater due to infiltration of pollutants | N/A | 111 (49.8) | N/A | N/A | N/A | N/A | 23 (35.9) |
| Reduced access to water for health care practices | N/A | 113 (50.7) | N/A | N/A | N/A | 6 (42.9) | 20 (31.3) |
| Increased risk of breakdown of final waste collection and transportation systems within/outside the health care facilities | N/A | 107 (48.0) | N/A | N/A | N/A | N/A | 22 (34.4) |
| Increased saltwater intrusion into aquifers, resulting in increased salinity of groundwater basins and well water | N/A | N/A | 33 (41.3) | N/A | N/A | N/A | N/A |
| Leakage from septic tanks, sewer systems, and instability of storage tanks and pipes | N/A | N/A | 38 (47.5) | N/A | N/A | N/A | N/A |
| Increased corrosion of the water and wastewater drainage system | N/A | N/A | 42 (52.5) | N/A | N/A | N/A | N/A |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Risk of environmental contamination by biological and chemical hazards | N/A | N/A | 48 (60.0) | N/A | N/A | N/A | 18 (28.1) |
| Loss of water pumping and treatment systems | N/A | N/A | 43 (53.8) | N/A | N/A | N/A | N/A |
| Saltwater intrusion in water and wastewater containment systems leading to reduced capacity for water treatment and distribution | N/A | N/A | 40 (50.0) | N/A | N/A | N/A | N/A |
| Reduced volume of stored freshwater | N/A | N/A | 50 (62.5) | N/A | N/A | N/A | N/A |
| Surface water ingress into septic tanks leading to overflow of effluents into streams, rivers and lakes | N/A | N/A | 38 (47.5) | N/A | N/A | N/A | N/A |
| Increased water and wastewater management repairs due to inundation or erosion | N/A | N/A | 43 (53.8) | N/A | N/A | N/A | N/A |
| Increased demand for drinking water from health workers engaged in outdoor activities | N/A | N/A | N/A | N/A | N/A | 11 (84.6) | N/A |
| Reduced effectiveness of chemicals used for water treatment | N/A | N/A | N/A | N/A | N/A | 3 (21.4) | N/A |

*N/A: Not assessed/doesn't not apply for that particular hazard*

### 5.10.4 Impacts of the hazards on energy

**Floods**: Over 65.9% of HCFs reported power failure as a result of floods, 69.0% reported the loss of vaccines, laboratorial supplies, and other essential refrigeration-dependent medical supplies, 44.8% reported the interruption of healthcare services requiring electricity, such as dialysis, oxygen supplies, and diagnosis equipment, 34.9% experienced the shutdown of cold storage systems, 33.1% reported disruption of energy-dependent water pumping and treatment and 62.3% reported temporary power supply interruption. About 43.7% reported reduced capacity to provide cleaning services, 48.9% reported reduced capacity to provide disinfection services that require electricity, and 64.8% of facilities reported possible damage to the alternative energy sources.
**Storms**: Over 65.9% of HCFs reported power failure, 62.3% reporting temporary power supply interruption, 34.9% of healthcare facilities experienced the shutdown of cold storage systems, 44.8% reported the interruption of healthcare services requiring electricity, 69.0% reported the loss of vaccines, and other essential supplies, 42.3% of facilities were unable to follow boil water advisories, 33.2% reported disruption in energy-dependent water pumping and treatment. About half, 50.0% of facilities reported difficulty in providing critical healthcare services such as dialysis, oxygen therapy, and diagnostic equipment, 43.7% of healthcare facilities reported reduced capacity to provide cleaning services, 48.9% reported reduced capacity to provide disinfection services.
51.6% of facilities reported damage to solar photovoltaic panels or other energy sources. Over 64.8% reported possible damage to alternative sources of energy as a result of storms. **Drought**: About 33.8% of HCFs reported power failure, 34.9% of healthcare facilities reported disruption in the use of medical equipment that requires electricity, 29.4% experienced the shutdown of cold storage systems, 32.7% reported the interruption of healthcare services requiring electricity, such as dialysis, oxygen supplies, and diagnosis equipment and 31.5% reported the loss of vaccines, laboratorial supplies, drugs, pharmaceuticals, and other essential refrigeration-dependent medical supplies. More than a third, 36.4% experienced intermittent power delivery due to drought, 35.2% reported reduced capacity to use medical and diagnostic equipment that require electricity, 40.2% reported disruption of the cooling system for medicines, vaccines, and medical and laboratorial supplies, 34.4% of facilities reported difficulty providing critical healthcare services, leading to the evacuation of patients to other health facilities, 57.4% of facilities reporting damage to solar photovoltaic panels or other energy sources.

***Table 34: Impact of the hazards on energy in healthcare facilities in Uganda***

| Impacts on Energy | Drought | Storms | Floods | Landslides | Water level rise | Lightening | Heat waves |
|---|---|---|---|---|---|---|---|
| Power failure | 110 (33.8) | 147 (65.9) | 120 (42.3) | 14 (50.0) | 43 (53.8) | 42 (65.6) | 3 (21.4) |
| Disruption in use of medical equipment that require electricity | 113 (34.9) | N/A | N/A | N/A | N/A | N/A | 5 (41.7) |
| Shutdown of cold storage systems | 97 (29.4) | N/A | 99 (34.9) | 9 (32.1) | 34 (42.5) | | |
| Interruption of health care services which require electricity such as dialysis, oxygen supplies, diagnosis equipment | 98 (32.7) | 100 (44.8) | 117 (41.2) | 8 (28.6) | 37 (46.3) | 26 (40.6) | |
| Loss of vaccines, laboratorial supplies, drugs, pharmaceuticals and other essential refrigeration-dependent medical supplies | 105 (31.5) | 57 (25.6) | 196 (69.0) | 6 (21.4) | 30 (37.5) | 19 (29.7) | 3 (21.4) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Unable to boil water advisories | 104 (32.3) | 82 (36.8) | 120 (42.3) | 11 (39.3) | 40 (50.0) | 26 (40.6) | 2 (14.3) |
| Disruption of the fuel supply chain | 79 (25.4) | 55 (24.7) | 74 (26.1) | 3 (10.7) | 40 (50.0) | 14 (21.9) | 2 (14.3) |
| Disruption of energy-dependent water pumping and treatment | 99 (32.1) | 74 (33.2) | 94 (33.1) | 4 (14.3) | | 19 (29.7) | 1 (7.1) |
| Intermittent power delivery | 118 (36.4) | N/A | N/A | N/A | N/A | N/A | 3 (23.1) |
| Temporary power supply interruption | 131 (40.4) | | 177 (62.3) | 17 (60.7) | 44 (55.0) | | |
| Reduced capacity to use medical and diagnostic equipment that require electricity | 112 (35.2) | N/A | N/A | N/A | N/A | N/A | 3 (21.4) |
| Disruption of cooling system for medicines, vaccines, and medical and laboratorial supplies | 131 (40.2) | N/A | N/A | N/A | N/A | N/A | N/A |
| Difficulty providing critical healthcare service deliveries (dialysis, oxygen therapy, diagnosis equipment), causing patients to be evacuated to other health facilities | 100 (34.4) | 66 (29.6) | 101 (35.6) | 7 (25.0) | 40 (50.0) | 24 (37.5) | 2 (14.3) |
| Reduced capacity to provide cleaning services that need electricity (laundry, dishwashing machines) | 103 (35.0) | 74 (33.2) | 124 (43.7) | 7 (25.0) | 33 (41.3) | 20 (31.3) | N/A |
| Reduced capacity to provide disinfection services that need electricity (autoclave, microwave) | 118 (38.2) | 90 (40.4) | 139 (48.9) | 10 (35.1) | | 27 (42.2) | 4 (28.6) |
| No ambient cooling thereby increasing staff and patient discomfort | 116 (37.1) | 74 (33.2) | 76 (26.8) | 4 (14.3) | 34 (42.5) | 18 (28.1) | 7 (53.8) |
| Loss of food or difficulty in keeping food refrigerated | 94 (31.8) | 74 (33.2) | 100 (35.2) | 8 (28.6) | 33 (41.3) | 20 (31.3) | 4 (30.8) |
| Interruption of internal access systems (elevators, automatic doors) | 75 (26.2) | N/A | N/A | N/A | N/A | N/A | N/A |
| Damage to solar photovoltaic panels or other energy sources | 128 (57.4) | N/A | N/A | N/A | N/A | 33 (51.6) | N/A |
| Reduced electricity capacity resulting in loss of medical supplies and decrease in health care services | 85 (38.1) | N/A | N/A | N/A | N/A | N/A | N/A |
| Possible damage to the emergency generator or other sources of energy | 72 (32.3) | N/A | 184 (64.8) | 5 (17.9) | 38 (47.5) | 19 (29.7) | N/A |
| Difficulty in providing thermal comfort, affecting health workers and patients | N/A | N/A | N/A | N/A | N/A | N/A | 5 (38.5) |

### 5.10.5 Impacts of the hazards on infrastructure, products and processes

#### *5.10.5.1 Impact of drought on infrastructure, technologies, products and processes in healthcare facilities in Uganda*

About 30.2% of the HCFs reported damage to vital equipment from power outages, 44.5% had an interruption of health care services delivery and operation, 32.6% reported disruption of internal communication and information systems, 44.4% reported reduced capacity of routine health care services, 36.2% had an interruption of diagnostics due to equipment damage, 53.9% reported interruption of water and food supply chains, and 53.2% reported increased healthcare costs for attending to all drought-related impacts. About 68.4% of the HCFs reported decreased local food security, 72.2% reported disruption of local food supply and 50.0% reported reduced capacity to deliver critical health care services due to water shortage as a result of drought.

***Table 35: Impact of Drought on Infrastructure, Technologies, Products and Processes in healthcare facilities in Uganda***

| **Impacts** | **Yes n (%)** | **No n (%)** | **Don't know n (%)** |
|---|---|---|---|
| Damage to vital equipment from power outages | 98 (30.2) | 220 (67.9) | 6 (1.8) |
| Interruption of health care services delivery and operation | 147 (44.5) | 178 (53.9) | 5 (1.5) |
| Disruption of internal communication and information systems | 107 (32.6) | 217 (66.2) | 4 (1.2) |
| Reduced capacity of routine health care services such as ambulatory, | 148 (44.4) | 182 (54.6) | 3 (0.9) |
| Interruption of diagnostics due to equipment damage | 118 (36.2) | 202 (62.0) | 6 (1.8) |
| Interruption of water and food supply chains | 178 (53.9) | 148 (44.8) | 4 (1.2) |
| Increased complex and emergency health care services (dialysis, complex treatments, cardiovascular and respiratory hospitalizations) | 98 (33.2) | 191 (64.7) | 6 (2.0) |
| Increased healthcare costs for attending to all drought-related impacts | 176 (53.2) | 147 (44.4) | 8 (2.4) |
| Decreased local food security | 229 (68.4) | 100 (29.8) | 6 (1.8) |
| Disruption of local food supply | 242 (72.2) | 90 (26.9) | 3 (0.9) |
| Reduced capacity to deliver critical health care services due to water shortage | 167 (50.0) | 164 (49.1) | 3 (0.9) |
| Reduced capacity to deliver basic health care services | 156 (46.3) | 179 (53.1) | 2 (0.6) |
| Temporary suspension of service deliveries due to water shortage | 119 (35.6) | 214 (64.1) | 1 (0.3) |
| Increase in temperature and reduction in air quality within the health care facility | 182 (53.8) | 152 (45.0) | 4 (1.2) |
| No functioning air conditioning system or electric fans or appropriate window position | 117 (39.4) | 172 (57.9) | 8 (2.7) |
| Possibility of reduced food supply due to lower access to food production | 220 (66.7) | 104 (31.5) | 6 (1.8) |
| Increased hospitalization rates requiring extra medical supplies and health workforce | 132 (39.8) | 192 (57.8) | 8 (2.4) |
| Possibility of higher costs to health care facilities due to lower/reduced food supply and higher prices | 213 (64.7) | 111 (33.7) | 5 (1.5) |
| Minimal impact on local operations equipment, with no impact on health care service deliveries | 120 (36.0) | 202 (60.1) | 11 (3.3) |
| Minimal impact on the supply chain | 117 (35.0) | 205 (61.4) | 12 (3.6) |
| Reduced capacity to provide local food access | 203 (61.3) | 124 (37.5) | 4 (1.2) |
| 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 | 155 (47.5) | 165 (50.6) | 6 (1.8) |

### 5.10.5.2 Impacts of storms on infrastructure, products, and processes

About 63.7% of the HCFs experienced direct damage to infrastructure (water storage tanks, roofs) from high winds, 42.6% experienced structural failure of the building, 42.6% had disruption to building access, and 34.5% had damage to communication and information systems and assets. About 30.5% of the HCFs reported loss or damage of essential supplies, 52.0% of facilities experienced disruption of Health Care Services and Operations, 35.0% of facilities reported cessation or prolonged disruption of services, 40.4% of facilities faced interruptions of supply chains, and 40.8% of facilities experienced increased treatment demand. Over 64.1% of facilities reported road damage, 61.0% of facilities faced difficulty in transporting patients and 57.8% experienced reduced Capacity to deliver Health Care Services.

*Table 36: Impacts of Storms on infrastructure, technology and processes in Uganda*

| Impacts | Yes n (%) | No n (%) | Don't know n (%) |
|---|---|---|---|
| Direct damage to infrastructure (water storage tanks, roofs) from high winds | 142 (63.7) | 81 (36.3) | 0 (0.0) |
| Structural failure of the building | 95 (42.6) | 127 (57.0) | 1 (0.4) |
| Disruption to building access | 95 (42.6) | 125 (56.1) | 3 (1.3) |
| Damage to machine rooms | 41 (18.4) | 167 (74.9) | 15 (6.7) |
| Damage to communication and information systems and assets | 77 (34.5) | 137 (61.4) | 9 (4.0) |
| Loss or damage of essential supplies (medications, treatments, medical devices, drugs, pharmaceuticals, vaccines, etc.) | 68 (30.5) | 153 (68.6) | 2 (0.9) |
| Interruption of complex and emergency health care services (surgery, complex treatment, urgent health care, etc.) | 64 (28.7) | 145 (65.0) | 14 (6.3) |
| Disruption of health care services and operations | 116 (52.0) | 102 (45.7) | 5 (2.2) |
| Cessation of services or prolonged disruption of services due to loss or damage | 78 (35.0) | 143 (64.1) | 2 (0.9) |
| Breakdown of routine healthcare services (such as ambulatory, immunization, maternity room, pharmacy, medication for chronic diseases, and other primary healthcare services) | 120 (53.8) | 101 (45.3) | 2 (0.9) |
| Interruption of diagnosis due to equipment damages | 76 (34.1) | 144 (64.6) | 3 (1.3) |
| Interruption of supply chains | 90 (40.4) | 131 (58.7) | 2 (0.9) |
| Long-term effect on the environment, requiring external assistance/interventions | 88 (39.5) | 132 (59.2) | 3 (1.3) |
| Damage to internal transportation systems (elevators, ramps, corridors, garage, etc.) | 54 (24.2) | 160 (71.7) | 9 (4.0) |
| Increased treatment demand for infectious, cardiovascular and respiratory diseases Increase in complex and emergency health care services (complex treatments, outbreaks, etc.) | 91 (40.8) | 128 (57.4) | 4 (1.8) |
| Structural damage to the building | 138 (61.9) | 84 (37.7) | 1 (0.4) |
| Damage to road, impairing access | 143 (64.1) | 80 (35.9) | 0 (0.0) |
| Difficult to transport patients due to damaged or disabled transportation systems | 136 (61.0) | 86 (38.6) | 1 (0.4) |
| Reduced capacity to deliver health care services due to damaged and reduced supplies | 129 (57.8) | 94 (42.2) | 0 (0.0) |
| Temporary suspension of service deliveries | 88 (39.5) | 135 (60.5) | 0 (0.0) |
| Damage to paper medical record storage | 78 (35.0) | 143 (64.1) | 2 (0.9) |
| Reduced capacity to access clinical and laboratorial supplies | 74 (33.2) | 147 (65.9) | 2 (0.9) |
| Impacts from trees falling on the facility causing damage to building infrastructure and injuries to people | 92 (41.3) | 129 (57.8) | 2 (0.9) |
| Increased hospitalization rates requiring extra medical supplies and health workforce | 73 (32.7) | 146 (65.5) | 4 (1.8) |

| | | | |
|---|---|---|---|
| Increased costs due to high demand of critical supplies during and after the event | 97 (43.5) | 123 (55.2) | 3 (1.3) |
| Increased costs due to necessary financial investment in the recovery of facility infrastructure (structural and nonstructural), post event | 111 (49.8) | 109 (48.9) | 3 (1.3) |
| Localized disruption of services with minor losses and damage | 125 (56.1) | 93 (41.7) | 5 (2.2) |
| Damage or loss of documents and records | 98 (43.9) | 124 (55.6) | 1 (0.4) |
| No lasting effect on the external environment of the facility | 84 (37.7) | 133 (59.6) | 6 (2.7) |
| Minimal impact on local operations and equipment, without compromising health care service deliveries Minimal impact on the supply chain | 117 (52.5) | 102 (45.7) | 4 (1.8) |

#### *5.10.5.3 Impacts of floods on infrastructure, products, and processes*

Majority, 76.1% of HCFs reported damage to roads, disrupting access, 71.5% of healthcare facilities faced difficulty in transporting patients, 58.1% of facilities had reduced capacity to deliver healthcare services, and 45.8% of facilities temporarily suspended service deliveries. About 43.0% of the HCFs reported flood damage or destruction of structural components, 62.3% of facilities experienced partial destruction due to floods and land erosion, 64.1% had blocked transport systems and flooded ambulance stations and 50.4% experienced damage to building access. About 23.9% of the HCFs had damage to the machine room, 24.3% had damage to critical equipment, 30.6% had damaged internal and external communication and information systems and 31.0% had loss or damage of healthcare facility essential supplies. More than half, 56.7% reported disruption in services and about a third (30.6%) of facilities had damage to communication systems, 31.0% experienced loss or damage to essential supplies, 32.4% faced interruptions in complex and emergency healthcare services. Over 52.1% of facilities experienced a breakdown in routine healthcare services, 35.6% faced interruptions in diagnosis due to equipment damage, 31.3% reported contamination of medical devices, instruments, and equipment, and 45.8% of facilities experienced interruptions in supply chains. Nearly half, 40.5% of facilities experienced disruption to communication and information systems, 37.7% of facilities faced damage to internal transportation systems. About 34.5% of healthcare facilities experienced damage to paper medical record storage, 53.2% of facilities reported increased costs in repairing damaged administrative equipment and furniture, and 38.7% of facilities experienced damage or loss of documents and records. Over 54.2% HCFs incurred increased costs due to necessary post-flood repairs, 66.9% of healthcare facilities experienced increased demand for providing cleaning and disinfection supplies, 52.1% of facilities faced mold, indoor and outdoor, requiring special cleaning-up or essential protective equipment for cleaners

***Table 37: Impact of floods on infrastructure, technologies, products and processes***

| **Impacts** | **Characteristic** | | |
|---|---|---|---|
| | **Yes n (%)** | **No n (%)** | **Don't know n (%)** |
| Flood damage or destruction of structural components (full or parts of the facility) | 122 (43.0) | 159 (56.0) | 3 (1.1) |
| Partial destruction by floods causing land erosion | 177 (62.3) | 105 (37.0) | 2 (0.7) |
| Blocked transport systems and flooded ambulance stations | 182 (64.1) | 98 (34.5) | 4 (1.4) |
| Damage to building access | 143 (50.4) | 137 (48.2) | 4 (1.4) |
| Damage to the machine room | 68 (23.9) | 202 (71.1) | 14 (4.9) |
| Damage to critical equipment | 69 (24.3) | 207 (72.9) | 8 (2.8) |
| Damaged internal and external communication and information systems | 87 (30.6) | 189 (66.5) | 8 (2.8) |
| Loss or damage of health care facility essential supplies (medications, medical devices, drugs, | 88 (31.0) | 194 (68.3) | 2 (0.7) |

| | | | |
|---|---|---|---|
| laboratory supplies, blood, pharmaceuticals, vaccines) | | | |
| Interruption of complex and emergency healthcare services (surgery, complex treatments, urgent care) | 92 (32.4) | 179 (63.0) | 13 (4.6) |
| Disruption of healthcare services delivery and operation | 161 (56.7) | 119 (41.9) | 4 (1.4) |
| A breakdown of routine healthcare services (such as ambulatory, immunization, maternity room, pharmacy, medication for chronic diseases, dental, and other primary healthcare services) | 148 (52.1) | 135 (47.5) | 1 (0.4) |
| Interruptions of diagnosis due to equipment damage | 101 (35.6) | 178 (62.7) | 5 (1.8) |
| Contamination of medical devices, instruments and equipment | 89 (31.3) | 191 (67.3) | 4 (1.4) |
| Interruption of supply chains | 130 (45.8) | 154 (54.2) | 0 (0.0) |
| Long-term effects on the environment and need external assistance/interventions | 124 (43.7) | 156 (54.9) | 4 (1.4) |
| Damage to internal transportation systems (elevators, ramps, corridors) | 107 (37.7) | 168 (59.2) | 9 (3.2) |
| Increased immediate and long-term costs to recover from damage | 137 (48.2) | 146 (51.4) | 1 (0.4) |
| Disruption to communication and information systems and assets | 115 (40.5) | 168 (59.2) | 1 (0.4) |
| Damage to roads, disrupting access to a healthcare facility | 216 (76.1) | 68 (23.9) | 0 (0.0) |
| Difficulty transporting patients due to damaged or disabled transportation systems | 203 (71.5) | 80 (28.2) | 1 (0.4) |
| Reduced capacity to deliver healthcare services due to damage and reduced supplies | 165 (58.1) | 118 (41.5) | 1 (0.4) |
| Temporary suspension of service deliveries | 130 (45.8) | 152 (53.5) | 2 (0.7) |
| Damage to paper medical record storage | 98 (34.5) | 183 (64.4) | 3 (1.1) |
| Reduced capacity to access clinical and laboratory supplies | 112 (39.4) | 170 (59.9) | 2 (0.7) |
| Increased hospitalization rates requiring extra medical supplies and a healthy workforce | 117 (41.2) | 164 (57.7) | 3 (1.1) |
| A high demand for cleaning services in all facility buildings after flood events requiring extra personal protective equipment | 157 (55.3) | 125 (44.0) | 2 (0.7) |
| Increased demand for costs for repairing or buying damaged or lost medical equipment and devices, needed for short-term recovery | 144 (50.7) | 138 (48.6) | 2 (0.7) |
| Increased costs due to necessary post-flood repairs | 154 (54.2) | 128 (45.1) | 2 (0.7) |
| Increased the costs of repairing all damaged administrative equipment and furniture | 151 (53.2) | 131 (46.1) | 2 (0.7) |
| Localized disruptions of services with minor loss and damage | 167 (58.8) | 114 (40.1) | 3 (1.1) |
| Damage or loss to healthcare facility documents and records | 110 (38.7) | 172 (60.6) | 2 (0.7) |
| No lasting effects on the external healthcare facility environment | 113 (39.8) | 166 (58.5) | 5 (1.8) |
| Minimal impact on local operations and equipment that do not compromise healthcare service deliveries | 138 (48.6) | 142 (50.0) | 4 (1.4) |
| Minimal impact on the supply chain, which can continue to support healthcare facility needs | 139 (48.9) | 142 (50.0) | 3 (1.1) |
| Possible mould, indoor and outdoor, requiring special | 148 (52.1) | 133 (46.8) | 3 (1.1) |

| | | | |
|---|---|---|---|
| cleaning-up or essential personal protective equipment for cleaners | | | |
| Increased demand for providing cleaning and disinfection supplies | 190 (66.9) | 93 (32.7) | 1 (0.4) |

#### *5.10.5.4 Impacts of water level rise on infrastructure, technology, products, and processes*

About 51.3% of the HCFs reported infrastructure destruction, 37.5% faced building collapse from coastal erosion and material corrosion, 40.0% reported the need for increased water treatment, 53.8% faced heightened maintenance demands, 36.3% experienced persistent facility flooding during high tides, impacting day-to-day operations, 57.5% reported blocked transport systems and flooded ambulance stations and 40.0% reported blocked building access. About 42.5% experienced interruptions in complex and emergency healthcare services, 57.5% faced disruption of healthcare service delivery and operations, 50% faced cessation of services or prolonged service disruption and interruptions of supply chains. Nearly half (45%) faced disruption of the food chain due to saline intrusion in agriculture. More than half (63.8%) reported damage to road access and difficulty in transporting patients, 56.3% faced reduced capacity to deliver healthcare services, 52.5% faced increased demand for cleaning services, 56.3% reported increased demand for providing all necessary essential or critical supplies. Over 62.5% faced increased costs in maintenance and repair the facility building and its assets, 42.5% reported damage or loss of documents and medical records and 47.5% faced increased costs due to demand for repositioning of all damaged or lost medical equipment.

***Table 38: Impact of water level rise on infrastructure, technology, products, and processes***

| **Impacts** | **Characteristic** | | |
|---|---|---|---|
| | **Yes n (%)** | **No n (%)** | **Don't know n (%)** |
| Infrastructure destruction (structural and non-structural; full or parts of the facility) | 41 (51.3) | 38 (47.5) | 1 (1.3) |
| Building collapse from coastal erosion and material corrosion | 30 (37.5) | 47 (58.8) | 3 (3.8) |
| Increased water treatment (desalinization process) | 32 (40.0) | 46 (57.5) | 2 (2.5) |
| Increased maintenance and repair of the facility building | 43 (53.8) | 37 (46.3) | 0 (0.0) |
| Ongoing facility flooding during high tides | 29 (36.3) | 49 (61.3) | 2 (2.5) |
| Blocked transport systems and flooded ambulance stations | 46 (57.5) | 33 (41.3) | 1 (1.3) |
| Blocked building access | 32 (40.0) | 46 (57.5) | 2 (2.5) |
| Damage to critical medical equipment | 32 (40.0) | 47 (58.8) | 1 (1.3) |
| Damage to essential supplies (medications, treatments, medical devices, drugs, laboratory supplies, pharmaceuticals, vaccines, blood, milk, nutritional supplies and other critical supplies) requiring prompt repositioning | 33 (41.3) | 46 (57.5) | 1 (1.3) |
| Interruption in complex and emergency healthcare services (surgery, complex treatments, urgent care, blood banks, etc.) | 34 (42.5) | 44 (55.0) | 2 (2.5) |
| Disruption of healthcare service delivery and operations, such as ambulatory, immunization, maternity room, pharmacy, medication for chronic diseases, and other primary healthcare services | 46 (57.5) | 32 (40.0) | 2 (2.5) |
| Cessation of services or prolonged service disruption due to loss or damage | 40 (50.0) | 38 (47.5) | 2 (2.5) |

| | | | |
|---|---|---|---|
| Interruption of supply chains | 40 (50.0) | 40 (50.0) | 0 (0.0) |
| Damage to internal access systems (e.g., elevators, ramps, corridors, garage) | 28 (35.0) | 48 (60.0) | 4 (5.0) |
| Increased costs of building maintenance | 50 (62.5) | 30 (37.5) | 0 (0.0) |
| Damage to medical and administration equipment and furniture | 33 (41.3) | 46 (57.5) | 1 (1.3) |
| Infrastructure damage (structural and non-structural; full or parts of the facility) | 43 (53.8) | 36 (45.0) | 1 (1.3) |
| Partial disruption of healthcare facility functions resulting from coastal erosion or corrosion | 38 (47.5) | 40 (50.0) | 2 (2.5) |
| Disruption of the food chain due to saline intrusion in agriculture | 36 (45.0) | 41 (51.3) | 3 (3.8) |
| Damage to road access | 51 (63.8) | 29 (36.3) | 0 (0.0) |
| Difficulty in transporting patients due to damaged or disabled transportation systems | 51 (63.8) | 28 (35.0) | 1 (1.3) |
| Reduced capacity to deliver health care services due to damage and reduced access to clinical, laboratory and medical supplies | 45 (56.3) | 35 (43.8) | 0 (0.0) |
| Temporary suspension of service deliveries | 38 (47.5) | 41 (51.3) | 1 (1.3) |
| High demand for cleaning services for the entire facility building, after a flood event | 42 (52.5) | 38 (47.5) | 0 (0.0) |
| The long-term effect on the environment needing external assistance/interventions | 41 (51.3) | 37 (46.3) | 2 (2.5) |
| Increased costs from the water desalinization process | 36 (45.0) | 40 (50.0) | 4 (5.0) |
| Possible replacement of sections of the health facility's building | 35 (43.8) | 44 (55.0) | 1 (1.3) |
| Increased costs due to demand for repositioning all damaged or lost medical equipment and devices | 38 (47.5) | 40 (50.0) | 2 (2.5) |
| Increased demand for providing all necessary essential or critical supplies (medications, treatments, medical devices, drugs, laboratory supplies, pharmaceuticals, vaccines, and other critical supplies) | 45 (56.3) | 32 (40.0) | 3 (3.8) |
| Increased costs of recovery of infrastructure, post- event | 41 (51.3) | 37 (46.3) | 2 (2.5) |
| Localized disruption of services with minor loss and damage | 48 (60.0) | 31 (38.8) | 1 (1.3) |
| Increase in costs to maintain and repair the facility building and its assets | 47 (58.8) | 32 (40.0) | 1 (1.3) |
| Damage or loss of documents and medical records | 34 (42.5) | 46 (57.5) | 0 (0.0) |
| Minor impact on local operations without compromising health care services | 48 (60.0) | 32 (40.0) | 0 (0.0) |
| Minimal impact on the supply chain | 46 (57.5) | 34 (42.5) | 0 (0.0) |
| Short-term negative effects on the environment | 47 (58.8) | 33 (41.3) | 0 (0.0) |

#### *5.10.5.5 Impacts of lightening on infrastructure*

More than a third, 42.2% reported direct damage to infrastructure (water storage tanks, roofs) from high winds, 40.6% reported structural damage of the building, posing risks to overall facility stability, 35.9% experienced breakdown of routine healthcare services, 34.4% reported interruption of supply chains, and 32.8% reported damage to communication and information systems. More than a quarter (26.6%) reported interruptions of complex and emergency health care services, 21.9% reported damage to internal transportation systems, 28.1% reported damage to roads impairing access and 25% reported damage to machine rooms.

***Table 39: Impact of lightning on infrastructure, technologies, products and processes***

| Impact | Characteristic | | |
|---|---|---|---|
| | Yes n (%) | No n (%) | Don't know n (%) |
| Direct damage to infrastructure (water storage tanks roofs) from high winds | 27 (42.2) | 34 (53.1) | 3 (4.7) |
| Structural failure of the building | 23 (35.9) | 39 (60.9) | 2 (3.1) |
| Disruption to building access | 15 (23.4) | 47 (73.4) | 2 (3.1) |
| Damage to machine rooms | 16 (25.0) | 43 (67.2) | 5 (7.8) |
| Damage to communication and information systems and assets | 21 (32.8) | 39 (60.9) | 4 (6.3) |
| Loss or damage of essential supplies (medications, treatments, medical devices, drugs, pharmaceuticals, vaccines, etc.) | 20 (31.3) | 42 (65.6) | 2 (3.1) |
| Interruption of complex and emergency health care services (surgery, complex treatment. urgent health care. etc.) | 17 (26.6) | 43 (67.2) | 4 (6.3) |
| Disruption of health care services and operations | 25 (39.1) | 36 (56.3) | 3 (4.7) |
| Cessation of services or prolonged disruption of services due to loss or damage | 21 (32.8) | 39 (60.9) | 4 (6.3) |
| Breakdown of routine health care services (such as ambulatory, immunization, maternity room, pharmacy, medication for chronic diseases, and other primary healthcare services | 23 (35.9) | 39 (60.9) | 2 (3.1) |
| Interruption of diagnosis due to equipment damages | 19 (29.7) | 40 (62.5) | 5 (7.8) |
| Interruption of supply chains | 22 (34.4) | 40 (62.5) | 2 (3.1) |
| Long-term effect on the environment, requiring external assistance/interventions | 17 (26.6) | 44 (68.8) | 3 (4.7) |
| Damage to internal transportation systems (elevator, ramps, corridors, garage, etc.) | 14 (21.9) | 48 (75.0) | 2 (3.1) |
| Increased treatment demand for infectious, cardiovascular and respiratory diseases | 19 (29.7) | 41 (64.1) | 4 (6.3) |
| Structural damage to the building | 26 (40.6) | 36 (56.3) | 2 (3.1) |
| Damage to road, impairing access | 18 (28.1) | 43 (67.2) | 3 (4.7) |
| Difficult to transport patients due to damaged or disabled transportation systems | 19 (29.7) | 42 (65.6) | 3 (4.7) |
| Reduced capacity to deliver health care services due to damaged and reduced supplies | 25 (39.1) | 37 (57.8) | 2 (3.1) |
| Temporary suspension of service deliveries | 21 (32.8) | 41 (64.1) | 2 (3.1) |
| Damage to paper medical record storage | 15 (23.4) | 47 (73.4) | 2 (3.1) |
| Reduced capacity to access clinical and laboratorial supplies | 20 (31.3) | 40 (62.5) | 4 (6.3) |
| Impacts from trees falling on the facility causing damage to building infrastructure and injuries to people | 24 (37.5) | 38 (59.4) | 2 (3.1) |
| Increased hospitalization rates requiring extra medical supplies and health workforce | 22 (34.4) | 39 (60.9) | 3 (4.7) |
| Increased costs due to high demand of critical supplies during and after the event | 26 (40.6) | 36 (56.3) | 2 (3.1) |
| Increased costs due to necessary financial investment in the recovery of facility infrastructure (structural and non-structural), post event | 23 (35.9) | 38 (59.4) | 3 (4.7) |
| Localized disruption of services with minor losses and damage | 27 (42.2) | 35 (54.7) | 2 (3.1) |
| Damage or loss of documents and records | 15 (23.4) | 47 (73.4) | 2 (3.1) |
| No lasting effect on the external environment of the facility | 26 (40.6) | 36 (56.3) | 2 (3.1) |
| Minimal impact on local operations and equipment, without compromising health care service deliveries Minimal impact on the supply chain | 27 (42.2) | 34 (53.1) | 3 (4.7) |

#### 5.10.5.6 Impacts of Landslides on infrastructure, technologies, products and processes

Majority, 64.3% of the HCFs reported partial destruction by floods causing land erosion, 71.4% experienced blocked transport systems and flooded ambulance stations, 53.6% reported damage to building access, 60.7% reported disruption of healthcare services delivery and operation, 53.6% experienced breakdown of routine healthcare services impacting essential services like immunization, maternity care, and 28.6% experienced interruptions in diagnostic services. About half (50%) reported increased immediate and long-term costs to recover from damage, 67.9% experienced heightened demand for cleaning services, and 46.4% reported increased costs related to medical equipment repair or replacement. A vast majority, 89.3% faced road damage, impacting access to healthcare, 82.1% reported challenges in patient transportation, and more than a third, 32.1% reported increased

*Table 40: Impacts of Landslides on infrastructure, technologies, products and processes in healthcare facilities in Uganda*

| Impact | Characteristic | | |
|---|---|---|---|
| | Yes n (%) | No n (%) | Don't know n (%) |
| Partial destruction by floods causing land erosion | 18 (64.3) | 10 (35.7) | 0 (0.0) |
| Blocked transport systems and flooded ambulance stations | 20 (71.4) | 8 (28.6) | 0 (0.0) |
| Damage to building access | 15 (53.6) | 13 (46.4) | 0 (0.0) |
| Demage to machine room | 2 (7.1) | 23 (82.1) | 3 (10.7) |
| Damage to critical equipment | 3 (10.7) | 25 (89.3) | 0 (0.0) |
| Damage of internal and external communication and information systems | 5 (17.9) | 23 (82.1) | 0 (0.0) |
| Loss or damage of health care facility essential supplies (medications, medical devices, drugs, Laboratorial supplies, etc.) | 5 (17.9) | 23 (82.1) | 0 (0.0) |
| Interruption of complex and emergency health care services (surgery, complex treatments, urgent care) | 5 (17.9) | 18 (64.3) | 5 (17.9) |
| Disruption of health care services delivery and operation | 17 (60.7) | 11 (39.3) | 0 (0.0) |
| Breakdown of routine health care services (such as ambulatory immunization, maternity room. pharmacy. medication for chronic diseases. dental, and other primary healthcare services) | 15 (53.6) | 12 (42.9) | 1 (3.6) |
| Interruption of diagnosis due to equipment damage | 8 (28.6) | 20 (71.4) | 0 (0.0) |
| Contamination of medical devices, instruments and equipment | 9 (32.1) | 19 (67.9) | 0 (0.0) |
| Interruption of supply chains | 12 (42.9) | 16 (57.1) | 0 (0.0) |
| Long-term effect on the environment needing external assistance/interventions | 12 (42.9) | 16 (57.1) | 0 (0.0) |
| Damage to internal transportation systems (elevators, ramps, corridors) | 6 (21.4) | 18 (64.3) | 4 (14.3) |
| Increased immediate and long-term costs to recover from damage | 14 (50.0) | 14 (50.0) | 0 (0.0) |
| Disruption to communication and information systems and assets | 6 (21.4) | 22 (78.6) | 0 (0.0) |
| Damage to road. disrupting access to health care facility | 25 (89.3) | 3 (10.7) | 0 (0.0) |

| | | | |
|---|---|---|---|
| Difficulty in transporting patients due to damaged or disabled transportation systems | 23 (82.1) | 5 (17.9) | 0 (0.0) |
| Reduced capacity to deliver health care services due to damage and reduced supplies | 14 (50.0) | 14 (50.0) | 0 (0.0) |
| Temporary suspension of service deliveries | 11 (39.3) | 17 (60.7) | 0 (0.0) |
| Damage to paper medical record storage | 4 (14.3) | 23 (82.1) | 1 (3.6) |
| Reduced capacity to access clinical and laboratorial supplies | 7 (25.0) | 21 (75.0) | 0 (0.0) |
| Increased hospitalization rates requiring extra medical supplies and health workforce | 9 (32.1) | 19 (67.9) | 0 (0.0) |
| High demand for cleaning services in all facility buildings after landslide event requiring extra personal protective equipment | 17 (60.7) | 11 (39.3) | 0 (0.0) |
| Increased demand in costs for repairing or buying damaged or lost medical equipment and devices. | 13 (46.4) | 15 (53.6) | 0 (0.0) |
| Increased costs due to necessary post landscape repairs | 15 (53.6) | 13 (46.4) | 0 (0.0) |
| Increased costs for repairing all damaged administrative equipment and furniture | 17 (60.7) | 11 (39.3) | 0 (0.0) |
| Localized disruption of services with minor loss and damage | 17 (60.7) | 11 (39.3) | 0 (0.0) |
| Damage or loss to health care facility documents and records | 5 (17.9) | 23 (82.1) | 0 (0.0) |
| No lasting effects on the external health care facility environment | 10 (35.7) | 17 (60.7) | 1 (3.6) |
| Minimal impact on local operations and equipment that do not compromise health care service deliveries | 12 (42.9) | 15 (53.6) | 1 (3.6) |
| Minimal impact on the supply chain, which can continue to support health care facility needs | 14 (50.0) | 13 (46.4) | 1 (3.6) |
| Possible mold indoor and outdoor, requiring special cleaning-up or essential personal protective equipment for cleaners | 11 (39.3) | 16 (57.1) | 1 (3.6) |
| Increased demand for providing cleaning and disinfection supplies | 19 (67.9) | 9 (32.1) | 0 (0.0) |

# 6 Climate Sensitive Health Outcomes in Uganda

## 6.1 Injury and mortality from extreme weather events

Extreme weather events like floods on the banks of river Manafwa and landslides at the foot of Mt. Elgon have in the past decade caused 1,000 deaths and displacement of over 5,000 individuals (Relief Web, 2019, Atuyambe et al., 2011). More than 400 deaths resulting from landslides occurred in Bududa district in 2010, while over 150 injuries and 45 fatalities from landslides and floods were reported in Eastern and Western Uganda in 2019 (OCHA, 2019). Landslides induced by heavy precipitation, in 2022, also led to 46 fatalities in Kasese and Mbale (Relief Web, 2022). The proportion of injuries arising from floods is; 31.7% for bruises or abrasions, 21.8% for broken bones or fractures, and 11.9% for sprains or strains. The proportion of injuries arising from landslides is; 44.4% for broken bones and fractures, 27.8% for bruises and abrasions, and 11.1% for internal organ injuries (Agrawal et al., 2013).

## 6.2 Water-borne diseases

Climate hazards such as flooding and surface runoff compromise water quality, accelerate the breeding of disease vectors such as flies, and enhance pathogen transmission. An increase in temperature also contributes to the proliferation of pathogens in food and water sources, further amplifying disease transmission (MWE, 2022, USAID, 2014, Adams, 2019, Godfrey et al., 2023). Thus, waterborne diseases, such as typhoid fever and cholera, remain on the increase, largely affecting children. The incidence of diarrheal diseases rose from 3.3 per 10,000 in 2020 to 3.7 per 10,000 in 2023, with the Kampala region reporting the highest incidence at 12.2 per 10,000, followed by Bugisu at 6.4 per 10,000 and Tooro at 5.7 per 10,000. The impacts of climate change on the incidence of diarrhoeal diseases are likely to aggravate the occurrence of cholera and typhoid outbreaks. Cholera outbreaks have been reported almost annually over the past two decades (Bwire et al., 2021, Bwire et al., 2013), while typhoid remains endemic, with over 56,000 cases reported per year (Ismail et al., 2020).

## 6.3 Non-communicable diseases

Climate change indirectly influences the prevalence and severity of non-communicable diseases (NCDs) in Uganda. Rising temperatures and changes in precipitation patterns can affect agricultural productivity and food security, leading to shifts in dietary patterns and nutritional deficiencies. Extreme weather events and natural disasters also disrupt healthcare systems, limiting access to essential medications and healthcare services for individuals living with chronic illnesses (Siiba et al., 2024). Failure to build health system resilience will increase the already high burden, where 36% of deaths were attributed to NCDs in 2019 (WHO, 2023). Additionally, the age-standardized mortality rate for major NCDs is as high as 709 per 100,000 in males and 506 per 100,000 in females in 2021 (WHO, 2023).

### 6.4 Respiratory illnesses

Climate change leads to changes in allergen concentrations, prolonged allergen seasons, declining air quality, increased presence of microbes and particulate matter, and air pollution, which increase the risk of respiratory illnesses (D'Amato et al., 2014, Tong et al., 2022, De Sario et al., 2013, Bernstein and Rice, 2013). Heightened heat and sunlight in congested areas can result in increased ozone exposure among the urban population. The impact of extensive exposure to smoke and pollution from wildfires is exacerbated by concurrent heat and drought conditions. Furthermore, intense precipitation events and flooding contribute to increased exposure to indoor humidity and mold. Molds add burden to individuals with asthma and allergies (Zuo et al., 2021). These increase bronchoconstriction and cough among individuals with asthma as they struggle to breathe in hot and humid air conditions (Khosravi et al., 2014).

### 6.5 Malnutrition and food-borne diseases

Utilization of fossil fuels, deforestation, encroachment on wetlands, and unsustainable agricultural practices diminish the accessibility of nourishing food and clean water thus contributing to dehydration, food insecurity, food-borne diseases, and malnutrition (Nuwagaba and Kisekka Namateefu, 2013, FAO, 2024). In Eastern and Northern Uganda, droughts have dried crops in the fields leading to diminished food production, thereby subjecting many to starvation and malnutrition (UNICEF, 2022). Uganda exhibits increased rates of undernutrition, with approximately 29% and 3.5% of children under the age of 5 experiencing stunted growth and body wasting respectively (Maniragaba et al., 2023). Toro region records the highest prevalence of stunting among children under five, while, the Arua region registers the highest levels of wasting, all partly attributed to climate change (Maniragaba et al., 2023). In a certain year, floods and hailstones led to crop losses and some farmers struggled to harvest even a single bag (100kgs) of maize (Forestry and environement department, 2011).

### 6.6 Zoonoses

According to the Uganda One Health Strategic Plan 2018 – 2022, climate change is exacerbating zoonotic disease outbreaks (MOH et al., 2018). Extreme weather events, including intense rainfall and flooding, in Uganda have led to an upsurge in epidemics caused by zoonotic diseases. For instance, in March 2016, Uganda experienced its first-ever outbreak of Rift Valley fever (RVF) in Kabale, following a period of heavy rainfall and extensive flooding. Additionally, the country has seen more serious outbreaks such as Ebola, Marburg, yellow fever, Crimean-Congo hemorrhagic fever (CCHF), plague, COVID-19, and avian influenza (MOH et al., 2018, Sekamatte et al., 2018, Buregyeya et al., 2020). These incidents indicate the interaction between climate change and the emergence of zoonotic diseases (MOH et al., 2018). Several zoonotic diseases are endemic in Uganda including Anthrax, Rabies, Brucellosis, and Trypanosomiasis (MOH et al., 2018, CDC, 2017).

## 6.7 Vector-borne diseases (Malaria, Schistosomiasis, lymphatic filariasis)

Extreme weather, heat waves, floods, and rising temperatures, mosquitoes, which are known vectors of a range of infectious diseases like dengue, malaria, chikungunya, yellow fever, RVFs, West Nile fever, Japanese encephalitis and Zika (Wong, 2023). Figure 2 shows dengue cases per region.

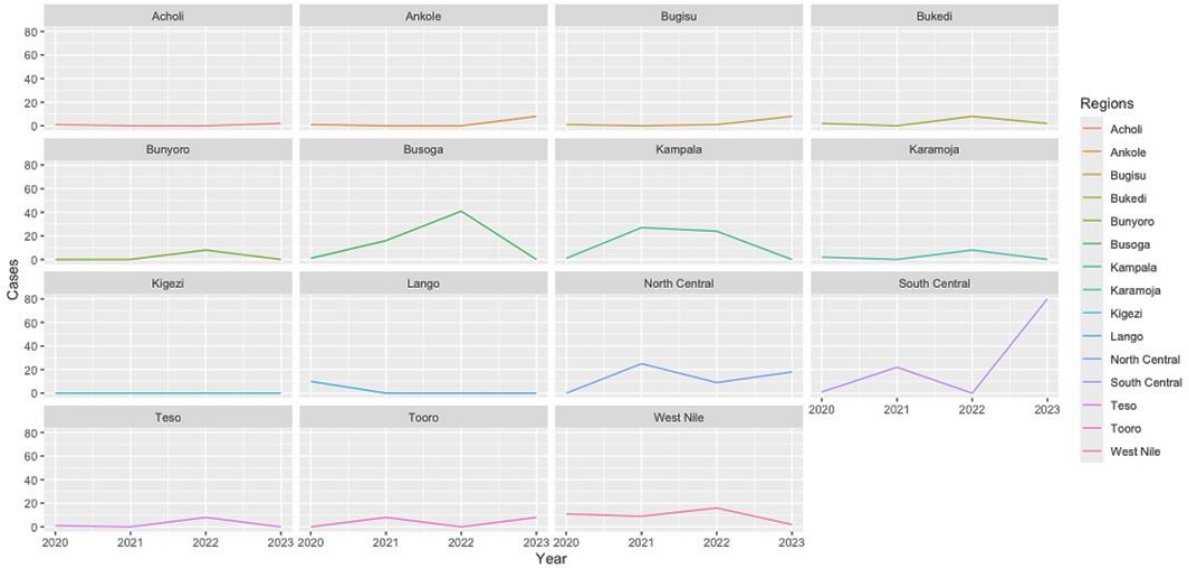



*Figure 14: Total Dengue Cases per Region in Uganda*

### 6.7.1 Malaria

Climate change threatens progress made towards malaria elimination (Ost et al., 2022). Uganda holds the unfortunate distinction of having the world's highest malaria incidence rate, with 478 cases per 1,000 population annually (MOH, 2023). The disease is endemic in 95% of the country, with even higher incidence (63%) in the mid-northern region. An estimated 60 million fever cases are treated annually across healthcare facilities (Okia et al., 2016). A study examining the consequences of variations in climatic factors such as temperature and rainfall on the malaria incidence among the Ugandan population revealed that (Muwanika et al., 2019). An increase in maximum temperature (hotter days) over three consecutive months led to an 8.1% decrease in monthly malaria cases in the long term. Conversely, a three-month rise in minimum temperature (warmer nights) was associated with a 16.7% increase in monthly malaria incidence over time. Rainfall also played a role: a sustained increase in rainfall over three months resulted in a 14% reduction in long-term monthly malaria cases (Muwanika et al., 2019). Figure 3 shows total malaria incidence per region.

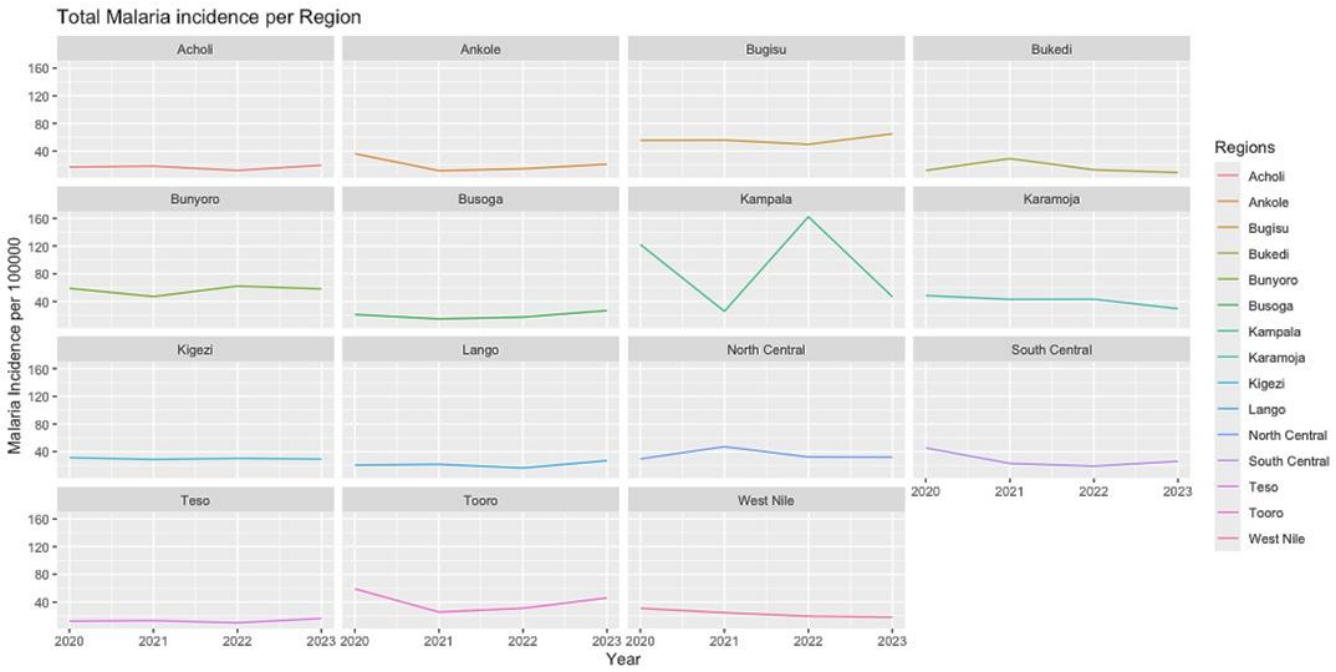



*Figure 15: Total Malaria incidence per Region in Uganda*

### 6.7.2 Schistosomiasis

The effects of climate change, particularly change in temperature, rainfall, flooding, and drought, have significant impacts on the transmission dynamics of schistosomiasis, primarily through their effects on the intermediate snail hosts and the Schistosoma parasites themselves Uganda (Adekiya et al., 2020, Tabo et al., 2024). These climatic factors influence the lifecycle, distribution, and population density of the snail hosts, thereby affecting the transmission rates of schistosomiasis (Adekiya et al., 2020, De Leo et al., 2020). Flooding events can significantly impact schistosomiasis transmission by expanding snail habitats and dispersing snails and parasites into new areas. Also, increased rainfall can lead to expanded snail habitats and higher snail populations, thereby increasing the risk of schistosomiasis transmission (Adekiya et al., 2020, De Leo et al., 2020). Schistosomiasis threatens millions in Uganda, with its prevalence ranging from 11–91% (Okia et al., 2016). An estimated 5.7 million people living near lakes, rivers, and irrigated areas across 63 districts are at risk of infection (Okia et al., 2016).

### 6.7.3 Lymphatic filariasis (elephantiasis, hydrocele)

In Uganda, an estimated 14.5 million people are at risk of infection in 54 districts (east, north, Bundibugyo), and are susceptible to a mosquito-borne disease called lymphatic filariasis (elephantiasis and hydrocele). The risk is highest in the eastern, northern, and Bundibugyo districts, where infection rates can reach over 40% in northeastern Uganda, compared to just 0.5% in western Uganda (Okia et al., 2016).

### 6.8 Mental and psychosocial health

Environmental experts in Uganda suggest a link between the country's changing climate and a rise in mental health issues among its citizens (New Vision, 2023). Climate change exacerbates various social and environmental factors that undermine mental health and psychosocial well-being. This escalation can manifest as emotional distress, the emergence of new mental health disorders, and the deterioration of existing conditions (IFCR, 2023). The spectrum of mental health impacts attributable to climate change spans from mild stress and discomfort to severe clinical disorders, including anxiety, sleep issues, depression, post-traumatic stress disorder (PTSD), and suicidal ideation (IFCR, 2023). Moreover, climate change affects individuals and communities by altering daily lives, perceptions, and experiences, compelling them to adapt, comprehend, and effectively address its consequences. Exposure to news about climate change further contributes to feelings of uncertainty, stress, and depression, leading to a pervasive sense of helplessness (IFCR, 2023).

## 7 Policies, guidelines, and directives that have been disseminated to support response to climate change concerns or to increase the resilience of communities and the health workforce

Several policies, guidelines, and directives have been developed especially by the Ministry of Water and Environment to tackle climate change-related hazards, irrespective of the sectors, in Uganda. These include the 2019 National Environment Management Act (NEMA).

**The National Environment Management Act 2019:** The NEMA Act calls for the prioritization of public and private projects or approaches that increase both the environment and people's resilience to the impacts of climate change. The Act also calls upon the lead agencies to promptly notify other relevant agencies and departments in case of a disaster to obtain any necessary support. The NEMA Act aimed among others at 1) reforming the law relating to environmental management, 2) providing for the management of the environment for sustainable development, and 3) providing for emerging environmental issues including climate change and associated disasters. The NEMA Act also provides for the strategic environmental assessment; addresses environmental concerns arising out of petroleum activities and midstream operations, provides for the management of plastics and plastic products; provides for the establishment of the Environmental Protection Force; provides for enhanced penalties for offenses under the Act; and procedural and administrative matters.

**Government directives:** Several directives aimed at mitigating the impacts of climate change. These directives for example prohibit cultivation in swampy areas, charcoal burning and transportation, and fines for unauthorised tree felling. In some districts, it was the responsibility of the agricultural officers and the National Forest Authority (NFA) to enforce these guidelines. According to these directives, approval for tree felling was upon agreement that for every tree cut down, ten new ones had to be planted. However, directives such as planting ten new trees for every tree cut down were challenging since these were individually owned. Nonetheless, the respondents acknowledged a shift in peoples' mindsets due to ongoing awareness campaigns on climate change. Adoption of the different directives aimed at mitigating the impacts of climate change was difficult in all settings, including those delivering healthcare. Despite electricity being available, it remained expensive just as the accessibility to alternative energy sources such as coal. Furthermore, the adoption of biogas by the healthcare workforce was hindered by significant cattle losses thus making it impractical.

# 8 Conclusion and recommendations

The VAA revealed that a significant proportion of the healthcare facilities exhibited high vulnerability to climate change-related hazards because they were unprepared in the different components of the healthcare facility. For instance, there was high vulnerability in the energy component because HCFs lacked secure locations for protection of emergency energy sources from hazards, inadequate coverage of all critical service areas and inconsistent checks of those alternative sources. The study also found a lack of participation of the health workforce in climate adaptation plans, inadequate preparedness of the workforce for outdoor work during extreme conditions, and gaps in their capacity to identify and manage health conditions worsened by climate impacts. Regarding WASH and Healthcare Waste, there were insufficient strategies for monitoring and reducing water contamination, limited preparedness to prevent vector breeding in facility water systems, and a lack of robust water safety and contingency plans. The assessment also revealed limited post-hazard recovery plans, absence of safe locations for critical equipment during emergencies, lack of safety plans to protect vital supplies from hazards, and inconsistent mechanisms for secure evacuation of health workers and patients. These findings highlight a need for implementation of climate change adaptation plans and policies, building capacity of the health workers, and strengthening of WASH management systems and water safety plans. There's also a need for improvement of the reliability of energy infrastructure, development of contingency plans and enhancement of infrastructure resilience, evacuation plans, and post-disaster recovery.

The study also revealed substantial impacts of climate change on the various components of HCFs in Uganda, with droughts, floods, rise of water levels, and landslides significantly affecting health workforce, WASH, energy, and infrastructure. Significant impacts included fatalities, reduced work capacity, mental health effects, interruptions in supply chains and disruptions in service delivery, emphasizing the need for mental health support and emergency plans. Additionally, infrastructure destruction, damage to vital equipment, water contamination, and disruption of waste management systems were also reported. The reported power failures, loss of essential supplies, and damage to alternative energy sources highlighted the critical importance of energy resilience for healthcare facilities during extreme weather events. Thus, proactive measures and adaptive strategies are imperative to enhance the climate resilience of HCFs and safeguard public health in the face of a changing climate.

## References


ADAMS, Q. 2019. Diarrheal diseases in rural and urban Uganda: examining the association between temperature and rainfall anomalies and diarrheal incidence.

ADEKIYA, T. A., ARULEBA, R. T., OYINLOYE, B. E., OKOSUN, K. O. & KAPPO, A. P. 2020. The effect of climate change and the snail-schistosome cycle in transmission and bio-control of schistosomiasis in Sub-Saharan Africa. *International journal of environmental research and public health,* 17**,** 181.

AFROBAROMETER. 2022. *Climate change in Uganda* [Online]. Available: https://www.afrobarometer.org/wp-content/uploads/2022/11/UgandaCC_.png [Accessed].

AGRAWAL, S., GOPALAKRISHNAN, T., GOROKHOVICH, Y. & DOOCY, S. 2013. Risk factors for injuries in landslide-and flood-affected populations in Uganda. *Prehospital and disaster medicine,* 28**,** 314-321.

ATUYAMBE, L. M., EDIAU, M., ORACH, C. G., MUSENERO, M. & BAZEYO, W. 2011. Land slide disaster in eastern Uganda: rapid assessment of water, sanitation and hygiene situation in Bulucheke camp, Bududa district. *Environ Health,* 10**,** 38.

BERNSTEIN, A. S. & RICE, M. B. 2013. Lungs in a warming world: climate change and respiratory health. *Chest,* 143**,** 1455-1459.

BLACK, R., BENNETT, S. R., THOMAS, S. M. & BEDDINGTON, J. R. 2011. Climate change: Migration as adaptation. *Nature,* 478**,** 447-9.

BUREGYEYA, E., ATUSINGWIZE, E., NSAMBA, P., MUSOKE, D., NAIGAGA, I., KABASA, J. D., AMUGUNI, H. & BAZEYO, W. 2020. Operationalizing the One Health Approach in Uganda: Challenges and Opportunities. *Journal of epidemiology and global health,* 10**,** 250-257.

BWIRE, G., MALIMBO, M., MAKUMBI, I., KAGIRITA, A., WAMALA, J. F., KALYEBI, P., BINGI, A., GITTA, S., MUKANGA, D. & MENGEL, M. 2013. Cholera surveillance in Uganda: an analysis of notifications for the years 2007–2011. *The Journal of infectious diseases,* 208**,** S78-S85.

BWIRE, G., WANIAYE, J. B., OTIM, J. S., MATSEKETSE, D., KAGIRITA, A. & ORACH, C. G. 2021. Cholera risk in cities in Uganda: understanding cases and contacts centered strategy (3CS) for rapid cholera outbreak control. *Pan Afr Med J,* 39**,** 193.

CDC 2017. One Health Zoonotic Disease Prioritization for Multi-Sectoral Engagement in Uganda.

CLIODHNA O'CONNOR, A. H. J. 2020. Intercoder Reliability in Qualitative Research: Debates and Practical Guidelines. *International Journal of Qualitative Methods,* 19**,** 1-13.

D'AMATO, G., CECCHI, L., D'AMATO, M. & ANNESI-MAESANO, I. 2014. Climate change and respiratory diseases. *European Respiratory Review,* 23**,** 161-169.

DANIEL TUNNER. 2022. Should you use inter-rater reliability in qualitative coding? Available: https://www.quirkos.com/blog/post/inter-rater-reliaiblity-qualitative-coding-data/.

DE LEO, G. A., STENSGAARD, A.-S., SOKOLOW, S. H., N'GORAN, E. K., CHAMBERLIN, A. J., YANG, G.-J. & UTZINGER, J. 2020. Schistosomiasis and climate change. *bmj,* 371.

DE SARIO, M., KATSOUYANNI, K. & MICHELOZZI, P. 2013. Climate change, extreme weather events, air pollution and respiratory health in Europe. *European Respiratory Journal,* 42**,** 826-843.

ENVIRONMENTAL ALERT. 2007. *Climate change: The time to act is now* [Online]. Kampala: Environmental Alert. Available: http://envalert.org/wp-content/uploads/2018/02/Climate-Change_time-to-act.pdf [Accessed 11-August 2022].

FAO. 2024. *It is not food if it is not safe: Advocating for food safety and quality assurance to improve Uganda's economy and people's health* [Online]. Available: ao.org/uganda/news/detail-events/en/c/1628194/#:~:text=According%20to%20the%20Uganda%20Ministry,dysentery%2C%20cholera%20and%20aflatoxin%20contaminatio [Accessed 12/03/2024 2024].

FORESTRY AND ENVIRONEMENT DEPARTMENT. 2011. *CLIMATE CHANGE EFFECTS ON NUTRITION AS A RESULT OF FOOD INSECURITY IN EASTERN UGANDA* [Online]. Available: https://www.ipcinfo.org/fileadmin/user_upload/fsn/docs/HLPE/CLIMATE_CHANGE_EFFECTS_ON_NUTRITION_THROUGH_FOOD_INSECURITY.pdf [Accessed 12/03/2024 2024].

GODFREY, B., IMELDA, T., LEOCADIA, K., MAKOBA, W. M., ANNE, N., SAMUEL, A. E., JULIAN, K., ALLAN, M., CHARLES, M. & SAMUEL, O. 2023. Rapid cholera outbreak control following catastrophic landslides and floods: A case study of Bududa district, Uganda. *African Health Sciences,* 23**,** 203-215.

GUINEY, R. 2012. Farming suicides during the Victorian drought: 2001–2007. *Australian Journal of Rural Health,* 20**,** 11-15.

HEPWORTH, N. & GOULDEN, M. 2008. Climate Change in Uganda: Understanding the implications and appraising the response.

IFCR. 2023. *MHPSS and the Climate Crisis: a short workshop guide* [Online]. Available: https://pscentre.org/resource/mhpss-and-the-climate-crisis-a-short-workshop-guide/ [Accessed].

ISMAIL, K., MAIGA, G., SSEBUGGWAWO, D., NABENDE, P. & MANSOURIAN, A. 2020. Spatio-temporal trends and distribution patterns of typhoid disease in Uganda from 2012 to 2017. *Geospatial health,* 15.

KHOSRAVI, M., COLLINS, P. B., LIN, R.-L., HAYES JR, D., SMITH, J. A. & LEE, L.-Y. 2014. Breathing hot humid air induces airway irritation and cough in patients with allergic rhinitis. *Respiratory physiology & neurobiology,* 198**,** 13-19.

LIN, H.-C., CHEN, C.-S., XIRASAGAR, S. & LEE, H.-C. 2008. Seasonality and climatic associations with violent and nonviolent suicide: a population-based study. *Neuropsychobiology,* 57**,** 32-37.

MANIRAGABA, V. N., ATUHAIRE, L. K. & RUTAYISIRE, P. C. 2023. Undernutrition among the children below five years of age in Uganda: a spatial analysis approach. *BMC Public Health,* 23**,** 390.

MOH 2022. Annual Health Sector Performance Report 2021/22. Ministry of Health, Uganda.

MOH. 2023. *UNDER THE NET: PROGRESSING TOWARDS LOWERING MALARIA BURDEN AND IMPACT IN UGANDA* [Online]. Available: https://www.health.go.ug/2023/09/13/under-the-net-progressing-towards-lowering-malaria-burden-and-impact-in-uganda/#:~:text=Uganda%20holds%20the%20unfortunate%20distinction,cases%20per%201%2C000%20population%20annually. [Accessed 11th March 2024].

MOH, MAAIF, MWE, UWA & USAID 2018. UGANDA ONE HEALTH STRATEGIC PLAN 2018 - 2022.

MUWANIKA, F., ATUHAIRE, L., OCAYA, B. & ISOTO, R. 2019. Consequences of Climate Variation on Malaria Incidence in Uganda. *Climatol Weather Forecasting,* 7**,** 2.

MWE 2021. National Climate Change Act, 2021. Uganda: Government of Uganda.

MWE 2022. Updated Nationally Determined Contribution (NDC).

NEW VISION. 2023. *Climate change fuelling mental health problems among Ugandans* [Online]. Available: https://www.newvision.co.ug/category/news/climate-change-fuelling-mental-health-problem-NV_172702 [Accessed 11th March 2024].

NIEK MOUTER, A. D. V. N. 2012. *Intercoder reliability for qualitative research: you win some, but do you lose some as well?* [Online]. Available: https://repository.tudelft.nl/islandora/object/uuid:905f391d-4b25-40cf-9292-e253b7e55db2/datastream/OBJ [Accessed 4 September 2022].

NUWAGABA, A. & KISEKKA NAMATEEFU, L. 2013. Climatic change, land use and food security in Uganda: A survey of Western Uganda.

OCHA. 2019. *Uganda: Floods & Landslides - Flash Update No. 1 (As of 19 December 2019)* [Online]. Available: https://reliefweb.int/report/uganda/uganda-floods-landslides-flash-update-no-1-19-december-2019 [Accessed 12/03 2024].

OKIA, M., OKUI, P., LUGEMWA, M., GOVERE, J. M., KATAMBA, V., RWAKIMARI, J. B., MPEKA, B. & CHANDA, E. 2016. Consolidating tactical planning and implementation frameworks for integrated vector management in Uganda. *Malaria Journal,* 15**,** 1-11.

OST, K., BERRANG-FORD, L., BISHOP-WILLIAMS, K., CHARETTE, M., HARPER, S. L., LWASA, S., NAMANYA, D. B., HUANG, Y., KATZ, A. B. & HOSPITAL, B. C. 2022. Do socio-demographic factors modify the effect of weather on malaria in Kanungu District, Uganda? *Malaria journal,* 21**,** 98.

RELIEF WEB. 2019. *Landslides kill 1,000 in Bugisu over the past decade* [Online]. Available: https://reliefweb.int/report/uganda/landslides-kill-1000-bugisu-over-past-decade [Accessed 4th March 2024].

RELIEF WEB. 2022. *Floods in Eastern Uganda kill at least 30 people and leave 400,000 without access to clean water* [Online]. Available: https://reliefweb.int/report/uganda/floods-eastern-uganda-kill-least-30-people-and-leave-400000-without-access-clean-water [Accessed 4th March 2024].

ROWE, G. & WRIGHT, G. 1999. The Delphi technique as a forecasting tool: issues and analysis. *International Journal of Forecasting,* 15**,** 353-375.

SEKAMATTE, M., KRISHNASAMY, V., BULAGE, L., KIHEMBO, C., NANTIMA, N., MONJE, F., NDUMU, D., SENTUMBWE, J., MBOLANYI, B. & ARUHO, R. 2018. Multisectoral prioritization of zoonotic diseases in Uganda, 2017: A One Health perspective. *PloS one,* 13**,** e0196799.

SIIBA, A., KANGMENNAANG, J., BAATIEMA, L. & LUGINAAH, I. 2024. The relationship between climate change, globalization and non-communicable diseases in Africa: A systematic review. *PLoS One,* 19**,** e0297393.

TABO, Z., KALINDA, C., BREUER, L. & ALBRECHT, C. 2024. Exploring the interplay between climate change and schistosomiasis transmission dynamics. *Infectious Disease Modelling,* 9**,** 158-176.

TONG, M., WONDMAGEGN, B., XIANG, J., HANSEN, A., DEAR, K., PISANIELLO, D., VARGHESE, B., XIAO, J., JIAN, L. & SCALLEY, B. 2022. Hospitalization costs of respiratory diseases attributable to temperature in Australia and projections for future costs in the 2030s and 2050s under climate change. *International Journal of Environmental Research and Public Health,* 19**,** 9706.

UNICEF. 2022. *On the Occasion of the 2022 Karamoja IPC for Acute Malnutrition Report Launch* [Online]. Available: https://www.unicef.org/uganda/press-releases/occasion-2022-karamoja-ipc-acute-malnutrition-report-launch [Accessed 2024 12/03/2024].

USAID. 2014. *AN OVERVIEW OF CLIMATE CHANGE AND HEALTH IN UGANDA* [Online]. Available: https://www.climatelinks.org/sites/default/files/asset/document/Uganda%2520CC%2520and%2520Health%2520Overview_CLEARED.pdf [Accessed 4th March 2024].

WHO. 2023. *Country Disease Outlook-Uganda* [Online]. Available: https://www.afro.who.int/sites/default/files/2023-08/Uganda.pdf [Accessed 11/03 2024].

WINKLER, M., SCHOEBITZ, M. L. & CISSÉ, G. 2015. Health and environmental risk and impact assessments of waste reuse business models proposed for Kampala. *Environmental health,* 256**,** 663033.

WINKLER, M. S., DIVALL, M. J., KRIEGER, G. R., BALGE, M. Z., SINGER, B. H. & UTZINGER, J. 2010. Assessing health impacts in complex eco-epidemiological settings in the humid tropics: Advancing tools and methods. *Environmental Impact Assessment Review,* 30**,** 52-61.

WONG, C. 2023. Climate change is also a health crisis—these 3 graphics explain why. *Nature,* 624**,** 14-15.

WORLD BANK. 2021. *DEEP DIVE INTO INTERNAL CLIMATE MIGRATION IN UGANDA* [Online]. Available: https://openknowledge.worldbank.org/server/api/core/bitstreams/22a49bba-e587-57c6-bf91-51a4eab96313/content [Accessed 22nd/08 2023].

WORLD HEALTH ORGANIZATION 2021a. Checklists to assess vulnerabilities in health care facilities in the context of climate change.

WORLD HEALTH ORGANIZATION 2021b. Climate change and health: vulnerability and adaptation assessment.

WOŹNIAK, W. 2014. Homogeneity of Focus Groups as a Pathway to Successful Research Findings? *Przegląd Socjologii Jakościowej,* 10**,** 6-23.

ZUO, C., LUO, L. & LIU, W. 2021. Effects of increased humidity on physiological responses, thermal comfort, perceived air quality, and Sick Building Syndrome symptoms at elevated indoor temperatures for subjects in a hot-humid climate. *Indoor Air,* 31**,** 524-540.