GUIDELINE

ON HOSPITAL DISASTER SAFETY ASSESSMENT (HDSA)

Updated as of July 2022

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Revised Guideline (Primary Hospitals) **OVERVIEW**

1. Background

Preparedness for responding to disasters is on the development agenda of governments and agencies in Bangladesh. Enhancing preparedness for effective response is also a significant priority in the Sendai Framework for Disaster Risk Reduction (2015-2030), which highlights the need to strengthen disaster risk prevention and reduction measures in critical facilities like hospitals and promote resilience of new and existing health facilities to ensure that they remain safe, effective, and operational during and after disasters.

One component of disaster risk reduction strategies employed in the health sector, among others, is assessing the safety of healthcare facilities, identifying their vulnerabilities, and setting priorities in dealing with existing gaps and capacity to respond to emergencies. As part of the hospitals' disaster preparedness, USAID's Program for Strengthening Emergency Preparedness and Resilience in Bangladesh (SERB) aims to strengthen the ongoing and previous efforts in emergency preparedness in Bangladesh to streamline, build-up, integrate, and institutionalize the outcomes of Hospital Risk Assessments (HRAs) conducted in 16 hospitals under the USAID's Strengthening Earthquake Resilience in Bangladesh Program from June 2013 – November 2019 adopting the Hospital Safety Index (HSI) tool developed by WHO/PAHO.

The WHO HSI tool is generic for global utilization, and the elements of the tool are formulated for application in large complex hospitals. USAID's SERB program facilitated the drafting of a national tool in the Bangladesh context and customize its indicators to conduct Hospital Disaster Safety Assessments (HDSA) in the healthcare facilities in the country as per the recommendation of the National Policy Dialogue (NPD) organized by the Asian Disaster Preparedness Center (ADPC) in November 2019 in collaboration with the DGHS on Hospital Emergency Preparedness and Safety.

2. HDSA Goal and Objectives

Goal: To enable the hospital managers, department heads and other health complex personnel to have a better understanding of the health facility's vulnerabilities from hazard exposure and utilize the result of the assessment in developing corrective action plans to improve hospital safety from disasters.

Objectives: HDSA is a preliminary diagnosis of the hospital's safety and capacity to continue provide critical services in the event of emergencies and disasters. The specific objectives of HDSA are to:

- Identify potential high-risk areas and elements within the hospital that might disrupt the normal operations and affect the delivery of emergency care during disasters.
- Develop recommendations to the hospital disaster committee to enhance hospital's capacity to respond to disasters and provide the needed lifesaving care to the affected population.
- Take appropriate measures to integrate relevant information of the assessment into the hospital's functional, structural planning, preparedness program and development initiatives to reduce disaster risks.

3. HDSA Components

HDSA comprises two components:

a) Assessment of hospital's vulnerabilities based on exposure to a particular hazard (HVL)

b) Assessment of hospital's safety level (HSL)

The vulnerability level is measured (or estimated) by combining the probability of the occurrence and the impact of a particular hazard. In this way, hazards can be classified as high (indicating a high probability of hazards taking place or high-impact hazards, or both), medium (a high probability of moderate hazards), and low (a low probability or hazards of low impact). The safety level is measured in the context of its functioning capacities, which means the hospital is likely or unlikely to function in emergencies and disasters. The degrees of levels of safety are estimated Low, Average, and High. ***Table 1: Defines the classification of degrees of HVL and HSL components.***

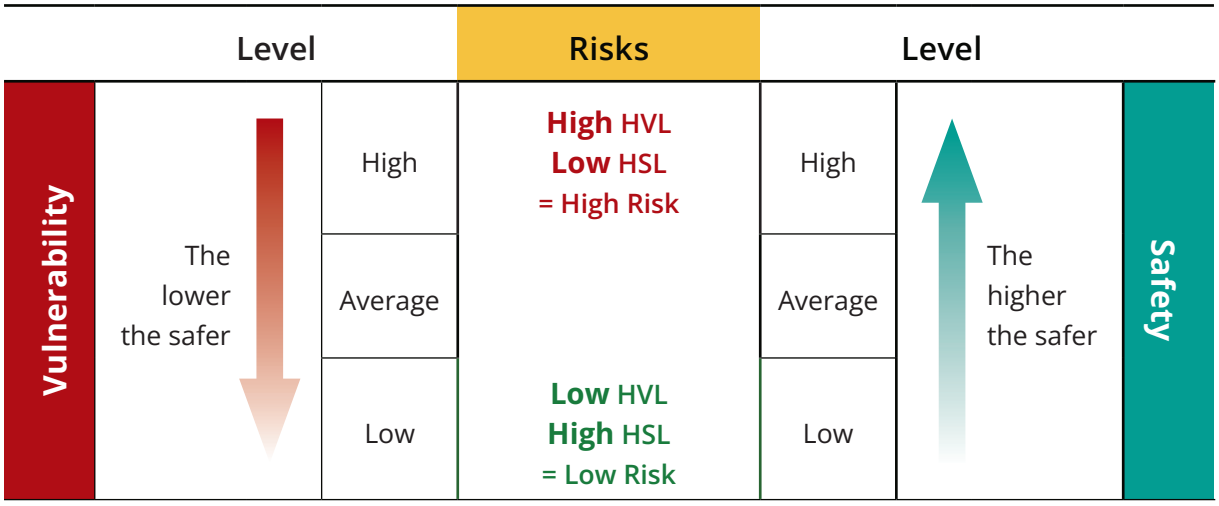
Table 1: HVL and HSL Classification with Rationale

HDSA Components	Level of Vulnerability and Safety		
	High	Average	Low
Hospital's Vulnerability Level (HVL)	High probability of hazards or high-impact hazards, or both	High probability of moderate-impact hazards	Low probability or hazards of low impact
Hospital's Safety Level (HSL)	Hospitals will likely function in emergencies and disasters.	Hospitals' ability to function during and after emergencies and disasters is potentially at risk, which means that the levels of safety are potentially at risk to protect the lives of patients and hospital staff during and after emergencies or disasters.	Hospital is unlikely to function during and after emergencies and disasters, which means that the safety levels are inadequate to protect the lives of patients and hospital staff during and after emergencies or disasters.

4. Hospitals' Risks, Safety and Vulnerability

As shown in Table 2, the lower the hospital's vulnerability to hazards and the higher the hospital's safety level, there will be "low risk." That means it is likely that hospitals will function in emergencies and disasters, and on the contrary, hospitals will be at "high risk" if the vulnerability level is high and the safety level is low.

Table 2: Safety vs Vulnerability



5. Safe Hospitals Checklist

HDSA is based on the checklist, as known as HSI tool which comprises several parameters (indicators) developed by WHO to make a preliminary diagnosis of the hospital's safety and capacity to provide services in the event of emergencies and disasters. The parameters (indicators), each of which has three safety rating levels including low, average and high (Refer to Table 1), are divided into four sections or modules:

Module 1: Hazards affecting the safety of the hospital

Module 2: Structural safety

Module 3: Non-Structural safety

Module 4: Emergency and disaster management

- **Module 1:** Parameters of Module 1 is the hazards that may directly affect the safety of the hospital and those for which the hospital may be expected to provide health services in response to emergencies and disasters. Safety level of the hospital is evaluated against the parameters in modules 2, 3 and 4, with reference to both the hazards identified in Module 1 and the maximum capacity of the hospital for emergencies and disasters identified in Form 1 (General Information about the Hospital).

- **Module 2:** Parameters of Module 2 are indicative of the safety of the structural elements of a facility's building (frameworks, pillars, load bearing walls, base, roofing, flooring, bars etc.); type and quality of construction materials made use of; tear and wear of the building and compliance with construction and refurbishment standards.

- **Module 3:** Parameters of Module 3 are indicative of the architectural safety (partition walls, windows, doors, decorative elements, access venues etc.); infrastructure protection, access, and physical security (proximity of hospital building to local hazards and how the overall layout of the hospital protects critical services from these hazards and from security threats); critical systems (power grids, water supply piping, heat supply, servicing of the plumbing system, ventilation system and climate control (air conditioning), supply of medical gases etc.); and equipment and supplies (including medical, diagnostic, and office equipment), nonclinical services, and supplies to provide patient treatment).

- **Module 4:** Parameters of Module 4 are indicative of the way the hospital management is organized to operationalize the hospital emergency response plan, resources available for emergency preparedness and response to emergencies, staff training and education, keeping safe the hospital services ensuring uninterrupted hospital operations.

6. HDSA Contextualization and Customization

HDSA contextualization and customization followed the November 2019 NPD recommendations, including the enactment of a national plan with the inclusion of a national HDSA tool, developing a relevant and effective hospital emergency response plan (HERP), adapting the HDSA and HERP tools to integrate its implementation at the national level and develop a research team to revise these tools considering the local context. The assessment followed the NPD recommendations and adopted the previous HRA experiences in selecting the indicators. The process involved: working with national program partners from NCDC/DGHS, NIPSOM, and WHO; reviewing the WHO HSI 2Ed tool; and developing a national assessment tool that the DGHS can use in conducting similar hospital assessments. Considering the service capacities and geographic locations of the primary healthcare facilities like the Upazila Health Complex, ADPC, in consultation with the DGHS and other stakeholders, has identified the number of HDSA indicators out of those listed in the WHO's HSI Guide for Evaluators and based on the lessons learned in the HRAs conducted previously under SERB1. With regards to the primary healthcare (PHC) free medical services are available at three tiers - Upazila, union, and ward. Upazila Health Complex (UHC) is the first referral level under PHC. Over 400 UHCs holding the capacity of nearly 19,000 hospital beds are functioning around the country. Table 3 depicts the review results by HDSA modules in the context of primary hospitals, divided into four sections or modules.

Table 3: Distribution of HSI by Modules

HDSA Modules	WHO HSI	Primary Hospitals
Hazards Affecting Healthcare Facilities (Module 1)	37	22
Structural Safety (Module 2)	18	18
Non-Structural Safety (Module 3)	93	55
Emergency and Disaster Management (Module 4)	40	29
Total	**188**	**124**

7. HDSA Methodology

HDSA is a self-assessment of hospitals with the participation of the concerned hospital and stakeholders; the external involvement is minimal. Following is a list of HDSA Forms, HSI Tools, HDSA Report Outline, and HVL and HSL Calculation.

- Hospital's General Information Form (Annex A)
- Guidance and Checklist by Modules (Annex B)
- HDSA Report Outline (Annex C)
- HVL and HSL Results and HSI Score (Annex D)

8. HDSA Procedure

HDSA involves two steps – Planning Workshop followed by Safety Assessment conducted in five phases, including 1) Preparatory, 2) Assessment, 3) Initial Findings Validation, 4) Final Reporting, and 5) Report Endorsement.

1) Preparatory Phase

The Disaster Health Management Committee (DHMC) which is established by order of the Directorate General of Health Service (DGHS) of the Ministry of Health and Family Welfare dated September 2013 the hospital will facilitate a meeting with the committee members to discuss various assessment elements and the process, including the HDSA tool's use. The meeting's expected outcome is to finalize the formation of an assessment team, assessment procedure and agree on the methodology and monitoring of the assessment. Following meeting decisions, HDSA Planning Workshop will be conducted, as part of the assessment procedure, at the target hospital to orient the hospital personnel who will comprise the assessment team on the HDSA tool. The potential participants of the workshop will include the head of the hospital, the physicians, nursing supervisors, admin staff, the representatives of Civil Surgeon (CS) of the district general hospitals, and the engineers from the Public Works Department (PWD) and Hospital Engineering Department (HED). The expected output of the workshop will be a draft plan to conduct the assessment using HDSA tool.

Prior to the workshop the assessment team will conduct an initial inspection of surroundings and the area of the hospital for an overview of the architectural and construction of the city, the type of damage that hazards could cause, and the areas of the city and of the hospital that would probably be most affected. During the initial inspection, the team will gather pertinent documentation from different sources, including fire services, police, service providers of water, electricity and telecommunications, and other community services.

2) Assessment Phase

Upon completing the hospital assessment planning workshop, the HDSA evaluators will meet with the assessment participants to conduct the assessment based on the agreed plan. The evaluators will form small groups from the assessment participants and assign a group to gather the hospital's general information using the form provided in Annex A and at least one group each for Modules 1, 2, 3, and 4 included in Annex B. Each of these groups shall represent a diversified staff of different hospital sections.

3) Initial Findings Validation Phase

Activities planned in this phase will include drafting the HDSA report prepared by the assessment team according to the Report Outline provided in Annex C and sharing the draft report with the hospital management for their feedback and validation. Annex D presents the procedures for summarizing the HVL and HSL based on the checklist information collected for Modules 1, 2, 3, and 4 and calculating the HDSA score for Modules 2, 3, and 4. The hazard levels assigned to the location of the hospital, including the level of hazard due to soil characteristics, are not counted when calculating a hospital's safety index.

4) Final Reporting Phase

Finalize the HDSA report using the prescribed outline (Annex C), incorporating hospitals' feedback and agreement of the initial findings by the hospital management. The final report will contain short-medium, and long-term recommendations and an action plan based on the HDSA score. The report, in addition to the general information of the hospital (such as location, facility type, hospital occupancy rate, and capacity collected using the General Information Form provided in Annex A), will cover a summary of the four modules:

- Information on hazards relating to the geographic location including the occurrence of different hazards.
- Observation and feedback on structural component.
- Non-Structural assessment of vulnerability factors.
- Functional assessment of existing emergency and disaster management services of the hospital.

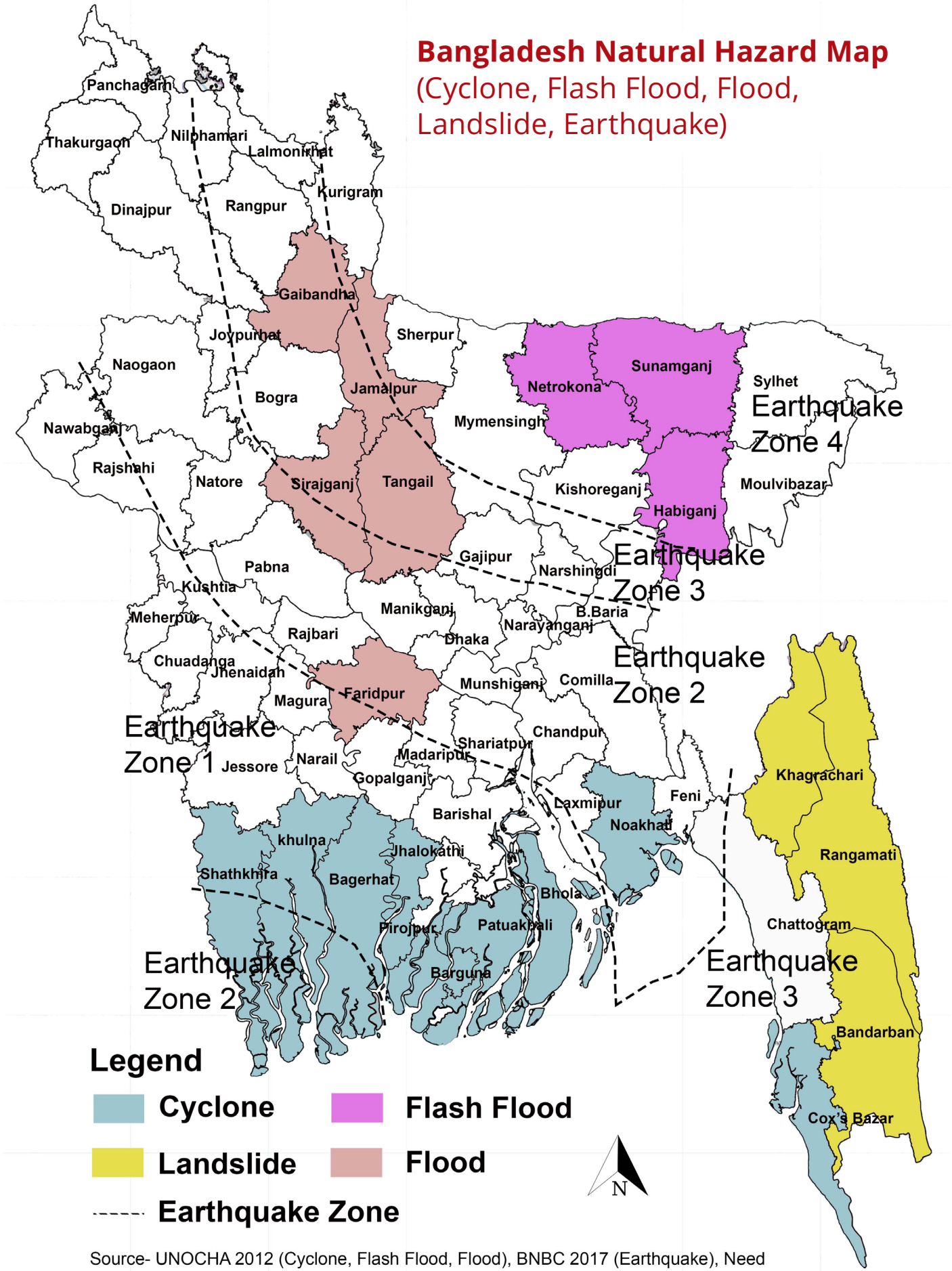
5) HDSA Report Endorsement

Finally, as part of the endorsement of the HDSA report, the evaluator will facilitate the acknowledgement of the Hospital Authority, CS, and DGHS. The disclosure will include the suggested re-assessment frequency to update progress as part of monitoring by the CS and DGHS.

9. HDSA Information Collection Steps

The evaluation team will collect the district or local risk map(s)[1] showing potential hazards for the hospital location and the hospital's catchment area, i.e., the geographic and population coverage of healthcare during emergencies and disasters. For example, maps showing earthquake zones, flood regions, cyclone-prone areas, and landslide locations. The availability of hazard maps or other hazard information will enable the evaluators to rate the hazard level readily. In the absence of hazard maps, the evaluators will collect the best available information on hazards from informed sources at the hospital and concerned government departments at the Upazila and use this information to estimate the hazard level. Evaluators will also collect soil or geotechnical analysis reports.

Bangladesh Natural Hazard Map
(Cyclone, Flash Flood, Flood, Landslide, Earthquake)



Source- UNOCHA 2012 (Cyclone, Flash Flood, Flood), BNBC 2017 (Earthquake), Need Assessment Working Group Bangladesh (NAWGB) 2019 (Landslide)

NB: Map only shows the most natural hazard prone districts of Bangladesh.

Step 1: The Evaluation Facilitator(s) will form at least five small groups of HDSA participants, represented by multi-disciplines including physicians, administrative staff, nurses, and clinical and non-clinical staff. Refer to the HDSA Methodology Section for detailed information on small group formation.

Step 2: Review the assigned part of the checklist containing the elements of the Sub-modules. Ask the Evaluation Facilitator for any clarification of the checklist and elements.

Step 3: Conduct the inspection of the hospital's surroundings for an overview of the architectural and construction features of the area, the type of damage that hazards could cause, and the areas of the hospital that would probably be most affected.

Step 4: Gather pertinent documentation from different offices/departments of the hospital. If needed, approach other entities – government offices, private organizations, fire service stations, and meteorological and geological agencies.

Step 5: Compile the information collected and present an oral report highlighting salient features – observations, challenges, etc.

Step 6: At the end of the checklist form, the group members will provide a summary comment or assessment highlight and enter their names, designation, and contact numbers. The HDSA facilitator will contact the group members if she/he needs any clarification or additional information.

EVALUATION TIPS

Recommended Evaluation Methods:

- Documentation Review
- Interview
- Observation
- Inspection

ANNEX A:

GENERAL INFORMATION ABOUT THE HOSPTAL

Name of the Hospital: _____

Address of Hospital: _____

Name and Contact Details of Hospital Director/Superintendent/In-Charge

_____

Name and Contact Details of Hospital Emergency/Disaster Manager:

_____

Type of Healthcare Facility: ☐ Primary ☐ Secondary ☐ Tertiary

Detail information: (Collect the following information from the hospital authority/hospital disaster management committee before the HDSA session; Provide remarks if Facilities/Resources/Services which is not available or planned/expected.)

Facilities/Resources/Services[2]	Description	Remarks
Telephone		
Email		
Website		
Establishment Year		
Type of Facilities		
General Description of Hospital (Institution to which it belongs, e.g., Ministry, Private entity, University)		

[2] *This would depend on the type of facility: Primary, Secondary or Tertiary. For example, in UHCs not all services and facilities may not be available.*

Facilities/Resources/Services[2]	Description	Remarks
Physical Distribution (List and briefly describe the main buildings in the hospital. Provide maps and diagrams of the hospital site and the local setting, including the physical distribution of the services, in the box below. Use additional pages, if necessary.)		
Total Number of Beds		
Average Bed Occupancy Rates (in normal situation)		
Average Bed Occupancy Rates (in emergency situation)		
Outpatients Services (Persons/Day)		
Ownership (Public/Private)		
Doctors		
Nurses		
Paramedics		
Staffs - Clinical (Sanction_____)	Female: Male:	
Staffs – Nonclinical (Sanction_____)	Female: Male:	
ICU/CCU Beds	Routine Capacity: Maximum Capacity: (For Emergencies/Disasters)	
OT	Routine Capacity: Maximum Capacity: (For Emergencies/Disasters)	
Other Department or Service (Specify)		
Number of Ambulances		
Pathological Lab (If yes, provide number of units)	Yes/No	
Blood Bank	Yes/No	

Facilities/Resources/Services[2]	Description	Remarks
Blood Transfusion Facility	Yes/No	
X –Ray	Yes/No	
CT Scan/MRI	Yes/No	
Angiogram	Yes/No	
First Aid	Yes/No	
Dispensary	Yes/No	
Social Welfare	Yes/No	
Dietary and Nutrition	Yes/No	
Linen	Yes/No	
Communication	Yes/No	
Generator	Yes/No	
Water Reservoir / Tanks	Yes/No	
Water System	Yes/No	
Gas	Yes/No	
Electricity	Yes/No	
Hospital Emergency Response Plan	Yes/No	
Hospital Disaster Committee	Yes/No	
Financial Allocation for Casualty Management	Yes/No	
Emergency Contact Person		
Designation		

Facilities/Resources/Services[2]	Description	Remarks
Mobile		
Telephone		
Additional Information (including history of prior emergencies and disasters the hospital had to cope with)		
Geographic Location: (Coastal Region/Hill Districts/Flood Prone/Others (Specify)		
Source(s) of Information Provider		

Draw a map of buildings, facilities and other main features of the hospital complex/campus.

ANNEX B:

HDSA GUIDANCE & CHECKLIST BY MODULES

Module 1:

Hazards Affecting the Safety of the Hospital

Module 2:

Structural Safety

Module 3:

Non-Structural Safety

Module 4:

Emergency and Disaster Management

Module 1:

Hazards Affecting the Safety of the Hospital

1. INTRODUCTION

Hazards affecting the safety of the hospital and the role of the hospital in an emergency and disaster management (HDSA Module 1)

Bangladesh is one of the most densely populated and hazard-prone countries. Natural calamities and human-induced disasters affect almost all parts of the country. So, the country's healthcare facilities are vulnerable to hazards that may affect the structural and non-structural safety of the hospital. Hospitals may face both internal and external disasters. The impact of internal disasters such as fire, floods, hazardous material exposure, and utility failures is typically limited to the hospital/healthcare facility. In contrast, external disasters include scenarios such as earthquakes, mass casualty events, pandemics, or epidemics where the hospital itself may or may not be affected but is a critical part of the more significant response. The most likely scenarios are that:

- **Community Affected – Hospital Unaffected:** Requiring hospitals to become involved in the larger disaster response.
- **Community Unaffected – Hospital Affected:** Impacting the internal disasters of hospitals.
- **Community Affected – Hospital Affected:** Requiring to address the sudden increase in demand for emergency response on top of hospitals' own needs.

The emergency and disaster management role of the hospital may extend beyond those hazards which could directly affect the safety of the hospital (e.g. the hospital may need to be prepared to receive and treat patients in response to a flood although the hospital is not affected or damaged by the flood itself).

So, the analysis of the geographical location of the hospital enables hazards to be assessed in relation to previous emergencies and disasters in the zone, hazards which may affect the hospital, and the location and type of land on which the hospital has been constructed. Besides, hospitals may experience internal hazards, such as hospital building fires, critical system failure (e.g. water, power) and security threats which can affect the safety of the building, patients, visitors and staff, and the functioning of the hospital.

Module 1 is used to determine the hazards that may directly affect the safety of the hospital and those for which the hospital may be expected to provide health services in response to emergencies and disasters. This module comprises 22 elements which are divided into two parts (Sub-Modules). Table-1 presents the distribution of elements by sub-modules:

Sub-Module 1.1 - Hazards (composed of natural hazards, including geological, hydro-meteorological, biological, and human-made hazards, including technological and societal hazards; and **Sub-Module 1.2** - Geotechnical properties of soils.

Table 1: Distribution of Elements by Sub-Modules

Sub-Modules	Elements
Sub Module 1.1: Hazards Affecting Hospital Safety	19
Sub Module 1.2: Geotechnical Properties of Soils	3
Total	**22**

Hazards Classification: Hazards can be classified as **High, Average, and Low** based on the probability of occurrence and impact of the hazard (Table 2). It is essential to take into account of the history of hazards affecting the hospital when rating the hazard level. The evaluators shall consider the potential threat of all hazards identified, including those likely to occur in the future.

Table 2: Hazard Classification

Classification	Rationale
High	High probability of hazards or high-impact hazards, or both
Average	High probability of moderate-impact hazards
Low	Low probability or hazards of low-impact

HDSA Information Collection Steps

In general, the HDSA involves six steps in information collection. Refer to the Overview section for detailed guidance on these steps.

Explanation and Guidance on Elements of Vulnerable Factors

Factors that make hospitals vulnerable include exposure to natural, biological, and human-made hazards, liquefaction, clay soils, and unstable slopes. The vulnerable factors and hazard classification are presented in Table 3, followed by explanation and guidance on each element that the evaluation group will assess under the HDSA.

Table 3: Factors Make Hospital Vulnerable

Factors			Hazard Classification		
			High	Average	Low
Sub-Module 1.1 Hazards	1.1.1 Natural	Earthquakes, Floods, Cyclone, etc.			
	1.1.2 Biological	Food borne diseases, Epidemics, Pandemics, etc.			
	1.1.3 Human-induced	Structural fires, Power outages, Transportation incidents, etc.			
	1.1.4 Societal	Civil unrest, Demonstrations, Displaced populations, etc.			
Sub-Module 1.2 Geotechnical Properties of Soil	1.2.1 Liquefaction	Exposure to hazards from saturation to loose subsoil			
	1.2.2 Clay Soils	Exposure to hazards from clay soil			
	1.2.3 Unstable Slopes	Exposure to hazards from slopes			

Module 1:

Hazards Affecting the Safety of the Hospital

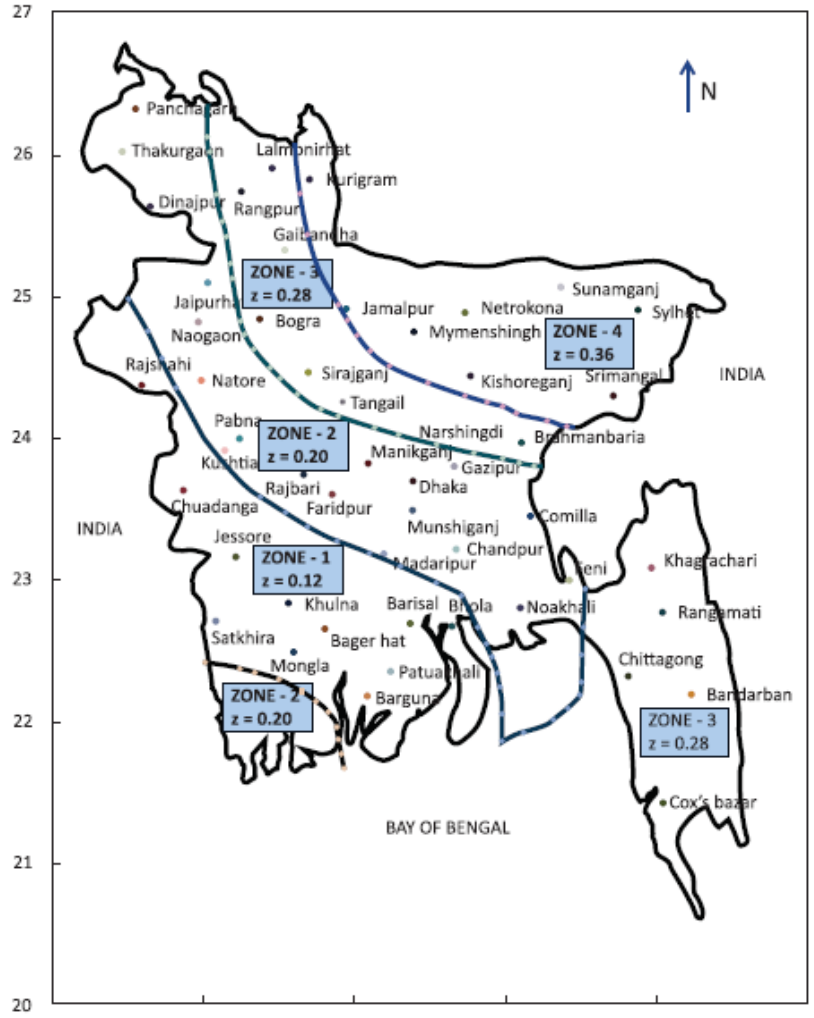
2. GUIDANCE

1) Hazards

1.1) Natural Hazards

1.1.1) Earthquakes: Upazila (NAME) / District (NAME) is located in the Very High Intensity Area / High Intensity Areas / Moderate Intensity Area / Low Intensity Areas[3] (See the Earthquake Zone Map below). In the case of moderate to severe earthquake heavy damage in the district of **(NAME)** and around is highly likely.

Earthquake Zone Map, Bangladesh



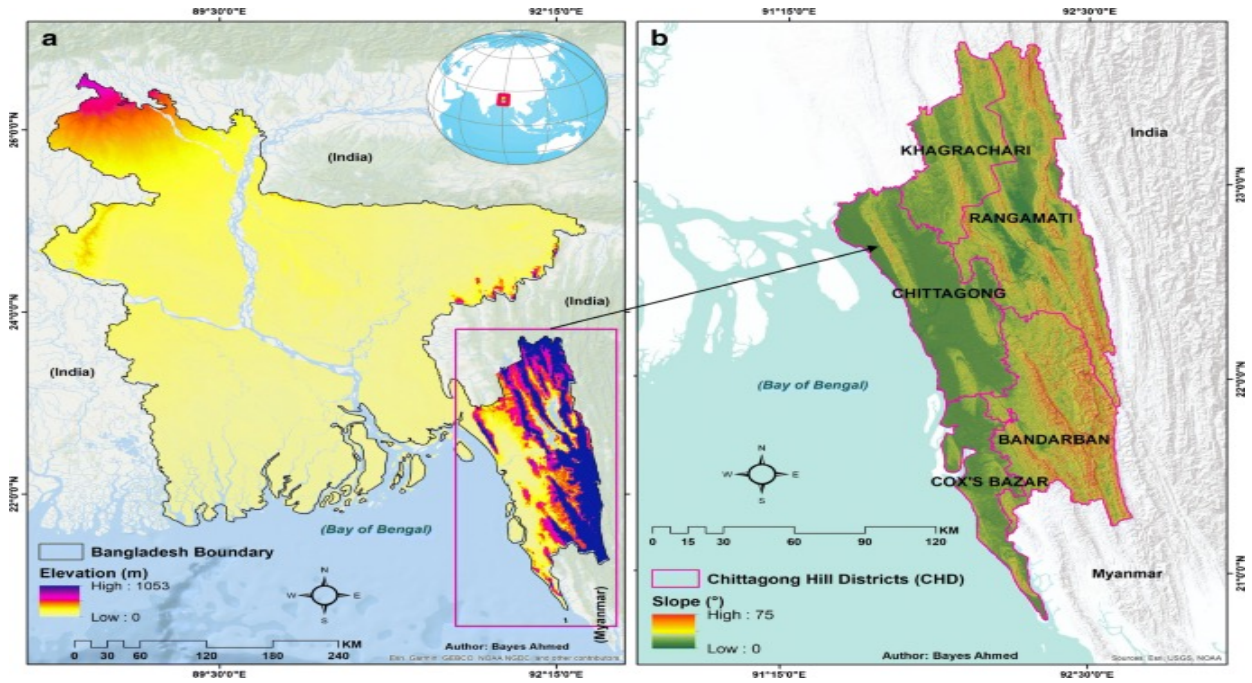
[3] *Bangladesh is divided into four seismic zones in terms of intensity of earthquakes: Zone 4 – Very High Intensity Area; Zone 3 – High Intensity Areas; Zone 2 – Moderate Intensity Area and Zone 1 – Low Intensity Areas*

Instructions:

1. Review the hazard maps or other hazard information, and rate the level of earthquake hazard (see Table 3) for the hospital location (including catchment area) in terms of geotechnical soil analyses.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to the earthquake (based on exposure of the catchment population or the specialized role of the hospital for the treatment of injured patients).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template below).

Hazards	Hazard Level				Should the hospital be prepared to respond to this hazard? If yes, mark the box.	Observations (Evaluator's Comments)
	No Hazard	Low	Average	High		
Element	☐	☐	☐	☐		

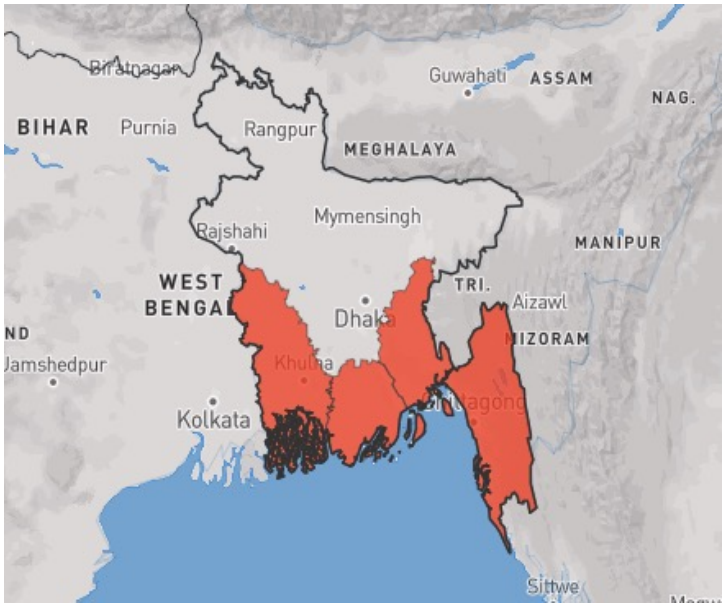
1.1.2) Landslides: In recent years, landslide disasters have caused considerable loss to human lives and damage to critical infrastructure, ecosystems, livelihoods, and the local economy in the three Chittagong Hill Districts (CHD), Chattogram, and Cox's Bazar, as shown in the map below. Communities living in these regions recurrently observe landslide disasters during the monsoon season (June–September). Note that unstable soils may cause landslides.



Instructions:

1. Review the hazard maps or other hazard information, and rate the level of landslide hazard (see Table 3) for the hospital location (including catchment area) in terms of geotechnical soil analyses. Note that landslides may be caused by unstable soils.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to landslides (based on exposure of the catchment population).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

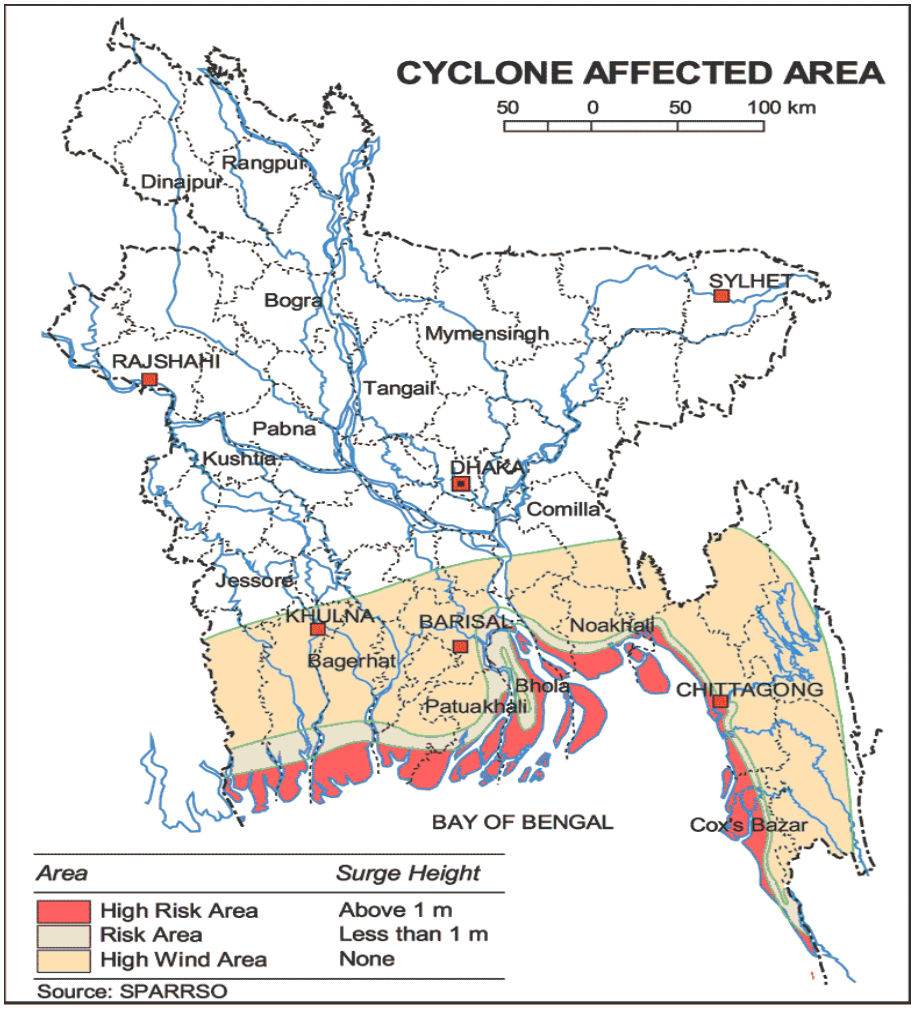
1.1.3) Tsunamis: The coastal region in Bangladesh is vulnerable to tsunami hazard is classified as a medium according to the currently available information. This means more than a 10% chance of a potentially damaging tsunami occurring in the next 50 years and is likely to impact the locations near the coast, as shown in the map below. The areas at risk of the tsunami will increase as the global mean sea level rises. According to the IPCC (2013), global mean sea level rise depends on various factors and estimates for 2100 range from 20 centimeters to nearly 1 meter.



Instructions:

1. Refer to the map above showing the areas vulnerable to tsunamis and their relevant information, and rate the level of tsunami hazard (see Table 3) caused by submarine seismic or volcanic activity for the hospital location.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to tsunamis (based on exposure of the catchment population).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

1.1.4) Tropical Cyclones and Storm Surges: As shown in the cyclone-affected area in Bangladesh, the country's coastal regions are hit by cyclones almost every year, with the highest wind speed reaching up to 220 km/hr and a tidal range of 3m high that may increase up to 7m. Cyclone season in the Bay of Bengal mainly occurs pre and post-monsoon season, between April-May and October-November. Annually, between five and six kilometers of the coastlines of Sandwip and Kutubdia islands and between two to three kilometers of Chokoria coastal area become inundated by the high tide or storm surges associated with the cyclone.



Instructions:

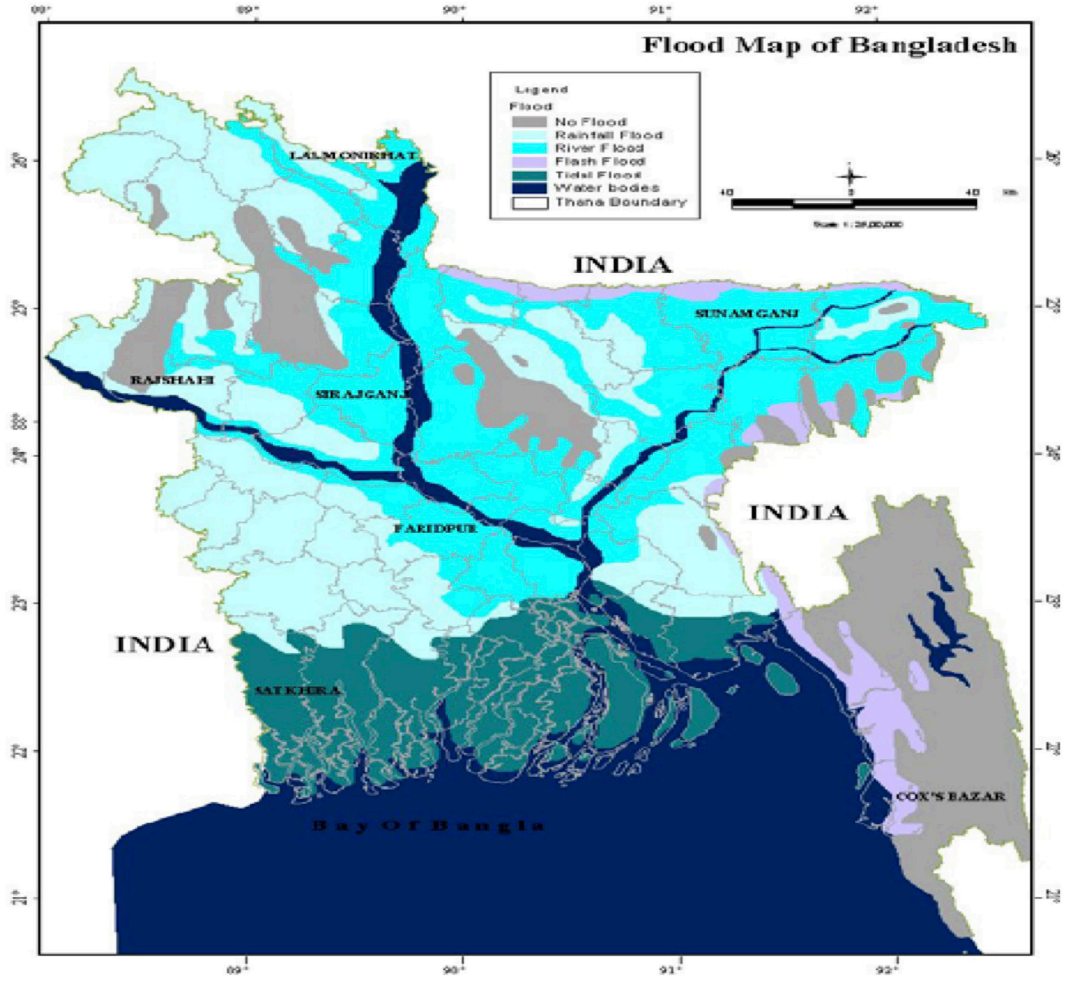
1. Refer to cyclone hazard map (presented above) or other hazard information, and rate the hazard level for the hospital location in terms of cyclones, and storm surges.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to cyclones, hurricanes or typhoons (based on exposure of the catchment population).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

1.1.5) Tornadoes: A tornado is a violently rotating column of air extending from a thunderstorm to the ground – it is often formed when warm and cold air masses clash. Tornados are unpredictable and can cause rapid destruction of homes and property and injury and death to humans and animals. Bangladesh experienced the deadliest tornado in recorded history on 26 April 1989, which killed some 1,300 people, injured 12,000, and 80,000 left homeless when a twister ripped through the Daulatpur-Saturia region of the Manikganj District (See the photo below). The most violent tornadoes are capable of tremendous destruction, with wind speeds of some 400km per hour (kph) or more.

Instructions:

1. Refer to the tornado hazard information and rate the tornado hazard level for the hospital location.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to tornadoes (based on exposure of the catchment population).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

1.1.6) River Floods and Erosion: Bangladesh is a land of many rivers and is very prone to flooding. The country also experiences the cumulative effects of floods due to water flashing from nearby hills, the accumulation of water inflow from upstream catchments, and locally heavy rainfall enhanced by drainage congestion. Flooding typically occurs during the monsoon season from June to September.



Instructions:

1. Refer to the Flood Hazard Map and other hazard information and rate the river flood hazard level of the hospital location (including the catchment area) in terms of river floods.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to river floods (based on exposure of the catchment population).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

1.1.7) Flash Floods: Flash flood is one of the five main types of natural floods occurring in Bangladesh[4]. Frequent and severe flash floods inundate significant areas of the country. Triggered by heavy rains, flash floods hit the country in an unusual intensity and frequency sweep through rural and urban areas.

Instructions:

1. Refer to regional and local hazard information and past incidents, and rate the flash flood hazard level for the hospital location.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to flash floods (based on exposure of the catchment population).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

1.1.8) High Tides, Coastal Floods: Flooding now occurs with high tides in many locations due to climate-related sea-level rise, land subsidence, and the loss of natural barriers. High tide flooding causes such public inconveniences as frequent road closures, overwhelmed storm drains, and compromised infrastructure. With 50% of the land at less than 8 meters above sea level, and a coastline of some 600 km, coastal flooding is a common problem, as witnessed in 2017. Cyclone Sidr hit the country in 2007 with heavy rains, strong winds, and storm surge. Around 3,000 people lost their lives, and damages cost amounting to $450 million. In 1970 and 1991, cyclones caused high waves leading to flooding of coastal regions in Bangladesh and causing the death of over 500,000 and 138,000 people, respectively.

Instructions:

1. Refer to regional and local hazard maps or other hazard information to identify other hydro-meteorological hazards and rate the corresponding hazard level for the hospital location.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to high tides, and coastal floods (based on exposure of the catchment population).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

[4] *(1) Riverine flood, (2) Rainfall flood, (3) Flash flood, (4) Tidal flood, and (5) Storm surge flood.*

1.1.9) Extreme Temperature (Heat Wave, Cold Wave): Extreme climatic events are increasing because of climate change impacts globally. Bangladesh is experiencing increased warm spell duration and temperature in the summer and decreased temperatures in the winter season. Both extreme heat and cold affect agriculture production. The lowest recorded temperature in 50 years was 2.6°C in Tetulia Upazila in Panchagarh in 2018. The children and older people suffer badly during the inclement weather, crowding hospitals and clinics, while the economically poor day laborers and rickshaw-pullers shiver in the extreme cold.

Instructions:

1. Refer to regional and local hazard maps or other hazard information, and rate the level of hazard due to extreme temperature or weather condition. Specify the hazard and rate the corresponding hazard level for the hospital location.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to extreme temperatures (based on exposure of the catchment population).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

1.2) Biological Hazards

1.2.1) Epidemics, Pandemics and Emerging Infectious Diseases: Bangladesh is one of the most vulnerable countries to climate change impacts also struck by the COVID-19 pandemic. The examples of endemic diseases that has a potential for a disease outbreak such as **dengue, cholera, and malaria.**

Malaria is an endemic illness. Bangladesh observed a decrease in malaria cases by 93% – from 84,690 cases in 2008 to 6,130 in 2020. In 2008, the number of severe malaria cases was 3,042, which fell to 92 in 2020, showing a decrease of 97%. There has been a 94% reduction in the total malaria deaths – from 154 in 2008 to 9 in 2020. However, 19 million people in 13 malaria-endemic districts share boundaries with the eastern states of India and Myanmar and endure the brunt of the disease. Contributing to about 93% of malaria cases in the country, the CHD (Chittagong Hill Districts) stand as the highest risk zone in the country.

Instructions:

1. With reference to any risk assessments, past incidents at the hospital and specific pathogens, rate the hazard level of the hospital related to epidemics, pandemics and emerging diseases.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to epidemics, pandemics, and emerging diseases (based on exposure of the catchment population or the specialized role of the hospital in the treatment of patients with infectious diseases).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

1.2.2) Food-borne Disease: Microbiological agents, especially bacteria, are probably the most common cause of food borne diseases. Other agents of food borne diseases include parasitic worms (helminths), toxins in animals, chemical residues, environmental pollutants, cleaning agents, disinfectants, etc. Incidence of food-borne diseases may be grouped under three categories: parasitic infection, chemical contamination, and natural food poison. Food borne diseases severely affect infants, young children, elderly people which ultimately creates a vicious cycle of diarrhea and malnutrition.

Instructions:

1. With reference to any risk assessments and past incidents at the hospital location (including catchment area), rate the hazard level of the hospital related to foodborne outbreaks.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to foodborne outbreaks (based on exposure of the catchment population).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

1.3) Human-Induced Hazards (Technological and Societal)

1.3.1) Technological Hazards

1.3.1.1) Fires (e.g. Building): Fears of building fires are rising across major cities in Bangladesh. According to records, nearly 19,000 fire incidents occurred in 2020, killing more than 200 people and incurring around BDT1.6 billion ($19M) in damages. The year before, the hazard killed a total of 184 people in more than 24,000 fires that cost an excess of BDT3.3 billion ($40M) in property damage.

Instructions:

1. Refer to hazard information on building fires inside and outside the hospital and any past incidents involving building fires and rate the fire hazard level for the hospital.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to building fires (based on exposure of the catchment population or the specialized role of the hospital for the treatment of burns patients).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

1.3.1.2) Power Outages: Power outage is one of the technological hazards that make Bangladesh's households, industries, healthcare facilities, and offices suffer. In some places, power outages are not frequent but regular, occurring every other day. In rural areas, people have long accepted repeated power outages.

Instructions:

1. Refer to any past incidents involving power outages for the hospital location, and rate the power outage hazard for the hospital.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to power outages.
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

1.3.1.3) Water Supply Disruption: Urban population and installation depend on water supply. The sudden water crisis affects people who do not get enough to drink, wash, feed crops, and causes economic decline. When water is scarce, sewage systems are highly to fail. The shortage of water impacts students in schools, patients, and personnel in healthcare facilities. Power cuts and load shedding affect the water supply.

Instructions:

1. Refer to any past incidents involving the disruption of the water supply for the hospital location and rate the hazard for the hospital.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to disruption of the water supply.
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

1.3.1.4) Transportation Incidents (e.g. air, road, rail, water transport):
There has been an alarming rise in road traffic accidents in Bangladesh over the past few years and has become a national problem. The country has a high road accident casualty rate, with official figures indicating more than 60 deaths per 10,000 motor vehicles. In 2020, eighteen people lost their lives every day on average in road accidents. As many as 6,686 people lost their lives, and 8,600 received injuries in a total of 4,891 road accidents in 2020 in Bangladesh. The river transport accidents are also alarming rising.

Instructions:

1. Refer to records of past major transport incidents in the catchment of the hospital.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to transport incidents (based on exposure of the catchment population).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

1.3.2) Societal Hazards

Bangladesh is currently suffering from various societal hazards. The HDSA will consider those societal hazards related to the risks of health consequences. The most common and frequent of them include civil unrest, mass gathering events, and refugee issues.

1.3.2.1) Civil Unrest (including demonstrations):

1. Refer to risk assessments and past incidents of civil unrest that have affected the hospital and rate the hospital's hazard level in relation to demonstrations and civil unrest.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to demonstrations and civil unrest (based on exposure of the catchment population).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

1.3.2.2) Mass Gathering Events:

1. Refer to risk assessments and past incidents of mass gathering events (meetings, exhibitions, rallies) that have affected the hospital, and rate the hospital's hazard level in relation to the mass gathering events.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to mass gatherings (based on exposure of the catchment population).
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

1.3.2.3) Displaced Populations (Refugees):

1. Refer to risk assessments and rate the hospital's hazard level in terms of people who have been displaced (Myanmar Refugees) because of conflict.
2. Determine whether the hospital should be prepared to respond to an emergency or disaster due to displaced populations.
3. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

2) Geotechnical Properties of Soils

Under this point, the aim is to have a general idea of the soil mechanics, the geotechnical parameters of the hospital location, and the level of stability (i.e., the thickness of the stratum) of the soil type. Collect soil or geotechnical reports from the concerned government departments at the Upazila (PWD and Municipality Office) or the region's Hospital Engineering Department (HED).

2.1) Liquefaction:

1. With reference to the geotechnical soil analysis at the hospital site, rate the level of the hospital's exposure to hazards from saturated and loose subsoil.
2. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

2.2) Clay Soils:

1. With reference to soil maps or other hazard information, rate the hospital's exposure to hazards from clay soil.
2. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

2.3) Unstable Slopes:

1. Refer to geological maps or other hazard information and specify the hospital's exposure to hazards from the presence of slopes.
2. Check the relevant box in the Checklist of Elements of Module 1 (See the template provided under Item # 1.1.1).

Module 1:

Hazards Affecting the Safety of the Hospital

3. CHECKLIST

Module 1: Hazards affecting the safety of the hospital and the role of the hospital in emergency and disaster management

This module is a rapid description of external and internal hazards or dangers and geotechnical properties of soils at the site of the hospital that may affect the safety or functioning of the hospital.

The module also identifies those hazards which could lead to emergencies and disasters for which the hospital would be expected to provide health services in emergency response. These events may not directly affect the safety of the hospital; however, the hospital should be prepared for such events. **This module is divided into two parts:**

1.1 Hazards

(comprising natural hazards, including geological, hydro-meteorological, and biological, and human-made hazards, including technological and societal hazards)

1.2 Geotechnical Properties of Soils

[No= No Hazard, L=Low, A= Average, H= High]

Hazards	Hazard Level				Should the hospital be prepared to respond to this hazard? If yes, mark the box.	Observations (Evaluator's Comments)
	No	L	A	H		
1.1) Natural Hazards (Earthquake, Landslides, etc.)						
1.1.1) Earthquakes Refer to national hazard maps or other hazard information and rate the level of earthquake hazard for the hospital's location (including catchment area) in terms of geotechnical soil analyses. Determine whether the hospital should be prepared to respond to an emergency or disaster due to earthquakes (based on exposure of the catchment population or the specialized role of the hospital for the treatment of injured patients).	☐	☐	☐	☐	☐	
1.1.2) Landslides Refer to district and local hazard maps or other hazard information for the region and rate the level of landslide hazard for the hospital's location. Note that landslides may be caused by unstable soils. Determine whether the hospital should be prepared to respond to an emergency or disaster due to landslides (based on exposure of the catchment population).	☐	☐	☐	☐	☐	
1.1.3) Tsunamis Refer to the map showing the areas vulnerable to tsunamis and their relevant information, and rate the level of tsunami hazard caused by submarine seismic or volcanic activity for the hospital location. Determine whether the hospital should be prepared to respond to an emergency or disaster due to Tsunamis (based on exposure of the catchment population).	☐	☐	☐	☐	☐	

Hazards	Hazard Level				Should the hospital be prepared to respond to this hazard? If yes, mark the box.	Observations (Evaluator's Comments)
	No	L	A	H		
1.1) Natural Hazards (Earthquake, Landslides, etc.)						
1.1.4) Tropical Cyclones Refer to regional and local maps of tropical cyclones. Specify the hazard and rate the corresponding hazard level for the hospital. Determine whether the hospital should be prepared to respond to an emergency or disaster due to the tropical cyclones (based on exposure of the catchment population).	☐	☐	☐	☐	☐	
1.1.5) Tornadoes (Local Storm) Refer to regional hazard maps or other hazard information and rate the hazard level for the hospital location in terms of tornadoes. Determine whether the hospital should be prepared to respond to an emergency or disaster due to tornadoes (based on exposure of the catchment population).	☐	☐	☐	☐	☐	
1.1.6) River Floods and Erosion Refer to regional and local hazard maps or other hazard information and rate the river floods or erosion hazard level of the hospital's location (including catchment area) in terms of river floods (and other watercourses, such as creeks). Determine whether the hospital should be prepared to respond to an emergency or disaster due to river floods or erosion (based on exposure of the catchment population).	☐	☐	☐	☐	☐	
1.1.7) Flash Floods Refer to regional and local hazard map, other hazard information and past incidents, and rate the flash flood hazard level for the hospital's location. Determine whether the hospital should be prepared to respond to an emergency or disaster based on flash floods (due to exposure of the catchment population).	☐	☐	☐	☐	☐	

Hazards	Hazard Level				Should the hospital be prepared to respond to this hazard? If yes, mark the box.	Observations (Evaluator's Comments)
	No	L	A	H		
1.1) Natural Hazards (Earthquake, Landslides, etc.)						
1.1.8) High Tides / Coastal Floods Refer to coastal hazard map, other hazard information and past incidents, and rate the high tides / coastal floods hazard level for the hospital's location. Determine whether the hospital should be prepared to respond to an emergency or disaster based on high tide or coastal floods (due to exposure of the catchment population).	☐	☐	☐	☐	☐	
1.1.9) Extreme Temperature (e.g. Heat Wave, Cold Wave, Extreme Winter Conditions) Refer to regional and local hazard maps or other hazard information and rate the level of hazard due to extreme temperature or weather condition. Specify the hazard and rate the corresponding hazard level for the hospital's location. Determine whether the hospital should be prepared to respond to an emergency or disaster due to extreme temperatures (based on exposure of the catchment population).	☐	☐	☐	☐	☐	
1.2) Biological Hazards						
1.2.1) Epidemics, Pandemics and Emerging Diseases With reference to any risk assessments, past incidents at the hospital and specific pathogens, rate the hazard level of the hospital related to epidemics, pandemics and emerging diseases. Determine whether the hospital should be prepared to respond to an emergency or disaster due to epidemics, pandemics and emerging diseases (based on exposure of the catchment population or the specialized role of the hospital for the treatment of patients with infectious diseases).	☐	☐	☐	☐	☐	

Hazards	Hazard Level				Should the hospital be prepared to respond to this hazard? If yes, mark the box.	Observations (Evaluator's Comments)
	No	L	A	H		
1.2) Biological Hazards						
1.2.2) Foodborne Diseases With reference to any risk assessments and past incidents at the hospital location (including catchment area), rate the hazard level of the hospital related to foodborne outbreaks. Determine whether the hospital should be prepared to respond to an emergency or disaster due to food-borne outbreaks (based on exposure of the catchment population).	☐	☐	☐	☐	☐	
1.3) Technological Hazards						
1.3.1) Structural Fires (e.g. building) Refer to local hazard maps or other hazard information on building fires inside and outside the hospital and any past incidents involving building fires and rate the fire hazard level for the hospital. Determine whether the hospital should be prepared to respond to an emergency or disaster due to building fires (based on exposure of the catchment population or the specialized role of the hospital for the treatment of burns patients).	☐	☐	☐	☐	☐	
1.3.2) Power Outages Refer to any past incidents involving power outages for the hospital location and rate the power outage hazard for the hospital. Determine whether the hospital should be prepared to respond to an emergency or disaster due to power outages.	☐	☐	☐	☐	☐	

Hazards	Hazard Level				Should the hospital be prepared to respond to this hazard? If yes, mark the box.	Observations (Evaluator's Comments)
	No	L	A	H		
1.3) Technological Hazards						
1.3.3) Water Supply Disruption Refer to any past incidents involving the disruption of the water supply for the hospital location and rate the hazard for the hospital. Determine whether the hospital should be prepared to respond to an emergency or disaster due to disruption of the water supply.	☐	☐	☐	☐	☐	
1.3.4) Transportation Accidents (e.g. air, rail, road, water transport) Refer to records of past major transport incidents and determine whether the hospital should be prepared to respond to an emergency or disaster due to transport incidents (based on exposure of the catchment population).	☐	☐	☐	☐	☐	
1.4) Societal Hazards						
1.4.1) Civil Unrest (including demonstrations, security threats, etc.) Refer to risk assessments and past incidents of civil unrest that have affected the hospital, and rate the hospital's hazard level in relation to demonstrations and civil unrest. Determine whether the hospital should be prepared to respond to an emergency or disaster due to demonstrations and civil unrest (based on exposure of the catchment population).	☐	☐	☐	☐	☐	
1.4.2) Mass Gathering Events (sporting events, festival and religious events, etc.) Determine whether the hospital should be prepared to respond to an emergency or disaster due to mass gatherings (based on exposure of the catchment population).						

Hazards	Hazard Level				Should the hospital be prepared to respond to this hazard? If yes, mark the box.	Observations (Evaluator's Comments)
	No	L	A	H		
1.4) Societal Hazards						
1.4.3) Displaced Populations Refer to risk assessments and rate the hospital's hazard level in terms of people who have been displaced because of conflict, community unrest and other sociopolitical circumstances, or due to high levels of immigration. Determine whether the hospital should be prepared to respond to an emergency or disaster due to displaced populations.	☐	☐	☐	☐	☐	

Geotechnical properties of soils:

Under this point, the aim is to have a general idea of the soil mechanics and the geotechnical parameters of the hospital location, as well as the level of stability (i.e. thickness of the stratum) of the soil type.

• Liquefaction • Clay soils • Unstable slopes

Evaluators may also obtain access to soil or geotechnical reports which can inform their analysis. Should there be no soil or hazard maps or geotechnical reports, evaluators should not stop the process; instead, they should rely on the best available information on liquefaction potential, soils and slopes from informed sources and use this information to estimate the level of the hazard. (Mention the source of information)

2.1) Liquefaction With reference to the geotechnical soil analysis at the hospital site, rate the level of the facility's exposure to hazards from saturated and loose subsoil.						
2.2) Clay Soils With reference to soil maps or other hazard information, rate the hospital's exposure to hazards from clay soil.						
2.3) Unstable Slopes Refer to geological maps or other hazard information and specify the hospital's exposure to hazards from the presence of slopes.						

Comments on the results of Module 1

Module 2:
Structural Safety

1. INTRODUCTION

A high level of safety of hospital buildings makes them resilient to earthquake, strong winds, floods, landslides, and erosion which are among those hazards likely to affect the hospital.

Module 2 – Structural Safety addresses the structural elements that are taken into account to calculate the hospital disaster safety rating. Columns, beams, walls, floor slabs, foundations, etc. are structural elements that form part of the load-bearing system of the building.

This module comprises 18 elements which are divided into two parts (Sub-Modules). Table 1 presents the distribution of elements by sub-modules.

Table 1: Distribution of Indicators/Elements by Sub-Modules

Sub-Modules	Indicators/Elements
Sub-Module 2.1: Prior events affecting building safety	3
Sub-Module 2.2: Building Integrity	15
Total	**18**

Limitations to Conducting Assessments

Structural safety assessment requires a group of engineers (civil, electrical, etc.) from the Health Engineering Department (HED) of DGHS to fully participate in the assessment. Not a technical engineering assessment.

A snap shot assessment of the vulnerability of the hospital and designed to provide a preliminary information on the safety level of the hospital.

The score does not intend as a label to a specific hospital but rather have a numerical value based from the quantitative description of the indicators for policy and decision makers for planning purposes.

So, the assessment of the structural component of the hospital is limited and observations were based on the understanding of the assessment team.

Structural Safety Classification: The level of safety of structural elements is classified as **High, Medium, and Low** based on their functioning during emergencies and disasters. Table 2 presents the rationale of these classification.

Table 2: Hazard Classification

Classification	Rationale
High	Highly likely that the hospital structure is able function during emergencies and disasters and withstand the impact of the hazard
Average	Likely that the hospital structure to function during emergencies and disasters with some minor damage.
Low	Unlikely that the hospital structure will function during emergencies and disasters. Structure will sustain major damage.

HDSA Information Collection Steps

In general, the HDSA involves six steps in information collection. Refer to the Overview section for detailed guidance on these steps.

Module 2:
Structural Safety

2. GUIDANCE

Parameters under the "Structural Safety" module are indicative of the safety of the structural elements of a facility's building (frameworks, pillars, load bearing walls, base, roofing, flooring, bars etc.); type and quality of construction materials made use of; tear and wear of the building and compliance with construction and refurbishment standards. **Guiding procedures to assess the indexes under this module include:**

- Consider all hospital buildings, including on-site staff residences, and combine the evaluations into a single rating against each item for the hospital.
- Combine the evaluations into a single rating against each item for the hospital.
- Record any key observations pertaining to the structural safety of specific buildings.
- Focus on occupied buildings and those which contribute most to acute care services in an emergency or disaster.
- Conduct assessment by structural engineers. In the absence of structural engineers, the assessment of the structural component will be a snapshot assessment of the vulnerability of the hospital to provide preliminary information on the safety level of the hospital.
- Refer to applicable national and local standards and building codes related to structural safety.
- Refer to Module 1 (Hazards Affecting Hospital Safety) for an assessment of hazards which may affect the hospital. There are hospitals located in hazard-prone areas (e.g. floodplain areas, coastal areas subject to storm surge and tsunami, or near seismic faults or hazardous facilities).
- Follow recommended evaluation methods, where applicable, such as interviews, observation, review of documentation, and inspection.

Sub-Module 2.1 Prior Events Affecting Building Safety

2.1.1. Prior Major Structural Damage or Failure of the Hospital Building(s):

The evaluation shall consider the events (earthquake/strong wind/landslide) equivalent in severity to those that current structural safety standards according to the Bangladesh National Building Code (BNBC) 2021 are intended to protect against earthquake/strong wind/landslide.

Recommended evaluation methods:

 Interview  Documentation Review  Inspection

1) Collect the information on the numbers, types, construction years, and usages of hospital buildings.

2) Determine whether the structural reports indicate that the level of safety has been compromised in the past by natural, technical, or societal hazards or by other factors. Note that, where safety is concerned, the cost of that compromise is too high. In the case of safety, compromise may cost lives, destroy productivity, ruin businesses.

3) Obtain accounts of historical damage to a facility from the personnel who have worked in the hospital for the longest time, irrespective of their position within the organization (i.e. include cleaning personnel, kitchen staff, and administration and support staff), as these can relate their experience of incidents or disasters in the past.

4) Ask specifically about structural damage that personnel may have observed. Request to see relevant publication/accounts (e.g. formal/ press/Internet reports or photographs) available with the hospital. Certain reports might be accessible on the Internet or through public records (e.g. library).

5) Determine whether the structural safety has been compromised using the evidence collected from staff, reports, photographs or visual inspection.

6) If such an event has not occurred in the vicinity of the hospital, leave boxes blank and provide comment in the checklist.

2.1.2. Hospital Built and/or Repaired Using the Current Safety Standards:

The first BNBC was developed in 1993 and was enacted in 2006 followed by amendment of the Building Construction Act-1952. As a living document, the national building code is updated periodically, generally within an interval of 4-5 years. The current BNBC 2021, gazette in February 2021, for building design and construction.

Recommended evaluation methods:

 Interview  Observation  Inspection

1) Review the prior construction work in the facility and the standards that were applied.

2) Use of current BNBC safety standard (which may differ from the old standard).

3) Gather evidence from contracts, or information gathered from interviewing, among others, procurement and maintenance staff and, if possible, construction personnel (e.g. design engineer, architect and/or contractor).

4) Verify whether the building has been repaired, the date of repairs, and whether repairs were carried out using the appropriate standards for safe buildings at the time of the repairs.

5) Check whether the standard used for the repairs differs from the current safety standard which is the reference for assessing this item.

2.2.3. Effect of Remodeling or Modification on the Structural Behavior of the Hospital:

Frequently, hospitals undergo modifications needed by different departments and services but without overall consideration of their effects on the structure's resistance to hazards or future events, thus increasing the vulnerability of the facility and its occupants. For instance, filling in an open space between two columns with a masonry wall redistributes loads in a building, and a modification such as this could cause columns to fail. Remodeling and modifications can be made using structural control – i.e. structural evaluation and proper rehabilitation or modification design that ensure good performance of the structure.

Recommended evaluation methods:

 Interview  Observation  Inspection

1) Verify the hospital records (usually available with the PWD or HED) whether the hospital modified the structural elements using current standards for safe buildings.
2) Overserve and inspect the condition and quality of the remodeling or medication works.
3) Take photographs if necessary.

Sub-Module 2.2 Building Integrity

2.2.1. Structural System Design:

The poor structural design indicates that damage from hazards to the structure of the hospital may cause building failure and collapse. For instance, if no evidence of reinforcement is found for concrete or masonry systems, the structural system design should be rated as "low." Moderate structural design provides partial protection and would cover situations where hazards may cause damage, but this damage is not likely to cause building collapse. A good rating would indicate that the building should not collapse when affected by hazards. Note that the term "design" also implies applying the design in the construction of buildings.

Recommended evaluation methods:

 Observation  Inspection

1) Inspect visually, and/or through engineering drawings, the structural system design of the buildings for all types of hazards.
2) Assess the overall quality of the structural system design of the hospital buildings, as there is a wide variance in the performance of buildings due to the designs and standards to which they have been built.
3) Pay attention to buildings in earthquake-prone zones and areas of high wind.

2.2.2. Condition of Buildings:

The condition of the building is closely related to the type of construction materials used for structural elements. The damaged structural elements may not function in maintaining overall structural stability and strength. For example, the risk posed by a damaged column on the ground floor is not the same as the risk posed by a similarly damaged column on the top floor. A crack may occur for various reasons; some indicate a severe problem (design, overload), and others do not (change in volume).

Recommended evaluation methods:  Observation  Inspection

It is important to talk to the hospital's maintenance staff when conducting the investigations.

1) Inspect the building, both internally and externally, for signs of deterioration such as broken plaster, cracks or sinking structural elements.
2) Identify the causes of deterioration.
3) Assess the location of the damages (such as cracks) and their angle to determine the condition of the building.
4) In assessing any damaged structural elements, determine their function in maintaining overall structural stability and strength.
5) If the building has been painted recently, check that cracks are not hidden.

2.2.3. Condition of Construction Materials:

This item is closely related to item 2.2.2 - Condition of the Buildings. If a structure is built primarily with reinforced concrete, the presence of cracks and rust can indicate that the construction used incorrect amounts of concrete components (cement, rock, sand, and water). This could also be evidence of water seepage into the concrete slab. As a result, permeability [5] may be high, and the resistance of materials low, which increases the vulnerability of these elements and puts the structure at risk. Concerning rusting iron and cracks in concrete, one or both of these conditions may be present. For example, concrete forms may show signs of rust, but cracks may or may not have evidence of oxidation.

Recommended evaluation methods:  Observation  Inspection

1) Observe whether the elements in poor condition are of structural value to the hospital building.
2) Use a ruler to measure the size of any cracks.

[5] *Permeability is a measure of the ease of passage of liquids or gases or specific chemicals through the material. Permeability is determined by applying a head and determining the depth of penetration or the amount of liquid or gas passing through the sample.*

2.2.4. Interaction of Non-Structural Elements with the Structure:

In extreme conditions, non-structural elements – because of their weight and rigidity – can affect the behavior of structural elements, putting the stability of a structure at risk. An example of non-structural/structural interaction would be, for instance, if a non-structural dividing wall falls during an earthquake because of a lousy anchor and the wall falls onto a staircase beam, obstructing the staircase and, in the worst case, destroying it.

Recommended evaluation methods:  Observation

1) Determine whether non-structural elements are completely tied to the structure – i.e. if "short columns" are present, if joints are flexible and if expansion joints have been used.
2) Review records, plans and drawing to evaluate the interaction of non-structural elements (dividing walls) with the structural elements (staircase).

2.2.5. Proximity of Buildings (Earthquake-induced Pounding):

In the case of an earthquake, buildings that are too closely spaced, depending on their height and proximity, can pound against each other until damage is sustained. Most earthquake building codes consider a minimum separation of 10 cm when the shorter of two adjacent buildings is 10m high, which is 1.0% of the height of the building.

Recommended evaluation methods:  Observation  Inspection

1) Inspect the exterior of the hospital to determine whether any pounding (repeated and heavy striking of buildings closely spaced; for example, in case of an earthquake, buildings that are too closely spaced, depending on their heights, can pound against each other until one or both collapse) problems might arise.
2) Check whether the floor plates are aligned. In buildings where floors are not aligned, pounding of floor slabs against adjacent columns or structural walls can cause serious damage that in severe cases can lead to collapse.
3) Identify the separation joints in buildings with multiple wings or distinct sections that are intended to perform as separate structures.
4) If the hospital is not in a high/moderate seismic zone, leave boxes blank and provide comments in the checklist.

2.2.6. Proximity of Buildings (Wind Tunnel Effect and Fire):

In the case of high wind events and fires, there can be wind tunnel effects between closely spaced buildings. Pressure from the wind can build around certain sections of a structure, placing much greater force than the load for which a multistorey building was designed. The separation of buildings can also reduce the spread of fires from one building to another.

Recommended evaluation methods:  Observation  Inspection

1) Inspect the exterior of the hospital to determine whether such problems might arise.

2) It is important to talk to hospital staff as there may be a noticeable impact when high winds occur periodically.

2.2.7. Structural Redundancy:

Redundancy is a normal part of structural systems and is essential for the safety of buildings, especially in high winds and earthquakes. The evaluation aims to ensure that the hospital building can resist the lateral forces caused by earthquakes, and high winds (major cyclones/hurricanes) in the two main orthogonal directions of the building. A building with fewer than three lines or axes of resistance in any major direction is vulnerable to significant resistance demands and rigidity. The axis is a central line that initially helps to organise a design. Often the axis is at the centre of a building or over an entrance doorway. In earthquake-prone areas, flat slab structural systems should not be permitted. Consequently such systems should attract a "low" rating in these circumstances.

Recommended evaluation methods:  Observation  Inspection

1) Review the structural plans (i.e., engineering drawings) of the hospital building.

2) Verify at the site whether the structure meets the design criteria in the two principal orthogonal directions.

2.2.8. Structural Detailing and Connections:

Joints for structural components are among the most critical design elements for lateral loads. These joints are used in the structure of all buildings and are especially important for hospitals in earthquake-prone areas.

Recommended evaluation methods:  Observation  Inspection

1) Notwithstanding the construction year of the building, determine the characteristics of joints both through on-site observation and by reviewing structural plans (i.e. engineering drawings), and apply clear-cut criteria to them; if the building is located in a moderate or high seismic zone, give more emphasis to detailing evaluation work.

2) When dealing with prefabricated construction, conduct a detailed examination of the joints; they will be numerous, not monolithic, and in most cases will be welded or wet joints.

3) Conduct visual assessments and check drawings.

4) Assess the joints for cracks or fractures, which would put the joints, and ultimately the structure, at risk.

5) Rate "low" safety in the case prefabricated buildings that are prone to damage in earthquake shaking.

2.2.9. Ratio of Column Strength to Beam Strength:

Columns are among the critical elements for the stability of the structure. They receive the load distributed by the beam and pass it on to the foundation. Even if beams are severely damaged, columns must resist loads to prevent the total collapse of the building. Columns, therefore, should always be stronger than beams.

Recommended evaluation methods:  Observation  Inspection

1) Review the structural design of the building to assess load distribution by the beam and onto the foundation.
2) Collect information on whether the columns are stronger than beams.

2.2.10. Safety of Foundations:

Buildings are more vulnerable to seismic forces when they do not have braced beams connected to the foundation. Assessment of foundations is vital to ascertain the hospital's safety level but is most challenging to evaluate because they are neither accessible nor visible. To add to this difficulty, corresponding plans for foundations are often not available. The plans may not be archived in the administration, maintenance department, or public record if the facility is old. In earthquake-prone areas, liquefaction can occur if the building is on saturated, unconsolidated soils, as in the case of sand beds, saturated silt or uncompact fill. Liquefaction has caused severe damage to infrastructure.

Recommended evaluation methods:  Observation  Inspection

1) It is crucial to make every effort to access the plans to determine the type of foundations (e.g., shallow, deep, isolated, and, if a combination, whether they are united or remote).
2) Determine the soil–structure interactions, the level of groundwater, and the type of soil at the building site, which plays a critical role in determining the facility's vulnerability to floods and differential settlement of the foundations' associated effects on vertical structural elements.
3) Review carefully to substantiate the incidence of liquefaction when the building is on saturated, unconsolidated soils, as in the case of sand beds, saturated silt, or uncompact fill.

2.2.11. Irregularities in Building Structure Plan (Rigidity, Mass, Resistance):

Irregular structures can be expressed in terms of shape, configuration and torsional eccentricity (i.e. the distance between the centre of mass and the centre of rigidity). The presence of large openings in horizontal diaphragms due to interior patios or for access to stairs and elevators make the structure more vulnerable to lateral loads caused by earthquakes and intense hurricanes. During extreme phenomena such as earthquakes or high winds, poorly distributed mass can cause excessive loads in some areas of a structure, resulting in its collapse.

Recommended evaluation methods:  Observation  Inspection

1) While inspecting the exterior and interior of the hospital, look for inconsistencies in the hospital plan from the perspective of rigidity (shape and type of materials used for resistant vertical elements) and the distribution of mass (concentrated and distributed).
2) Identify at the site and using diagrams whether seismic joints divide the structure into regular parts or whether irregular configurations are present, such as L-shaped, T-shaped, U-shaped or cruciform plans, or more complicated configurations.
3) Check the relative position of the frames (framework of beams and columns) and the shear walls since this will determine the response of horizontal diaphragms (slabs) in terms of displacement and rotation.
4) Determine whether, during extreme phenomena such as earthquakes or high winds, the poorly distributed mass may cause excessive loads in some areas of a structure, resulting in its collapse. If these conditions exist and whether there are structural elements designed to mitigate them.

2.2.12. Irregularities in Elevation of Buildings:

The narrowness of the building (height-to-width ratio) in the principal orthogonal directions can give an idea of the building's ability to withstand vibrations generated by lateral loads caused by earthquake and wind forces. Besides irregularities in the elevation of buildings, variation of the type and mass and rigidity of materials can alter resistance to loads that affect the structure.

Recommended evaluation methods:  Observation  Inspection

Observation and Inspection of each building.

1) Take note of any abrupt changes in the elevation of each building. Refer to items 2.2.11. (Irregularities in Building Structure Plan - Rigidity, Mass, Resistance), and 2.2.13. (Irregularities in the height of storeys).
2) Determine whether elements (such as columns and walls) are symmetrically distributed in height to the edges, providing rotational rigidity.
3) Take note of high mass concentrations on the upper floors, owing to heavy items such as machinery, equipment, and water tanks on the upper floors. These can increase inertial forces and cause excessive displacement.

2.2.13. Irregularities in Height of Storeys:

Differences in height between the floors (often the case in the lobby and lower floors of hospitals) can cause concentrations of tension in changes of level. A so-called "soft floor," an undesirable feature in earthquake-prone zones, can be present due to significant rigidity changes due to variations in height. An in-fill wall can convert a column designed for support and its entire height into a "short" column. Short columns have caused the collapse of buildings that were supposedly resistant to seismic forces.

Recommended evaluation methods:  Observation  Inspection

1) Take note of any abrupt changes in the height of storeys. Refer to items 2.2.11. Irregularities in Building Structure Plan (Rigidity, Mass, Resistance): and 12.2.12. Irregularities in Elevation of Buildings.
2) Check the differences in height between the floors (often the case in the lobby and lower floors of hospitals), which can cause concentrations of tension in changes of level.
3) Inspect whether an in-fill wall has converted a column designed for support and its entire height into a "short" column.

2.2.14. Structural Integrity of Roofs:

The slope of the roof, roof overhangs, and roof deck connections resist uplift loads. The objective of this item is to ensure that the roof is entirely and securely fastened, welded, riveted, or cemented. Satisfactory connections include a high frequency of fasteners. There should be screw attachment rather than puddle welds or powder-driven pins; for precast concrete decks, there should be anchor plates and nuts; and for wood-sheathed roof decks, there should be screws and fixations in the corner regions of the roof.

Recommended evaluation methods:  Observation  Inspection

1) Assess whether the roof slope, roof overhangs, and roof deck connections resist uplift loads.
2) Look for large roof overhangs of more than 50 cm in high wind areas.
3) Check that the reinforced cast is in place to have exceptionally good wind performance in concrete roof decks.
4) Check that connections include a high frequency of fasteners – for steel roof decks, there should be screw attachment rather than puddle welds or powder-driven pins; for precast concrete decks, there should be anchor plates and nuts; and for wood-sheathed roof decks, there should be screws and fixations in the corner regions of the roof.

2.2.15. Structural Resilience to Hazards Other than Earthquakes and Strong Winds:

This element focuses on structural safety for multiple hazards other than earthquakes and strong winds. A hospital may have increased its safety concerning specific threats, but not to the full range of hazards that may affect the facility, thus leaving the hospital at high risk. About hazards present in the area where the hospital is located, structural expertise is needed to assess whether the building as a whole has the level of structural safety necessary to enable it to continue providing health services in emergencies and disasters. Refer to hazards that may affect the site of the hospital (see Module 1).

Recommended evaluation methods:  Inspection

1) Assess the building structure's global structural performance and resilience for single or multiple hazards other than high winds (sustained or periodic) and earthquakes (e.g., other meteorological hazards, flooding and other hydrological hazards, landslides, and other geological hazards).
2) Use your knowledge and expertise to assess the danger that these hazards could pose to the structural elements of the hospital.
3) Assess how hazards, and the hospital's proximity to these hazards, make the structural elements of the hospital less safe.
4) Verify whether the hospital is adequately designed − from the structural standpoint − to withstand other phenomena (e.g., landslides, floods, fires, and explosions) and whether the hospital has implemented preventive or corrective measures necessary to improve the level of safety.
5) Identify any measures the hospital has adopted to reduce structural safety risks (e.g., anti-flood gates).
6) Assess the possible behavior of the complete building in light of all the other hazards in the area. For example, a hospital may be located on an "unstable" incline and has a risk of sliding, or a resilience measure such as a containment wall may have been built to stabilize the slope and protect the building. Note that a building can be adequately designed to resist earthquakes and hurricanes but can still be vulnerable to floods or volcanic eruptions.

Module 2:
Structural Safety

3. CHECKLIST

Module 2 - Structural Safety of Hospital Building:

This module addresses the structural elements that are considered to calculate the hospital safety rating. Columns, beams, walls, floor slabs, foundations etc. are structural elements that form part of the load-bearing system of the building.

The module on structural safety is divided into two sub-modules, namely: i. Prior events affecting building safety; and ii. Building integrity.

Limitations while conducting risk assessments: Not a technical engineering assessment; A snapshot assessment of the vulnerability of the hospital and designed to provide a preliminary information on the safety level of the hospital. The score does not intend as a label to a specific hospital but rather will be a numerical value based on the quantitative description of the indicators for policy and decision makers for planning purposes.

Indicators of the Structural Safety are as below. (L=Low, A=Average, H=High)

Sub-Module 2.1 Prior Events Affecting Hospital Safety	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
2.1.1. Prior major structural damage or failure of the hospital building(s) *Safety ratings:* Low = Major damage and no repairs; Average = Moderate damage and building only partially repaired; High = Minor or no damage, or building fully repaired. *IF SUCH AN EVENT HAS NOT OCCURRED IN THE VICINITY OF THE HOSPITAL, LEAVE BOXES BLANK AND PROVIDE COMMENT.*	☐	☐	☐	
2.1.2. Hospital built and/or repaired using current safety standards *Safety ratings:* Low = Current safety standards not applied; Average = Current safety standards partially applied; High = Current safety standards fully applied.	☐	☐	☐	
2.1.3. Effect of remodeling or modification on the structural behavior of the hospital *Safety ratings:* Low = Major remodeling or modifications have been carried out with major compromising effect on the performance of the structure; Average = Moderate remodeling and/ or modifications with minor effect on the performance of the structure; High = Minor remodeling and/or modifications; no modifications were carried out; or major remodeling and/ or modification enhancing the structural behavior or having no negative. Please elaborate how this process will materialize. Like final document submitted that will be acknowledge/signed off by DGHS, CS and hospital director for implementation of the corrective action plan. Also need to include the suggested re assessment frequency to update progress as part of monitoring by DGHS/CS.	☐	☐	☐	

Sub-Module 2.2 Building Integrity	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
2.2.1. Structural system design *Safety ratings:* **Low** = Poor structural system design; **Average** = Moderate structural system design; **High** = Good structural system design.	☐	☐	☐	
2.2.2. Condition of the building *Safety ratings:* **Low** = Cracks on the ground and first floors; Major deterioration caused by weathering or normal ageing; **Average** = Some deterioration caused only by weathering or normal ageing; **High** = No deterioration or cracks observed.	☐	☐	☐	
2.2.3. Condition of the construction materials *Safety ratings:* **Low** = Rust with flaking; cracks larger than 3mm (concrete), excessive deformations (steel and wood); **Average** = Cracks between 1 and 3 mm present (concrete), moderate and visible deformations (steel and wood) or rust with no flaking; **High** = Cracks less than 1 mm (concrete), no visible deformations; no rust.	☐	☐	☐	
2.2.4. Interaction of Non-Structural elements with the structure *Safety ratings:* **Low** = Partition walls rigidly attached to the structure, suspended ceilings or facades interacting with the structures, damage would have significant effect on the structure; **Average** = Some of the preceding non-structural elements interacting with the structures, damage would not affect the structure; **High** = There are no non-structural elements affecting the structure.	☐	☐	☐	

Sub-Module 2.2 Building Integrity	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
2.2.5. Proximity of buildings (for earthquake-induced pounding) *Safety ratings:* Low = Separation is less than 0.5% of the height of the shorter of two adjacent buildings; Average = Separation is between 0.5% and 1.5% of the height of the shorter of two adjacent buildings; High = Separation is more than 1.5% of the height of the shorter of two adjacent buildings. *IF THE HOSPITAL IS NOT IN A HIGH/MODERATE SEISMIC ZONE, THEN LEAVE BOXES BLANK AND PROVIDE COMMENT.*	☐	☐	☐	
2.2.6. Proximity of buildings (wind tunnel effect and fire) *Safety ratings:* Low = Separation less than 5 m; Average = Separation between 5 m and 15 m; High = Separation more than 15 m.	☐	☐	☐	
2.2.7. Structural redundancy *Safety ratings:* Low = Fewer than three lines of resistance in each direction; Average = Three lines of resistance in each direction or lines without orthogonal orientation; High = More than three lines of resistance in each orthogonal direction of the building.	☐	☐	☐	
2.2.8. Structural detailing, including connections *Safety ratings:* Low = No evidence of engineered building records, or built according to an old design standard; Average = Built according to previous design standards and no retrofitting work to a current standard; High = Built according to a current standard.	☐	☐	☐	

Sub-Module 2.2 Building Integrity	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
2.2.9. Ratio of column strength to beam strength *Safety ratings:* Low = Strength of beams is obviously greater than strength of columns; Average = Strength of beams is similar to strength of columns; High = Strength of columns is greater than strength of beams.	☐	☐	☐	
2.2.10. Safety of foundations *Safety ratings:* Low = No evidence that foundations were designed according to standards (foundation size, soil survey) and/or there is evidence of damage; no plans are available; Average = Little evidence (drawings, soil survey) that foundations were designed according to standards; and/or there is evidence for moderate damage; High = Strong evidence that foundations were designed according to standards with strong evidence of no damage.	☐	☐	☐	
2.2.11. Irregularities in building structure plan (rigidity, mass, resistance) *Safety ratings:* Low = Shapes are irregular, and structure is not uniform; Average = Shapes on plan are irregular but structure is uniform; High = Shapes on plan are regular and structure has uniform plan, and there are no elements that would cause significant torsion.	☐	☐	☐	
2.2.12. Irregularities in elevation of buildings *Safety ratings:* Low = Significant discontinuous or irregular elements, significant variation in elevation of buildings; Average = Several discontinuous or irregular elements, some variation in the elevation of buildings; High = No significant discontinuous or irregular elements, little or no variation in elevation of buildings.	☐	☐	☐	

Sub-Module 2.2 Building Integrity	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
2.2.13. Irregularities in height of storeys *Safety ratings:* Low = Height of storeys differs by more than 20%; Average = Storeys have similar heights (they differ by less than 20% but more than 5%); High = Storeys are of similar height (they differ by less than 5%).	☐	☐	☐	
2.2.14. Structural integrity of roofs *Safety ratings:* Low = Monopitch or flat light roofs, and/or large roof overhangs; Average = Pre-stressed concrete roof, gable roof with gentle slope, satisfactorily connected, no large roof overhangs; High = Reinforced cast in place on concrete roof deck or hipped light roof, satisfactory connections, no large roof overhangs.	☐	☐	☐	
2.2.15. Structural resilience to hazards other than earthquakes and strong winds *Safety ratings:* Low = Low structural resilience to hazards present at the site of the hospital; Average = Satisfactory structural resilience (taking account of structural risk reduction measures in place); High = Good structural resilience (taking account of risk reduction measures in place).	☐	☐	☐	

Comments on Module 2.
(Include reference to the building type(s), structural system(s) and age(s) of buildings. Attach site plan, list all buildings and indicate those that were assessed.)

Module 3:
Non-Structural Safety

1. INTRODUCTION

Module 3 – Non-Structural Safety: Non-Structural elements are critical to the functioning of the hospital but are distinct from structural elements as they do not form part of the load-bearing system of the hospital buildings. Elements of non-structural include the architectural items, emergency access and exit routes to and from the hospital, critical systems (e.g., electricity, water supply, waste management, fire protection), medical, laboratory, and office equipment (whether fixed or mobile), supplies used for analysis and treatment. This module enables evaluators to conduct an assessment of the non-structural safety of hospitals. The results contribute to the overall calculation of the hospital safety index. There are 55 indicators divided among four submodules, as shown in Table 1.

Table 1: Distribution of Indicators/Elements by Sub-Modules

Sub-Modules	Indicators/Elements
Sub-Module 3.1: Architectural Safety	12
Sub-Module 3.2: Infrastructure Protection, Access, and Physical Security	4
Sub-Module 3.3: Critical Systems	26
Sub-Module 3.4: Equipment and Supplies	13
Total	**55**

Parameters of the "Non-Structural Safety" Module are indicative of the safety of critical supply systems (power grids, water supply piping, heat supply, servicing of the plumbing system, ventilation system and climate control (air conditioning), supply of medical gases etc.); safety of non-structural elements of construction (partition walls, windows, doors, decorative elements, access venues etc.); safety of medical equipment and devices, furniture; conditions for the storing of assets and fire security. Guiding procedures to assess the indexes under this module include:

- Consider all hospital buildings, including on-site staff residences, and combine the evaluations into a single rating against each item for the hospital.
- Combine the evaluations into a single rating against each item for the hospital.
- Record any key observations pertaining to the structural safety of specific buildings.

- Focus on occupied buildings and those which contribute most to acute care services in an emergency or disaster.
- Conduct assessment by structural engineers.
- Refer to applicable national and local standards and building codes related to structural safety.
- Refer to Module 1 (Hazards Affecting Hospital Safety) for an assessment of hazards which may affect the hospital. There are hospitals located in hazard-prone areas (e.g. floodplain areas, coastal areas subject to storm surge and tsunami, or near to seismic faults or hazardous facilities).
- Follow recommended evaluation methods, where applicable, such as interview, observation, review of documentation, and inspection.

Non-Structural Safety Classification:

The level of safety of non-structural elements is classified as **High, Average, and Low** based on their functioning during emergencies and disasters. Table 2 presents the rationale of this classification.

Table 2: Non-Structural Safety Classification

Classification	Rationale
High	Highly likely that the hospital will function during emergencies and disasters
Average	Likely that the hospital will function during emergencies and disasters
Low	Unlikely that the hospital will function during emergencies and disasters

HDSA Information Collection Steps

The assessment of the non-structural elements should consider the increased demand for hospital services in response to emergency and disaster situations. Evaluators should assess the non-structural safety of all hospital buildings, including on-site staff residences, and should combine the evaluations into a single rating against each item for the hospital overall. Evaluators should record any key observations pertaining to the non-structural safety of specific buildings. Particular attention should be paid to occupied buildings and those which contribute most to acute care services in an emergency or disaster. The assessment should be more rigorous in those areas that are critical for providing both health care and associated services in an emergency or disaster.

Many hospitals are located in hazard-prone areas (e.g. floodplain areas, coastal areas subject to storm surge and tsunami, or near to seismic faults or hazardous facilities). Evaluators should refer to Module 1 for an assessment of hazards which may affect the hospital. Evaluators need to use their knowledge and expertise to assess the danger that hazards pose to non-structural elements of the hospital, including how the proximity to hazards makes the non-structural elements less safe.

It is recommended that evaluators should always refer to applicable Public Works Department (PWD), and Health Engineering Department (HED) design and specifications related to non-structural safety when evaluating a facility. Further references for Module 3 are indicated against the items where applicable and are listed at the end of this module. Where appropriate, items include guidance regarding recommended evaluation methods – interview, observation, review of documentation, and inspection.

It is recommended that the architectural safety submodule is assessed by a structural engineer, architect or qualified building professional, while the other submodules could be assessed by persons with expertise and experience in hospital and health engineering, facilities management and/or hospital operations.

In general, the HDSA involves six steps in information collection. Refer to the Overview section for detailed guidance on these steps.

Sub-Module 3.1: Architectural Safety

2. GUIDANCE

Architectural elements are essential to the performance of the building but do not form part of the load-bearing system. Architectural elements are evaluated to determine their vulnerability to a range of internal and external hazards.

Architectural safety involves doors, windows, internal and exterior walls, facings, roofing, suspended ceilings, floor coverings and elevators, as well as the pathways for staff and patients inside and outside the building, such as corridors, stairways and ramps.

Evaluators should verify the condition and safety of elements and whether any potential damage to the elements would impede the performance of hospital operations. The architectural safety of the hospital is measured by **12 indicators/elements.**

HDSA should use the structural engineers, architects, or qualified building professionals to evaluate these indicators.

Sub-Module 3.1 Indicators (12 Indicators)

3.1.1. Major damage and repair of Non-Structural elements:

Non-Structural elements are critical to the functioning of the hospital. Thus, the elements require protection and security, routine maintenance, and timely repair, replacement, and replenishment. Elements of non-structural include the architectural elements, emergency access and exit routes to and from the hospital, critical systems (e.g., electricity, water supply, waste management, fire protection), medical, laboratory, and office equipment (whether fixed or mobile), supplies used for analysis and treatment.

Recommended evaluation methods:

 Interview  Observation  Inspection

1) Verify whether the hospital's non-structural elements were affected by any hazards (natural, biological, technological, societal) or other factors, and whether repairs have been conducted.
2) To get historical accounts of damage to a facility, ask for reports about the extent of non-structural damage and the repairs, and talk with personnel who have worked the longest in the hospital (irrespective of their position within the organization, e.g. cleaning personnel, kitchen staff, administration, and support staff).
3) Check the publication/accounts (e.g. formal/press/internet reports, photographs). Certain reports might be accessible on the Internet or through public records (e.g. library).
4) Focus on damage which may have affected the safety and function of particular non-structural elements.
5) Determine if the non-structural safety has been compromised using the evidence collected or from visual inspection of the damage and repairs.
6) Verify whether the non-structural elements have been repaired, the date of repairs, and whether repairs were carried out using the appropriate standards for non-structural elements at the time of the repairs.
7) If such an event has not occurred in the vicinity of the hospital, leave boxes blank and provide comment.

3.1.2. Condition and safety of doors, exits and entrances:

Doors should be completely attached to the frames with no obvious gaps (between the door and frame, or between the frame and wall). Doors and door frames are a good indication whether the adjacent structures have moved, especially if there are gaps, if the door is difficult to open, or if there is excessive wear. Doors, exits and entrances should be free of obstacles and wide enough to allow rapid movement of patients and hospital staff in emergency situations.

Recommended evaluation methods:  Observation  Inspection

1) Check the condition of the hospital's doors, exits and entrances and their ability to resist wind, fire, and seismic and other forces. In the case of automated doors, check if there is a provision to open the door safely and if there are alternative manual operations.
2) Pay special attention to doors, exits and entrances to critical areas for emergency situations, such as emergency department, intensive care unit, operating theatres, etc.

3.1.3. Condition and safety of windows and shutters:

Windows, shutters and frames should be able to withstand appropriate forces such as wind or impact damage, especially in critical areas of the hospital (e.g. emergency department, operating theatres, intensive care unit, sterilization unit, pharmacy, etc.). It is advisable to use windows with laminated glass or polycarbonate glazing in critical areas, especially for hospitals at high risk of earthquakes which often cause breakage of glass due to the significant defluxions of the building. If frames are not secure, wind and rain can ingress into the building, damaging medical equipment, which may impact on patient care and the safety of staff and patients.

Recommended evaluation methods:  Observation  Inspection

1) Check the thickness and type of glass in the windows and the integrity of the frame with the wall.
2) Where wooden frames and shutters are used, check them for rot, moisture and termite damage.
3) Check whether the frames are secure.

3.1.4. Condition and safety of other elements of the building envelope (e.g. outside walls, facings):

Elements of building envelopes should be maintained and protected, and they should be repaired and replaced without any delay. It is recommended that, in earthquake-prone zones, facings should not be veneered but should be integrated into the wall. In earthquake-prone zones or high-wind areas, these walls should be appropriately braced to the structural elements to resist seismic and wind forces.

Recommended evaluation methods:  Observation  Inspection

1) Review the technical and construction status of the elements of the building envelope, including outside walls and facings, which can be made of different materials such as masonry, glass, wood, aluminum, and composite materials.

2) Review the elements, whether they are cracked, misshapen, or loose.

3) If a building envelope has fixed sections of glass or wood, apply the same evaluation criteria as for windows and shutters made of these materials.

4) Conduct a more rigorous analysis at hospital entrances and in the critical areas responsible for providing health and associated services in emergencies and disasters.

3.1.5. Condition and safety of roofing:

Leakage from water systems on a roof can put a hospital, or sections of the hospital, out of service. The location, weight and safety of equipment on the roof can affect the roof's vulnerability to different natural forces.

Recommended evaluation methods:  Observation  Inspection

1) Make a thorough examination of the roof by visiting or observation.

2) Check for impermeability (leak-proof) of the roof, the safety and condition of equipment located on the roof, and drainage.

3.1.6. Condition and safety of perimeter walls and fencing:

The security and functionality of the hospital can be affected by the condition of surrounding walls and fencing that define the hospital grounds. Without some means of control at the perimeter, emergency and disaster situations may invoke an influx of people to the hospital that may compromise hospital functions.

Recommended evaluation methods:  Observation  Inspection

1) Check the security and functionality aspects (discussed above) in detail when surveying the hospital grounds and neighboring areas.

2) Obtain a good perspective of the issues from an elevated position (e.g. upper floors of the building) or from aerial photographs.

3.1.7. Safe conditions for movement outside the hospital buildings:

Hospitals must ensure the movement in the hospital grounds and outside the buildings so pedestrians, ambulances, and supply transport can access the facility with the speed required during emergencies and disasters. This item also complements item 3.2.2 (Sub-Module 3.2) on access routes, which focuses on roads outside the hospital grounds, and item 3.2.3 (Sub-Module 3.2) on emergency exit and evacuation routes. The impact on access for people with mobility impairments and wheelchairs should be considered and tested. External obstacles to access can severely disrupt the function of the facility.

Recommended evaluation methods:  Observation  Inspection

1) Observe whether there are trees, lamp posts, and architectural designs that could fall because of natural forces and obstruct pedestrian and vehicle access to the facility.
2) Check the pavement within the hospital grounds for potholes, raised areas or other obstacles that could impair pedestrian and vehicle traffic.

3.1.8. Safe conditions for movement inside the building (e.g. corridors, stairs):

The interior corridors of the hospital should be spacious and free of obstacles to ensure ease of movement for personnel, stretchers, and medical equipment. Particular attention should be given to stairways and exits because of their importance if evacuation occurs during earthquakes or other emergencies. Access for people with mobility or sensory impairments, as well as wheelchair access, should be considered. Adequate signage must be present to facilitate the movement of staff, patients, and visitors. Areas with restricted access should be under the surveillance of hospital security personnel.

Recommended evaluation methods:  Observation  Inspection

1) Verify that conditions are safe for movement throughout the facility. The interior corridors, stairways and exits are spacious and free of obstacles to ensure ease of movement for personnel, stretchers and medical equipment.
2) Verify the access for people with mobility or sensory impairments, as well as wheelchair access.
3) Verify whether the signage is adequate to facilitate the movement of staff, patients and visitors.

3.1.9. Condition and safety of internal walls and partitions:

Hospitals' internal walls and partitions can be made of masonry, glass, wood, aluminium, etc., and may combine these materials. In earthquake-prone and high-wind areas, interior walls should be adequately braced by structural elements so that they can resist seismic shaking and wind forces. The evaluation of internal walls should be more rigorous in critical areas such as intensive care units, emergency departments, operating theatres, and laboratories.

Recommended evaluation methods:  Observation  Inspection

1) Review these elements' technical and construction aspects to ensure they are not cracked, deformed, or loose.
2) Rate the hospital on the basis of the materials' conditions and the bracing's level against the hazards identified as potentially affecting the hospital.

3) In earthquake-prone and high-wind areas, Check whether interior walls are adequately braced by structural elements so that they can resist seismic shaking and wind forces.

4) Assess the internal walls in critical areas such as intensive care units, emergency departments, operating theatres, and laboratories.

3.1.10. Condition and safety of false or suspended ceilings:

There is a wide variety of false or suspended ceilings used in buildings. Those made of metal are the heaviest and cause the most significant damage if they fall. The level of bracing is a major determinant of the safety ratings for the hospital. The bracing is usually not visible. In earthquake-prone zones, both angled and vertical bracing should brace ceilings from horizontal seismic forces. In areas where these elements are subject to strong winds, they can fall, become projectiles, collide with other objects and, in the worst case, injure people. If they do fall, they can obstruct critical areas and passageways in the hospital, thus affecting its functional capacity.

Recommended evaluation methods:  Observation  Inspection

1) Check the condition of the ceilings and anchors, and the weight and stability of ceiling tiles. In the case the bracing is not visible, request relevant personnel (e.g. maintenance staff) to take some ceiling sections apart.

2) Check whether both angled and vertical bracing are used to brace ceilings from horizontal seismic forces.

3) If the hospital does not have false or suspended ceilings, leave boxes blank and provide comment.

3.1.11. Condition and safety of stairways and ramps:

Hospitals should give particular attention to the safety of stairways and ramps because of their importance in the case of evacuation. These elements should be free of obstacles or of items that could fall and obstruct them. They should have railings to be used safely at their maximum capacity; the stairs themselves are free from damage and have marked or defined edges keeping in mind that hospital patients will be more vulnerable than typical users.

Recommended evaluation methods:  Observation  Inspection

1) Check whether the stairways and ramps have railings and are free of obstacles.

2) Check whether the stairways and ramps are clearly marked or defined edges.

3) Assess whether damage or failure of stairways and ramps could endanger occupants of the hospital.

4) Focus on areas where there is the highest concentration of people and use.

5) If there are no stairs and ramps, leave boxes blank and provide comment.

3.1.12. Condition and safety of floor coverings:

Floors are made of various materials, such as terrazzo, ceramic, clay tile, linoleum, and wood. They may be attached with adhesives, laid over a membrane (such as a floating floor), or suspended. There should be no uneven sections or depressions that could cause people to fall or cause carts and equipment to tip over. In areas where there are large numbers of conduits, cables, and suspended floors, evaluators should ensure that the flooring is braced to resist lateral seismic loads.

Recommended evaluation methods:  Observation  Inspection

1) Verify that the flooring is watertight, anti-skid, and free of cracks or loose sections, especially in critical and high-traffic areas.
2) Check whether the floors are even sections or without any depressions.
3) Check whether the flooring is braced to resist lateral seismic loads, particularly in areas where there are large numbers of conduits, cables, and suspended floors.

Module 3:
Non-Structural Safety

Sub-Module 3.1: Architectural Safety

3. CHECKLIST

Sub-Module 3.1: Architectural Safety: Elements that are essential to the performance of the building but do not form part of the load-bearing system. Architectural elements are evaluated to determine their vulnerability to a range of internal and external hazards.

Architectural safety involves doors, windows, internal and exterior walls, facings, roofing, suspended ceilings, floor coverings and elevators, as well as the pathways for staff and patients inside and outside the building, such as corridors, stairways, and ramps.

Indicators of Architectural Safety Level of Hospital are as below.
(L=Low, A=Average, H= High)

Sub-Module 3.1 Architectural safety	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.1.1. Major damage and repair of Non-Structural elements *Safety ratings:* Low = Major damage and no repairs completed; Average = Moderate damage, building only partially repaired; High = Minor or no damage, or building fully repaired. *IF SUCH AN EVENT HAS NOT OCCURRED IN THE VICINITY OF THE HOSPITAL, LEAVE BOXES BLANK AND PROVIDE COMMENT.*	☐	☐	☐	

Sub-Module 3.1 Architectural safety	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.1.2. Condition and safety of doors, exits and entrances *Safety ratings:* Low = Doors, exits and entrances in poor condition, subject to damage which would impede the function of this and other elements, systems or operations; entrance width is less than 115cm; Average = In fair condition, subject to damage but damage would not impede the function of this and other elements, systems or operations; or entrance width is less than 115cm; High = In good condition, no or minor potential for damage that would impede the function of this and other elements, systems or operations; and entrance width is equal to or larger than 115cm.	☐	☐	☐	
3.1.3. Condition and safety of windows and shutters *Safety ratings:* Low = Windows and shutters in poor condition, subject to damage which would impede the function of this and other elements, systems or operations (e.g. weak protective glazing); Average = In fair condition, subject to damage but damage would not impede the function of this and other elements, systems or operations; High = In good condition, no or minor potential for damage that would impede the function of this and other elements, systems or operations; protective glass (e.g. polycarbonate glazing, blast film) has been added in critical wards.	☐	☐	☐	
3.1.4. Condition and safety of other elements of the building envelope (e.g. outside walls, facings) *Safety ratings:* Low = Building envelope in poor condition, subject to damage which would impede the function of this and other elements, systems or operations; Average = In fair condition, subject to damage but damage would not impede the function of this and other elements, systems or operations; High = In good condition, no or minor potential for damage that would impede the function of this and other elements, systems or operations.	☐	☐	☐	

Sub-Module 2.2 Building Integrity	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.1.5. Condition and safety of roofing *Safety ratings:* Low = Roofing in poor condition, subject to damage which would impede the function of this and other elements, systems or operations; Average = In fair condition, subject to damage but damage to element(s) would not impede the function of this and other elements, systems or operations; High = In good condition, no or minor potential for damage that would impede the function of this and other elements, systems or operations.	☐	☐	☐	
3.1.6. Condition and safety of perimeter walls and fencing *Safety ratings:* Low = Perimeter walls and fencing in poor condition, subject to damage which would impede the function of this and other elements, systems or operations; Average = In fair condition, subject to damage but damage to element(s) would not impede the function of this and other elements, systems or operations; High = In good condition, no or minor potential for damage that would impede the function of this and other elements, systems or operations.	☐	☐	☐	
3.1.7. Safe conditions for movement outside the hospital buildings *Safety ratings:* Low = Obstacles or damage to structure or road and walkways will impede vehicle and pedestrian access to buildings or endanger pedestrians; Average = Obstacles or damage to structure or road and walkways will not impede pedestrian access, but will impede vehicle access; High = No obstacles, or potential for only minor or no damage that will not impede pedestrian or vehicle access.	☐	☐	☐	

Sub-Module 2.2 Building Integrity	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.1.8. Safe conditions for movement inside the building (e.g. corridors, stairs) *Safety ratings:* Low = Obstacles and damage to element(s) will impede movement inside the building and endanger occupants; Average = Obstacles or damage to elements will not impede movement of people but will impede movement of stretchers, wheeled equipment; High = No obstacles, potential for no or minor damage which will not impede movement of people or wheeled equipment.	☐	☐	☐	
3.1.9. Condition and safety of internal walls and partitions *Safety ratings:* Low = Internal walls and partitions in poor condition, subject to damage which would impede the function of this and other elements, systems or operations; Average = In fair condition, element(s) are subject to damage but damage would not impede the function of this and other elements, systems or operations; High = In good condition, no or minor potential for damage that would impede the function of this and other elements, systems or operations.	☐	☐	☐	
3.1.10. Condition and safety of false or suspended ceilings *Safety ratings:* Low = False or suspended ceilings in poor condition, subject to damage which would impede the function of this and other elements, systems or operations; Average = In fair condition, element(s) subject to damage but damage would not impede the function of this and other elements, systems or operations; High = In good condition, no or minor potential for damage that would impede the function of this and other elements, systems or operations. *IF THE HOSPITAL DOES NOT HAVE FALSE OR SUSPENDED CEILINGS, LEAVE BOXES BLANK AND PROVIDE COMMENT.*	☐	☐	☐	

Sub-Module 2.2 Building Integrity	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.1.11. Condition and safety of stairways and ramps *Safety ratings:* Low = In poor condition, subject to damage or there are obstacles, which would impede the function of this and other elements, systems or operations; Average = In fair condition, subject to damage but damage and obstacles would not impede the function of this and other elements, systems or operations; High = In good condition, no obstacles, potential for no or minor damage that would impede the function of this and other elements, systems or operations. *IF THERE ARE NO STAIRS AND RAMPS, LEAVE BOXES BLANK AND PROVIDE COMMENT.*	☐	☐	☐	
3.1.12. Condition and safety of floor coverings *Safety ratings:* Low = Floor coverings in poor condition, subject to damage which would impede the function of this and other elements, systems, or operations; Average = In fair condition, subject to damage but damage would not impede function; High = In good condition, no or minor potential for damage that would impede the function of this and other elements, systems or operations.	☐	☐	☐	

Comments on the results of Sub-Module 3.1:

Module 3:
Non-Structural Safety

Sub-Module 3.2: Infrastructure Protection, Access and Physical Security

2. GUIDANCE

Sub-Module 3.2 focuses on checking the proximity of hospital building to local hazards and how the overall layout of the hospital protects critical services from these hazards and from security threats. The hospital should also have good road and pedestrian access and exit routes so that it operates effectively during emergencies and disasters.

Sub-Module 3.2 Indicators (4)

3.2.1. Location of hospital's critical services and equipment in the hospital in relation to local hazards:

Many facilities lose their critical services (e.g., emergency care), systems, and equipment (e.g., patients' records or power generators) upon which health-care services depend due to positioning these services and equipment in locations vulnerable to local hazards. For instance, hospitals that store patients' records and emergency power generators in underground space may be placing them at risk of flooding, destroying the records, and submerging the generators, thus affecting normal and emergency functions.

Recommended evaluation methods:

 Interview  Observation  Inspection

1) Review the safety of the location of critical services and equipment.
2) Verify the measures taken by the hospital to protect critical supplies such as emergency power, medicines and patients' records.

3.2.2. Hospital access routes:

Access is essential if the hospital is to function properly. The emphasis in this item is on access routes outside the hospital grounds.

Recommended evaluation methods:

 Interview  Observation  Documentation Review (including Maps)  Inspection

1) Review the main access routes to the hospital. Maps showing micro- and macro-locations of the hospital are helpful.
2) Determine the effectiveness of the hospital's security and protection system in terms of vehicle and pedestrian access.

3) Review the access for people with mobility impairments.

4) Conduct interviews with hospital employees, patients and, where possible, people living near the facility, who can provide information about the types of routes and at what time of day routes are congested.

5) Note the presence and condition of waterways (e.g. creeks, rivers) and storm drains that service the area.

6) Determine whether flooding or storm run-off would flood certain access routes, making them impassable.

7) Note the structures and trees along the access routes that would impede traffic if they fell during an emergency or a disaster such as an earthquake, or in a high-wind event such as a cyclone.

8) Check whether the hospital has alternate routes in case major access routes are obstructed. 9. Determine whether alternate routes are taken into account in the hospital's emergency and disaster risk management programmes, including response plans.

3.2.3. Emergency exits and evacuation routes:

Hospitals should have exit and evacuation routes, and they are marked and free of obstacles to enable emergency evacuation. The emergency doors should be locked from the inside so that they do not impede an emergency evacuation. If the hospital relies on automatic doors, these doors should have provisions to open manually or alternative exit points.

Recommended evaluation methods:

 Observation  Inspection

1) Verify that hospital exit and evacuation routes are clearly marked and free of obstacles to enable emergency evacuation.

2) Verify that evacuation routes are indicated both inside and outside the hospital.

3) Check that the emergency doors are not locked from the inside.

4) If the hospital has automatic doors, check that these doors can be opened manually or there are alternative exit points.

3.2.4. Physical security of building, equipment, staff and patients:

The physical security of hospitals is essential to convey a sense of security to patients and the community. All physical security elements (listed below) of a hospital should be supported by hospital policies, procedures, and staff awareness and training.

Recommended evaluation methods:

 Interview  Observation  Documentation Review  Inspection

Verify that there are physical security measures in place to:

- Prevent unauthorized entry
- Prevent violence and kidnapping (especially from newborns and child wards)
- Reduce vandalism
- Secure equipment and supplies from theft.
- Secure perimeter
- Secure cashier
- Secure personnel and patient files
- Secure pharmacy
- Secure tool stores.

The measures for security include:

- Physical design and layout (e.G. Walls, fences)
- Access control (e.G. Security cards)
- Locks and alarms
- Closed-circuit television (cctv) and closed circuit digital video (ccdv) systems
- Asset tracking and inventory control
- Clear signage
- Emergency exit
- Alternative stair

Module 3:
Non-Structural Safety

Sub-Module 3.2: Infrastructure Protection, Access and Physical Security

3. CHECKLIST

Indicators of Infrastructural Protection, Access and Physical Security of Hospital are as below. (L=Low, A=Average, H= High)

Sub-Module 3.2 Infrastructure Protection, Access and Physical Security	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.2.1. Location of hospital's critical services and equipment in the hospital in relation to local hazards *Safety ratings:* Low = No protection measures taken; subject to damage, failure and disruption of critical services and hospital operations in emergencies and disasters; Average = Partial measures to protect critical services from local hazards are taken; subject to damage with some disruption of critical services and hospital operations in emergencies or disasters; High = Many measures are taken to protect critical services; high probability that critical services and hospital will operate with no or limited disruption in emergencies and disasters.	☐	☐	☐	
3.2.2. Hospital access routes *Safety ratings:* Low = Access routes subject to obstacles and damage that would impede access and the function of other elements, systems or operations; Average = Access routes subject to some obstacles and damage that would not impede access and function; High = No or minor potential for obstacles or damage that would impede access and the function of other elements, systems or operations.	☐	☐	☐	

Sub-Module 3.2 Infrastructure Protection, Access and Physical Security	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.2.3. Emergency exits and evacuation routes *Safety ratings:* Low = Exit and evacuation routes are not clearly marked and many are blocked; Average = Some exit and evacuation routes are marked and most are clear of obstacles; High = All exit and evacuation routes are clearly marked and free of obstacles.	☐	☐	☐	
3.2.4. Physical security of building, equipment, staff and patients *Safety ratings:* Low = No measures are in place; Average = Some physical security protection is in place (e.g. locked storage for supplies and equipment, asset tracking and inventory control); High = Wide range of security measures in place (e.g. design and layout, physical barriers, access control and door security systems, locked storage for supplies and equipment).	☐	☐	☐	

Comments on the results of Sub-Module 3.2:

Module 3:
Non-Structural Safety

Sub-Module 3.3: Critical Systems

2. GUIDANCE

Sub-Module 3.3 focuses on the safety, capacity, operational management, preventive maintenance and restoration of critical systems for the functioning of the hospital. The critical systems of the hospital are divided into 8 sections and consists of 29 indicators. Table-1 presents the distribution of elements by sections.

Table 1: Distribution of Indicators/Elements by Sub-Modules

Sections Sub-Module 3.3	Indicators/Elements
3.3.1 Electrical systems	5
3.3.2 Telecommunications system	3
3.3.3 Water supply system	4
3.3.4 Fire protection system	4
3.3.5 Waste management systems	3
3.3.6 Fuel storage systems (e.g. gas, gasoline and diesel	1
3.3.7 Medical gases systems	5
3.3.8 Heating, ventilation and air-conditioning (HVAC) systems.	4
Total	**29**

Critical systems' failure or disruption of can stop or impede the functioning of hospitals. Failure does not usually put the structural stability of a building at risk but can endanger people and the contents of a building.

3.3.1 Electrical Systems (5 Indicators)

3.3.1.1. Capacity of alternate sources of electricity (e.g., generators):
This indicator addresses both the capacity of alternate sources and the length of delay in starting the alternate source of power for critical hospital areas in emergency and disaster situations. Uninterrupted power supply (UPS) and battery backup may provide an interim measure before the generator starts to supply power to essential areas. In earthquake-prone areas, the hospital should ensure that batteries for the UPS and/or for starting up generators will not fall and be damaged, rendering backup power unavailable. If batteries are likely to fall in an earthquake, rate the alternate power source low. The generator and auxiliary units should be safe from the risk of water damage in flood-prone areas.

Recommended evaluation methods:

1) Verify that the alternate source(s) of power begin(s) to operate within seconds of the hospital losing power and continue(s) to operate to cover power demands for critical services throughout the hospital – particularly in the emergency department, intensive care unit, sterilization units, operating theatres and maternity unit (i.e., areas of the hospital that are most critical to meeting service demands in times of emergency.
2) Check the safety measures for generator and auxiliary units from the risk of water damage if the hospital is located in flood-prone areas.
3) Verify that the hospital's power plant operators have training in emergency preparedness and response.
4) Check to see that there are flashlights and basic communications equipment available.

3.3.1.2. Regular tests of alternate sources of electricity in critical areas:
Most hospitals have diesel-run generators as their alternate sources of electricity, and the generators require regular and routine maintenance. It helps avoid potential failures in the system to be anticipated and can indicate necessary measures should a power failure occur.

Recommended evaluation methods:

1) Determine how frequently generator performance tests with satisfactory results are carried out.

2) Examine the generator maintenance and test records.

3) Determine how problems with generator function, repairs and potential failures are communicated to the unit responsible for maintenance.

3.3.1.3. Condition and safety of electrical equipment, cables and cable ducts:

Hospitals should protect the electrical networks from flooding and fire in earthquake-prone zones and areas of high winds and ensure their anchor. They need channeling through cable racks or conduits to prevent twisting, breaking, or general deterioration. When cables travel along roofs that empty through drainpipes or gargoyles, position the wires above the overflow level. In earthquake-prone areas, when electricity lines pass from building to building or over expansion joints in the same building, these joints should have sufficient flexibility to accommodate the relative movements during earthquakes. An essential element is the separation of electrical networks from other systems that they may affect – such as water supply or sewage systems. If they are close to protective systems for atmospheric electrical discharge, consider metal shielding and additional electrical earthing and bonding.

Recommended evaluation methods:

 Observation  Inspection

1) Check the condition of the electrical networks throughout the hospital

2) Check to see the electric networks are protected from flooding and fire, and anchored, particularly in the earthquake-prone zones and areas of high wind.

3) Check that the electric connection wires are channeled through cable racks or conduits.

4) When the building has a basement or other areas that are likely to flood, inspect the location of sockets, large switchgear or isolators and whether they need to be raised.

5) In earthquake-prone areas, when electricity lines pass from building to building or over expansion joints in the same building, check that these joints have sufficient flexibility to accommodate the relative movements during earthquakes.

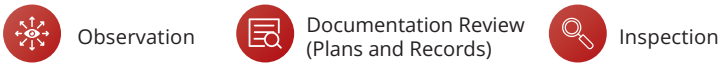
6) Inspect the position of outside power lines in relation to features on the hospital grounds; whether they are placed underground to protect them from damage and flying debris during high winds.

7) If electricity poles are located on hospital grounds, check to see that the transformers are well anchored.

3.3.1.4. Condition and safety of internal and external lighting systems:

Lighting systems are one of the major non-structural elements in a hospital. If lighting does not function correctly, especially in critical areas, it will have a major effect on how the hospital functions.

Recommended evaluation methods:



1) Check to see that both internal and external lighting are operational and correctly sectioned so that any area that needs lighting has it.
2) Find from the maintenance staff whether the hospital has sufficient stock of lighting supplies (e.g. flashlights, head-torches, batteries and light bulbs in case of light failure in a disaster).
3) Verify that the emergency lighting systems are adequate for the level and type of use of an area, especially on stairs and walkways, in corridors and in the critical medical and nonmedical areas of the hospital.
4) Inspect whether lighting is clear of plants or other vegetation which could pose a physical risk or affect performance. Visual inspection can be supplemented by information from maintenance and inspection records.

3.1.1.5. Emergency maintenance and restoration of electric power supply and alternate sources:

Hospitals should maintain operations manual for electrical power systems and preventive maintenance records. Hospitals should document the emergency procedures for maintaining systems in emergency/disaster situations. They also need to train personnel to maintain the correct level of safety of the electrical power supply and alternate sources (e.g., generators) of the hospital in both routine and emergency/disaster situations.

Recommended evaluation methods:

1) Inspect the operations manual for electrical power systems, as well as preventive maintenance records.
2) Verify that the hospital has established emergency procedures for maintaining systems in emergency/disaster situations.
3) Check that the hospital has trained staff to maintain the correct level of safety of the electrical power supply and alternate source (e.g. generators) of the hospital in both routine and emergency/disaster situations.

3.3.2. Telecommunications Systems (3 Indicators)

3.3.2.1. Condition and safety of telecommunication system:

Besides land phone connections, the hospitals' telecommunications systems include official mobile phones provided to a limited number of staff, and broadband internet services connected to a limited number of offices. Some hospitals have intercom systems, and few hospitals have radio and satellite telephones as alternative communications sources. As part of their internal communication systems, some hospitals use loudspeakers, public address systems, speaker systems, intercoms, and similar systems to facilitate communication with personnel, patients, and visitors to the hospital.

Recommended evaluation methods:

 Observation  Documentation Review (Plans and Records)  Inspection

1) Verify the hospital's whole telecommunication system, its condition (maintenance), and safety (protected from fires, cut).
2) Identify the hospital's departments and staff access to the types of communication systems (land phone, intercom, mobile phone, internet, or other alternative sources of communication).
3) Determine the percentage of coverage following the information available of the preceding question.
4) Verify and test the condition of loudspeakers, public address systems, speaker systems, intercoms and similar systems that are used for internal communication with personnel, patients and visitors to the hospital.

3.3.2.2. Condition and safety of low- and extra-low-voltage systems (Internet and telephone):

As part of hospitals' telecommunications systems, they may have cables for computer and telephone networks which comprise the main components of low-voltage and extra-low-voltage systems, such as servers and network hubs.

Recommended evaluation methods:

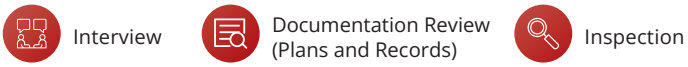
 Observation  Documentation Review (Plans and Records)  Inspection

1) Verify the status of cables for computer and telephone networks are properly connected to the antennas, transmission equipment, line and voltage controllers, receivers, wiring and the grounding mechanism.

3.2.2.3. Emergency maintenance and restoration of standard and alternate communications systems:

Generally, the hospitals' maintenance section/division is responsible for maintaining the operations manual and preventive maintenance records for telecommunication systems. Hospitals should establish emergency procedures for maintaining standard and alternate communications systems in emergency/disaster situations. They also need to train personnel to maintain the correct level of safety of the telecommunication systems.

Recommended evaluation methods:



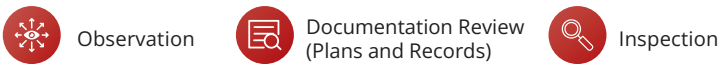
1) Inspect the operations manual, if any available, for telecommunication systems, and preventive maintenance records.
2) Verify that the hospital has established emergency procedures for maintaining systems in emergency/disaster situations.
3) Check that the hospital has trained staff to maintain the correct level of safety of the telecommunication systems of the hospital in both routine and emergency/disaster situations.

3.3.3. Water Supply Systems (4 Indicators)

3.3.3.1. Water reserves for hospital services and functions:

Hospitals shall maintain a permanent reserve of water that is sufficient at least for 72 hours following official national guidance, in addition to a water reserve for fires (it is advised to provide at least 300 liters daily per bed). Hospitals also store water to meet the essential services sufficiently, which could be ascertained from service and maintenance records.

Recommended evaluation methods:



1) Verify that water tanks have a permanent reserve sufficient to provide water for at least 72 hours.
2) Check whether the hospital has facilities/arrangements for maintaining an advisable amount of water for fire control.
3) Verify that water storage is sufficient to satisfy essential services. For this information, check the service and maintenance records.

3.3.3.2. Safety of the water distribution system:

Hospitals' water distribution systems comprise storage tanks, valves, pipes, and connections. The components connecting the local water service to the cisterns are a critical part of the network. The cistern float valve controls the amount of water that enters the tank and shuts off flow when the cistern is full. If the valve is not correctly working, water will be wasted without filling the cistern, and the run-off can erode structural supports. Leaking pipes can cause damage in any of the areas where they are located: along with suspended ceilings, behind walls, and underground. Pipe connections are vulnerable and should be checked for signs of deterioration.

Recommended evaluation methods:

 Observation  Documentation Review (Plans and Records)  Inspection

1) Verify the condition and proper function of all elements of the water distribution system, including storage tanks, valves, pipes, and connections.
2) Check the components connecting the local water service to the cisterns to see measures to control water wastage.
3) Check the general condition of the hospital water distribution network to ensure that water reaches the necessary service points.
4) Check the pipe connections (e.g., leakage) for any signs of deterioration
5) Check whether flexible connections are used, for example, between exterior tanks and points where pipes enter the building and between pumps and impulsion pipes.

3.3.3.3. Supplementary pumping system:

Hospitals' critical systems should be redundant, beginning with systems inside the hospital. Hospitals should maintain a supplementary or backup pumping system in case the water supply is interrupted. The number of pumps will depend on the water flow and its variations, and the need to have reserve equipment to deal with emergency situations.

Recommended evaluation methods:  Observation

1) Identify the existence and operation of the supplementary or back-up pumping system.
2) Check the number of pumps (2 pumps are desirable) and their capacity.
3) Identify the existence and operation of supplemental power and connection to the back-up power supply (for pumping) and supplementary pumps (in case of pump failure).

3.3.3.4. Emergency maintenance and restoration of water supply systems: Hospital's maintenance section/division maintains the operations manual and preventive maintenance records for the water supply systems. Hospitals also need to train personnel to maintain the correct level of safety of water quality controls, supplies, and alternative sources to the hospital in both routine and emergency/disaster situations.

Recommended evaluation methods:

 Interview  Documentation Review (including Records)

1) Inspect the operations manual, if any available, for water supply systems, and preventive maintenance records.
2) Verify that the hospital has established emergency procedures for maintaining systems in emergency/disaster situations.
3) Check that the hospital has trained staff to maintain the correct level of safety of water quality controls, supplies and alternative sources to the hospital in both routine and emergency/disaster situations.

3.3.4 Fire Protection System (4 Indicators)

3.3.4.1. Condition and safety of the fire protection (passive) system: Hospitals must be wholly protected against fire since this type of hazard can stop services in a hospital when they are most needed. Hospitals are considered buildings that are extremely difficult to evacuate; therefore, the most critical aspect of fire safety is to have the best means of prevention and protection in place.

Protection of patients and staff when there is a building fire is of utmost concern. Passive fire protection measures will consider each area's combustible level, compartmentalization level, the use of incombustible material, fireproof doors, firewalls, and the location of doors and windows in respect to other buildings and other areas.

The main objective should be to prevent fires from starting and, if a fire starts, to prevent its spread to avoid the total evacuation of the building.

Recommended evaluation methods:

 Observation  Documentation Review (Plans and Records)  Inspection

1) Determine whether the hospital design incorporates firewalls, doors, and designated escape routes, which provide a high level of safety.
2) Review the fire protection measures in areas at highest risk of fire, such as boiler rooms, fuel tank storage, medical gases, electrical panels, electrical switch rooms, and pharmacy,
3) Verify this information in maintenance records, the facility's fire plans, and policies and procedures.

3.3.4.2. Fire/smoke detection systems:

The early detection of fire and smoke is a critical line of defense against fire in hospitals. There should be detectors and fire alarms that are visual and audible, and the system must allow for the transmission of local alarms, general alarms, and verbal instructions.

Recommended evaluation methods:

 Interview  Documentation Review (Plans and Records)  Inspection

1) Review the installation, maintenance and testing of the fire and smoke detection systems throughout the hospital.
2) Verify that the hospitals has detectors and fire alarms and those are both visual and audible.
3) Conduct interviews with personnel responsible for testing and verifying the maintenance record and technical documents from manufacturers and installers.
4) Check the functioning of one of the fire alarms in an unstaffed part of the hospital where manual detection of fires may be delayed and may lead to heavy losses.

3.3.4.3. Water supply for fire suppression:

Hospitals must have a source for a permanent water supply that they can use effectively in case of fire. This supply is in addition to the water supply used for the hospital's general functioning and hospital services. The source could be reticulated water mains or a water source for fire – such as water reservoirs, a nearby pond or stream, or adequately maintained and serviced external fire hydrants. Hospitals should test the water pumps (electric or diesel) linked to the fire extinguisher system regularly.

Recommended evaluation methods:

 Observation  Documentation Review (Plans and Records)  Inspection

1) Review and confirm that the hospital has a source for a permanent supply of water to use in case of fire effectively.
2) Verify that the hospital regularly tests the water pumps (electric or diesel) that link to the fire extinguisher system.
3) Reconcile this information with the site drawings, plans, and the facility's policies and procedures.

3.3.4.4. Emergency maintenance and restoration of the fire protection system:

The maintenance section/division should provide the operations manual for the fire protection systems, as well as records showing preventive maintenance of fire extinguishers and fire hydrants.

Evaluators should verify that:

- A manual plus training on the management of fire protection systems are available.
- There are records of preventive maintenance of extinguishers and hydrants.
- The equipment is to be found in the appropriate places and is freely accessible.
- The network of pipes, pumps and accessories is exclusively for the hydrants.
- Hoses are appropriately joined to the valves on the cabinets for the hydrants.
- The network of hydrants has its own water cistern.
- The fire safety officer (warden) team in the hospital has been established.
- Personnel are trained and drills have been carried out.
- A plan of action and procedures for fire response are available.
- Inflammable materials and liquids are stored in safe places that are reserved exclusively for these substances.

Recommended evaluation methods:

3.3.5 Waste Management Systems (3 Indicators)

3.3.5.1. Safety of wastewater and liquid waste systems:

Wastewater or sewerage systems consist of a network of pipes that carry the wastewater from the hospital to the sewer unit or a separate system. They also include unique techniques such as septic tanks, infiltration wells, oxidation ponds, filters, hydraulic traps, or siphons. These systems treat and dispose of residuals, prevent the entrance of odor or insects from the treatment or excreta systems, and unclog and clean the pipes. Ventilation systems maintain atmospheric pressure within wastewater systems. Hospitals must filter out grease, plaster, mud, and sand to effectively perform treatment and excreta systems.

Recommended evaluation methods:

 Observation  Documentation Review (Plans and Records)  Inspection

1) Verify the physical and functional condition of equipment, clamps and anchors, the means of discharge or evacuation, leakages due to defective or missing hardware, and the state of the waste vents in covers.
2) Look for leaks in the system and assess the state of the registry (presence of fecal matter).
3) Check overflows of deposits, the location of treatment tanks, pits, septic tanks, percolation of wells, grease, plaster, or mud traps, and the proximity of wastewater systems to potable water systems verifying that the sanitation system lies downstream from the potable water system.
4) Check and ensure that facilities for hospital wastewater disposal cannot contaminate local serviceable drinking water.
5) Verify types of independent or combined systems for water intake through the system's base (drains, showers, others) as a result of rain or flooding.
6) Check the operation of the valves that prevent sewage water from regurgitating back into the cistern and the location of the treatment systems with respect to the potable water management system.
7) Visual inspection will supplement the information from drawings, plans, and site records.
8) Check if there are sufficient toilets (at least 1 per 15 patients and staff) that are functioning and accessible and safely separate the user from excreta.

3.3.5.2. Safety of solid waste system:

Solid waste should be managed and disposed of safely and adequately in accordance with appropriate legislation and guidance. Specific hazardous wastes (i.e., sharps, non-sharps, infectious wastes, blood samples, pharmaceuticals) require special consideration. There are three essential steps to the management of hazardous solid waste:

- **Segregation or classification of waste.** The level of preparedness of personnel and the establishment of biosecurity protocols must be checked, including the use of appropriate containers for different types of waste, such as high-resistance red polypropylene bags for hazardous substances, sharps containers, and containers for special elements.

- **Handling and storage.** Hazardous materials should be safely stored in sealed bags. The area must be located away from inpatient services (in service areas) and closed in a way that prevents break-ins. The location should be covered but accessible for cleaning, protected to avoid flooding or leakage outside the area, clearly marked with the universal symbol, accessible to transportation teams, and with enough storage space to hold the amount of waste that accumulates between collections.

- **Collection and transportation.** Transportation to the place of final treatment or disposal will be in special, closed vehicles with specific timelines, leaving the collection area perfectly clean. Containers used for hazardous materials should be placed away from traffic areas, should be secured to walls so that they cannot be moved easily, and must have safety covers.

Recommended evaluation methods:

1) The evaluators should ensure that hazardous solid waste do not pollute the environment and does not cause any risk to health.
2) Visual inspection will supplement the information from maintenance and inspection records.

3.3.5.3. Emergency maintenance and restoration of all types of hospital waste management systems:

The maintenance division should provide the operations manual and preventive maintenance records for hazardous solid waste management systems.

Recommended evaluation methods:

1) Verify that there are emergency procedures for maintaining hazardous solid waste systems in emergency/disaster situations.
2) Check that personnel have been trained to an appropriate standard to maintain the correct level of safety of waste management systems of the hospital in both routine and emergency/disaster situations.

3.3.6 Fuel storage systems (e.g. gas, gasoline and diesel) (1 Indicators)

3.3.6.1. Fuel reserves:

Fuel reserves (fuel supplies or storage) ensure the availability of fuel to respond to emergencies and disasters. Hospitals that do not have fuel reserves or fuel tanks and are provided with fuel from petrol stations on a contractual basis, for instance, should be given a low rating. In earthquake-prone areas, the fuel connections between the generator and the tank should be flexible.

Recommended evaluation methods:  Observation  Inspection

1) Verify that the hospital has fuel supplies or storage tanks of adequate size and safety.
2) Verify the level of demand for fuel at the maximum capacity of the hospital, taking into account the additional capacity required to respond to emergencies and disasters.
3) Check the size of reserve tanks to ensure that the reserve is sufficient to meet the demand for each type of fuel at the maximum capacity of the hospital for at least 72 hours (bearing in mind there may be a high increase in service demand) to enable the hospital to respond in emergencies and disasters.
4) Observe how much fuel is available at the time of the assessment.
5) Determine how often fuels are delivered and whether supplies can be delivered effectively during emergencies or following disasters, especially if access and road networks have been compromised.

3.3.7 Medical Gases Systems (5 Indicators)

3.3.7.1. Location of storage areas for medical gases:

Oxygen supply banks and storage tanks of medical gases should be located outside the hospital building because of the risk of tank discharge and explosion. These areas should be well-ventilated, well-illuminated, and legibly marked and labeled. There should be a secure enclosure around the site, signifying that the gases and equipment are dangerous. The location should be in an area unlikely to flood, at a distance from any heat sources, and protected from flying or falling debris. The site should be easily accessible for facilities, maintenance, and fire response personnel.

Recommended evaluation methods:  Observation  Inspection

1) Verify that there is a site designated solely for storage of tanks and/or cylinders and related equipment for medical gases, and that only this equipment occupies the designated area.

2) Check that these areas are well-ventilated, well-illuminated and legibly marked and labelled. 3. Check that there is a secure enclosure around the site, with signage indicating that the gases and equipment are dangerous.

3) Verify that the location is unlikely to flood, at a distance from any heat sources, and protected from flying or falling debris.

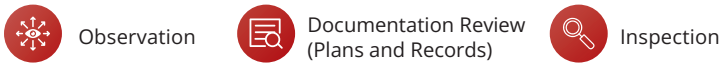
4) Verify that the site is easily accessible for facilities, maintenance and fire response personnel.

3.3.7.2. Safety of storage areas for medical gas tanks and/or cylinders:

Hospitals should ensure that the medical gas bottles, tanks, and cylinders are safe and secure, prevented from falling over, and protected from hazards (e.g., obstacles, fire, anchors, and braces). The size of the storage areas must also be adequate for the correct handling of bottles, tanks, and cylinders from deliveries. Each cylinder containing gas must have permanent marks that show whether it has pure gas or a mix of gases inside. Storage areas should also show the types of risks and safety measures to be taken to apply the necessary control actions when manipulating the cylinders. The cylinders should not be painted.

In earthquake-prone zones and high-wind areas, medical gas tanks in storage areas should be well-braced or anchored if these tanks or cylinders should not be stored in undesignated parts of the hospital, such as corridors. Fire extinguishing equipment must be available, and personnel must be trained in its use.

Recommended evaluation methods:



1) Visit areas where medical gas bottles, tanks, and cylinders are stored to verify that they are safe, secure, and prevented from falling over and protected from hazards (e.g., obstacles, fire, anchors, braces).

2) Verify that the size of the storage areas is adequate for the correct handling of bottles, tanks, and cylinders from deliveries.

3) Check that the storage areas show the signs of the types of risks and safety measures.

4) Check that the medical gas tanks in storage areas are well-braced or anchored in earthquake-prone high-wind zones and regions.

5) If these tanks or cylinders are stored in undesignated parts of the hospital, such as corridors, the rating should be “low.”

6) Ascertain that the personnel responsible for managing medical gases know all safety procedures and isolation requirements for each type of gas used.

7) Verify the availability of fire extinguishing equipment and train personnel for this equipment.

8) Visual inspection will supplement the information from maintenance and inspection records.

3.3.7.3. Condition and safety of medical gas cylinders and related equipment in the hospital:

Gas bottles, tanks, and cylinders are usually located in the service areas where they are used. They contain a variety of gases under high pressure; some are toxic, others are flammable. In general, the gas containers should be well-ventilated, braced, or anchored to avoid damage to their valves if they fall and to avoid injuring patients and staff or damaging other equipment. Each oxygen outlet should have a valve that can close the supply. Quick access to the premises is necessary, and the location of the keys should be legibly marked for authorized personnel to use.

In earthquake-prone zones and high-wind areas, vertical oxygen tanks should be anchored in three or four directions with welded connections, bolts, or evenly spaced tie-downs; horizontal tanks should be anchored to walls so they cannot slide as a result of shaking during seismic events. Medical gas distribution pipes should have flexible connections when passing from building to building or across expansion/ seismic joints in earthquake-prone regions.

Recommended evaluation methods:

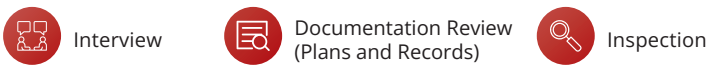
Follow the list of tasks mentioned in the preceding item.

3.3.7.4. Availability of alternative sources of medical gases:

1) Verify that alternative or standby sources for medical gases have an oxygen supply bank with the necessary reserve capacity and have reserve cylinders or bottles available.

2) Confirm whether the supplier of medical gases is in the vicinity and has reserves available to enable an appropriate supply chain in an emergency. Evaluators can obtain this information through supplier contract details and organizational policies and procedures.

Recommended evaluation methods:



3.3.7.5. Emergency maintenance and restoration of medical gas systems:

The maintenance section/division should provide the operations manual and preventive maintenance records for the medical gas system.

Recommended evaluation methods:

 Interview

 Documentation Review (Plans and Records)

1) Verify that there are emergency procedures for maintaining the medical gas system in emergency/disaster situations.
2) Check that personnel have been trained to an appropriate standard to maintain the correct level of safety of the hospital's medical gas systems in both routine and emergency/disaster situations.

3.3.8 Heating, Ventilation, and Air-conditioning (HVAC) Systems (4 Indicators)

3.3.8.1. Adequate location of enclosures for HVAC equipment:

Enclosures for boilers should be located away from the hospital building. Preferably, they should be housed in installations with some roof cover, isolated from fuel storage, in areas that are easy to access and difficult to obstruct or flood. When central air-conditioning units are on the roof of buildings, they should be protected from the weather. Any HVAC equipment should be easy to access (obstacles to access should be cleared) and positioned in locations that are protected from flooding.

Recommended evaluation methods:

 Observation

 Inspection

1) Check/verify the locations of enclosures for HVAC described above.

3.3.8.2. Safety of enclosures for HVAC equipment:

Enclosures for HVAC equipment should always be accessible and large enough to allow the operators to work comfortably on the equipment. Extractors for steam should ventilate the boiler room. The control panel should be steam-proof and protected from the temperature of the boiler. The enclosure should be equipped with fire-extinguishing equipment and alternate emergency lighting.

The following information should be legibly marked in the boiler room:

- Instructions for stopping the system with emergency alarms and quick-cut mechanisms;

- Name, telephone number and address of the person or entity responsible for building maintenance;
- Address and telephone number of the nearest fire station and the person responsible for the building;
- Location of the fire extinguisher in the room and signs to other fire extinguishers;
- Signs to the fire exits;
- A map of the emergency exit route).

Recommended evaluation methods:

 Interview  Observation  Inspection

1) Verify that the enclosures for HVAC equipment are always accessible and are large enough to allow the operators to work comfortably on the equipment.
2) Confirm that the information listed above is legibly marked in the boiler room.

3.3.8.3. Condition and safety of air-conditioning equipment:

Air-conditioning units are very heavy and generally located in areas with ventilation, such as on roofs, upper floors of the hospital, or floors dedicated to building machinery and equipment. Because of their weight, air-conditioning units can significantly change the behavior of the structure. Unless they are well-secured or anchored, the units can move or overturn and, as a result, can cause the partial or total collapse of the building.

Smaller split systems have the evaporator inside and the compressor and condenser outside, on the roof, patio, or elsewhere. The outdoor equipment is vulnerable to strong winds and floods and must be well-anchored and located out of reach of water that would damage the electrical system. Indoor units should be firmly anchored to structural elements; they could injure people or damage other equipment if they fall.

Recommended evaluation methods:

 Observation  Documentation Review (Plans and Records)  Inspection

1) Check the condition and safety of air-conditioning units which may be local or central, compact or not.
2) Check the condition and safety of window units or small portable units.
3) Visual inspection will supplement the information from maintenance and inspection records.

3.3.8.4. Emergency maintenance and restoration of HVAC systems:

The hospital's maintenance section/division should provide the operations manual and preventive maintenance records for the HVAC systems. Evaluators should verify that there are emergency procedures for maintaining the HVAC systems in emergency/disaster situations. Evaluators should check that personnel have been trained to an appropriate standard to maintain the correct level of safety of the hospital's HVAC systems in routine and emergency/disaster situations.

Recommended evaluation methods:

 Interview

 Documentation Review (Plans and Records)

Module 3:
Non-Structural Safety

Sub-Module 3.3: Critical Systems

3. CHECKLIST

Sub-Module 3.3 Critical Systems: This sub-module focuses on the safety, capacity, operational management, preventive maintenance and restoration of critical systems for the functioning of the hospital.

Critical systems include electrical, telecommunications, water supply, fire protection, waste management, fuel storage, medical gases, and heating, ventilation and air conditioning (HVAC) systems.

The failure or disruption of critical systems can stop or impede the functioning of hospitals. Failure does not usually put the structural stability of a building at risk but can endanger people and the contents of a building.

Indicators of Critical Systems of the Hospital are as below.
(L=Low, A=Average, H= High)Status of hospital's critical system is as below.

3.3 Critical systems	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.3.1 Electrical systems				
3.3.1.1. Capacity of alternate sources of electricity (e.g. generators) *Safety ratings:* Low = Alternate source(s) is(are) missing or covers less than 30% of demand in critical areas, or can only be started manually; Average = Alternate source(s) covers 31–70% of demand in critical areas and starts automatically in less than 10 seconds in critical areas; High = Alternate source(s) start(s) automatically in less than 10 seconds and cover(s) more than 70% of demand in critical areas.	☐	☐	☐	

3.3 Critical systems	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.3.1 Electrical systems				
3.3.1.2. Regular tests of alternate sources of electricity in critical areas *Safety ratings:* Low = Tested at full load every 3 months or more; Average = Tested at full load every 1 to 3 months; High = Tested at full load at least monthly.	☐	☐	☐	
3.3.1.3. Condition and safety of electrical equipment, cables and cable ducts *Safety ratings:* Low = Electrical equipment, power lines, cables and ducts are in poor condition, there are no protective measures; Average = Electrical equipment, power lines, cables and ducts are in fair condition; some measures provide partial protection and security; High = Electrical equipment, power lines, cables and ducts are in good condition, well-secured and in good working order.	☐	☐	☐	
3.3.1.4. Condition and safety of internal and external lighting systems *Safety ratings:* Low = Internal and external lighting systems are in poor condition, there are no protective measures; Average = In fair condition; some measures provide partial protection; High = In good condition, well-protected and in good working order.	☐	☐	☐	
3.3.1.5. Emergency maintenance and restoration of electric power supply and alternate sources *Safety ratings:* Low = Documented procedures and maintenance/inspection records do not exist; Average = Documented procedures exist, maintenance/inspection records are up to date, personnel have been trained, but resources are not available; High = Documented procedures exist, maintenance/inspection records are up to date, personnel have been trained, and resources are in place for implementing emergency maintenance and restoration.	☐	☐	☐	

3.3 Critical systems	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.3.2 Telecommunications systems				
3.3.2.1. Condition and safety of communication system (This is besides the land phone connections; Refer to the Guidance on this indicator) *Safety ratings:* Low = Antennas and bracing in poor condition, there are no protective measures; Average = Antennas and bracing are in fair condition, some measures provide partial protection; High = Antennas and bracing are in good condition, well-secured and protection measures are in place. *IF THERE ARE NO ANTENNAS, LEAVE BOXES BLANK AND PROVIDE COMMENT.*	☐	☐	☐	
3.3.2.2. Condition and safety of low- and extra-low-voltage systems (internet and telephone) *Safety ratings:* Low = Low voltage systems in poor condition, there are no protective measures; Average = Low voltage systems in fair condition, some measures provide partial protection; High = Good condition, well-secured and other protection measures in place.	☐	☐	☐	
3.3.2.3. Emergency maintenance and restoration of communications systems *Safety ratings:* Low = Documented procedures and maintenance/ inspection records do not exist; Average = Documented procedures exist, maintenance/ inspection records are up to date, personnel have been trained, but resources are not available; High = Documented procedures exist, maintenance/ inspection records are up to date, personnel have been trained, and resources are in place for implementing emergency maintenance and restoration.	☐	☐	☐	

3.3 Critical systems	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.3.3 Water supply system				
3.3.3.1. Water reserves for hospital services and functions *Safety ratings:* Low = Sufficient for 24 hours or less or water tank does not exist; Average = Sufficient for more than 24 hours but less than 72 hours; High = Guaranteed to cover at least 72 hours.	☐	☐	☐	
3.3.3.2. Safety of the water distribution system *Safety ratings:* Low = Less than 60% are in good operational condition; Average = Between 60% and 80% are in good condition; High = Above 80% are in good condition.	☐	☐	☐	
3.3.3.3. Supplementary pumping system *Safety ratings:* Low = There is no back-up pump and operational capacity does not meet mini- mum daily demand; Average = Supplementary pumps are in fair condition but would not meet the minimum daily demand for water; High = All supplementary pumps and back-up systems are operational and would meet the minimum demand for water.	☐	☐	☐	
3.3.3.4. Emergency maintenance and restoration of water supply systems *Safety ratings:* Low = Documented procedures and maintenance/ inspection records do not exist; Average = Documented procedures exist, maintenance/ inspection records are up to date, personnel have been trained, but resources are not available; High = Documented procedures exist, maintenance/ inspection records are up to date, personnel have been trained, and resources are in place for implementing emergency maintenance and restoration.				

3.3 Critical systems	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.3.4 Fire protection system				
3.3.4.1. Condition and safety of the fire protection (passive) system *Safety ratings:* Low = Element(s) are subject to damage, and damage would impede the function of this and other elements, systems or operations; Average = Element(s) are subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the function of this and other elements, systems or operations.	☐	☐	☐	
3.3.4.2. Fire/smoke detection systems *Safety ratings:* Low = No system has been installed; Average = System is partially installed, or infrequently maintained and tested; High = System is installed and well-maintained and tested frequently.	☐	☐	☐	
3.3.4.3. Water supply for fire suppression *Safety ratings:* Low = A source of permanent supply which could be used for fire suppression does not exist; Average = A source of permanent supply of water is available for fire suppression; there is limited capacity available, and no maintenance and testing has been conducted; High = A source of permanent water supply with significant capacity for fire suppression is available, regularly maintained and frequently tested.	☐	☐	☐	
3.3.4.4. Emergency maintenance and restoration of the fire protection system *Safety ratings:* Low = Documented procedures and maintenance/ inspection records do not exist; Average = Documented procedures exist, maintenance/ inspection records are up to date, personnel have been trained, but resources are not available; High = Documented procedures exist, maintenance/inspection records are up to date, personnel have been trained, and resources are in place for implementing emergency maintenance and restoration.				

3.3 Critical systems	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.3.5 Waste management systems				
3.3.5.1. Safety of wastewater and liquid waste *Safety ratings:* Low = System for hazardous wastewater disposal does not exist or is in poor condition; Average = System is in fair condition but little or no evidence of compliance and maintenance; High = Disposal system has good capacity and evidence of compliance and maintenance.	☐	☐	☐	
3.3.5.2. Safety of solid waste system *Safety ratings:* Low = System for hazardous waste disposal does not exist or is in poor condition; Average = System is in fair condition but little or no evidence of compliance and maintenance; High = Disposal system is in good condition with good capacity and evidence of compliance and maintenance.	☐	☐	☐	
3.3.5.3. Emergency maintenance and restoration of all types of hospital waste management systems *Safety ratings:* Low = Documented procedures and maintenance/ inspection records do not exist; Average = Documented procedures exist, maintenance/ inspection records are up to date, personnel have been trained, but resources are not available; High = Documented procedures exist, maintenance/ inspection records are up to date, personnel have been trained, and resources are in place for implementing emergency maintenance and restoration.	☐	☐	☐	

3.3 Critical systems	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.3.6 Fuel storage systems (e.g. gas, gasoline and diesel)				
3.3.6.1. Fuel reserves *Safety ratings:* Low = Sufficient for 24 hours or less, or fuel tank does not exist; Average = Sufficient for more than 24 hours but less than 72 hours; High = Guaranteed to cover at least 72 hours.	☐	☐	☐	
3.3.7 Medical gases systems				
3.3.7.1. Location of storage areas for medical gases *Safety ratings:* Low = No sites reserved for medical gases, or sites for medical gases are at high risk of failure due to hazards; there are no protective measures, and storage is not accessible; Average = Reserved areas in fair condition and fair location; some measures provide partial protection; High = In good condition, well-secured and other protective measures in place; storage is accessible.	☐	☐	☐	
3.3.7.2. Safety of storage areas for medical gas tanks and/or cylinders *Safety ratings:* Low = Medical gas tanks and cylinders in storage areas are poor condition; no protection measures, not secured; personnel are not trained to operate medical gas and fire extinguishing equipment; Average = Medical gas tanks and cylinders in storage areas are in fair condition, some measures provide partial protection; the quality of anchors and braces is inadequate; personnel are trained to operate equipment; High = Good condition, well-secured and protected, anchors are of good quality for major hazards; medical gas and fire extinguishing equipment operated by qualified personnel.				

3.3 Critical systems	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.3.7.3. Condition and safety of medical gas cylinders and related equipment in the hospital *Safety ratings:* Low = Medical gas tanks and cylinders in hospital areas are in poor condition, no protective measures; not secured; Average = Medical gas tanks and cylinders are in fair condition; the quality of anchors and braces is inadequate; some measures provide partial protection; High = Good condition, well-secured and protected; anchors are of good quality for major hazards.				
3.3.7.4. Availability of alternative sources of medical gases *Safety ratings:* Low = Alternative sources are not available; Average = Alternative sources in place but delivery of supplies takes longer than 15 days; High = Sufficient alternative sources are available at short notice (less than 15 days).				
3.3.7.5. Emergency maintenance and restoration of medical gas systems *Safety ratings:* Low = Documented procedures and maintenance/ inspection records do not exist; Average = Documented procedures exist, maintenance/ inspection records are up to date, and personnel have been trained, but resources are not available; High = Procedures exist, maintenance/inspection records are up to date, personnel have been trained, and resources are in place for implementing emergency maintenance and restoration.				

3.3 Critical systems	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.3.8 Heating, ventilation, and air-conditioning (HVAC) systems				
3.3.8.1. Adequate location of enclosures for HVAC equipment *Safety ratings:* Low = HVAC enclosures are not accessible, and they are not located in a safe site; there are no protective measures; Average = HVAC enclosures are accessible, located at a safe site; some measures provide partial protection from hazards; High = HVAC enclosures are accessible, in a safe location and protected from hazards.	☐	☐	☐	
3.3.8.2. Safety of enclosures for HVAC equipment *Safety ratings:* Low = HVAC equipment is not accessible; no protection measures for safe operation and maintenance; Average = HVAC is accessible; some measures provide partial protection; High = HVAC equipment is accessible, wide range of protection measures in place.	☐	☐	☐	
3.3.8.3. Condition and safety of air-conditioning equipment *Safety ratings:* Low = Air-conditioning units in poor condition, not secured; Average = Air- conditioning units are in fair condition; some measures provide partial protection (e.g. quality of anchors and braces is inadequate); High = Good condition, well-secured and protected from hazards (e.g. anchors are of good quality).				
3.3.8.4. Emergency maintenance and restoration of HVAC systems *Safety ratings:* Low = Documented procedures and maintenance/ inspection records do not exist; Average = Documented procedures exist, maintenance/ inspection records are up to date, personnel have been trained, but resources are not available; High = Documented procedures exist, maintenance/ inspection records are up to date, personnel have been trained, and resources are in place for implementing emergency maintenance and restoration.				

Comments on the results of Sub-Module 3.3:

Module 3:
Non-Structural Safety

Sub-Module 3.4: Equipment and Supplies

2. GUIDANCE

In hospitals, medical equipment and supplies play a vital role in the diagnostics, monitoring, and treatment of patients.

Hospitals use an extensive range of equipment (including medical, diagnostic, and office equipment), nonclinical services, and supplies to provide patient treatment and fulfill other critical roles in the hospital. The safety of equipment and supplies, especially in hospitals prone to earthquakes and high winds, is threatened due to the risk of falling, sliding, hanging, and loosening. The Submodule 3.4 is divided into three sections. Table-1 presents the distribution of elements by sections.

Table 1: Distribution of Indicators/Elements by Sub-Modules

Sections Sub-Module 3.4	Indicators/Elements
3.4.1 Office and storeroom furnishings and equipment (fixed and movable)	2
3.4.2 Medical and laboratory equipment and supplies used for diagnosis and treatment.	8
3.4.3 Medicines, Supplies, and Equipments	6
Total	**16**

3.4.1 Office and storeroom furnishings and equipment (fixed and movable) (2 Indicators)

3.4.1.1. Safety of shelving and shelf contents:

The office and storeroom furnishings and equipment (fixed and movable) shelving and shelf contents, including computers and printers, air-conditioning equipment available at the delivery room, X-Ray room, and OT should be secured from falling sliding, hanging, and loosening. The hospital should maintain a designated storage facility. Shelves should not pose an occupational hazard or be at risk of falling in a hazardous event. They will not obstruct emergency access, evacuation routes or emergency exits. Shelves of medical contents should all have lips or railings to prevent bottles or other materials from falling. Connecting the shelves increases lateral stability, lessening the chance that they will fall.

Recommended evaluation methods:  Observation  Inspection

1) Verify that shelving (whether as shelving units or wall attachments) and its contents are safely secured from falling.
2) Check that the shelving and its contents are located where they will not obstruct emergency access, and evacuation routes or emergency exits.
3) Check that the shelves of medical contents have lips or railings.
4) In hospitals prone to earthquakes and high winds, verify that shelves are anchored to the walls and/or are braced and that the contents are secured.
5) Check that the clinical areas, offices, libraries and clinical records archives commonly have shelving units with glass doors and these units are connected to each other and have unbreakable material instead of glass.

3.4.1.2. Safety of computers and printers:

Much of a hospital's information is found on its computers. To ensure that a facility continues to function, computers and their contents must be secured against damage caused by natural hazards.

Recommended evaluation methods:  Observation  Inspection

1) Verify that computer tables are secure and will not move. Check if tables are on wheels, the wheels should be in the locked position.
2) In hospitals at risk of flooding or heavy rain, computer centres and computers, particularly servers, check that they are located where they will not be at risk of water damage.

3) Note that the basements and ground-floor areas are particularly susceptible to flooding.

4) Check whether the sprinkler systems for firefighting systems do not pose damage to computers and other electronic equipment.

3.4.2 Medical and laboratory equipment and supplies used for diagnosis and treatment (8 Indicators)

3.4.2.1. Safety of medical equipment in operating theatres and recovery rooms:

In hospitals in earthquake-prone zones or at risk of high winds, the safety of operating equipment, including lamps, anesthesia equipment, and surgical tables, are safe and operational; the table or cartwheels should all be locked. The ceiling light fixtures in surgery should function, the hinges on the extension arm should be adjusted appropriately. These fixtures should be well-anchored to beams to prevent them from swinging. The life support equipment should be anchored entirely, eliminating the possibility of disconnection from the patient. Flexible hoses and tubes with swivel connectors and automatic shut-off valves should be used for connecting equipment to medical gases, water, or steam. Cables that connect equipment to a power source should pass through a conduit so that they cannot tangle during rotational motion. Equipment should not be placed above the patient. Equipment should be braced against a wall when not in use, with brakes applied to carts and rolling tables.

Recommended evaluation methods:  Observation  Inspection

1) Verify that medical equipment is safely secured concerning natural and other hazards; check that the lamps, anesthesia equipment, and surgical tables are safe and operational; the table or cartwheels are locked.

2) Check that the operating theatres and recovery rooms are safe from the effects of natural hazards, including flooding, earthquakes, and winds.

3) Check that the ceiling light fixtures in surgery are functioning, the hinges on the extension arm are appropriately adjusted, and fixtures are well-anchored to beams to prevent them from swinging.

4) Inspect that all equipment's braces, latches, and castor brakes are in usable condition.

5) Check that the life support equipment are wholly anchored.

6) Check that the equipment are braced against a wall, with brakes applied to carts and rolling tables.

3.4.2.2. Condition and safety of radiology and imaging equipment:

The radiology and imaging equipment such as X-ray equipment and carts holding the equipment and brakes for cartwheels must be safely secured and functional. These equipment shall be located where flooding cannot damage them. In the case of computed axial tomography (CAT), they shall be functional and safely secured. The operators should be familiar with all safety protocols for using the equipment. In earthquake-prone areas, adequate anchors for the heavy equipment are needed to keep it from tipping or moving. Power connections and other connections should be flexible; cables should be disconnected than broken. Hospital equipment is susceptible to sudden changes in voltage (e.g., computed tomography scanner, mammography equipment, excimer laser, magnetic resonance imaging scanner).

Recommended evaluation methods:

 Interview  Observation  Inspection

1) Verify that radiology and imaging equipment is safely secured; check that they are located in flooding safe areas.
2) Verify that the condition of X-ray equipment and carts holding the equipment is in good condition and secured; the cart wheels' brakes are functional.
3) Check whether the radiology and imaging equipment operators are trained and familiar with all safety protocols for using the equipment.

3.4.2.3. Condition and safety of laboratory equipment and supplies:

Operators of the laboratory equipment and supplies shall pay special attention to handling and securing biological samples. Biosafety measures should be in place. If biological and chemical containers break or leak at any time, technicians, patients, or the laboratory itself could be contaminated. Further safety measures may be required to protect laboratory equipment and supplies from movement or damage due to hazardous phenomena. Refrigeration units for laboratory supplies should be in good order, and their contents should be secured. In hospitals in earthquake-prone zones or high-wind areas, shelving used to store laboratory supplies, including biological and chemical containers, must be well-anchored (see item 3.4.2.1). There should be adequate fire protection items or systems such as extinguishers, standpipe systems, and laboratory staff to operate this equipment.

Recommended evaluation methods:

 Interview  Observation  Inspection

1) Inspect whether the biosafety measures are in place and the biological samples are kept securely and handled safely.
2) Check whether hospitals maintain safety measures to protect laboratory equipment and supplies from movement or damage due to hazardous phenomena.

3) Inspect the refrigeration units for laboratory supplies to ensure that they are in good order and their contents are secured.

4) In hospitals in earthquake-prone zones or high-wind areas, check that shelving used to store laboratory supplies, including biological and chemical containers, is well-anchored.

5) Inspect whether the hospital has adequate fire protection items or systems such as extinguishers, standpipe systems.

6) Check whether the laboratory staffs are trained and familiar with all safety protocols for using the equipment.

3.4.2.4. Condition and safety of medical equipment in emergency care services unit:

Equipment such as crash carts, oxygen tanks, monitors shall be in working order and secured.

Recommended evaluation methods:  Observation  Inspection

Refer to the instructions in items 3.4.2.1 and 3.4.2.2 when assessing the condition and safety of equipment in the emergency care services unit.

3.4.2.5. Condition and safety of medical equipment in intensive or intermediate care unit:

The essential and specialized intensive care equipment such as life-support systems, ventilators, resuscitation equipment, oxygen tanks, monitors shall be in good working order and well-secured. Added hazards of contamination or infection are likely in the quarantine units of the hospital.

Recommended evaluation methods:

 Interview  Observation  Inspection

1) Refer to the instructions in items 3.4.2.1 and 3.4.2.2 when assessing the condition and safety of equipment in the intensive care unit.

2) Check that essential and specialized intensive care equipment is in good working order and is well-secured.

3) Rigorously inspect the quarantine units of the hospital.

3.4.2.6. Condition and safety of equipment and furnishings in the pharmacy:

Refrigeration units for medicine and other supplies in the pharmacy shall be in good order, and their contents are secured. In hospitals in earthquake-prone zones or high-wind areas, shelving used to store medicines must be well-anchored. Because some materials in the pharmacy are flammable, there should be adequate fire protection items or systems such as extinguishers, standpipe systems. The pharmacy staff must be trained in operating the equipment in the pharmacy. Measures should be in place to ensure that the pharmacy is secured against theft.

Recommended evaluation methods:  Observation  Inspection

1) Refer to the instructions in items 3.4.2.1 and 3.4.2.2 when assessing the condition and safety of equipment in the pharmacy.
2) Inspect whether the refrigeration units for medicine and other supplies are in good order and secure their contents.
3) In hospitals in earthquake-prone zones or high-wind areas, verify that the shelving used for the storage of medicines is well-anchored.
4) Check whether the pharmacy has adequate fire protection items or systems (extinguishers, standpipe systems, etc.) because some materials in the pharmacy are flammable.
5) Check whether the pharmacy staffs are trained in operating the equipment and supplies.
6) Check whether the pharmacy is secured against theft.

3.4.2.7. Condition and safety of medical equipment for obstetric emergencies and neonatal care:

Specific neonatal equipment includes incubators, resuscitation equipment, oxygen tanks, and monitors. While a hospital may not have specialized services for neonatal care, but equipment and supplies available for a basic level of emergency care for obstetric emergencies and neonatal care.

Recommended evaluation methods:  Observation  Inspection

1) Refer to the instructions in items 3.4.2.1 and 3.4.2.2 when assessing the condition and safety of equipment for obstetric emergencies and neonatal care.
2) If the hospital has no specialized services for neonatal care, check that equipment and supplies are available for a basic level of emergency care for obstetric emergencies and neonatal care.

3) Check that equipment is in working order and is secured.

4) Review the sanitation and hygiene maintained in the units, particularly in birthing rooms, because of the vulnerable condition of newborns.

5) Check that the doors and windows are resistant to strong winds because if water penetrates the area, specialized equipment can be damaged or destroyed.

3.4.2.8. Condition and safety of medical equipment and supplies for emergency care for burns:

While a hospital may not have specialized services for burns patients, but equipment and supplies are available for a basic level of emergency care for burns. This equipment includes life-support systems, ventilators, oxygen tanks, monitors, crash carts, etc.

Recommended evaluation methods:  Observation  Inspection

1) Refer to the instructions in items 3.4.2.1 and 3.4.2.2 when assessing the condition and safety of the equipment for emergency care for burns.

2) If the hospital has no specialized services for burns patients but equipment and supplies available for a basic level of emergency care for burns, check that basic and/or specialized burn care equipment and supplies are in good working order and well-secured.

3.4.3. Medicines, Supplies and Equipment (6 Indicators)

3.4.3.1. Medicines and supplies:

In responding to emergencies and disasters, hospitals may require the additional capacity of medicines and supplies. The additional stock will allow the hospitals to cover the maximum demand for at least 72 hours to ensure that the hospital can sustain services in an emergency or disaster.

Recommended evaluation methods:

 Interview  Documentation Review (Plans and Records)  Inspection

1) Verify whether the demand for medicines and supplies is at the planned maximum capacity of the hospital.

2) Check if the availability of medicines will cover the maximum demand for at least 72 hours.

3.4.3.2. Medical equipment specifically used in emergencies and disasters:

The medical equipment and instruments used in the hospital specifically in emergencies include endotracheal intubation kits, chest drain sets, surgical sets, neck collars, backboards, pelvic binders, infusion/transfusion sets, emergency obstetric kits, nebulizers, heavy duty oximeter, nasal cannula, oxygen masks, etc. The level of the demand for medical instruments at the maximum capacity of the hospital, taking into account the types of services provided and the additional capacity required to respond to emergencies and disasters, the availability of instruments should cover the maximum demand for at least 72 hours.

Recommended evaluation methods:

 Interview  Documentation Review (Plans and Records)  Inspection

1) Verify the existence and maintenance of medical equipment and instruments used in the hospital, specifically in emergencies, as indicated above.
2) Check if the availability of medical equipment will cover the maximum demand for at least 72 hours.

3.4.3.3. Supply of medical gases:

The medical gases used in anesthesia and intensive care are oxygen, nitrous oxide, medical air, Entonox, carbon dioxide, and heliox. Oxygen is one of the most widely used gases for life-support and respiratory therapy besides anesthetic procedures. The level of demand for medical gases at the maximum capacity of the hospital, taking into account the types of services provided by the hospital and the additional capacity required to respond to emergencies and disasters. The availability of medical gases should cover maximum demand for at least 15 days to ensure that the hospital can provide services in emergencies. The 15-day supply standard is used because large quantities of medical gases are required, and deliveries of these gases tend to be infrequent.

Recommended evaluation methods:

 Interview  Documentation Review (Plans and Records)  Inspection

1) Verify the level of demand for medical gases at the maximum capacity of the hospital.
2) Check that the availability of medical gases will cover maximum demand for at least 15 days to ensure that the hospital can provide services in emergencies.
3) Check the reserve capacity of each type of medical gas used in the hospital, taking into account both the central supply bank and the cylinders or bottles in areas of service.
4) Verify the existence of up-to-date emergency contact details (telephone numbers and addresses) of medical gas suppliers.

3.4.3.4. Mechanical volume ventilators:

Ventilators are chiefly used in intensive care medicine, home care, emergency medicine (as standalone units), and anesthesiology (as a component of an anesthesia machine). Hospitals shall maintain an inventory of the quantity, condition, and protocols for the use of this equipment is available (usually from the Hospital Emergency/Disaster Committee). The level of demand for mechanical volume ventilators at the maximum capacity of the hospital, taking into account the types of services provided by the hospital and the additional capacity required to respond to emergencies and disasters. The ventilators available should cover the maximum demand for at least 72 hours to ensure that the hospital can sustain services in an emergency or disaster.

Recommended evaluation methods:

 Interview  Documentation Review (Plans and Records)  Inspection

1) Verify that the inventory of the quantity, condition, and protocols for using this equipment is available.
2) Verify the level of demand for mechanical volume ventilators at the maximum capacity of the hospital.
3) Check that the ventilators available will cover the maximum demand for at least 72 hours.

3.4.3.5. Life-support equipment:

Hospitals shall maintain an inventory of the quantity, condition, and protocols for using the equipment such as defibrillators, ventilators that are available (usually from the Hospital Emergency/Disaster Committee). The level of the demand for life-support equipment at the maximum capacity, taking into account the types of services provided by the hospital and the additional capacity required to respond to emergencies and disasters. The availability of life-support equipment should cover the maximum demand for at least 72 hours to ensure that the hospital can sustain the provision of services in an emergency or disaster.

Recommended evaluation methods:

 Interview  Documentation Review (Plans and Records)  Inspection

1) Verify the inventory of the quantity, condition, and protocols for using this equipment (e.g., defibrillators, ventilators).
2) Verify the level of the demand for life-support equipment at the maximum capacity of the hospital.
3) Evaluators should check that the availability of life-support equipment will cover the maximum demand for at least 72 hours.

3.4.3.6. Supplies, equipment or crash carts for cardiopulmonary arrest:
Hospitals shall maintain the inventory of the quantity, condition, locations, and protocols for using the equipment and supplies for managing cardiopulmonary arrest (usually from the Hospital Emergency/Disaster Committee). The level of the demand for cardiopulmonary arrest at the maximum capacity of the hospital, taking into account the types of services provided by the hospital and the additional capacity required to respond to the most likely emergencies and disasters. The availability of these supplies and equipment should cover the planned maximum capacity for at least 72 hours to ensure that the hospital can sustain services in an emergency or a disaster.

Recommended evaluation methods:

 Interview

 Documentation Review (Plans and Records)

 Inspection

1) Verify that the inventory of the quantity, condition, locations, and protocols for using the equipment and supplies for managing cardiopulmonary arrest is available.
2) Verify the level of the demand for cardiopulmonary arrest at the maximum capacity of the hospital.
3) Check that the availability of these supplies and equipment will cover the planned maximum capacity for at least 72 hours.

Module 3:

Non-Structural Safety

Sub-Module 3.4: Equipment and Supplies

3. CHECKLIST

Sub-Module 3.4: Equipment and Supplies: All staff use a large range of equipment (medical, diagnostic and office equipment), nonclinical services and supplies to provide treatment to patients and fulfil other critical roles in the hospital.

The condition, safety, and stability of all equipment to protect it from damage that has the potential to cause injury to building occupants and to disrupt the functioning of the hospital services.

Indicators of Critical Systems of the Hospital are as below. (L=Low, A=Average, H= High) Status of hospital's critical system is as below.

Indicators of Critical Systems of the Hospital are as below.
(L=Low, A=Average, H= High) Status of hospital's critical system is as below.

3.4 Equipment and supplies	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.4.1 Office and storeroom furnishings and equipment (fixed and movable)				
3.4.1.1. Safety of shelving and shelf contents *Safety ratings:* Low = Shelving is not safely located (or in seismic and wind-prone areas not attached to walls in more than 20% of cases); Average = Shelving is safely located (and attached to walls in seismic and wind-prone areas) and contents are secured in 20–80% of cases; High = More than 80% of shelving and the contents of shelves are safely located, attached to walls, and contents are secured.	☐	☐	☐	

3.4 Equipment and supplies	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.4.1 Office and storeroom furnishings and equipment (fixed and movable)				
3.4.1.2. Safety of computers and printers *Safety ratings:* Low = No measures to protect computers from hazards are in place; Average = Computers are in safe locations, some measures offer partial protection from hazards; High = Computers are in safe locations, well-secured and good protective measures in place.	☐	☐	☐	
3.4.2 Medical and laboratory equipment and supplies used for diagnosis and treatment				
3.4.2.1. Safety of medical equipment in operating theatres and recovery rooms *Safety ratings:* Low = The operating theatres are in an unsafe location, equipment is lacking or in poor condition or there are no protective measures; Average = The operating theatres are in a safe location, equipment is in fair condition, and some measures provide partial protection; High = Operating theatres are in a safe location, equipment is in good condition, is well-secured and measures provide protection.	☐	☐	☐	
3.4.2.2. Condition and safety of radiology and imaging equipment *Safety ratings:* Low = The radiology and imaging equipment is not in a safe location, equipment is lacking or in poor condition, or there are no protective measures; Average = The equipment is in a safe location, is in fair condition, and some measures offer partial protection; High = Equipment is in a safe location, is in good condition, well-secured and measures provide good protection.	☐	☐	☐	

3.4 Equipment and supplies	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.4.2 Medical and laboratory equipment and supplies used for diagnosis and treatment				
3.4.2.3. Condition and safety of laboratory equipment and supplies *Safety ratings:* Low = Biosafety measures are poor, laboratory equipment is lacking or in poor condition, or there are no protective measures; Average = Biosafety measures are in place, the equipment is in fair condition, and some measures provide partial protection; High = Biosafety measures are in place, equipment is in good condition, well-secured and measures provide good protection.	☐	☐	☐	
3.4.2.4. Condition and safety of medical equipment in emergency care services unit *Safety ratings:* Low = The medical equipment is lacking or in poor condition or there are no protective measures; Average = The equipment is in fair condition and some measures provide partial protection; High = Equipment is in good condition, well-secured and measures provide good protection.	☐	☐	☐	
3.4.2.5. Condition and safety of medical equipment in intensive or intermediate care unit *Safety ratings:* Low = The medical equipment is lacking or in poor condition, or there are no protective measures; Average = The equipment is in fair condition and some measures provide partial protection; High = Equipment is in good condition, is well-secured and measures provide good protection.	☐	☐	☐	

3.4 Equipment and supplies	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.4.2 Medical and laboratory equipment and supplies used for diagnosis and treatment				
3.4.2.6. Condition and safety of equipment and furnishings in the pharmacy *Safety ratings:* Low = The equipment in the pharmacy is lacking or in poor condition, or there are no protective measures; Average = The equipment is in fair condition and some measures provide partial protection; High = Equipment is in good condition, is well-secured and measures provide good protection.	☐	☐	☐	
3.4.2.7. Condition and safety of medical equipment for obstetric emergencies and neonatal care *Safety ratings:* Low = Equipment is lacking or in poor condition, or there are no protective measures; Average = Equipment is in fair condition and some measures provide partial protection; High = Equipment is in good condition, is well-secured and measures provide good protection.	☐	☐	☐	
3.4.2.8. Condition and safety of medical equipment and supplies for emergency care for burns *Safety ratings:* Low = Equipment is lacking, is in poor condition, or there are no protective measures; Average = Equipment is in fair condition and some measures provide partial protection; High = Equipment is in good condition, is well-secured and measures provide good protection.	☐	☐	☐	

3.4 Equipment and supplies	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.4.3 Medicines, Supplies and Equipment				
3.4.3.1. Medicines and supplies *Safety ratings:* Low = Nonexistent; Average = Supply covers less than 72 hours at maximum capacity; High = Supply guaranteed for at least 72 hours at maximum hospital capacity.	☐	☐	☐	
3.4.3.2. Medical equipment specifically used in emergencies and disasters *Safety ratings:* Low = Nonexistent; Average = Supply covers less than 72 hours at maximum hospital capacity; High = Supply guaranteed for at least 72 hours at maximum hospital capacity.	☐	☐	☐	
3.4.3.3. Supply of medical gases *Safety ratings:* Low = Less than 10 days' supply; Average = Supply for between 10 and 15 days; High = Supply for at least 15 days.	☐	☐	☐	
3.4.3.4. Mechanical volume ventilators *Safety ratings:* Low = Nonexistent; Average = Supply covers less than 72 hours at maximum hospital capacity; High = Supply guaranteed for at least 72 hours at maximum hospital capacity.				

3.4 Equipment and supplies	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
3.4.3 Medicines, Supplies and Equipment				
3.4.3.5. Life-support equipment (defibrillators, ventilators Oxygen concentrator, Kidney dialysis machine, etc.) *Safety ratings:* Low = Nonexistent; Average = Supply covers less than 72 hours at maximum hospital capacity; High = Supply guaranteed for at least 72 hours at maximum hospital capacity.	☐	☐	☐	
3.4.3.6. Supplies, equipment or crash carts for cardiopulmonary arrest *Safety ratings:* Low = Nonexistent; Average = Supplies and equipment for cardiopulmonary emergencies (or crash carts) in good condition but cover less than 72 hours at maximum hospital capacity; High = Supplies and equipment for cardiopulmonary emergencies (or crash carts) guaranteed in good condition and adequate supplies for at least 72 hours at maximum hospital capacity.	☐	☐	☐	

Comments on the results of Sub-Module 3.4:

Module 4:

Emergency and Disaster Management Capacity of Hospital

1. INTRODUCTION

Parameters of the "Emergency and disaster management" module are indicative of the way the hospital management is organized as to:

- **Implement disaster response plans,**
- **Make resources available for emergency preparedness and response to emergencies,**
- **Enhance staff skills**
- **Maintain safe hospital services ensuring uninterrupted normal operation.**

Module 4 considers the level of the preparedness of a hospital's organization and personnel and its essential operations to provide patient services in response to an emergency or disaster. The focus of this module of the Hospital Safety Index is the readiness of the hospital to respond to emergencies and disasters.

The relevant hospital should support hospitals' emergency and disaster risk management programs and health-sector policies or directives, which give the necessary authority for the Hospital Emergency/Disaster Committee and the designated emergency management coordinator to plan, coordinate and implement the hospital's emergency and disaster risk management program.

Hospitals also should link their emergency and disaster risk management program to other relevant hospital policies and programs for hospital business continuity management. Module 4 has 7 submodules, as provided in Table 1.

Table 1: Distribution of Indicators/Elements by Sub-Modules

Sections Sub-Module 3.4	Indicators/ Elements
4.1 Coordination of emergency and disaster management activities	4
4.2 Hospital emergency and disaster response and recovery planning	3
4.3 Communication and information management	4
4.4 Human Resouceser	4
4.5 Logistics and finance	4
4.6 Patient care and support services	6
4.7 Evacuation, decontamination and security	4
Total	**29**

HDSA Information Collection Steps

In general, the HDSA involves six steps in information collection. Refer to the Overview section for detailed guidance on these steps.

Module 4:

Emergency and Disaster Management Capacity of Hospital

2. GUIDANCE

1. Refer to Module 1 – Hazards Affecting Hospitals' Safety for an assessment of the hazards or events for which the hospital should be prepared to provide an emergency or disaster response.

Note that the range of events may extend beyond those hazards which could directly affect the safety of the hospital. For instance, the hospital may need to be prepared to receive and treat patients in response to a flood when the hospital is not affected or damaged by the flood itself.

The hospital should also be prepared to respond to internal hazards, such as hospital building fires, critical system failure (e.g. water, power) and security threats which can affect the safety of the building, patients, visitors and staff, and the functioning of the hospital. Evaluators should use their knowledge and expertise to assess the preparedness of the hospital to respond to emergencies and disasters.

Always refer to applicable national and local standards and codes related to hospital emergency and disaster management when evaluating a facility.

Sub-Module 4.1: Coordination of Emergency and Disaster Management Activities

Submodule 4.1 assesses the hospital organization and the capacity of key hospital personnel required to effectively coordinate hospital emergency and disaster management, focusing on preparedness and response.

Hospitals should establish their Disaster Health Management Committee (DHMC), established by order of the DGHS, sometimes known as the Hospital Emergency/ Disaster Management Committee or Emergency/Disaster Risk Management Committee, as a multidepartment and multidiscipline entity. Refer to the Guidelines for Hospital Management during Disasters and Emergencies (Guideline Number 18) under Section 2.4 (Disaster Risk Management Guidelines) of the Standing Orders on Disasters (SOD) 2019, which stipulates that Guideline/Protocols/Standard Operating Procedures (SOPs) are critical tools to perform planned activities. Respective authorities should develop/ update such guidelines based on good practices and changing contexts.

DHMC has an overall organizational leadership and coordination role over the hospital's emergency and disaster management functions and with health, emergency management, and other actors at local and national levels. This committee defines the levels of authority, roles, and responsibilities within a hospital so that activities and services align with the hospitals overall goals and roles in the healthcare system and local or national emergency and disaster management arrangements.

The committee membership comprises different hospital departments, and government departments (CS, FSCD, etc.) and external organizations aims to promote collaboration and improve efficiency and effectiveness of communications throughout the hospital before, during, and after emergencies and disasters.

DHMC will guide the risk assessments (including safety assessments), provide oversight of measures to reduce hazards and vulnerability, and improve the overall safety and security of the health facility. The HDSA is one of the principal inputs in developing the hospital's risk reduction and preparedness program.

The committee may be responsible for assigning and providing direction to a staff member to carry out the day-to-day responsibilities for coordinating the emergency and disaster management activities, particularly for strengthening the hospital's preparedness.

Sub-Module 4.1 has 4 indicators. The evaluation guidance/instruction including recommended methods to HDSA personnel are as below.

4.1.1. Hospital Emergency/Disaster Committee

1) Verify that the hospital has a committee formally established (with policy directives) to coordinate a) hospital emergency response and recovery operations; and b) preparedness measures to develop the hospital's readiness for response and recovery.
2) Verify that the hospital positions on the Hospital Emergency/Disaster Committee are occupied by senior personnel from different key hospital departments/disciplines (e.g., hospital director, hospital superintendent, director of administration, chief of nursing, medical director, chief of surgery, chief of laboratory services, chief of maintenance, chief of emergency services, chief of transportation, chief of security and chief of support services including representative from the Infection Prevention and Control team or Committee of the hospital).
3) Obtain a copy of the committee's terms of reference and verify that the list of members corresponds to current personnel.
4) Determine whether the committee functions effectively by meeting regularly and taking action to fulfill its responsibilities via effective leadership and coordination. ***Note:*** *The leadership and commitment of senior executives are critical for supporting emergency and disaster management, including preparedness, response, and recovery.*

Recommended evaluation methods: Interview, Documentation Review (including Terms of Reference)

4.1.2. Committee member responsibilities and training

1) Determine whether committee members are fulfilling their collective and individual responsibilities regarding emergency and disaster management (i.e., in preparedness, response, and recovery operations).
2) Verify that the committee members have participated in internal or external training courses that enable them to understand the committee's role concerning hospital emergency and disaster management and their roles.
3) Look for evidence of active participation by members in coordination meetings, joint assessments, planning, and implementation of activities in preparedness, response, and recovery.

Recommended evaluation methods:  Interview  Documentation Review

4.1.3. Designated emergency and disaster management coordinator

1) Verify whether a) a staff member has been designated as the hospital emergency/disaster management coordinator, and b) how much of that person's time is devoted to emergency and disaster management.
2) Check whether emergency and disaster management is the person's primary responsibility.

   Note: *If the coordinator responsibility is assigned to a staff member, but it is not his/her primary task, there is a risk that emergency management responsibilities (e.g., about preparedness, response, and recovery) will not get enough time or financial and human resources to enable it to implement.*

Recommended evaluation methods:  Interview  Documentation Review (including Terms of Reference)

4.1.4. Emergency Operations Centre (EOC)

1) Verify that an EOC has a designated safe and secure location.
2) Check that the hospital has arrangements to quickly equip a converted meeting room for EOC.
3) Determine that minimum equipment and supplies are readily available to set up the EOC for communications, information management (documentation, monitoring boards, and/or screens), identification, security, and well-being of EOC staff.
4) Verify that the EOC is backed up by an information management system that supports emergency operations and links to data from the hospital's information management system.
5) Check that the hospital has an established procedure for setting up and managing the EOC, including the designation of a responsible person to set up and ensure smooth operation of the logistical aspects of the center.
6) Verify that the hospital has an alternate EOC with the same characteristics.

Recommended evaluation methods:

 Interview  Documentation Review (Plans and Records)  Inspection

Sub-Module 4.2:
Hospital emergency and disaster response and recovery planning

Sub-Module 4.2 evaluates the hospital's operational planning for internal and external emergency and disaster events.

The purpose of emergency and disaster planning is to identify measures that should be put into practice before, during, and after an emergency or disaster so that the hospital is ready to respond and essential hospital services continue to function.

The hospital's plans and procedures for emergency or disaster response should be documented and detailed in an existing hospital emergency or disaster response plan which:

- Integrates the hospital response plan with the community or local response plan and with health response plans at other levels;
- Provides for cooperation with other services and institutions;
- Includes referral and counter-referral of patients (to and from other facilities);
- Takes into account of technical and logistical support, as appropriate, to the type of organization and complexity of the facility.

HDSA should ensure that hospital response and recovery planning will enable the hospital to conduct the following actions:

- **Before:** Anticipate events that are expected to affect the hospital and its operations and that may require an emergency or disaster response.
- **During:** Activate and implement the response plan and procedures, including the hospital incident management plan.
- **After:** Return to normal activities and hospital operations, evaluate the effectiveness of the preparedness measures and the response, such as with an after-action review (AAR), leading to planning for corrective actions. Plans and procedures for resuming normal function and repairing any damage should be addressed in a recovery plan that may be separate or part of the response plan.

Sub-Module 4.2 has 3 indicators. The evaluation guidance/instruction including recommended methods for HDSA personnel are as below.

4.2.1. Hospital emergency or disaster response plan

1) Verify that the hospital has a documented, routinely reviewed, and updated all-hazards emergency or disaster response plan that defines actions to be taken in anticipation of, during, and after any emergency or disaster to which the hospital is expected to respond.
2) Review the plan and confirm if the hospital has the necessary resources to implement it.
3) Check the content of the response plan. ***Note:*** *At least the content of the all-hazards plan includes sections on the hospital incident management system, coordination, logistics, roles and responsibilities of key staff and departments, human and financial resources, patient reception and management, including triage and decontamination, communication, staff welfare, and security as a minimum.*
4) Verify if an After Action Review (AAR) is conducted after a major incident affecting the hospital, including identification of lessons for planning corrective action. ***Note:*** *Hospitals should review their response and recovery plans after a major incident and regularly test the plans through simulations and drills. This validation exercise should be a major part of the response plan and should be one of the major tasks for the Hospital Emergency/Disaster Committee and staff who coordinate emergency management activities in the hospital. It may take the form of a debriefing of the hospital personnel involved in the incident response. The AAR or validation exercise results are helpful for the committee for further actions, including improvement and updating plans.*

Recommended evaluation methods:  Interview  Documentation Review (Plans)

4.2.2. Procedures to activate and deactivate plans

1) Verify that there are procedures for how, when, and by whom the emergency response plan, sub-plans, and contingency plans are activated and deactivated, including triggers and early warning mechanisms. In particular, determine:
    - **What** are the types of signals and criteria applied for activating plans for internal or external events?
    - **Who** has the responsibility for activating and deactivating the hospital's emergency or disaster response plans?
    - **Whether** hospital staff have received training in the activation procedures?
    - **How** often are the activation procedures tested?
    - **What** are the activation procedures for out-of-office hours, at weekends and during holidays?

Note: Activation may be triggered or requested by local authorities, the civil defense organization (FSCD), emergency services (BDRCS), public safety agencies (Police, Ansar and BGB), a central agency responsible for the health/medical emergencies (DGHS), or other local entities (CS). These requesting entities may provide information about what casualties the hospital could expect – such as the type of the event, the number of casualties, the nature of their injuries or other health effects, estimated time of arrival at the hospital.

Recommended evaluation methods:  Interview  Documentation Review (including Procedures)

4.2.3. Hospital recovery plan

1) Verify that the hospital has a documented, routinely reviewed, and updated all-hazards hospital recovery plan that defines actions to be taken to recover normal functions of the hospital after an emergency or disaster. ***Note:*** *In some response plans, elements of recovery may be included. The recovery plan should provide continuity of recovery and rehabilitation of patient services, the recovery needs of personnel, the replenishment of supplies and equipment replacement, and procedures for determining priorities for assessment and rehabilitation of the hospital's structural, non-structural elements which may have been damaged.*
2) Verify that the recovery plan, and response plan, are linked to the business continuity plan (discussed in items 4.6.1 & 4.6.2) for the hospital.

Recommended evaluation methods:  Interview  Documentation Review (Plans)

Sub-Module 4.3: Communication and Information Management

4.3.1. Emergency internal and external communication

1) Verify that a) the hospital switchboard (central service responsible for routing calls) has a functional internal and external communication system (e.g., paging, telephone service) and b) the switchboard operators understand emergency codes and how to use them.
2) Check whether there are backup measures, such as the use of messengers, in case primary systems fail. ***Note:*** *Both equipment and procedures should also be tested regularly (at least annually).*

Recommended evaluation methods:

 Interview  Observation  Documentation Review (Plans and Records)  Inspection

4.3.2. External stakeholder directory

1) Verify that an up-to-date directory with contact information of external stakeholders and emergency support services is available to the Hospital Emergency/Disaster Committee, EOC staff, and other key hospital administration and emergency staff, including switchboard operators.
2) Verify that the hospital has an assigned staff responsible for maintaining and regularly updating the directory.
3) Check a random set of telephone numbers, focusing on external stakeholders.
4) Check communication with the Health Sector's cluster of UHC.

Recommended evaluation methods:

 Interview  Documentation Review  Inspection

4.3.3. Procedures for communicating with the public and media

1) Verify that the hospital has a) procedures established for communicating with the public and media in case of an emergency or disaster and b) nominated a spokesperson(s) for this role.
2) Determine if spokespersons have received specific media training and if exercises have tested this skill.

Recommended evaluation methods:

 Interview  Documentation Review (including Procedures and Reports)

4.3.4. Management of patient information

1) Check how the hospital and the response plans deal with safe storage and movement of medical and other critical patient records.
2) Verify that procedures are in place to ensure continuity of medical record-keeping, timely access to patient data, and secure storage of confidential information.
3) Check that the electronic data are secured from unauthorized access. ***Note:*** *Medical records usually have legal status and may be used in legal matters.*
4) Verify that the backup procedures of electronic systems are in place considering emergencies and disasters.

Recommended evaluation methods:

 Interview  Documentation Review (including Procedures and Reports)

Sub-Module 4.4: Human Resources

4.4.1. Staff contact list

1) Verify that an up-to-date contact list of all hospital personnel is available and is accessible to EOC staff and hospital administrators.
2) Check a random set of telephone numbers for accuracy.

Recommended evaluation methods:

 Interview  Documentation Review  Inspection

4.4.2. Staff availability:

During normal functioning, the actual staffing levels of hospitals may be lower than the planned staffing levels for a wide range of reasons – including funding shortages, security concerns, staff absenteeism, etc. The availability of staff will have a significant bearing on the capacity of the hospital to deliver services in response to an emergency or disaster.

1) Determine the current workforce availability compared to service delivery requirements of all major departments (e.g., emergency medicine, surgery, internal medicine, orthopedics, support services, security) during normal functioning (non-emergency). For example, if a department should have a staffing level of 10 staff and only 4 staff are available, the staff availability is 40%.
2) Verify the existing staffing compared to the DGHS's staffing plan for the Upazila Health Complex.

Recommended evaluation methods:

 Interview  Documentation Review  Inspection

4.4.3. Mobilization and recruitment of personnel during an emergency or disaster

1) Verify that procedures are in place for the mobilization of existing on-duty and off-duty staff and recruitment and training of employable personnel and volunteers to meet surge capacity needs of high-demand clinical and support services (e.g., emergency department, surgery, intensive care units, security, managerial and administrative support).
2) Verify if staff emergency rosters exist and are maintained.
3) Verify that these rosters have identified staff who are on call at all times for key roles for the immediate response to emergencies and disasters and other staff who will be mobilized following the scale of the response. ***Note:*** *The rosters should consider addressing evening, weekend, and holiday coverage, as well as necessary incentives (e.g., overtime pay).*

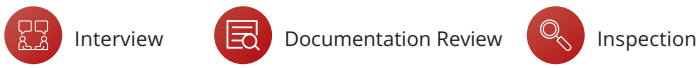
Recommended evaluation methods:

 Interview  Documentation Review (including Procedures)

4.4.4. Well-being of hospital personnel during an emergency or disaster

1) Verify if space has been designated and measures are available so hospital personnel can rest, sleep, eat, drink, observe faith-based practices and meet personal needs during an emergency.
2) Verify whether, in large-scale emergencies in which family members of staff are affected, the plans refer to the support (e.g., child care or elder care) the hospital can provide for immediate family members to encourage staff to continue working. ***Note:*** *If the hospital does not have resources for this, it should have arrangements with local social welfare groups that could consider prioritizing supporting family members of hospital staff.*

Recommended evaluation methods:

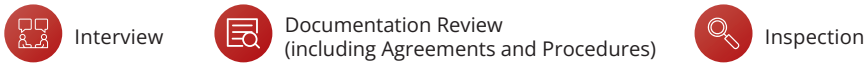


Sub-Module 4.5: Logistics and Finance

4.5.1. Agreements with local suppliers and vendors for emergencies and disasters

1) Verify that agreements (e.g., memoranda of understanding, mutual aid agreements) with local suppliers, vendors, and utility companies/agencies are in place to ensure procurement and delivery of essential medications, equipment, and supplies during times of shortage or increased demand, as in the case of emergencies and disasters.
2) Check with the hospital staff a) if there is a list of suppliers and vendors, and b) if the hospital has checked whether the vendors and suppliers y have arrangements to be operational in times of emergency. ***Note:*** *Consider an average score if there are doubts about the operational capability of major vendors or suppliers in an emergency.*

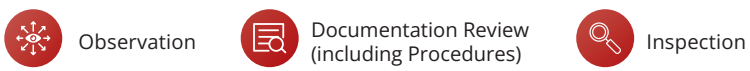
Recommended evaluation methods:



4.5.2. Transportation during an emergency

1) Verify that procedures are in place to ensure availability and access to ambulances and other vehicles and necessary modes of transportation for the movement of patients, staff, equipment, and supplies during an emergency or disaster.
2) Verify that procedures address the communications between hospitals, vehicles, and personnel at the scene of the emergency and coordination of patient distribution and referral.
3) Review that hospitals apply safety and security procedures to vehicles' use, storage, and maintenance.

Recommended evaluation methods:



4.5.3. Food and drinking water during an emergency

1) Verify that procedures are in place to provide food and water to patients and personnel during an emergency.
2) Check that the hospital has established measures and facilities for supplying and storing food and drinking water during the emergency
3) Check that hospital has included funds for food in the budget.
4) Verify that the hospital has provision for extra food and water requirements for ambulance staff and patients.

Recommended evaluation methods:  Interview  Documentation Review (including Procedures)

4.5.4. Financial resources for emergencies and disasters

1) Verify that the hospital has a specific budget and access to funds for use in response to emergency and disaster situations and recovery.
2) Check whether the hospital has:
   - Sufficient budget to implement measures outlined in the plan;
   - Cash available for immediate purchases, and there is a list of suppliers that will extend credit to the hospital;
   - Information on the required quantity and availability of medical equipment and supplies.
3) Verify that the hospital has additional financial resources calculated annually for the overall emergency and disaster risk management program, including preparedness measures.

Recommended evaluation methods:  Interview  Documentation Review

Sub-Module 4.6: Patient Care and Support Services

4.6.1. Continuity of emergency and critical care services

1) Verify whether procedures exist to ensure operational continuity of emergency and critical care services on evenings, weekends, and holidays (e.g., emergency room, intensive care unit, operating theatre, and services) for emergency and disaster situations.
2) Determine whether the hospital has trained staff in these procedures and whether the hospital can mobilize resources at all times.
3) Verify that the hospital has identified in advance non-essential hospital services that they can suspend in order to maximize resources (e.g., staff, clinical support, financial) for critical services during emergencies and disasters.

Recommended evaluation methods:  Interview  Documentation Review (including Procedures and Reports)

4.6.2. Continuity of essential clinical support services

1) Verify that procedures exist to ensure operational continuity of essential clinical support or ancillary services (e.g., laboratory, radiology, pharmacy) during an emergency.
2) Determine whether the hospital has staff trained in these procedures and can mobilize resources at all times.

Recommended evaluation methods:  Interview  Documentation Review (including Procedures and Reports)

4.6.3. Expansion of usable space for mass casualty incidents

1) Verify that procedures are in place to expand space and provide access to extra beds for mass casualty incidents – i.e. when the number of patients exceeds normal capacity.
2) Check whether the hospital has identified the expansion areas; if yes, then verify that these areas are signed.
3) Verify that the hospital has trained staff, tested the procedures for expanding space and adequate resources available for implementation. Note: Procedures for expansion of capacity should be part of hospital exercises.

Recommended evaluation methods:

 Interview  Documentation Review (including Procedures)  Inspection

4.6.4. Triage for major emergencies and disasters

1) Verify that the hospital has designated space and trained personnel to carry out triage in a major emergency/disaster situation.
2) Check whether the hospital has tested the triage procedures for a major emergency or disaster.
3) Verify that the hospital has resources (e.g., staff, materials) available to conduct triage. Note: If chemical or radioactive materials may be present, triage should occur outside the hospital and before patients enter the emergency department.

Recommended evaluation methods:

 Interview  Documentation Review (including Procedures and Reports)  Inspection

4.6.5. System for referral, transfer and reception of patients

1) Verify that the hospital has documented criteria for receiving and referring patients during an emergency or disaster.
2) Review that the plan includes specific procedures for the transfer and reception of patients to and from other health facilities, which may be within and outside the hospital's geographical area.

Recommended evaluation methods:

 Interview  Documentation Review (including Procedures and Reports)

4.6.6. Post-mortem procedures in a mass fatality incident

1) Verify that the hospital has established procedures for appropriate management of dead bodies, including temporary storage of cadavers, during a mass fatality incident. ***Note:*** *The procedures may include on-site or off-site arrangements to increase mortuary capacity, cold storage facilities, and levels of staffing and expertise (e.g., disaster victim identification). Hospitals should ensure appropriate handling of the dead with particular regard for religious and cultural expectations.*
2) Check that the hospital has trained staff in applying these procedures.

Recommended evaluation methods:

 Interview  Documentation Review (including Procedures)  Inspection

Sub-Module 4.7: Evacuation, Decontamination and Security

4.7.1. Evacuation plan

1) Verify that the hospital has established criteria and procedures for **vertical, horizontal, and partial evacuation** of patients, visitors, and staff to a safe location with the necessary medical, logistical and administrative support.
2) Verify that the criteria enable triage for evacuation of patients.
3) Check whether the hospital has conducted the staff training and review the regularity of evacuation drills.

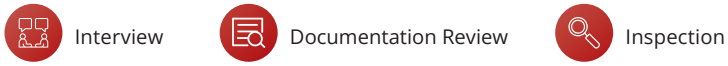
Recommended evaluation methods:

 Interview  Documentation Review (Plan)  Inspection

4.7.2. Personal protection equipment and isolation for infectious diseases and epidemics

1) Verify the availability of personal protection equipment for staff working in areas at high risk of exposure to infectious diseases.
2) Check whether the hospital established the isolation areas.
3) Verify the level of the demand for personal protective equipment at the maximum capacity of the hospital, taking into account the types of services provided by the hospital and the additional capacity required to respond to emergencies and disasters.
4) Check that the availability of personal protective equipment is sufficient for this maximum demand for at least 72 hours to ensure that the hospital can sustain the provision of services in an emergency or disaster.
5) Check arrangements and timing for the resupply of personal protective equipment.
6) Review the hospital conducts training regularly to maintain and update skills in applying for personal protection.
7) Check the procedures for conducting isolation of patients.

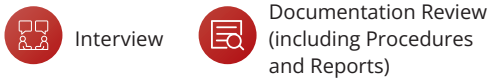
Recommended evaluation methods:



4.7.3. Emergency security procedures

1) Verify that the hospital has established procedures to ensure the security of patients, personnel and the facility (e.g., early control of access points, triage site(s), other areas of patient flow, traffic, parking, emergency/disaster coordination center) in an emergency, and to sound alerts and respond to security threats. ***Note:*** *These would include threats of violence or attacks directed at the hospital or community.*
2) Determine whether security personnel and staff in critical areas are trained in the emergency procedures and how often the procedures are tested.

Recommended evaluation methods:



4.7.4. Computer system network security

1) Verify that systems and procedures are in place to secure the hospital computer network against malicious programs and internal and external attacks. ***Note:*** *The focus should be on protecting the data, including patient records and equipment vital to the normal functioning of the hospital.*
2) Check with the responsible person from information technology services to ensure that regular monitoring of current cyber threats and activities is in place to minimize risks and respond to any threats.
3) Verify that the hospital plans to respond to and recover from cyberattacks or computer system failures. ***Note:*** *The plan should include data backup procedures, arrangements for restoring or replacing computing hardware and software, and an information technology recovery plan.*

Recommended evaluation methods:

 Interview

 Documentation Review (including Procedures and Reports)

Module 4:

Emergency and Disaster Management Capacity of Hospital

3. CHECKLIST

Indicators of Module 4 are as below. (L=Low, A=Average, H= High)

Submodule 4.1 - Coordination of emergency and disaster management activities: This sub-module assesses the hospital organization and the capacity of key hospital personnel required for effective coordination of hospital emergency and disaster management, with a focus on preparedness and response.

4.1 Coordination of emergency and disaster management activities	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
4.1.1. Hospital Emergency/Disaster Committee *Safety ratings:* Low = Committee does not exist, or 1–3 departments or disciplines represented; Average = Committee exists with 4–5 departments or disciplines represented, but is not fulfilling functions effectively; High = Committee exists with 6 or more departments or disciplines represented and is fulfilling functions effectively.	☐	☐	☐	
4.1.2. Committee member responsibilities and training *Safety ratings:* Low = Committee does not exist or members are untrained and responsibilities not assigned; Average = Members have received training and have been officially assigned; High = All members are trained and are actively fulfilling their roles and responsibilities.	☐	☐	☐	

4.1 Coordination of emergency and disaster management activities	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
4.1.3. Designated emergency and disaster management coordinator *Safety ratings:* Low = There is no staff member who has been assigned responsibilities as the emergency/disaster management coordinator; Average = Emergency/disaster management coordination tasks have been assigned to a staff member, but it is not his/her main task; High = A staff member is assigned the emergency and disaster management coordination responsibilities as his/her main task, is fulfilling the role of implementing the hospital's preparedness programme.	☐	☐	☐	
4.1.4. Emergency Operations Centre (EOC) *Safety ratings:* Low = The EOC is not designated or is in an unsafe or insecure location; Average = The designated EOC is in a safe, secure and accessible location, but would have limited operational capacity immediately in an emergency; High = The EOC is in a safe, secure, and accessible location with immediate operational capacity.	☐	☐	☐	

Sub-Module 4.2: Hospital emergency and disaster response and recovery planning. Evaluates the hospital's operational planning for internal and external emergency and disaster events.

The purpose of the emergency and disaster planning is to identify measures that should be put into practice before, during and after an emergency or disaster so that the hospital is ready to respond and essential hospital services continue to function.

The hospital's plans and procedures for emergency or disaster response should be documented and detailed in an existing hospital emergency or disaster response plan which:

- Integrates the hospital response plan with the community or local response plan, and with health response plans at other levels;
- Provides for cooperation with other services and institutions;
- Includes referral and counter-referral of patients (to and from other facilities);
- Takes into account technical and logistical support, as appropriate to the type of organization and complexity of the facility.

4.2 Hospital emergency and disaster response and recovery planning	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
4.2.1. Hospital emergency or disaster response plan *Safety ratings:* Low = Plan is not documented; Average = Documented plan is complete, but is not easily accessible, not up to date (more than 12 months since the last update); High = Plan is complete, easily accessible, reviewed/updated at least annually, and resources are available to implement the plan.	☐	☐	☐	
4.2.2. Procedures to activate and deactivate plans *Safety ratings:* Low = Procedures do not exist or exist only as a document; Average = Procedures exist, personnel have been trained, but procedures are not updated or tested annually; High = Up-to-date procedures exist, personnel have been trained, and procedures have been tested at least annually.	☐	☐	☐	

4.2 Hospital emergency and disaster response and recovery planning	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
4.2.3. Hospital recovery plan *Safety ratings:* Low = Recovery plan is not documented; Average = Documented plan is complete, but not easily accessible, not up-to-date (more than 12 months since last review/update); High = Documented plan is complete, easily accessible, and reviewed/updated at least annually.	☐	☐	☐	
4.3 Communication and information management				
4.3.1. Emergency internal and external communication *Safety ratings:* Low = Central internal and external communication system functions inconsistently or incompletely; operators are not trained in emergency communication; Average = System functions appropriately, operators have received some training in emergency communication, tests are not conducted at least annually; High = System functions completely and operators are fully trained in emergency use, and tests of the system are conducted at least annually.	☐	☐	☐	
4.3.2. External stakeholder directory *Safety ratings:* Low = Directory of external stakeholders does not exist; Average = Directory exists but is not current (more than 3 months since it was updated); High = Directory is available, is up to date and is held by key emergency response staff.	☐	☐	☐	
4.3.3. Procedures for communicating with the public and media including existing patients in the hospital *Safety ratings:* Low = Procedures do not exist, no spokesperson nominated; Average = Procedures exist and nominated spokespersons have been trained; High = Procedures exist, nominated spokespersons have been trained, and procedures have been tested at least annually.	☐	☐	☐	

4.3 Communication and information management	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
4.3.4. Management of patient information *Safety ratings:* Low = Procedures for emergency situations do not exist; Average = Procedures for emergency situations exist and personnel have been trained but no resources are available; High = Procedures for emergency situations exist, personnel have been trained, and resources are in place for implementation.	☐	☐	☐	
4.4 Human resources				
4.4.1. Staff contact list *Safety ratings:* Low = Contact list does not exist; Average = List exists, but is not current (more than 3 months since it was updated); High = List is available and up to date.	☐	☐	☐	
4.4.2. Staff availability *Safety ratings:* Low = Less than 50% of staff are available to run each department adequately; Average = 50–80% of staff are available; High = 80–100% of staff are available.	☐	☐	☐	
4.4.3. Mobilization and recruitment of personnel during an emergency or disaster *Safety ratings:* Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained, but the human resources for an emergency situation are not available; High = Procedures exist, personnel have been trained, and the human resources are available to meet anticipated needs in an emergency.	☐	☐	☐	

4.4 Human resources	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
4.4.4. Well-being of hospital personnel during an emergency or disaster *Safety ratings:* Low = A designated space and measures do not exist; Average = Space has been designated, but measures cover less than 72 hours; High = Measures are ensured for at least 72 hours.	☐	☐	☐	
4.5 Logistics and finance				
4.5.1. Agreements with local suppliers and vendors for emergencies and disasters *Safety ratings:* Low = No arrangements exist; Average = Arrangements exist, but are not fully operational; High = Arrangements exist and are fully operational.	☐	☐	☐	
4.5.2. Transportation during an emergency *Safety ratings:* Low = Ambulances and other vehicles and modes of transportation are not available; Average = Some vehicles are available, but not in sufficient numbers for a major emergency or disaster; High = Appropriate vehicles in sufficient numbers are available during emergencies/ disasters.	☐	☐	☐	
4.5.3. Food and drinking-water during an emergency *Safety ratings:* Low = Procedures for food and drinking-water for emergencies are non-existent; Average = Procedures exist, food and drinking-water is guaranteed for less than 72 hours; High = Food and drinking-water for emergencies is guaranteed for at least 72 hours.	☐	☐	☐	

4.5 Logistics and finance	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
4.5.4. Financial resources for emergencies and disasters *Safety ratings:* Low = Emergency budget or mechanism to access emergency funds is not in place; Average = Funds are budgeted and mechanisms are available but cover less than 72 hours; High = Sufficient funds are guaranteed for 72 hours or more.	☐	☐	☐	
4.6 Patient care and support services				
4.6.1. Continuity of emergency and critical care services *Safety ratings:* Low = Procedures do not exist or exist only as a document; Average = Procedures exist, personnel have been trained but would not be available at all times; High = Procedures exist, personnel have been trained, and resources are available to implement procedures at maximum hospital capacity for emergency and disaster situations at all times.	☐	☐	☐	
4.6.2. Continuity of essential clinical support services *Safety ratings:* Low = Procedures do not exist or exist only as a document; Average = Procedures exist and personnel have been trained but would not be available at all times; High = Procedures exist, personnel have been trained, and resources are available to implement procedures at maximum hospital capacity for emergency and disaster situations at all times.	☐	☐	☐	
4.6.3. Expansion of usable space for mass casualty incidents *Safety ratings:* Low = Space for expansion has not been identified; Average = Space has been identified; equipment, supplies and procedures are available to carry out the expansion and staff have been trained, but testing has not been conducted; High = Procedures exist and have been tested, personnel have been trained, and equipment, supplies and other resources are available to carry out the expansion of space.	☐	☐	☐	

4.6 Patient care and support services	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
4.6.4. Triage for major emergencies and disasters including during disease outbreak *Safety ratings:* Low = Designated triage location or procedures do not exist; Average = Triage location and procedures exist and personnel have been trained, but procedures have not been tested for emergency and disaster situations; High = Location and procedures exist and have been tested, personnel have been trained, and resources are in place to implement at maximum hospital capacity in emergency and disaster situations.	☐	☐	☐	
4.6.5. System for referral, transfer and reception of patients *Safety ratings:* Low = Procedures do not exist or exist only as a document; Average = Procedures exist and personnel have been trained, but procedures have not been tested for emergency or disaster situations; High = Procedures exist and have been tested, personnel have been trained, and resources are available to implement measures at maximum hospital capacity in emergency or disaster situations.	☐	☐	☐	
4.6.6. Post-mortem procedures in a mass fatality incident *Safety ratings:* Low = Procedures for a mass fatality incident do not exist or exist only as a document; Average = Procedures exist and personnel have been trained, but the level of resources required for emergency and disaster situations is not available; High = Procedures exist, personnel have been trained, and resources are available for implementation of procedures at maximum hospital capacity in emergency and disaster situations.	☐	☐	☐	

4.7 Evacuation, decontamination, and security	Safety Level			Observations (Evaluator's Comments)
	L	A	H	
4.7.1. Evacuation plan *Safety ratings:* Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained in procedures, but tests are not conducted regularly; High = Plan exists, personnel have been trained, and evacuation drills are held at least annually.	☐	☐	☐	
4.7.2. Personal protection equipment and isolation for infectious diseases and epidemics *Safety ratings:* Low = No personal protective equipment is available for immediate use by hospital staff, or no isolation area exists; Average = Supply is available for immediate use, but is sufficient for less than 72 hours of maximum hospital capacity, isolation areas are established, staff training and testing of procedures are not conducted annually; High = Supply is guaranteed for at least 72 hours of maximum hospital capacity and alternate sources are in place for resupply, isolation areas are established, staff training and testing of procedures are conducted at least annually.	☐	☐	☐	
4.7.3. Emergency security procedures *Safety ratings:* Low = Emergency security procedures do not exist or exist only as a document; Average = Documented procedures exist and personnel have been trained in emergency security procedures but testing is not conducted at least annually; High = Personnel are trained and tests of the documented procedures are held at least annually.	☐	☐	☐	
4.7.4. Computer system network security *Safety ratings:* Low = The hospital does not have a computer security system plan and procedures in place; Average = The hospital has a basic cyber security plan in place but it is not monitored and updated regularly; High = The hospital has a cyber security plan in place and it is updated regularly.	☐	☐	☐	

Comments on the results of Module 4:

ANNEX C:

HDSA REPORT OUTLINE

Cover Page

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Acronyms

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Detailed Report

- HDSA Background
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- HDSA Summary Results
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ANNEX D:

HVL AND HSL RESULTS AND HSI SCORE

D.1. Summarizing HVL and HSL Information

Step 1: Calculating the Hazard Vulnerability Level (HVL) of Hospital

- Refer to the Checklist of the Module 1 – Hazard Affecting the Safety of the Hospital, which is used to determine the hazards that may directly affect the safety of the hospital and those for which the hospital may be expected to provide health services in response to emergencies and disasters.
- Compile the levels of vulnerability (high, average and low) of the hazards which are identified for each sub-module in the checklist. Present the results as illustrated in the table below.

Module 1: Hazards Affecting Hospital

Table 1: Results of Hospital Vulnerability Level (Distribution of Indicators)

Submodules	Indicators (#)	Vulnerability Level			
		High	Average	Low	Not Applicable
Sub Module 1.1: Hazards Affecting Hospital Safety	19	6	4	4	5
Sub Module 1.2: Geotechnical Properties of Soils	3	2	-	-	1
Module Total	**22**	**8**	**4**	**4**	**6**

Step 2: Calculating the Hospital Safety Level (HSL)

- Refer to the Checklists of the three Modules: Module 2 - Structural Safety; Module 3 - Non-Structural Safety; and Module 4 - Emergency and Disaster Management Capacity (Functional Capacity).
- HSL is evaluated against the parameters in modules 2, 3 and 4, with reference to both the hazards identified in Module 1 and the maximum capacity of the hospital for emergencies and disasters identified in Form (General Information about the Hospital.
- Compile the levels of safety (high, average and low) of the indicators of sub-modules/modules 2, 3, and 4 which are identified in their respective checklists. Present the results as illustrated in the tables below.

Module 2: Structural Safety

Table 2: Results of Hospital Safety Level (Distribution of Indicators)					
Submodules	Indicators (#)	Vulnerability Level			
		High	Average	Low	Not Applicable
Sub-Module 2.1. Prior events affecting building safety	3	-	-	2	1
Sub Module 2.2. Building integrity	15	-	4	8	3
Module Total	**18**	**-**	**4**	**10**	**4**

Module 3: Non-Structural Safety

Table 3: Results of Hospital Safety Level (Distribution of Indicators)					
Submodules	Indicators (#)	Vulnerability Level			
		High	Average	Low	Not Applicable
Sub-Module 3.1. Architectural Safety	12	-	9	2	1
Sub Module 3.2. Infrastructure Protection, Access and Physical Security	4	1	2	1	-
Sub-Module 3.3. Critical Systems	26	3	1	22	-
Sub Module 3.4. Equipment and Supplies	13	1	7	4	1
Module Total	**55**	**5**	**19**	**29**	**2**

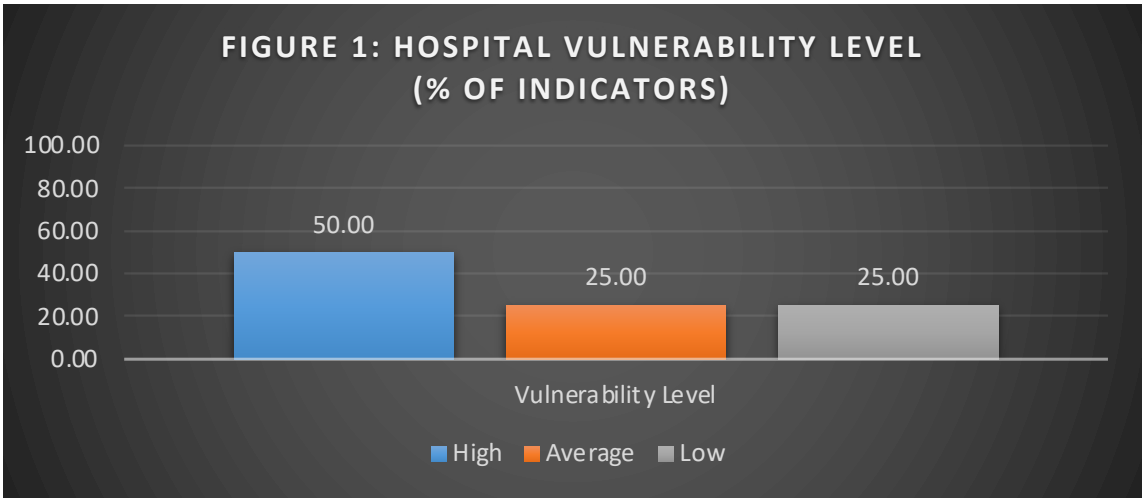
Module 4: Functional Capacity

Table 4: Results of Hospital Safety Level (Distribution of Indicators)					
Submodules	Indicators (#)	Vulnerability Level			
		High	Average	Low	Not Applicable
4.1 Coordination of emergency and disaster management activities	4	-	-	4	-
4.2 Hospital emergency and disaster response and recovery planning	3	-	-	3	-
4.3 Communication and information management	4	-	2	2	-
4.4 Human resources	4	-	4	0	-
4.5 Logistics and finance	4	-	3	1	-
4.6 Patient care and support services	6	-	5	1	-
4.7 Evacuation, decontamination and security	4	1	1	2	-
Module Total	**29**	**1**	**15**	**13**	**-**

Step 3: Summarizing the HVL and HSL Results

a. Hospital Vulnerability Level (HVL): Figure 1 portrays the results of Hospital's vulnerability level (HVL) evaluated against the 16 out of 22 elements that are likely to affect the safety of the hospital as shown in Table 1.

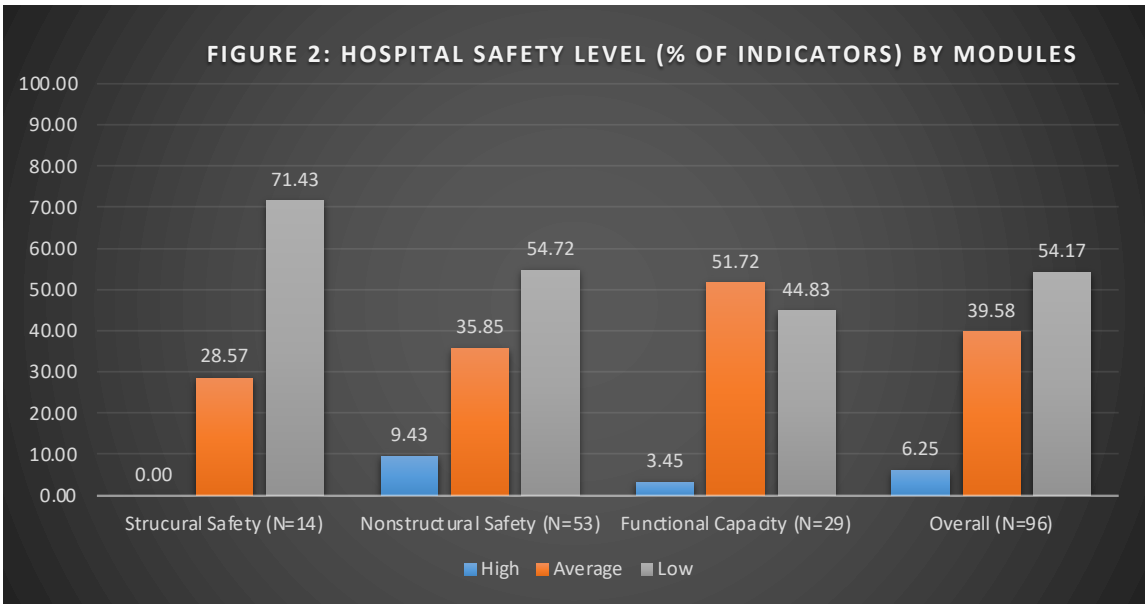
Note: 6 indicators did not apply in the context of the location and vulnerability of hospital assessed.



The HVL results, **for example, can be illustrated as:** The hospital is highly vulnerable to earthquakes and fires, moderately vulnerable to landslides, river floods, and flash floods, epidemics, malaria, water supply disruption, insignificantly vulnerable to extreme temperature, food-borne diseases, transportation incidents, mass gathering events, and unstable slopes.

b. Hospital Safety Level (HSL): Figure 2 portrays the overall and module-wise results of the Hospital's safety level (HSL) evaluated considering the 96 out of 102 elements of the structural, non-structural, and functional capacity modules.

Note: 6 indicators did not apply in the context of the hospital assessed.



The HSL results, for example, can be illustrated as: Overall, out of these elements (96), the levels of safety of 6.25 percent are high, meaning these elements are highly likely to function in emergencies and disasters; 39.58 percent are average, meaning likely to function in emergencies and disasters; 54.17 percent are low, meaning unlikely to function in emergencies and disasters.

c. Hospitals' Overall Risks, Safety and Vulnerability: Table 5 illustrates the comparative results of the Hospital's overall HVL and HSL. A deeper analysis of these levels shows that the high (50.0%) and average (25.0%) HVL together (75.0%) is higher than the high (6.25%) and average (39.58%) HSL (45.83%), meaning the safety of the Hospital is at moderate to high risk. This analysis designates that the hospital is unlikely to function during and after emergencies and disasters. The current levels of safety and emergency and disaster management are inadequate to protect the lives of patients and hospital staff during and after emergencies or disasters. In this scenario, urgent intervention measures are needed.

Table 5: Safety vs Vulnerability

	Level		Risks	Level		
Vulnerability	The lower the safer	High (50.0%)	**High** HVL **Low** HSL = High Risk	High (6.25%)	The higher the safer	Safety
		Average (25.0%)		Average (39.58%)		
		Low (25.0%)	**Low** HVL **High** HSL = Low Risk	Low (54.17%)		

D.2. Calculating Module-Specific Index and Overall Hospital Safety Index

Relative Weight of Modules: There are two models for the weighting of the modules (Module 2, 3, and 4) to calculate the safety index:

Model 1: (Where there is a higher risk of earthquake and/or cyclones)

- Structural safety module has a weighted value of 50% of the index;
- Non-Structural module has a weighted value of 30%; and
- Emergency and disaster management module is weighted at 20%.

Model 2: All the modules are given equal weight, so that

- Structural safety module has a weighted value of 33.3% of the index;
- Non-Structural module has a weighted value of 33.3%; and
- Emergency and disaster management is weighted at 33.3%.

The sum of the weighted results of the three modules gives a hospital safety rating expressed as the probability (percentage) that a facility will be able to function in an emergency or disaster situation. - Table 6 presents the steps of calculating the module-specific and overall score of HSI.

Table 6:
Hospital Safety Index: Calculation of Module-specific Index and Overall Hospital Safety Index

1. MODULE-Specific Index

Step 1: Input the safety level results from Table 2.

MODULE	Unlikely to function (Safety level = Low)	Likely to function (Safety level = Average)	Highly likely to function (Safety level = High)	Total
Structural safety (MODULE 2)	71.43	28.57	0.00	100
Nonstructural safety (MODULE 3)	54.72	35.85	9.43	100
Emergency and disaster management (MODULE 4)	44.83	51.72	3.45	100

Step 2: Input horizontal weights in the YELLOW cells which are to be used for this purpose. These will indicate relative safety levels between Low/Average/High in reference to High. It is proposed to use the figures below that were agreed by the WHO/PAHO - DiMAG to calibrate the individual module scores against a common point of reference. In this case, the relative safety levels are in the ratio of 1:2:4.

MODULE	Horizontal weight	Horizontal weight (example)
Unlikely to function	0.25	0.25
Likely to function	0.50	0.50
Highly likely to function	1.00	1.00

Step 3: Automatic tabulation of CRUDE (non-bias-adjusted) safety index by module.

MODULE	Crude safety index
Structural safety (MODULE 2)	0.32
Nonstructural safety (MODULE 3)	0.41
Emergency and disaster management (MODULE 4)	0.41

Step 4: Automatic calculation of the weight range to be used for bias adjustment in safety and vulnerability indexes.
NOTE: In order to prevent bias due to the random figures used in the module's weights, it was agreed to use a range that takes into account both extremes of the horizontal weight scale. In this case, the minimum level of safety is 0.25 and the maximum score is 1. Using a range also allows the evaluator to graphically appreciate these indexes and how they relate to each other. It has been suggested that these indexes could be viewed using the "glass half-empty/half-full" concept. The more safe the hospital becomes, vulnerability will be reduced or, in more words, the glass will get fuller.

Range = Upper horizontal weight - lower horizontal weight = 0.75

Step 5: Automatic calculation of ADJUSTED (bias-free) safety index and vulnerability index by module. Formulas are below.

$$\text{Safety index} = \frac{\text{Crude safety index - Lower range limit}}{\text{Range}}$$

$$\text{Vulnerability index} = \frac{\text{Upper range limit - Crude safety index}}{\text{Range}}$$

MODULE	Safety index	Vulnerability index
Structural safety (MODULE 2)	0.10	0.90
Nonstructural safety (MODULE 3)	0.21	0.79
Emergency and disaster management (MODULE 4)	0.21	0.79

Step 6: Automatic comparison of safety index with base recommendations.

Safety index	Category	What should be done?
0 – 0.35	c	Urgent intervention measures are needed. The hospital is unlikely to function during and after emergencies and disasters, and the hospital's current levels of safety and emergency and disaster management are inadequate to protect the lives of patients and hospital staff during and after emergencies or disasters.
0.36 – 0.65	b	Intervention measures are needed in the short term. The hospital's current levels of safety and emergency and disaster management are such that the safety of patients and, hospital staff, and the hospital's ability to function during and after emergencies and disasters are potentially at risk.
0.66 – 1	a	It is likely that the hospital will function in emergencies and disasters. It is recommended, however, to continue with measures to improve emergency and disaster management response capacity and to carry out preventive measures in the medium- and long-term to improve the safety level in case of emergencies and disasters.

MODULE	Health facility status
Structural safety (MODULE 2)	c
Nonstructural safety (MODULE 3)	c
Emergency and disaster management (MODULE 4)	c

Table 6:
Hospital Safety Index: Calculation of Module-specific Index and Overall Hospital Safety Index (Cont.)

2. Overall Safety Index

Step 7: To calculate overall safety index and vulnerability index, input the vertical weights in the YELLOW cells which are to be used for this purpose. They will indicate a percentage of contribution of a module to overall safety index (total weights of modules is 100 %). Examples below are figures in the ratio of 5 : 3 : 2 (model 1) and in the ratio of 1 : 1 : 1 (model 2). Model 1 is the ratio used in the original version of the HSI and could be considered for a group of hospitals which are at higher risk of structural failure in earthquakes or high winds. Model 2 is proposed for countries or regions where earthquakes and high winds are not considered to be likely hazards.

MODULE	Vertical weight	Vertical weight (model 1)	Vertical weight (model 2)
Structural safety	50.00	50.00	33.33
Nonstructural safety	30.00	30.00	33.33
Emergency and disaster management	20.00	20.00	33.33
Total (%)	**100.00**	**100.00**	**100.00**

Step 8: Automatic tabulation of overall safety index.

Overall safety index =	**0.15**

Safety index	Category	What should be done?
0 – 0.35	**C**	Urgent intervention measures are needed. The hospital is unlikely to function during and after emergencies and disasters, and the hospital's current levels of safety and emergency and disaster management are inadequate to protect the lives of patients and hospital staff during and after emergencies or disasters.
0.36 – 0.65	**B**	Intervention measures are needed in the short term. The hospital's current levels of safety and emergency and disaster management are such that the safety of patients and, hospital staff, and the hospital's ability to function during and after emergencies and disasters are potentially at risk.
0.66 – 1	**A**	It is likely that the hospital will function in emergencies and disasters. It is recommended, however, to continue with measures to improve emergency and disaster management response capacity and to carry out preventive measures in the medium- and long-term to improve the safety level in case of emergencies and disasters.

Step 9: Automatic comparison of overall safety index with base recommendations above.

Overall health facility status:	**C**

Notes:

1. Given that each item has three levels of safety (high, average and low), and to avoid any distortion at the time of evaluation, a constant value is applied to each level of safety. Values are standardized to enable comparisons between hospitals for each module and for the overall hospital safety index. The safety index has a maximum value of 1 (one) and a minimum of 0 (zero).

2. Weighted values, standardization and calculations take into account that it is very difficult for a hospital to remain perfectly safe or operational, so it is rare for a facility to be given a safety index of 1.

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1300 Pennsylvania Avenue, N.W.
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adpc

ASIAN DISASTER PREPAREDNESS CENTER

SM Tower, 24th Floor, 979/66-70, Paholyothin Road,
Phayathai, Bangkok 10400 Thailand

Tel : +66 (0)2298 0681 to 92

: Asian Disaster Preparedness Center - ADPC

: adpc.net

: @ADPCnet

: adpc@adpc.net