Safety Assessment of Hospitals through the Determination of Safety Index Score

Final year project report

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PROJECT GUIDE

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Abstract

Hospitals have an important role in order to maintain and improve health and to function without interruption in emergency situations. Hospitals are considered as a place of hope and offers sense of security in aftermath of a disaster situation. Safe hospitals have a symbolic value losing a health facility leads to sense of insecurity and social political instability. Disaster- resilient hospitals must be able to protect the lives of patient and staff and continue to function. Hospitals need to ensure the structural, Nonstructural safety and functional capacity. The responsibility to take adequate measures for a safe and secure hospital environment lies not only with the government or hospital authorities but also involves training and awareness among community viz patients, visitors and hospital staff at all levels. Hospital Safety Index is one of the indicators that can help to determine the efficiency of hospitals in disasters situations. This study was done in order to assess the safety of one of the referral hospitals in Madurai. Methods: In this applied study, a referral hospital in Madurai was studied based on structural, nonstructural and functional factors by using WHO/PAHO standard checklist.

According to the results, the final Safety Index score placed this hospital into C category of three categories of safety. It means that the lives and safety of occupants of this hospital deemed at risk during disasters.

The Hospital Safety Index helps authorities to quickly determine where interventions can improve safety. The safety index is not only a tool for making technical assessments, but it provides a new approach to disaster prevention and mitigation for the health sector. Calculating the safety score allows hospital to establish maintenance and monitoring routines and look at actions to improve safety in the medium term. This quick overview will give decision makers a starting point for establishing priorities and reducing risk and vulnerability in healthcare facilities.

Keywords*: Health, Safety & Environment; Air, Water & Noise Monitoring; Chemical Industry.*

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NAVIIN D

TABLE OF CONTENTS

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Background

Nearly all communities are exposed to a variety of adverse phenomena, whether of natural origin or caused by human activity. Among these are hurricanes, floods, earthquakes, chemical accidents, and outbreaks of disease. All of these adverse events disrupt the routine life of a community and have a range of human and material consequences. Homes are destroyed, communities are isolated, and basic services are damaged. People lose their jobs and businesses; crops are destroyed and agricultural production is brought to a standstill; domestic animals are lost. There is chaos. People go missing, are injured, or killed. Disasters are not natural. Disaster risk, defined as the likelihood that damages will overwhelm the ability of the affected community to respond, is the function of a hazard in combination with vulnerability.

Hazards can be of natural origin or caused by human activity, but vulnerability is always an expression of planning, construction, and development. Communities have more or less resilience to the disasters that occur at their location. The extent and severity of the damage caused by an adverse event is inversely proportional to the level of resilience of a community: the more resilient, the less damage. Finally, the capacity to respond determines whether an adverse event will be an emergency or develop into a disaster. Human activity determines the likelihood of damage and the capacity to respond to a disaster. The main factors influencing disaster risk are: human vulnerability expressed primarily by levels of poverty and social inequality; rapid population growth, mainly among the poor who settle in areas that present a variety of natural hazards (e.g., river beds, riverbanks, and steep slopes); increasing environmental degradation, particularly because of poor land-use practices and their impact on climate change; poor planning; and the lack of early warning systems. We can say, then, that disasters "respect" borders and social conditions. Disasters cause proportionally more damage to developing countries and the poorest communities.

Hospitals / Health systems rely on a range of public, private and nongovernmental health facilities to work together to serve the community. In times of emergency, this is even more important.

Hospitals, primary health care Centre's, laboratories, pharmacies and blood banks work with non-health sectors, including energy and water supplies, transport, and emergency services to ensure the continuity of health services.

Hospitals are considered a place of hope and offers sense of security in the aftermath of a disaster situation. Safe hospitals have symbolic value losing a health facility leads to sense of insecurity and social, political instability. Disaster-Resilience hospitals must be able to protect the lives of patient and staff and continue to function. Hospitals need to ensure structural, Non-structural and functional capacity. The responsibility to take adequate measures for a safe and secure hospital environment lies not only with government or hospital authorities but also involves training awareness among community viz patients, visitors and hospitals staff at all levels. Hospitals are highly complex facilities that play a vital role in the medical response to disasters; they are the symbol of faith and hope for the entire community during such tragic events. However they are susceptible to impact of disasters with respect to their structural, non-structural and functional elements.

Many hospitals have been damaged and rendered nonfunctional as a consequence of a disaster. The resilience of a hospital along with its capability of effective medical response to disasters is a key part of any disaster plan. Hence the most crucial element that needs to be ensured with every emergency is that health facilities should not be casualties.

More lives can be saved if the hospitals and health facilities sustain its functionality during and in the aftermath of an event.

During emergencies, hospitals play a vital role in:

- Providing emergency care to the injured (e.g. trauma care, surgery and blood transfusions) and to the critically ill, as in outbreaks of communicable disease.
- Collecting and analyzing data on illness to detect and prevent potential outbreaks.
- Delivering health care before and after an emergency (for the management of chronic disease, maternal and child health services, and psychosocial support).

- Providing immunization services to prevent outbreaks of diseases, such as measles, that lead to needless deaths of susceptible populations (commonly children).
- Providing critical services, including laboratories, blood banks, ambulances, rehabilitation, aged care and pharmacies. Hospitals also represent enormous investments for any country. Destruction of such facilities results in significant economic burdens. Failure of hospitals and emergency services during a disaster can greatly affect public morale and a community's social and health capital.

1.2 Risks Involved

1.2.1 Traumatic injury and death

Associated with structural collapse and non-structural failures, patients and health workers at an unsafe facility may be killed or injured by trauma associated with the disaster.

1.2.2 Disruption of health services

- Destruction of hospitals interrupts acute and chronic health care, community disease surveillance, laboratory analysis, blood and drug supplies, and support for community health programs, both over the short and long term post-disaster phase.
- Overcrowding can functionally disrupt health services if the hospital lacks arrangements to respond to a surge of patients and visitors.

1.2.3 Impeded emergency response

- Hospitals represent community focal points for mounting and coordinating emergency responses in the midst of disasters.
- Loss of hospitals as a health care facility hinders immediate responses and may divert emergency responders and resources away from the community to focus on rescue of hospital occupants and salvage of critical hospital supplies.

1.2.4 Loss of economic investment

- Destruction of hospitals represents a huge economic loss, particularly since vital health resources are diverted to rebuild the facility in place of funding community programs and healthcare designed to maintain the population's health.

Chapter 2

Literature Review

The following papers have been reviewed and the methodology of the project **"Hospital Safety Index"** which helps the health facilities to assess their safety and avoid becoming a casualty of disasters has been identified and followed.

S.No	Title of Paper	Year	Author Name	Findings
1	Hospitals Safety from Disasters in Iran: The Results from Assessment of 224 Hospitals	28 February 2014	1. Ali Ardalan,[*] 2. Maryam Kandi 3. Mohammad Taghi Talebian, 4. Hamidreza Khankeh,[*]	Our study showed that the overall disaster safety status of the Iran's hospitals was 33 out of 100. More than half of the hospitals were found as low safe and the rest were moderately safe. Accordingly, we did not observe any hospital in the high safe category. Hospitals safety assessment using the HSI shows significant variation by region. The assessments on 45 hospitals in Caribbean

				countries revealed that only 2% of the hospitals were completely safe, 80% were moderately safe and 18% were low safe. While the assessments on 66 hospitals in Moldova classified 24.6% of the hospitals as high safe, 67.2% as moderate safe and only 8.2% as low safe [10]. The results derived from the HSI can be considered as indicators for measurement of the health system resilience for disasters.
2	Hospital safety index (HSI) analysis in confronting disasters: A case study from Iran	June 2014	Katayoun Jahangiri[1], Yasamin O Izadkhah[2], Azam Lari[3]	According to the results, the final Hospital Safety Index score places this hospital in category "C" among three existing classifications of safety, which means that the hospital's current safety levels are inadequate to protect the lives of

				patients and hospital staff during and after a disaster. **Conclusions:** Urgent intervention measures and rapid assessment will give decision-makers a starting point to identify priorities in order to reduce risk and vulnerability in hospitals and health care facilities
3	Evaluation of Hospital Safety in the republic of moldova	November 2014	1. Mihail Pisla 2. Silviu Domente 3. Leonid Chetraru 4. Radu Ostaficiuc	Following the completion of the "Republic of Moldova hospital safety index assessment" project, there have been assessed 66 facilities out of a total number of 82 hospitals overall (80.5 per cent) running currently operations in the country, with an appropriate safety index assigned to each, which is a value representation of their ability to withstand and carry on running in the

				wake of some possible disasters Striking. 2. Safety index scores for the assessed hospitals vary quite significantly: from 0.29 up to 0.83. 3. 15 hospitals (6 national, 4 municipal, and 5 district-level), or 24.6 per cent of public hospitals in the country, were listed under the safety group A, being indicative of high resilience to the impact of some possible disasters, as well as of their ability to run operations safely under the adverse conditions caused by emergencies. 41 hospitals (7 national, 6 municipal, and 28 district-level), or 67.2 per cent, were listed under the safety

				group B, being indicative of an average resilience to the impact of some possible disasters and of some shortcomings in securing a hospital's operations during emergencies. 5 hospitals (4 national and 1 district-level), or 8.2 per cent, were listed under the safety group C, encompassing those hospitals that as per the used methodology fail to ensure resilience to the impact of disasters and cannot ensure safe running of operations during emergencies. 4. Of the 17 national hospitals in place, 6 (35.3 per cent) were listed under the safety group A, 7 (41.2 per cent) – under the safety group B, and 4 (23.5 per cent) – under the safety group C.

				Of the 10 municipal hospitals, 5 apiece, i.e. 50 per cent, were listed under the safety Groups A and B respectively. Of the 34 district-level hospitals in place, 5 (14.7 per cent) were listed under safety group A, 41 (82.4 per cent) – under the safety group B, and 1 (2.9 per cent) – under the safety group C.
4	A Safety Index for Hospital Buildings	October, 2012	1. Aiello Antonietta 2. Pecce Marisa 3. Sarno Luigi Di 4. Perrone Daniele 5. Rossi Fernando	A simplified methodology, based on questionnaires, has been developed aiming to map the seismic risk of critical Constructions, as hospital buildings, on a territorial scale. The proposed methodology is based on the Hospital Safety Index assessed by Pan American Health Organization, modified by the

				authors to comply with specific national features influencing the seismic risk.
5	Evaluation and Analysis of Hospital Disaster Preparedness in Jeddah	November 2014	1. Nidaa A. Bajow 2. Shahnaz M. Alkhalil	The finding shows that hospitals included in this study have tools and indicators in hospital preparedness but with lack of training and management during disaster. So the research shed light on hospital disaster preparedness. Considering the importance of preparedness in disaster, it is necessary for hospitals to understand that most of hospital disaster preparedness is built in the hospital system.
6	Implementing the Hospital Emergency Incident Command System: an integrated	2004 December	1. Zane RD 2. Prestipino AL.	Implementation of the HEICS provides a consistent command structure for hospitals that enables consistency and commonality with

	delivery system's experience			other hospitals and disaster response entities.
7	Evacuation and sheltering of hospitals in emergencies: a review of international experience	2009 September	1. Bagaria J 2. Heggie C 3. Abrahams J 4. Murray V	This study recommends the collection of case studies the development of a database to assist with the research and development of well-tailored hospital evacuation plans. These recommendations reflect and support the 2008-2009 World Disaster Reduction Campaign on Hospitals Safe from Disasters and the timely 2009 Global Platform priority that, Critical services and infrastructure such as health facilities and schools must be safe from disasters

Chapter 3

Materials and Methods

3.1 Hospital Safety Index

3.1.1 Introduction

The **Hospital Safety Index** helps health facilities assess their safety and avoid becoming a casualty of disasters.

The Hospital Safety Index provides a snapshot of the probability that a hospital or health facility will continue to function in emergency situations, based on structural, nonstructural and functional factors, including the environment and the health services network to which it belongs. By determining a hospital's Safety Index or score, countries and decision makers will have an overall idea of its ability to respond to major emergencies and disasters. The Hospital Safety Index does not replace costly and detailed vulnerability studies. However, because it is relatively inexpensive and easy to apply, it is an important first step toward prioritizing a country's in hospital safety.

Determining the Hospital Safety Index is a new way of managing risk in the health sector. It allows a health facility's level of safety to be monitored over time. Safety no longer has to be a 'yes-or-no' or an all-or-nothing situation, but can instead be improved gradually.

The Hospital Safety Index was developed through a lengthy process of dialogue, testing and revision, over a period of two years, initially by the Pan American Health Organization's **Disaster Mitigation Advisory Group (DiMAG)** and later with input from other specialists in Latin America and the Caribbean.

3.1.2 Calculating the Hospital Safety Index

There are a number of steps to calculating a health facility's Safety Index. First, an Evaluation Team uses the standardized **Safe Hospitals Checklist** to assess the level of safety in 145 areas of the hospital. Once the Checklist has been completed, the Evaluation Team collectively validates the scores and enters them into a scoring calculator, which weights each variable according to its relative importance to a hospital's

ability to withstand a disaster and continue functioning. The safety score is calculated automatically.

The final Safety Index score places a health facility into one of three **categories of safety**, helping authorities determine which facilities most urgently need interventions:

- **Category A** is for facilities deemed able to protect the life of their occupants and likely to continue functioning in disaster situations.
- **Category B** is assigned to facilities that can resist a disaster but in which equipment and critical services are at risk.
- **Category C** designates a health facility where the lives and safety of occupants are deemed at risk during disasters.

Calculating the safety score allows health facilities to establish maintenance and monitoring routines and look at actions to improve safety in the medium term. This quick overview will give countries and decision makers a starting point for establishing priorities and reducing risk and vulnerability in healthcare facilities.

3.1.3 General coordination

The group responsible for general coordination is made up of professionals at the decision-making level from relevant agencies (Ministry of Health, Social Security, etc.) who initiate the evaluation process in each institution. This group will calculate the safety index, gather data, and develop and maintain databases, among other duties. They are also responsible for selecting and training evaluators, forming the evaluation teams, and facilitating the first contact between the evaluation team and representatives of the institution being evaluated.

The general coordination group has overall responsibility for carrying out recommendations of the evaluation team in terms of improvements to a facility. The group is responsible for overseeing the safety of the health network in general in case of disasters. It participates in strategic decision-making and developing plans, programs, and policies for the welfare of the health service network in case of disasters.

Evaluators should be professionals who work in the areas of health facility construction, providing health services, administration, or hospital support activities (e.g., maintenance). If possible, evaluators should have at least five years of experience in structural design, construction, and/or hospital management in disasters. When people with this background are not available, professionals with less experience or students at an advanced level in equivalent fields of study may be selected. Evaluators with less experience should be supervised by national and/or international experts in the subject. In either case, the aim is for expert observation in evaluating elements of the hospital.

The evaluation is conducted by a multidisciplinary team, preferably including:

- engineers with training in structural engineering,
- architects with training in hospital design,
- specialists in hospital equipment and/or electrical and mechanical maintenance,
- Health care professionals (doctors, nurses, etc.),
- specialists in planning and/or administration and logistics,
- Others (security specialists, municipal inspectors, etc.)

It is important to consider the needs of the facility and its position in the hospital network when forming the evaluation team. For example, geotechnical engineers or engineers specializing in seismic resistance should be part of the team evaluating health facilities located in seismic zones. The size and number of teams can vary according to the complexity of the facility. The e team should request the advice of specialists when necessary. All professionals involved in the process receive training in the objectives and methodology of the safe hospitals evaluation, filling out the Safe Hospitals Checklist, interpretation of results, and preparation of a final report.

3.1.4 Organization of the evaluation team

Once the health facility is chosen, the evaluation team is formed, taking into account features of the facility and its surroundings. Each team must have a coordinator. Besides his or her own official identification, each evaluator must have identification that accredits them as part of the evaluation team. This will be part of their certification after completing the training course for safe hospitals, as established by the general coordination group.

Team coordinator: is designated by the appropriate authority or chosen by the evaluation team. Ideally, the team coordinator will have prior experience in risk reduction and disaster response as well as experience in assessing hospitals for safety in disaster situations, preferably using this methodology.

The team coordinator responsibilities are to arrange pre-evaluation interviews with hospital personnel in order to finalize evaluation arrangements. If necessary, will arrange for the team's transport, lodging, and security, and procure the materials and tools needed for the evaluation. He must provide documentation from other facilities that is pertinent to the evaluation, organize interviews with staff from different divisions of the health facility, and organize sub-groups, as necessary, for the evaluation.

As part of his operative responsibilities, the coordinator must provide evaluation team members with copies of the Safe Hospitals Checklist and collect them when comments and recommendations have been made. He should track the process until formal presentation of the evaluation is made to facility authorities, and make contact with national and/or international experts should the team want assistance.

Evaluators: The evaluators' responsibilities are to inspect the structure, to collect and analyze relevant documentation, to collaborate in filling out the forms, and to provide technical input in the final recommendations and in calculations of the Hospital Safety Index. Each evaluator is responsible for completing an evaluation form. Where a sub-group makes an assessment, evaluators in that sub-group will complete only the section of the form that corresponds to their assignment. Evaluators are responsible for consolidating the information and modifying it in accordance with results of the first meetings following the evaluation.

A high level of ethical and cordial behavior is expected from team members. The results of the evaluation report are to be treated as confidential. Under no circumstances will an evaluator discuss the results of the evaluation with outside parties.

Evaluators must not interfere in the daily operations of the facility. He or she must not handle equipment or give advice to staff on matters having to do with operations. The evaluator should take safety measures during the evaluation and wear personal protective gear when appropriate. It is expected that the evaluator will dedicate himself or herself to the evaluation for the time required.

3.1.5 Equipment and materials

The following equipment and materials will be needed during the evaluation:

- Guide for Evaluators of Safe Hospitals (this document)
- Map of the area surrounding the health facility
- Natural hazard map(s)
- Plan of the health facility
- Forms (Form 1: General information; Form 2: Safe Hospitals Checklist)
- Notebooks, pencils, pens
- Two-way radio or cell phone
- Directory of key personnel involved in the evaluation
- Flashlights with charged batteries
- Still camera, video camera, tape recorder (optional)
- Light tools (measuring tapes, chisels, etc.) (optional)
- Calculator (optional)
- Other tools considered necessary for technical assessment

Evaluation team members should carry with them:

- Personal identification
- Evaluation team accreditation
- Comfortable and appropriate work clothing
- Necessary protective items (helmet, protective glasses, etc.)

3.1.6 Role of the Hospital Disaster Committee in the evaluation

The members of the Hospital Disaster Committee should be present throughout the evaluation process, as well as hospital authorities and personnel who are involved in decision-making or who have vital information about the elements being evaluated.

In terms of the evaluation, the main responsibilities of the Hospital Disaster Committee are: to provide all documentation needed to carry out the evaluation; to cooperate in the inspection of the structure by demonstrating or explaining the actual situation and facilitate an accurate diagnosis; to support the diagnosis process with comments and evidence; and to facilitate participation of key hospital personnel through interviews and or meetings about the evaluation. Everyone should keep in mind that the objectives of the evaluation process are to take the necessary steps to reduce risk, mitigate damage from disasters, and create social awareness about disaster prevention.

The **Hospital Disaster Committee** (also known as, for example, the "Emergency and Disaster Committee" or "Risk Management Committee") is the hospital entity responsible for articulating, directing, assessing, and coordinating hospital activities for the periods before, during, and after a disaster, ensuring the participation of all hospital workers. The e structure of this committee should reflect that of the particular facility, but in general should have the following membership:

- Hospital director
- Director of administration
- Chief of emergency unit (coordinator)
- Chief of nursing
- Medical director
- Chief of maintenance and transportation
- Chief of security
- Labor union representative
- Community representative
- Other hospital personnel as deemed necessary.

The committee's main task is to guide the development and execution of a plan that integrates management of risk and of disaster and emergency response. Among other responsibilities, the committee determines the hospital's internal disaster response standards and functions, oversees permanent training and education for staff , and promotes cooperation and integration with the community it serves. The e by-laws of the Hospital Disaster Committee should be formalized before the evaluation process begins.

3.1.7 Initial inspection of surroundings

First, the evaluators make a preliminary inspection of the city or area where the facility is located. This provides an overview of the architectural and construction features of the city, the type of damage that natural hazards could cause, and the areas that would probably be most affected. The evaluators will become familiar with primary and alternate routes used to access the hospital. During the initial inspection, the team gathers pertinent documentation from different sources, including fi re services, the police, and other community services. All of this information is included in the final report. Next is inspection of the hospital exterior. This involves filling out the forms that identify the building and type of structure, construction quality, irregularities, and general

condition, including the condition of facings, balconies, ledges, etc. The e condition of neighboring structures is documented, and evaluators determine whether outside evacuation areas are safe. The team identifies irregularities in the terrain, (for example whether there are steep slopes nearby) and any large bodies of water (ocean, rivers, lakes) near the hospital that could elevate the ground water level.

3.1.8 Using the Checklist

When the process of using the checklist begins, it is important to consider the time required to complete the evaluation, the availability of all interested parties (evaluation team, members of the Hospital Disaster Committee, others), as well as any hospital requirements (shifts, treatment hours, patients, etc.). The e evaluation should be interactive and dynamic and have input from the members of the Hospital Disaster Committee, members of the evaluation team, and outside parties (municipal and health authorities) as deemed necessary. Elements to be evaluated are grouped into modules. Calculation of the safety index is weighted differently for individual modules, depending on their importance to the overall safety of the hospital. For example, a deficiency in a structural element will not be weighted the same as a deficiency in a nonstructural element.

Modules can be evaluated individually or together, but finally, they must be integrated to obtain a single measurement. The e organization of the evaluation should take into account the strategic aspects of the evaluated institution and its surroundings, so that "evaluating teams" can be put together, including the number of groups and the specialization of the experts needed.

The on-site evaluation of the facility should take no more than eight hours. However, time must also be scheduled for organizational meetings prior to the evaluation. These meetings should be arranged to include members of the evaluation team, representatives from the Ministry of Health or Social Security agency responsible for the facility, the management staff of the hospital, and members of the community.

The evaluation team is divided into subgroups, each having a different focus. Features of the facility and its surroundings determine the e composition of subgroups. Each subgroup should have at least two people, each having expertise in certain areas of the evaluation.

It is advisable to take photographs to obtain as much documentation during the evaluation as possible, and with authorization from the facility administration, to use recording cameras and voice recorders. However, this equipment should not be used if it intimidates interviewees in any way or lessens the level of confidence between evaluators and facility staff. Each question in the checklist must be answered unless there is an indication that an answer can be left blank. Sampling questions is not allowed. If there is doubt about rating an element, it is preferable to give a lower than a higher safety rating. Any element classified as having a low level of safety will be given priority for attention. During the process of completing the checklist, evaluators should not make comments about operations in the facility, unless specifically addressed in the evaluation. Value judgments expressed by individual evaluators or the group is not considered part of the evaluation.

Evaluators should make notes about their observations in the column reserved for comments in the checklist, in the row pertaining to an element. These comments are helpful when compiling the evaluation report. While they do not form part of the numerical calculations of the safety index, comments are included in the recommendations for the facility that are made by evaluators. In the comments section an evaluator might justify a positive or negative rating, include questions raised by the facility about a response in the checklist, or emphasize urgent measures that should be taken to improve the hospital's safety. The e comments section can also include general references to the facility that are not included in the evaluation modules or that might warrant another opinion.

The evaluation and comments must be made in the local language. Any translations of the material must be faithful to the meaning of the content. Once the evaluation is completed, the facility being evaluated has the opportunity to add general comments regarding the process and the evaluation team. This feedback is essential for improving the evaluation process. Recommendations are the responsibility of the general coordination, who should present them in writing in the final report.

3.1.9 Finalizing the evaluation

Once the on-site evaluation is complete, the evaluation team meets to share, consolidate, and discuss their findings. Following this, a meeting is organized which includes all interested parties, whether or not they were directly involved in the evaluation. Members of team subgroups will make general observations about the data collected at this meeting. Subsequent discussion and suggestions will be used to make changes to the evaluation documents, or comments can be noted.

When there is disagreement between the evaluation team and the hospital disaster committee or administration of the hospital, it should be noted as an observation to the evaluation. The corrected document is signed and dated by members of the evaluation team, and a copy is delivered to the director of the facility. The e original report with any additional documentation (photographs, documents, recordings, etc.) is delivered to the general coordination group. They, in turn, are responsible for fi ling all documentation, updating the database of the tabulated results of hospital assessments, and calculating the safety index. The general coordination group prepares the final report which includes recommendations made by the evaluation team.

The report should be presented at the final meeting, where feedback is expected from the evaluated institution regarding the general evaluation process, so that improvements can be made in future evaluations.

Following the presentation of the final report to the facility, the next stage of tasks and responsibilities for both groups will emerge. The general coordination group must diligently follow-up with inspections of the measures deemed necessary to improve the facility's safety index. The hospital that was evaluated must carry out necessary improvements in the times recommended. The hospital must then inform the general coordination group and proceed to final inspections, if this step has been agreed upon. A copy of the final report will be filed by the coordination group along with supporting documentation in a fi le identified with the name of the facility, and subdivided into dates of evaluations. The e database will be updated and dates will be agreed on for the follow-up process

3.1.10 Brief Description of the Evaluation Forms

Form 1: "General information about the health facility"

This form includes general information about the health facility being evaluated and its treatment capacity.

- General information: Name and address of the facility, contact numbers, names of administrators, number of beds, hospital occupancy rate, number of personnel, diagram of the facility and its surroundings, position in the health services network of the area, number of persons treated, others.
- Treatment capacity: number of beds by services or surgical and medical specialty; expansion capacity in case of disaster. The hospital's disaster committee should complete this form before the evaluation. If possible a diagram of the hospital setting and the distribution of services should accompany it, with a legend describing them.

Form 2: "Safe Hospitals Checklist"

The checklist is used for preliminary diagnosis of the hospital's safety in the event of disasters. It contains 145 variables, each of which has three safety levels: low, medium, and high.

It is divided into four sections or modules:

1. Geographic location of the health facility
2. Structural safety
3. Non-structural safety
4. Functional capacity

Issues to keep in mind while using the checklist are as follows:

a) The contents of the checklist and the elements being evaluated are formulated for application in general or specialized hospitals.

b) The component on geographic location is for determination of the hazards that exist in the area; these hazards are not included in the calculation of the safety index.

c) Modules 2-4 have values that are weighted differently in accordance with their significance in the event of a disaster. The e values for structural components represent 50% of total values in the index, nonstructural components represent 30% and functional capacity represents 20%.

d) Each item has different importance in relationship to other items in the same module. Items with the most relevance are shaded or highlighted and are weighted more heavily than other items.
e) The values assigned to each variable are in accordance with established standards (for example, PAHO manuals, local construction codes, and institutional standards and rules).
f) Criteria are applied most strictly in the critical areas of the hospital where the demand for treatment is greatest in an emergency
g) For the evaluation process to be considered complete, all items must be analyzed.
h) The e checklist includes instructions for filling in each of the items. Only one box for each item being evaluated should be marked with an "X" (low, medium, or high) for safety level, level of organization, level of implementation, or level of availability.

3.1.11 Four modules of the checklist

1. Geographic location of the health facility

The first module allows for a rapid description of hazards or dangers and geotechnical properties of soils at the site of the health facility. This information should be taken into account when determining safety levels of the elements in the other modules.

2. Structural safety

Evaluating structural safety of the facility involves assessment of the type of structure, materials, and previous exposure to natural and other hazards. The e objective is to determine if the structure meets standards for providing services to the population even in cases of major disaster, or whether it could be impacted in a way that would compromise structural integrity and its functional capacity. Safety in terms of prior events involves two elements. The first is whether the facility has been exposed to natural hazards in the past, and its relative vulnerability to natural hazards. Second, the evaluators must determine how the facility was impacted or damaged in the past and how the damage was addressed. The evaluators attempt to identify potential risks in terms of the type of design, structure, construction materials, and critical components of the structure. Structural systems and the quality and quantity of construction materials provide the stability and resistance of a building against natural forces. Making adjustments in a

structure for a given phenomenon is essential, since a structural solution can be valid for hurricanes but not for earthquakes.

3. Non-structural safety

The failure of non-structural elements does not usually put the stability of a building at risk, but it can endanger people and the contents of a building. Evaluators determine whether these elements could separate, fall, or tip which could have an impact on important structural elements. Evaluators will verify the stability of non-structural elements (provided by, for example, supports, anchors, and secure storage) and whether equipment can function during and after a disaster (for example, whether there are safety valves for reserve water tanks and alternative connections to networks, etc.). The is analysis includes the safety of critical networks (for example, the water system, power, communications); heat, ventilation, and air conditioning (HVAC) systems in critical areas; and medical diagnostic and treatment equipment. Architectural elements such as facings, doors, windows, and cantilevers are evaluated to determine their vulnerability to water and the impact of flying objects. Safety of access to the facility and internal and external traffic are taken into account in this section, along with lighting systems, fi re protection systems, false ceilings, and other components.

4. Safety based on functional capacity

How hospital personnel are organized to respond in disaster situations is central to evaluating a hospital's capacity to function during and after a disaster. The is module looks at the general organization of hospital management, implementation of disaster plans and programs, resources for disaster preparedness and response, level of training and disaster preparedness of the staff , and the safety of the priority services that allow the hospital to function. The e hospital administrators should provide evaluators with any documentation that is relevant to their hospital disaster plan.

More than half of the 16,000 hospitals in Latin America and the Caribbean are in areas at high risk for disasters. The **Hospital Safety Index** helps health facilities assess their safety and avoid becoming a casualty of disasters.

The Hospital Safety Index provides a snapshot of the probability that a hospital or health facility will continue to function in emergency situations, based on structural, nonstructural and functional factors, including the environment and the health services

network to which it belongs. By determining a hospital's Safety Index or score, countries and decision makers will have an overall idea of its ability to respond to major emergencies and disasters. The Hospital Safety Index does not replace costly and detailed vulnerability studies. However, because it is relatively inexpensive and easy to apply, it is an important first step toward prioritizing a country's investments in hospital safety. Determining the Hospital Safety Index is a new way of managing risk in the health sector. It allows a health facility's level of safety to be monitored over time. Safety no longer has to be a 'yes-or-no' or an 'all-or-nothing situation, but can instead be improved gradually.

The Hospital Safety Index was developed through a lengthy process of dialogue, testing and revision, over a period of two years, initially by the Pan American Health Organization's **Disaster Mitigation Advisory Group (DiMAG)** and later with input from other specialists in Latin America and the Caribbean.

3.2 Calculating the Hospital Safety Index

There are a number of steps to calculating a health facility's Safety Index. First, an Evaluation Team uses the standardized **Safe Hospitals Checklist** to assess the level of safety in 145 areas of the hospital. Once the Checklist has been completed, the Evaluation Team collectively validates the scores and enters them into a scoring calculator, which weights each variable according to its relative importance to a hospital's ability to withstand a disaster and continue functioning. The safety score is calculated automatically.

The final Safety Index score places a health facility into one of three **categories of safety**, helping authorities determine which facilities most urgently need interventions:

- **Category A** is for facilities deemed able to protect the life of their occupants and likely to continue functioning in disaster situations.
- **Category B** is assigned to facilities that can resist a disaster but in which equipment and critical services are at risk.
- **Category C** designates a health facility where the lives and safety of occupants

are deemed at risk during disasters.

Calculating the safety score allows health facilities to establish maintenance and monitoring routines and look at actions to improve safety in the medium term. This quick overview will give countries and decision makers a starting point for establishing priorities and reducing risk and vulnerability in healthcare facilities.

- The **First** step in calculating the Hospital Safety Index is to carry out the evaluation and complete the checklist process, which evaluates the health facility's location, structural and nonstructural safety, and organization of hospital staff .We should point out that the hazard levels assigned to the location of the hospital, including the level of hazard due to soil characteristics, are not counted when calculating the Safety Index.
- The **Second** step is to calculate the results from the checklist , with the use of a series of formulas that assign specific values to each variable. The calculations are based on how the evaluators rated each element and the relative importance of that element to overall safety of the hospital in case of disaster. **Relative weight of variables, sections and components**

Variables or elements are grouped into sub-modules, and a group of sub-modules constitutes one module. The e value of each variable is multiplied by its relative weight in a sub-module. The sum of values of all the variables of a sub-module gives 100% of that sub-module.

Each sub-module is weighted in relation to the other sub-modules in the same module. The sum of the weighted values of the sub-modules gives 100% of the respective module. Because it is possible to separate the results for sub-modules and for modules, it is easier to identify the critical areas of the hospital. As mentioned earlier, the module for structural safety has a weighted value of 50% of the index, the nonstructural module has a weighted value of 30%, and functional capacity is weighted at 20%. The e 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 a disaster situation.

Given that each variable has three levels of safety (high, average, and low), and to avoid any distortion at the time of evaluation, each level of safety receives a constant

value. The Safety Index has a maximum value of 1 (one) and a minimum of 0 (zero). Calculations and weighted values take into account that it is very difficult for a hospital to remain perfectly operational, so it is rare for a facility to be given a safety index of "1."

3.2.1 Entering data into the Safety Index Calculator

When formulas are applied to the data from the checklist, values are assigned to each item, and weighted values are assigned to each sub-module and to each module. The formulas calculate the overall safety index and a specific value for the structural, non-structural, and organization/functionality modules. The e checklist results are entered as number "1" in the corresponding cells and the calculation page automatically applies a series of formulas to carry out the following steps:

- Automatically corrects input errors
- Assigns weighted values for the safety of each variable, each sub-module, and each module(structural, non-structural, and functional)
- Calculates and graphs relative safety for each module (percentage)
- Calculates and graphite Hospital Safety Index
- Automatically classifies the hospital with "A", "B", or "C" (see the following graphic)
- According to the hospital safety classification, provides general recommendations about how to correct deficiencies.

3.2.3 General recommendations for intervention

Safety index Classification

0 – 0.35 C: Urgent intervention measures are needed. The hospital's current Safety levels are inadequate to protect the lives of patients and Hospital staff during and after a disaster.

0.36 –0.65 B: Intervention measures are needed in the short-term. The hospital's current safety levels are such that patients, hospital staff, and its ability to function during and after a disaster are potentially at risk.

0.66 – 1 A: It is likely that the hospital will function in case of a disaster. It is recommended, however, to continue with measures to improve response capacity and to carry out preventive measures in the medium- and long-term to improve the safety level in case of disaster.

The evaluator should interpret results in the context of other health facilities in the area's health service network, the location of the facility, and the type of population it serves.

3.2.4 Instructions to complete the checklist

Before applying the checklist, make sure that the previous steps described in the proceedings and recommendations for the evaluation of the health facility have been completed. In this section each one of the 145 aspects or variables to be evaluated are described and guidance is provided as to how best to establish the corresponding degree of safety: High (H), Average (A) or Low (L). All of the variables need to be evaluated and assessed and the result of the evaluation should be noted down in the check list.

The degree of safety will be evaluated in accordance with the standards established for each variable and the individual and collective experience of the group of evaluators. It is recommended that additional information or comments on the variable assessed should be noted in the observations column. Take into account that some variables include a note in capital letters which indicates the possibility that it may not be possible to evaluate this variable and as a result, this could be left blank, with no answer. Even in these cases, careful analysis is recommended to reconfirm that the condition described in capital letters is fulfilled before leaving this blank and evaluating the following variable.

On completion of each module in the check list: Geographical location, structural safety, non- structural safety and functional capacity, comments or general observations should be noted as well as the name and signature of the evaluators.

I. Geographic location of the health facility

Analysis of the geographical location of the facility enables hazards to be assessed in relation to previous emergencies and disasters which have occurred in the zone, and the place and type of land where the health facility has been constructed. Natural and anthropogenic hazards should be taken into account. This aspect is divided into two categories: Hazards and geotechnical properties of the soil.

The hospital disaster committee should be requested to provide in advance the map or maps which specify the hazards in the zone. Should there be no maps; other local entities should be approached, such as multispectral risk reduction bodies, for example, the Civil Protection or Defense, the Emergency Commission etc.

It is necessary to analyze this information to evaluate the safety of the facility in its surroundings in relation to hazards. This is fundamental for the evaluation team and the hospital committee since they will set the boundaries of the evaluation in respect of the following points, correcting setting out "the factors against which the facility should be safe", given the frequency, magnitude and intensity of destructive phenomena (hazards) and the geotechnical properties of the soil.

This point of the evaluation does not lend itself to measurement; nor does it form part of the calculation of the hospital safety index. Nevertheless, it is useful to asses each one of the variables appropriately, taking into account the surroundings and the context of the area in which the hospital is located.

Hazards

Under this point, the different types of hazards are analyzed (geological, hydro-meteorological, social, environmental, chemical and technical) related to the location where the health facility is located. The extent of the hazard to which the hospital is exposed is considered to be directly proportional to the probability of the occurrence of a hazard and its magnitude.

In this way, they can be classified as high (high probability of a hazard taking place or high-magnitude hazard), medium (high probability of a moderate hazard) and low (low probability or a hazard of low magnitude).Refer to hazard maps. Request the Hospital Disaster Committee to provide the map(s) showing safety hazards at the site of the building.

Geological phenomena

•Earthquakes

Rate the hazard level of the hospital in terms of geotechnical soil analyses.

•Volcanic eruptions

Refer to hazard maps of the region to rate the hospital's exposure to hazard in terms of its proximity to volcanoes, volcanic activity, routes of lava flow, pyroclastic flow and ash fall.

•Landslides

Refer to hazard maps to rate the level of hazard for the hospital in terms of landslides caused by unstable soils (among other causes).

•Tsunamis

Refer to hazard maps to rate the level of hazard for the hospital in terms of previous tsunami events caused by submarine seismic or volcanic activity.

Hydro-meteorological phenomena

•Cyclones

Refer to hazard maps to rate the hazard level of the hospital in terms of Cyclones. It is helpful to take into account the history of such events when rating the hazard level of the facility.

•Torrential rains

Rate the hazard level for the hospital in relation to flooding due to intensive rainfall based on the history of such events.

•Storm surge or river flooding

Rate the hospital's level of exposure to storm surge or river flooding hazards based on previous events that did or did not cause flooding in or around the hospital.

•Landslides

Refer to geological maps to rate the hospital's level of exposure to landslide hazards caused by saturated soils.

•Others (specify)

Refer to hazard maps to identify other hydro-meteorological hazards not listed above. Specify the hazard and rate the corresponding hazard level for the hospital.

Social phenomena

•Population gatherings

Rate the hospital's exposure to hazard in relation to the type of population it serves, its proximity to population gatherings and prior events that have affected the hospital.

•Displaced populations

Rate the hospital's exposure to hazard in terms of people who have been displaced as a result of war, socio-political circumstances, or due to immigration and emigration.

•Others (specify)

If other social phenomena affect the safety of the hospital, specify them and rate the level of hazard for the hospital accordingly.

Environmental phenomena

• Epidemics

With reference to any past incidents at the hospital and specific pathogens, rate the hospital's exposure to hazards related to epidemics.

•Contamination (systems)

With reference to any past incidents involving contamination, rate the hospital's exposure to hazards from contamination of its systems.

•Infestations

With reference to the location and past incidents at the hospital, rate the hospital's exposure to hazards from infestations (flies, fleas, rodents, etc.).

•Others (specify)

With reference to any past incidents at the hospital specify any other environmental phenomena not included above that might compromise the level of safety of the hospital.

Chemical and/or technological phenomena

•Explosions

With reference to the hospital's surroundings, rate the hospital's exposure to explosion hazards.

•Fires

With reference to the exterior of the hospital building, rate the hospital's exposure to external fires.

•Hazardous material spills

With reference to the hospital's surroundings, rate the hospital's exposure to hazardous material spills.

•Others (specify)

Specify and rate other chemical or technological hazards in the area where the hospital is located.

Geotechnical properties of soils

Under this point, the aim is to have a general idea of the soil mechanics and the geotechnical parameters as well as the levels of foundation inherent to the soil type.

•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.

•Clay soils

With reference to soil maps, rate the hospital's exposure to hazards from clay soil.

•Unstable slopes

Refer to geological maps and specify the hospital's exposure to hazards from the presence of slopes.

II. Elements related to structural safety of the building

Addresses the elements related to the first of the three modules or components which are taken into account to calculate the safety index: the structural safety of the building. Columns, beams, walls, floor slabs, foundations, etc., are structural elements

that form part of the load-bearing system of the building. This checklist was developed specifically to evaluate buildings of reinforced concrete. The aspects addressed in this structural module should be assessed by structural engineers; therefore, the sub-group which undertakes the assessments in this module should preferably be coordinated by a structural engineer.

The module on structural safety is divided into two sub-modules:

1. Prior events affecting hospital safety

2. Safety of the structural system and type of materials used in the building Classifications will be “High”, “Average”, and Low”.

Prior events affecting hospital safety

This corresponds to sub-module 2.1 and is made up of 3 items or rows in the checklist (developed under items 1 to 3).

1. Has there been prior structural damage to the hospital as a result of natural phenomena?

The evaluators will determine whether structural reports indicate that the level of safety has been compromised in the past by a natural phenomenon.

To get historical accounts of damage to the facility, it is important to interview personnel who have worked the longest in the hospital, no matter their position. Cleaning personnel, kitchen staff, ad- ministration, or support staff can relate their experiences in the hospital during disasters in the past. Ask specifically about structural damage they might have observed. Most people remember damage to non- structural elements, which are usually numerous. If the hospital has suffered recent damage, it is likely that there are published accounts of the event. Certain reports might be accessible on the Internet.

In some cases the question does not apply to the facility because a variable does not exist. Only in such cases, and where there are instructions to leave boxes blank if the question does not apply, should the question not be answered.

The safety index has a special formula for calculating elements that are not applicable. When ratings from the checklist are entered, only the elements that have been evaluated are calculated.

Safety ratings for item No. 1 are: Low = Major damage; Average = Moderate damage; High =Minor damage.

2. Was the hospital built and/or repaired using current safety standards?

The evaluator will verify whether the building has been repaired, the date of repairs, and whether repairs were carried out using standards for safe buildings. Once the date of repairs is established, it will be possible to determine what construction standards were in force when repairs were made.

As mentioned earlier, elements that are highlighted in the checklist are particularly important for the evaluation, which is the case for this question. Evaluators should make an in-depth assessment of prior construction work in the facility. They should interview a variety of people, particularly maintenance staff who have experience in the facility, and, if possible, the people responsible for the construction.

Safety ratings for Item No. 2 are: Low: Current safety standards not applied; Average = Current safety standards partially applied; High = Current safety standards fully applied.

3. Has remodeling or modification affected structural behavior of the facility?

The evaluators should determine whether modifications were carried out using safe building standards. Frequently, hospitals "suffer" modifications that different departments and services need. These changes may be made without considering what effect they will have on the structure's resistance to hazards or future events, increasing vulnerability for the facility and its occupants. For example, filling in an open space between two columns with a masonry wall redistributes loads in a building. A modification such as this could cause columns to fail.

Safety ratings for item No. 3 are: Low = Major remodeling or modifications have been carried out; Average = Moderate remodeling and/or modifications; High = Minor remodeling and/or modifications or no modifications were carried out.

Safety of the structural system and type of materials used in the building

This second aspect to be assessed in the structural module corresponds to sub-module 2.2 and is made up of 10 items or rows in the checklist developed under items 4 to13.

4. Condition of the building

Evaluators will inspect the building for signs of deterioration, such as broken plaster, cracks, or sinking structural elements, and determine the causes. It is important to interview the hospital's maintenance staff in this regard. When assessing any damaged structural elements evaluators should determine their function in maintaining overall structural stability. For example, the risk posed by a damaged column on the ground floor is not the same as for one on the top floor. The condition of the building is closely related to the type of construction materials used for structural elements. A crack can occur because of a variety of things, some indicate something serious (design, overload) and others do not (change in volume). It is also important to assess the location of the cracks and their angle to determine the condition of the building.

Safety ratings for item No. 4 are: Low = Deterioration caused by weathering; cracks on the first floor and irregular height of buildings; Average = Deterioration caused only by weathering; High = Good; no deterioration or cracks observed.

5. Construction materials used

This item is closely related to item 4 ("Condition of the building"). For example, when the structure is built primarily with reinforced concrete, which is an excellent material, the presence of cracks and rust can indicate that incorrect amounts of concrete components (cement, rock, sand, and water) were used. As a result, permeability may be

high and the resistance of materials low, which increases the vulnerability of these elements and puts the structure as a whole at risk. The evaluators should indicate whether the elements in poor condition are of structural value to the hospital building.

Regarding 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.

Safety ratings for item No. 5 are: Low = Rust with flaking; cracks larger than 3mm; Average = Cracks between 1 and 3 mm or rust powder present; High = Cracks less than 1 mm; no rust.

6. 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. The evaluators must determine whether non-structural elements are completely tied to the structure, if "short columns" are present, if joints are flexible, and whether expansion joints have been used. An example of non-structural/structural interaction is as follows: a non-structural dividing wall falls during an earthquake because of a bad anchor; the wall falls onto a staircase beam, obstructs the staircase and, in the worst case, destroys it.

Safety ratings for item No. 6 are: Low = separation of less than 0.5% of the height of the partition/ joint; Average = separation between 0.5 and 1.5% of the height of the partition/joint; High = separation above 1.5% of the partition/joint.

7. Proximity of buildings (hazards of pounding, wind tunnel effects, fires, etc.)

Buildings that are closely spaced can cause different problems depending on the forces that affect them. For example, in the case of an earthquake, buildings that are too closely spaced, depending on their heights, can pound against each other until one or both collapse. In the case of hurricanes, there are 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 multi-story building was designed.

Evaluators should inspect the exterior of the hospital to determine whether such problems might arise.

Safety ratings for item No. 7 are: 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.

8. Structural redundancy

Redundancy is a normal part of structural systems, and is essential for the safety of hospital buildings. The evaluation aims to ensure that the hospital can resist the lateral forces caused by earthquakes and in major hurricanes in the two main orthogonal directions of the building.

Evaluators will review structural plans of the hospital building and verify at the site whether the structure actually meets the design criteria in the two principal orthogonal directions. A building with fewer than three lines or axes of resistance in any of the major directions is vulnerable to major demands of resistance and rigidity.

While not one of the items in the checklist, evaluators should be aware that the three lines of resistance do not guarantee structural redundancy in rigid-framed buildings, with structural beams and/or walls, and with good beam-column connections. In some cases it will be necessary to evaluate structural safety of other designs such as flat slab with flat beams and note the safety level.

Safety ratings for item No. 8 are: 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.

9. Structural detailing, including connections

Joints for structural components are among the most critical design elements for lateral loads, especially when caused by earthquakes. Notwithstanding the construction year of the building, the evaluator should try to determine characteristics of joints both through on-site observation and by reviewing structural plans, and develop clear-cut criteria for them, especially in seismic areas. When dealing with prefabricated construction, the evaluator must do a detailed examination of the joints; they will be numerous, not monolithic, and in most cases welded or wet joints. They should be assessed for cracks or fractures, which would put the joints and, ultimately, the structure at risk.

Safety ratings for item No. 9 are: Low = Built before 1970; Average = Built between 1970 and 1990; High = Built after 1990 and according to standards.

10. Safety of foundations

Foundations are the most difficult structural elements to evaluate because they are neither accessible nor visible. And to add to this difficulty, corresponding plans for the foundations are often not available. If the facility is old the plans might not be in the archived either in the administration or maintenance department. In some cases the plans may be with a construction company that has done studies for the purpose of expansion, remodeling, or repairs.

It is important to make every effort to access the plans to have precise criteria for the foundation, to determine the type of foundation (shallow, deep, isolated, combination, etc.) and whether they are united or isolated. Buildings are more vulnerable to seismic forces when they do not have braced beams connected to the foundation.

When evaluating this item it is important to take into account the information about soils at the site from the sub-module 1.2 “Geographic location of the hospital” to determine soil-structure interactions. The ground water level and type of soil at the building site play a critical role in determining the facility’s vulnerability to floods and differential settlement of the foundation, with the well-understood effects on vertical

structural elements. Liquefaction can occur if the building is on saturated, unconsolidated soils, as in the case of sand beds, saturated silt, or uncompact fill, among others. Liquefaction has caused severe damage to infrastructure, and the evaluator should carefully substantiate whether such conditions are present at the hospital site.

Safety ratings for item No. 10 are: Low = Information is lacking or foundation depth is less than 1.5 m; Average = Plans and soil studies are lacking but foundation depth is more than 1.5 m; High = Plans, soil studies are available and foundation depth is more than 1.5 m.

11. Irregularities in the plan (rigidity, mass, and resistance)

Irregular structures can be expressed in terms of shape, configuration, and torsional eccentricity (i.e., the distance between the center of mass and the center of rigidity). While evaluators inspect the exterior and interior of the hospital, they should look for inconsistencies in the hospital plan from the perspective of rigidity (shape and type of materials used for resistant vertical elements) as well as the distribution of mass (concentrated and distributed). The evaluator should try to identify at the site and by using diagrams whether there are seismic joints that 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.

Another aspect that the evaluator must check is the relative position of the frames (framework of beams and columns) and the shear walls since this determines the response of horizontal diaphragms (slabs) in terms of displacement and rotation. 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. The evaluator should determine if these conditions exist and whether there are structural elements designed to mitigate these effects.

Safety ratings for item No. 11 are: Low = Shapes are irregular and structure is not uniform; Average = Shapes are irregular but structure is uniform; High = Shapes are regular, structure has uniform plan, and there are no elements that would cause torsion.

12. Irregularities in height (rigidity, mass, and resistance)

In elevation of a hospital building, as in the case of the plan, irregularity can be found in shape, configuration, and torsional eccentricity. As in item No. 11, the evaluator must take note of any abrupt changes in configuration. 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. The evaluator should check 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. The so-called "soft floor," an unfavorable feature in seismic zones, can be present owing to significant changes in rigidity due to variations in height. The evaluator should be aware that an in-fill wall can convert a column designed for support along its entire height into a "short" column. Short columns have been the cause of collapse in buildings that were supposedly resistant to seismic forces. The evaluator should take note of high concentrations of mass on upper floors of a hospital, owing to the placement of heavy items like machinery, equipment, and water tanks on upper floors. These can increase inertial forces and cause excessive displacement. Besides irregularities in plan, variation of the type as well as mass and rigidity of materials can alter the resistance to loads that affect the building. The evaluator should also determine whether elements (such as columns and walls) are symmetrically distributed in height, to the edges, providing rotational rigidity.

Safety ratings for item No. 12 are: Low = Height of storeys differs by more than 20% and there are significant discontinuous or irregular elements; Average = Stories have similar heights (they differ by less than 20% but more than 5%) and there are few discontinuous or irregular elements; High = Stories of similar height (they differ by less than 5%); there are no discontinuous or irregular elements.

13. Structural resilience to various phenomena (meteorological, geological, among others)

For this item, evaluators will refer to hazards present at the site of the hospital, found in the first module, "Elements relating to the geographic location of the health facility." Expertise is needed to determine whether the hospital facility as a whole can function adequately given its geographic location and the natural forces that can affect it. The evaluator will look at variables both independently and in their entirety to estimate structural behavior in response to different hazards or dangers other than earthquakes. For example, a building's design might be adequate to resist seismic forces but it could be very vulnerable to hurricanes, and vice versa. For this item, evaluators will give greater weight to the qualitative part of the safety index, that is, the level of exposure to each hazard. This will satisfy the answer as to whether the facility's structural design is adequate to resist natural forces.

Safety ratings for No. 13 are: Low = Low structural resilience to natural hazards present at the site of the hospital; Average = Satisfactory structural resilience; High = Excellent structural resilience.

III. Elements related to non-structural safety

Aspects related to the second of the three modules are now assessed quantitatively in the calculation of the Hospital Safety Index: non-structural safety.

Elements that do not form part of the load-bearing system of the hospital facility are considered as non-structural. These include critical systems such as electrical, water supply and sanitary networks and heating, ventilation, air-conditioning systems etc; the furniture and office equipment, whether fixed or mobile, as well as medical and laboratory equipment, supplies used for analysis and treatment as well as architectural components of the building, and so forth.

There are five sub-modules, as follows:

1. Critical systems (including electrical, telecommunications, water supply, fuels, and medical gases).

2. Heating, ventilation, and air conditioning systems in critical areas.

3. Fixed and mobile furnishings and equipment (including computers, printers, etc.)

4. Medical and laboratory equipment and supplies used for diagnosis and treatment.

5. Architectural components of the building.

Critical systems

This first sub-module is number 3.1 and is divided into five sub-groups

Electrical system

14. Generator has capacity to meet 100% of demand

The evaluator will verify that the generator begins to operate within seconds of the hospital losing power, covering power demands for the entire hospital. If it cannot meet 100% of demand for the entire hospital, it should meet demands for the emergency department, intensive care unit, sterilization unit, and operating theatre, that is, areas of the hospital that are most critical to maintaining its services. Evaluators should confirm that power plant operators have emergency preparedness training. The work area should be checked to see that there are flashlights and basic communications equipment.

Safety ratings for item No. 14 are: Low = Generator can only be started manually or covers 0–30% of demand; Average = Generator starts automatically in more than 10 seconds or covers 31%–70% of demand; High = Generator starts automatically in less than 10 seconds and covers 71%–100% of demand.

15. Regular tests of generator performance are carried out in critical areas

The evaluators will determine how frequently generator performance tests with satisfactory results are carried out. This allows potential failures in the system to be anticipated, and provides measures to be taken should a failure occur. The evaluators can also determine how issues about generator function and repairs are communicated to the unit responsible for maintenance.

Safety ratings for item No. 15 are: Low = Tested every 3 months or more; Average = Tested every 1 to 3 months; High = Tested at least monthly.

16. Generator protected from damage due to natural phenomena

Evaluators will determine whether or not the generator is for use out of doors, and based on this, its location. For outdoor generators, evaluators will inspect the casing and any form of protective covering. Depending on its location, the potential for flood damage should be evaluated. Its vulnerability to strong winds or proximity to adjacent structures that might fall and cause damage due to wind or seismic forces should also be evaluated. Drainage at the generator's location should be evaluated: how runoff is managed if the equipment is outside, and if placed indoors, whether there are floor drains or openings.

It should be ascertained that the generator is well anchored and braced, without the possibility of falling or shifting. This involves inspection of supports for the generator in the ground or flooring and the condition and type of connections (checking for corrosion or other deterioration). If springs are used to avoid vibration and noise, they must be well anchored since these devices amplify seismic waves. The connections for fuel lines and electric cables must be flexible to avoid breakage should the generator shift or fall. The lower that these heavy pieces of equipment are placed in the structure, the less the chance that they will turn over, but they can still slide.

There should be easy and safe access to the equipment. The possibility that cables or fuel lines would block doors or other exits should be considered if the equipment shifts or falls.

Evaluators should check the availability and storage of fuel, confirming that supplemental tanks are always full and are located so that fuel can reach the generator by gravity rather than depend on pumping at the moment of an emergency. Evaluators will inspect the physical condition of the fuel tanks and electrical and hose connections. The condition of the batteries and replacement batteries for the starter should be also inspected, to ensure that they cannot be damaged. Check for protection against electrical discharge caused by atmospheric changes, etc.

Safety ratings for item No. 16 are: Low = No; Average = partially; High = Yes.

17. Safety of electrical equipment, cables, and cable ducts

The condition of the electrical networks throughout the hospital should be checked. They should be completely anchored and protected from strong winds or flooding and channeled through electric cable racks or conduits that protect them from twisting, breaking, or general deterioration. When cables travel along roofs that empty through drain pipes or gargoyles, they should be positioned above the overflow level. When the building has a basement or other areas that are likely to flood, evaluators will inspect the location of sockets and whether they need to be raised.

An important element is the separation of electrical networks from other systems that they could affect as water supply or sewage systems. If they are in close proximity to protective systems for electrical atmospheric discharge, metal shielding should be considered.

Evaluators should inspect the position of outside power lines in relation to features on the hospital grounds. Electric poles should not be located on hospital grounds, but if they are, evaluators should ensure that transformers are well anchored. The possibility that poles could fall because of soil liquefaction or wind should be considered. Tree branches can break or interfere with above-ground power lines; likewise, tree roots can interfere with buried lines.

Safety ratings for item No. 17 are: Low = No; Average = partially; High = Yes.

18. Redundant system for local electric power supply

The failure of local power supplies can cause a "domino" effect in the health facility, that is, successive outages can occur. The evaluator should confirm that there is redundancy in the power supply, without counting on the hospital's own emergency generating system. There should be more than one entrance to the facility from the local power supply, which should be from another circuit, clearly located in other places and independent from the internal emergency system.

Safety ratings for item No. 18 are: Low = No; Average = partially; High = Yes.

19. Protection for control panel, overload breaker switch, and cables

The evaluator will check the accessibility as well as condition and operation of the general distribution board, as well as control panels distributed throughout the facility. The location should be checked to ensure that access cannot be blocked, that doors and windows are intact, and that there is sufficient drainage to avoid flooding from a sudden gush of water.

The performance of the distribution board must be checked, including the capacity of the breaker, its connections to the system, and the supports or anchors used for all of the panels and corresponding equipment. Panels should be labeled indicating which control devices serve circuits in different areas. Evaluators should verify the qualifications of the person responsible for operating the system, as well as how he/she has been trained to communicate in an emergency.

Connections to the emergency back-up system, emergency lighting, and interior alarm systems must be inspected. If these connections are located close to the emergency generator, all cables should be appropriately channeled and in good condition.

Safety ratings for item No. 19 are: Low = No; Average = partially; High = Yes.

20. Lighting system for critical areas of the hospital

Evaluators will review lighting in critical areas of the hospital, including the emergency unit, intensive care unit, operating theatre, laboratories, etc. They will test levels of lighting in rooms, the function of lighting fixtures, and determine the safety of their bracing or supports. Some lights are suspended from ceilings; others are attached to the structure. In the case of lighting used in surgery or obstetrics, manufacturers' installation instructions generally suggest that they be bolted to beams. The evaluator should ensure that lighting fixtures are not supported by false ceilings, especially where there are seismic hazards. Where water filtration occurs on upper floors, leaks could cause short circuits in light fixtures. Evaluators should confirm that lighting is connected to the emergency power system.

Safety ratings for item No. 20 are: Low = No; Average = partially; High = Yes.

21. External electrical systems installed on hospital grounds

Evaluators will determine whether external substations or transformers are on hospital grounds and their power capacity. These systems should be completely enclosed and there should be signs clearly indicating that they are a power source. They should be isolated from fuel tanks. Anchors or supports should be sufficient to prevent them from tipping over or sliding. Evaluators should take into account the possibility of oil leaks in the case of a transformer and breaks in electrical cables. Transformers or substations should not be placed close to trees because branches can break or interfere with above-ground power lines; likewise, tree roots can interfere with buried lines. They should be protected from electrical atmospheric discharge.

Safety ratings for item No. 21 are: Low = No electrical substations installed on hospital's grounds;

Average = Substations installed but do not provide enough power to hospital; High = Electrical substations installed and provide enough power to the hospital.

Telecommunications system

22. Condition of antennas and antenna bracing

Evaluators will verify the condition of antennas, their bracings and supports. Antennas and lightning rods are exposed and attached to the highest part of the structure, and therefore vulnerable to strong winds. There should be at least three tie-downs, spaced 120 degrees apart; four tie-downs should be spaced 90 degrees apart. Grounding devices for lightning rods should be correctly installed and not be used to anchor other systems.

Safety ratings for item No. 22 are: Low = Poor or does not exist; Average = Satisfactory; High = Good.

23. Condition of low-voltage systems (Internet and telephone connections/cables)

Verify that cables are properly connected in strategic areas to avoid system overload. Cables for computer and telephone networks should be protected from events such as high winds and flooding, so that the systems can function in adverse conditions. The main components of low current systems, such as servers and network hubs should be in protected areas that are free of items that could potentially block access.

To connect the telephone exchange to each of the extensions or telephones in a building, there is a system of wires that must run separately from electrical wires, to avoid overloading the system. Likewise, internal communications wires must be isolated. The wires should be protected in polyethylene tubes; plastic electrical boxes should house the outlets and be placed at least half a meter above the floor.

Safety ratings for item No. 23 are: Low = Poor or does not exist; Average = Satisfactory; High = Good.

24. Condition of alternative communications systems

The evaluator will check the condition of the hospital's alternative communications systems, including two-way mobile radios, satellite telephone, Internet, and loudspeakers, in order to maintain internal as well as external contact in the event of a

disaster. Components of internal networks should be reviewed to ensure that vulnerability at different points in the system has been eliminated. It is important to keep in mind that internal communications are dependent on the operation of the emergency power generation system in case of a disaster.

Safety ratings for item No. 24 are: Low = Poor or does not exist; Average = Satisfactory; High = Good.

25. Condition of anchors and braces for telecommunications equipment and cables

The evaluators should confirm that telecommunications equipment is anchored. Telephone ex- change consoles, computers, and servers should have anchors to prevent tipping or sliding. There should be adequate conduit tubing for cables to prevent them from deteriorating.

Safety ratings for item No. 25 are: Low = Poor; Average = Satisfactory; High = Good.

26. Condition of external telecommunications systems installed on hospital grounds

The evaluators will verify that exterior telecommunications systems do not interfere with hospital communications.

Safety ratings for item No. 26 are: Low = External telecommunications systems cause major interference with hospital communications; Average = External telecommunications systems cause moderate interference with hospital communications; High = External communications cause no interference with hospital communications.

27. Site has adequate conditions for telecommunications systems

Evaluators should check the condition of the sites for the telephone exchange and computer network server. Depending on the type and size of the exchange, the space must accommodate switching equipment, power supply, storage batteries, and climate control equipment; there must also be room for opera- tors and maintenance workers. Battery storage areas should be ventilated separately.

Doors and windows should close tightly to keep out wind and water, and doors should have moderate fire proofing. There should be adequate lighting for personnel to work, but the equipment should be protected from direct sunlight. It is preferable to place equipment against one wall. To avoid water damage, water filtration apparatus, toilets, and bathrooms should not be on floors above the equipment. Cables and wires should be encased in conduit tubing to prevent deterioration. All equipment should be anchored according to its weight and dimensions. The evaluator should verify that installations are not subject to explosion, in case of sparks.

Safety ratings for item No. 27 are: Low = Poor or does not exist; Average = Satisfactory; High = Good.

28. Safety of internal communications systems

Verify the condition of loudspeakers, public address systems, speaker systems, intercoms and others, that serve to communicate with the personnel, patients, and visits in the hospital. Confirm also the existence of audible systems as bells, horns used to disseminate alarms, alerts or evacuation. The existence of redundant and alternate systems for internal communication guarantee that personnel, patients and visits are timely and clearly contacted in emergencies and disaster. The evaluators should request that the internal communications systems are tested and confirm that the message was well received.

Safety ratings for item No. 28 are: Low = Poor or does not exist; Average = Satisfactory; High = Good.

Water supply system

29. Water tank has permanent reserve that is sufficient to provide at least 300 liters daily, per bed, for 72 hours

Evaluators will verify that water storage is sufficient to satisfy user demand for three days. Typically, water storage for hospitals is in cisterns or reserve tanks on the ground floor and elevated tanks. It is important to check locations in the hospital that are

not served by the main water system, and confirm their reserves are sufficient for three days. If wells exist on hospital grounds, the percentage of supply they provide and whether they are used regularly or as reserves should be ascertained.

Safety ratings for item No. 29 are: Low = Sufficient for 24 hours or less; Average = Sufficient for more than 24 hours but less than 72 hours; High = Guaranteed to cover at least 72 hours.

30. Water storage tanks are protected and in secure locations

Evaluators will visit all water tanks, whether elevated on towers or on the building, or inside, in the case of pressurized or hydro-pneumatic systems. Cisterns should not be located in areas susceptible to flooding because of the risk of contamination nor should they be in areas with landslide hazards. They should have manhole covers to prevent access to non-authorized personnel and items from falling inside. The tanks should not show cracking or vegetation growth. It is important to determine whether the failure of a water tank would flood critical areas of the hospital, and there should be overflow and drainage areas for such a contingency.

Elevated tanks should meet these same criteria in addition to being supported above structural roof elements. Special attention should be given to how plastic tanks are supported and anchored. In high winds they can tip over if they are empty, which will affect the attached pipes. Air valves extend above the level of the tank cover and should be braced to avoid movement or breakage in high winds. Any hydraulic network components on the roof should be anchored.

Safety ratings for item No. 30 are: Low = The site is susceptible to structural or non-structural failure; Average = Failure would not cause collapse of tank; High = Low possibility of functional failure.

31. Alternative water supply to major distribution network

The agencies or mechanisms necessary to supply the hospital with water, in case the public system fails, should be identified.

There should be redundancy in all-critical or lifeline systems, and it is advisable for the facility's main cistern to be supplied by the local service in at least two places that can maintain the necessary reserve capacity. Another option is to use private wells to supply the facility; their availability should be confirmed. The evaluator should identify the entity responsible for restoring local water supply should it fail, and check access from tanker trucks to water storage tanks.

Safety ratings for item No. 31 are: Low = Provides less than 30% of demand; Average = Provides 30% to 80% of demand; High = Provides more than 80% of daily demand.

32. Condition of water distribution system

Evaluators will check the condition and proper performance of all aspects of the water distribution system including storage tanks, valves, pipes, and connections. The components connecting 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 in proper working order water will be wasted without filling the cistern, and the runoff can erode structural supports.

It is important that evaluators check the general condition of the hospital distribution network to ensure that water reaches the necessary service points. Leaking pipes can cause damage in any of the areas where they are located: along suspended ceilings, behind walls, and underground. Pipe connections are vulnerable and should be checked for signs of deterioration. It is important to check that flexible connections are used, for example, between exterior tanks and points where pipes enter the building and between pumps and impulsion pipes. Flexible connections should be used where components are in contact with structural elements, and should be firmly anchored so that the structure and water pipes move together in the case of seismic shaking.

Safety ratings for item No. 32 are: 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.

33. Supplementary pumping system

As mentioned elsewhere, critical systems should be redundant, beginning with systems inside the hospital. Evaluators should identify the existence and performance of the supplementary or back-up pumping system. At least two pumps should be in place (to ensure that if one pump fails, there is a back-up) to move water between reserve and compensation tanks if the main system fails in an emergency. The pumps should both be able to meet the minimum demand for water needs of the hospital. The same requirements hold for water distribution in the facility that is independent from the main pumping system.

Safety ratings for item No. 33 are: Low = There is no back-up pump and operational capacity does not meet daily demand; Average = All pumps are in satisfactory condition; High = All pumps and back-up systems are operational.

Fuel storage (gas, gasoline, and diesel)

34. Fuel tanks have at least 5-day capacity

Fuel tanks should be located in a safe place and properly secured. The fuel used for the generator may not be the same used for hospital boilers and other services, so it is important that all fuel tanks be very clearly labeled, and where possible, stored in different areas. The evaluators should check the size of reserve tanks, check that the reserve is sufficient to meet the demand for each type of fuel, and determine how often fuels are delivered.

Safety ratings for item No. 34 are: Low = Fuel storage is not secured and has less than 3-day fuel capacity; Average =Fuel storage has some security and has 3- to 5-day fuel capacity; High = Fuel storage is secure and has capacity for 5 or more days.

35. Fuel tanks and/or cylinders are anchored and in a secure location

Because of the weight of fuel tanks, it is important that they are well anchored to prevent them from tipping in the case of seismic events. The evaluators should determine whether anchors are metal and whether they are in good condition. Where tanks are

supported by concrete or brick walls, the walls should be checked for cracks and the braces or anchors checked for signs of sinking. Large horizontal tanks can slide and break connection hoses, so in seismic areas they should be supported with clamps.

It is important to keep in mind that the heavier the tank and the higher the center of gravity, the greater the likelihood that it will tip over. Cylinders positioned vertically should be tied down in at least three directions. This item is closely related to item No. 36, and can be evaluated at the same time.

Safety ratings for item No. 35 are: Low = There are no anchors and the tank enclosure is unsafe; Aver- age = Anchors are inadequate; High = Anchors are in good condition and the tank enclosure is adequate.

36. Safe location of fuel storage

Evaluators should verify that the tanks containing flammable liquids are at a safe distance from the hospital and its electrical plant, boilers, kitchens, and other areas that could pose a fire risk. Where tanks are in enclosed areas they should have adequate supports and the enclosure should be built of non-combustible materials. These areas should be well-marked and well-illuminated, behind fencing, kept under surveillance, and, where possible, have a security alarm, but at the same time be easily accessible for authorized personnel. Fuel tank storage areas should have good drainage and be in locations that are not prone to flooding, landslides, or soil liquefaction. In the case of strong winds, they should be protected from flying objects. Fuel storage should be sheltered from construction and any other activities that could potentially damage them. In addition to reviewing the site, evaluators should check fire protection equipment associated with the fuel storage.

Safety ratings for item No. 36 are: Low = There is risk of failure and that tanks are not accessible; Average = One of the two conditions has been met; High = the fuel storage tanks are accessible and they are located in a secure site.

37. Safety of the fuel distribution system (valves, hoses, and connections)

Fuel leakages are extremely dangerous and it is important to control them carefully. This implies correct performance of all valves, hoses, and connections. The evaluators should ensure that connections are flexible where attached to equipment and where they cross structural elements. However, when connections are joined to structural elements they should be rigid, assuming there is no possibility of settling.

Safety ratings for item No. 37 are: Low = Less than 60% of system is in good operational condition; Average = between 60% and 80% of system is in good operational condition; High = More than 80% of system is in good operational condition.

Medical gases (oxygen, nitrogen, etc.)

38. Sufficient medical gas storage for minimum of 15-day supply

The evaluators will check the reserve capacity for each type of medical gas used in the hospital between the central supply bank and the cylinders or bottles in areas of service. It is also important to confirm the frequency of deliveries of gases.

Safety ratings for item No. 38 are: Low = Less than 10-day supply; Average = Supply for between 10 and 15 days; High = Supply for at least 15 days.

39. Anchors for medical gas tanks, cylinders, and related equipment

Gas tanks and cylinders are located in the service areas where they are used. They contain a variety of gases; some are toxic, others are flammable. They must be well anchored because their valves are easily damaged if they fall, and to avoid injuring patients or staff or damaging other elements. Vertical oxygen tanks should be anchored in three or four directions with welded connections or bolts. Evaluators should ensure that anchoring is adequate and the materials are in good condition. Narrow vertical oxygen tanks should be secured with three, evenly spaced tie-downs in case of high winds or seismic activity. Horizontal tanks should be anchored to walls so they cannot slide as a result of shaking during seismic events. See also item No. 35.

Safety ratings for item No. 39 are: Low = Anchors are lacking; Average = Quality of anchors is inadequate; High = Anchors are of good quality.

40. Availability of alternative sources of medical gases

Evaluators should verify that alternative sources for medical gases have an oxygen supply bank with the necessary reserve and have reserve bottles available. It should also be confirmed whether the supplier of medical gases is in the vicinity and has reserves available. Safety ratings for item No. 40 are: Low = Alternative sources are lacking or are below standard; Average = Alternative sources exist and are in satisfactory condition; High = Alternative sources exist and are in good condition.

41. Appropriate locations for storage of medical gases

Oxygen supply banks as well as storage tanks should be located outside of the hospital building because of the risk of tank explosion. The site should be easily accessible, in an area unlikely to flood, at a distance from any heat sources, and protected from flying or falling objects.

Safety ratings for item No. 41 are: Low = Storage is not accessible; Average = Storage is accessible but hazards exist; High = Storage is accessible and there are no hazards.

42. Safety of medical gas distribution system (valves, pipes, connections)

Storage devices and distribution networks use color coding to identify different types of medical gases. In addition to different colors, the bottles or cylinders for each type of gas use different valves, eliminating the hazard of connecting the wrong type of gas. Notwithstanding these precautions, the evaluator should check the color coding.

The major danger if gas tanks fall is that the valves will break and there will be an uncontrolled flow of gases, with dangerous consequences. It is important to inspect the valves and ensure that couplings are flexible and there is enough play to tolerate small movement, but that tanks cannot fall or knock against each other while they are connected to the supply bank. Tubing should be protected and correctly anchored to structural

elements. Flexible couplings should be used where tubing crosses structural joints. It is important to examine the network for leaks.

Safety ratings for item No. 42 are: Low = Less than 60% of system is in good working condition; Average = between 60% and 80% of system is in good working condition; High = More than 80% of system is in good working condition.

43. Protection of medical gas tanks and/or cylinders and related equipment

Evaluators will verify that there is a site designated solely for tanks and/or cylinders and related equipment for medical gases and that only this equipment occupies the designated area. As outlined in item No. 41, it is advisable that the site be at a distance from the hospital buildings, that there be fencing around the site, and signage indicating that the equipment is dangerous. Evaluators will ascertain that the personnel responsible for managing medical gases know all safety procedures for each type of gas being used.

Safety ratings for item No. 43 are: Low = No areas are used exclusively for this equipment and there are no qualified personnel to operate it; Average = Areas are used exclusively for this equipment but personnel are not trained to operate it; High = There are areas used exclusively for this equipment and it is operated by qualified personnel.

44. Adequate safety in storage areas

The evaluator will verify that tanks, storage areas, oxygen supply banks, etc., are used exclusively for medical gases. The sites should be easily accessible and free from potential obstructions. Their size must be adequate for the correct handling of bottles or tanks from the delivery point, to storage, and to the area where they are put to use. Fire extinguishing equipment must be available, and personnel trained in using it.

Safety ratings for item No. 44 are: Low = No areas are reserved for storage of medical gases; Average = Areas are reserved for storage of medical gases but safety measures are inadequate; High = There are areas reserved for storage of medical gases and the site does not present risks.

Heating, ventilation, and air-conditioning (HVAC) systems in critical areas

This is the second sub-module of the non-structural module which addresses aspects which should be taken into account whilst checking heating, ventilation and air-conditioning systems in the critical areas of the hospital. This covers items 45-51 in the checklist.

45. Adequate supports for ducts and review of flexibility of ducts and piping that cross expansion joints

All HVAC ductwork and pipes must be supported adequately by the building structure, without the possibility of horizontal movement, especially in seismic areas. The bracing should be rigid and with ad- equate slope to allow ductwork to move in three directions. Ductwork that crosses roofs should be anchored so that wind suction will not affect it, and be placed above the level of the roof's spillway. Evaluators should check the distance between supports to ensure that there are no deflections caused by the weight of the ducts, which could cause them to fall. Where ductwork is hidden by false ceilings, ceiling tiles should be removed to check the ducts. Supports for ductwork that crosses between blocks of buildings should be inspected to ensure that they will not fall and/or damage elements around the ducts.

Safety ratings for item No. 45 are: Low= Supports are lacking and connections are rigid; Average = Supports are present or connections are flexible; High = Supports are present and connections are flexible.

46. Condition of pipes, connections, and valves

Pipes should travel through conduits so that they are protected from humidity. Evaluators will check how valves operate and will review the condition of pipes at key points to ensure they are protected in kitchens, boilers, or any areas where there is steam and the coatings or isolation of piping could be affected. Evaluators should check that condensations will not affect isolation of piping and that leaks from upper floors will not affect components. Humidity can ruin false ceilings and other elements or equipment that comes in contact with the piping.

Piping should have flexible connections where it crosses expansion joints of the building. In cases where the pipes carry hot water or steam, evaluators should confirm that expansion connections are used, as well as safety valves for the system. The pipes should be completely supported and at a distance from electrical panels or wiring. Safety valves or air valves for steam, hot, or room temperature water respond to seismic amplifications like inverted pendulums, so they should have lateral supports.

Safety ratings for item No. 46 are: Low= Poor; Average = Satisfactory; High = Good.

47. Condition of anchors for heating and/or hot water equipment

Generally, boilers or water heaters produce hot water or steam. They are vulnerable and can pose major risks. Their weight puts them at the mercy of inertial forces in an earthquake. They can tip over due to seismic shaking, which can break the water pipes, causing flooding. The water supply for the fire extinguishing sys- tem can be put at risk when water connections are broken. Fire danger increases if cables or gas hoses are cut or liquid fuel spills. To avoid these hazards, evaluators should confirm that the boiler is completely anchored to the foundation. Individual hot water heaters should be connected at the top and bottom to a solid wall. If one anchor detaches, it is unlikely that the water heater will slide. Solar heaters are usually located on roofs and are vulnerable to strong winds as well as seismic forces. Evaluators should confirm that these elements are well fastened to the roofing.

Safety ratings for item No. 47 are: Low = Poor; Average = Satisfactory; High = Good.

48. Condition of anchors for air-conditioning equipment

Air conditioning units can be local or central, compact or not. Central air conditioning units can either be compact or split with a fan coil unit. They are very heavy and are 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, they can significantly change the behavior of the structure. Unless they are well anchored, they can move or overturn, and as a result can cause partial or total collapse of the building. The explanation in item No. 47 about heavy heating equipment is valid for

air conditioning units as well. Smaller units are located in the areas that they serve and are window or portable units.

Smaller split systems have the evaporator inside and the compressor and condenser outside, on the roof, patio, or elsewhere. The outside 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; if they should fall they could injure people or damage other equipment.

Safety ratings for item No. 48 are: Low = Poor; Average = Satisfactory; High = Good.

49. Location of enclosures for HVAC equipment

Enclosures for boilers should be 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, protected from elements that might obstruct access, and in areas that are protected from flooding.

Safety ratings for item No. 49 are: Low = Poor; Average = Satisfactory; High = Good.

50. Safety of enclosures for HVAC equipment

Evaluators should confirm that enclosures for HVAC equipment are always accessible and large enough to allow the operators to work comfortably on the equipment. Extractors for steam should ventilate the boiler room. Evaluators will confirm that lighting is adequate to see the controls and that there is adequate drainage for runoff of water, grease, or fuel. 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 emergency lighting. The sanitary water disposal network, if this is found inside the enclosure, should be connected separately from the rain water disposal network, avoiding the entry of water during heavy rains as a result of sanitary devices at a lower level.

Safety ratings for item No. 50 are: Low = Poor; Average = Satisfactory; High = Good.

51. Operating condition of HVAC equipment (boiler, air-conditioning systems, exhaust, etc.)

Key areas of the hospital are dependent on the proper operation of HVAC equipment. These areas include the kitchen, sterilization center, refrigerators, medicine storage, laundry, operating rooms, and intensive care unit. Under normal conditions equipment failure can wreak havoc; when an unexpected event occurs, failure can result in disaster.

Because they are critical elements, HVAC equipment should be redundant. The hospital should have at least two boilers, so that if one is undergoing maintenance or fails, the other will function. Untreated water used in boilers can cause deterioration, so there should be a water softener in the area. The most common failures in this equipment occur because of the controls. Overheating occurs because of low water level, and variation in the pressure of the boiler causes inefficient operation. If overheating or pressure variations coincide with failure of a safety valve there can be an explosion. Deposits of scale will be evident if the water softener is not adequate; these deposits lessen efficiency and corrode the metal.

The evaluator should make a basic inspection of the condition of the controls, the exterior appearance of the boiler, review laboratory analysis of the water, and check operation of the equipment alarm. The level of training of the operator is important. Evaluators should ask if the operator has a copy of the operation and maintenance manual (for daily cleaning) and how specialists do often-preventive maintenance. They should see that extractor's function correctly to eliminate steam from boiler rooms, from the kitchen, and from operating rooms. Controls and alarms on the central air conditioning equipment should also be checked. Portable systems can be used in an emergency in key areas.

Safety ratings for item No. 51 are: Low = Poor; Average = Satisfactory; High = Good.

Office and storeroom furnishings and equipment (fixed and movable) including computers, printers, etc.

This is the third sub-module of the non-structural module. Here the aspects related to furnishings, to office equipment and the security of store-rooms is considered, including both fixed and mobile components. It includes items 52-54 on the checklist.

52. Anchors for shelving and safety of shelf contents

Evaluators should check that shelving is fixed to walls and/or has safety supports and that they have a lip or railing to keep contents from falling. Offices, libraries, and clinical records archives commonly have shelving units with glass doors. The units should be connected to each other and unbreakable material should replace the glass. Where there are rows of high, freestanding shelves, they must be anchored to the floor, connected to each other at the top by ties that cross the room and attached to the wall at either end of the row of shelves. Connecting the shelves increases lateral stability, lessening the chance that they will fall. For tall shelving made of combustible material, the condition of lighting fixtures and wiring near the shelves should be inspected. The evaluator should check areas where falling shelves would obstruct exits. Depending on the type of material in the office or storeroom, there should be fire-extinguishing equipment near the exits, and personnel should know how to operate it.

Safety ratings for item No. 52 are: Low = Shelving is not attached to walls; Average = Shelving is attached but contents are not secured; High = Shelving is attached and contents are secured.

53. Safety of computers and printers

In the information technology age, 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 dam- age caused by natural phenomena. The evaluators will confirm that computers, printers, and servers are secured to tables or that there is a lip or railing that will prevent equipment from sliding off the table. If tables are on wheels, the wheels should be in the locked position. Where there is raised access flooring that allows

computer wiring to run under the floor, the evaluators should check anchors to the structural slab and vertical and horizontal bracing.

Safety ratings for item No. 53 are: Low = Poor; Average = Satisfactory; High = Good or does not require anchor.

54. Condition of office furnishings and other equipment

Evaluators should check office furnishings and other equipment following the criteria outlined for items 52 and 53, and adapts to these criteria to the hospital being evaluated. Articles hung on walls and above desks (clocks, pictures, televisions, etc.) must be completely anchored and not hang directly above a work station or door. Particularly in seismic zones, filing cabinets on wheels should have chocks or be attached to walls to keep them from sliding; filing drawers should have latches to keep them from sliding open. Evaluators should consider potential damage caused by strong winds: these forces can break large windows, damaging the furnishings and contents of offices and other rooms.

Safety ratings for item No. 54 are: Low = Poor; Average = Satisfactory; High = Good or does not require anchor.

Medical and laboratory equipment and supplies used for diagnosis and treatment

This is the fourth sub-module on non-structural elements and includes safety of medical and laboratory equipment, emphasizing critical hospital services. It includes items 55-66 on the checklist.

55. Medical equipment in operating theaters and recovery rooms

The evaluators will first determine whether equipment is functional, and then check safety fastenings and anchors. Ceiling light fixtures in surgery should function, the hinges on the extension arm should be properly adjusted, and fixtures should be well anchored to beams to prevent them from swinging. The operating table should be completely immobilized. Anesthesia equipment, electrosurgical units, monitors, and

instruments should be attached to rolling carts, which in turn should be secured to the operating table when in use. Braces, latches, and caster brakes on all equipment should be inspected.

Life support equipment should be completely anchored, 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 it cannot tangle during rotational motion. Equipment should not be placed above the patient. When not in use, equipment should be braced against a wall, with brakes applied to carts and rolling tables.

Safety ratings for item No. 55 are: Low = the equipment is in poor condition or it is not secured; Average = the equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.

56. Condition and safety of radiology and imaging equipment

The condition of X-ray equipment and carts holding the equipment should be checked; brakes for cart wheels must be functional. Where computed axial tomography (CAT) scanners are used, evaluators should verify that they function, and ensure that they are located where flooding cannot damage them. Operators should be familiar with all safety protocols for using the equipment. Criteria used in item 55 can be applied to equipment that should be anchored.

Because this equipment is heavy and vulnerable to horizontal seismic forces, adequate anchors are needed to keep them from tipping or moving. The higher the center of gravity of these items, the greater the possibility they will tip over. Power and other connections should be flexible: it is better for cables to be disconnected than to break. Hospital equipment is highly sensitive to sudden changes in voltage (e.g., computed tomography scanner, mammography equipment, magnetic resonance imaging scanner) so evaluators should ensure that they have voltage regulators and earth grounding to protect equipment from electrical discharge.

Safety ratings for item No. 56 are: Low = The equipment is in poor condition or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.

57. Condition and safety of laboratory equipment

The criteria for items 52 to 56 can be adapted when evaluating the condition and safety of laboratory equipment. When inspecting the laboratory, evaluators should pay special attention to handling and securing toxic samples. If containers break or leak during a disaster, technicians, patients, or the laboratory itself could be contaminated.

Safety ratings for item No. 57 are: Low = the equipment is in poor condition or it is not secured; Average = the equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.

58. Condition and safety of medical equipment in emergency services unit

Criteria in items 52-57 are valid when adapted to equipment in the emergency services unit. Evaluators should check that this equipment, which includes crash carts, oxygen tanks, monitors, etc., is in working order and is secured.

Safety ratings for item No. 58 are: Low = the equipment is in poor condition or it is not secured; Average = the equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.

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

Most criteria in items 52-58 are valid when adapted to equipment in the intensive care unit. Evaluators should check that basic and specialized intensive care equipment is in good working order and well secured. This equipment includes life support systems, ventilators, resuscitation equipment, oxygen tanks, monitors, etc. The most rigorous inspection should be carried out in quarantine units of the hospital be- cause of the added hazards of contamination or infection.

Safety ratings for item No. 59 are: Low = The equipment is in poor condition or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.

60. Condition and safety of equipment and furnishings in the pharmacy

Criteria in items 52-57 are valid when adapted to equipment in the pharmacy. Refrigeration units for medicine should be inspected to ensure they are in good order and their contents secured. Shelving used for storage of medicines must be well anchored (see item 52). Because some materials in the pharmacy are flammable, there should be adequate fire protection items or systems (extinguishers, standpipe systems, etc.) and pharmacy staff must be trained in operating this equipment.

Safety ratings for item No. 60 are: Low = The equipment is in poor condition or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.

61. Condition and safety of equipment in the sterilization unit

Most criteria in items 52-57 and 60 are valid when adapted to equipment in the hospital's sterilization unit. Evaluators should check the condition of autoclaves, and review the operator's training in managing them in the case of emergency. Water leaks originating outside of the unit and possible contamination of stored items is an issue in sterilization units, so evaluators should determine whether there are water filtration systems on upper floors, water outlets, or, in the worst case, toilets that could contaminate stored items. Proper labeling for routing sterile and contaminated equipment should be checked. Evaluators must ensure that safety measures are being used for shelving and trolleys where sterilized materials are stored (see item 52); materials can be contaminated if shelves or trolleys tip over during a seismic event. Autoclaves are heavy and they should be completely anchored in seismic zones. The evaluators must also ensure that fire protection items or systems are present (including extinguishers, standpipe systems, etc.) and that the staff is qualified to use it. The proximity of doors and windows to the materials being sterilized should be checked, as well as the materials used for doors and windows.

Safety ratings for item No. 61 are: Low = The equipment is in poor condition or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.

62. Condition and safety of medical equipment for neonatal care

Criteria in items 52-59 are valid when adapted to equipment for neonatal care. Evaluators should check that equipment is in working order and is secured. Specific neonatal equipment includes incubators, resuscitation equipment, oxygen tanks, monitors, etc. Sanitation and hygiene should be rigorously reviewed in these units, particularly in birthing rooms, because of the vulnerable condition of newborns. Doors and windows should be able to resist strong winds; if water penetrates the area, specialized equipment can be damaged or destroyed. It is difficult to transfer newborns to other areas of the hospital because of their vulnerability.

Safety ratings for item No. 62 are: Low = The equipment is lacking, is in poor condition, or is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.

63. Condition and safety of medical equipment and supplies for burn management

Most criteria in items 52-59 are valid when adapted to equipment for burn management. Evaluators should check that basic and specialized burn care equipment and supplies are in good working order and well secured. This equipment includes life support systems, ventilators, oxygen tanks, monitors, crash carts, etc.

Safety ratings for item No. 63 are: Low = The equipment is lacking, is in poor condition, or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.

64. Condition and safety of medical equipment for nuclear medicine and radiation therapy

Criteria in items 52-57 and 60 are valid when adapted to nuclear medicine and radiation therapy. Evaluators should check the handling, condition, and safety of samples.

Supplies should be stored in areas where they cannot fall or be hit by other objects. If containers break or leak during a disaster, technicians and patients could be contaminated. Drums used for radioactive waste must have secure covers. It is important to verify that radiation sensors and chambers for handling samples function correctly, and that signs indicate restricted areas. As in other areas of the hospital, fire extinguishing equipment should be checked, and it should be verified that staff know how to handle it.

Safety ratings for item No. 64 are: Low = The equipment is lacking, is in poor condition, or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.

65. Condition and safety of medical equipment in other services

Many of the elements addressed in items 52-64 will be applicable in other services of the hospital not already addressed. These could include cardiology, orthopedics, pediatrics, maternity, physiotherapy, etc. The evaluators should carry out a review of the remaining areas, giving the most weight to areas that would influence the overall function of the hospital.

Safety ratings for item No. 65 are: Low = More than 30% of equipment is at risk of material or functional failure and/or equipment puts the entire service's operation at direct or indirect risk; Average = Between 10% and 30% of equipment is at risk of loss; High = Less than 10% of equipment is at risk of loss.

66. Anchors for shelving and safety of medical contents

This item should be evaluated at the same time as item 52. Evaluators should verify that shelves found in all critical areas which are considered in this fourth sub-module are attached to walls and/or have safety supports. Shelving units should be anchored together, especially in seismic zones. Shelves should all have lips or railings to prevent bottles or other material from falling. Where there are rows of high, free-standing shelves, they must be anchored to the floor, connected to each other at the top by ties that cross the room and attached to the wall at either end of the row of shelves. Connecting the shelves increases lateral stability, lessening the chance that they will fall. For tall shelving

made of combustible material, the condition of lighting fixtures and wiring near the shelves should be inspected. Depending on the type of material in the area being evaluated, there should be fire extinguishing equipment near the exits.

Safety ratings for item No. 66 are: Low = Shelves are anchored or shelf contents are secured in less than 20% of cases; Average = Shelves are anchored or shelf contents are secured in 20% to 80% of cases; High = More than 80% of shelves are anchored and the contents of shelves are secured (or shelving and contents do not require anchors).

Architectural elements

This fifth aspect to be evaluated in the non-structural module is covered by sub-module 3.5 and it is composed of 18 items or lines in the checklist (includes items 67 to 84).

67. Condition and safety of doors and entrances

The evaluators should check the condition of doors and entrances to the hospital and their ability to resist wind, seismic, and other forces. They should be completely attached to the frames, and the frames, in turn, must be firmly anchored to the surrounding walls or panels. Doors and entrances should be free of obstacles and wide enough to allow rapid movement of patients and hospital staff in emergency situations. Evaluators should pay special attention to doors and entrances to critical areas such as the emergency services unit, intensive care unit, operating theatres, etc.

Safety ratings for item No. 67 are: Low = Subject to damage and damage to element(s) would impede the performance of this and other components, systems, or operations; Average = Subject to damage but dam- age to element(s) would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.

68. Condition and safety of windows and shutters

As in the case of doors, outlined in item 67, windows should be able to resist hurricane force winds, especially in critical areas of the hospital such as emergency

services, operating theaters, intensive care unit, sterilization unit, pharmacy, etc. Where possible, evaluators should check the thickness and type of glass in the windows, since these two parameters, along with the area of glass exposed to wind, define the resistance of glass windows. It is advisable to use windows with laminated glass or made of polycarbonate in critical areas. Where wood windows are used, they should be checked for moisture and termite damage. If windows are not secure, wind and rain can destroy or damage medical equipment. Evaluators often underestimate the loss of hospital beds and impact on patients by not taking into account rain and wind damage to rooms.

Safety ratings for item No. 68 are: Low =Subject to damage and damage to element(s) would impede the performance of this and other components, systems, or operations; Average = Subject to damage but damage to element(s) would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.

69. Condition and safety of other elements of the building envelope (outside walls, facings, etc.)

Hospital facilities' external building envelope can be of different materials, such as masonry, glass, wood or aluminum and sometimes they are even of mixed materials. It is recommended that in seismic zones facings should not be veneered, but should be integrated into the wall. The evaluator should review the technical and construction status of the building envelope components. They should be reviewed to ensure that they are not cracked, misshapen or loose. In relation to this last point, these walls should be appropriately braced to the structural components, so that they resist seismic movements or strong hurricane wind forces, amongst other considerations. The analysis should be much more rigorous in the critical areas. In the event of building envelopes with fixed sections of glass or wood, the evaluator should apply the same restrictions as in the case of shutters made of these materials.

Safety ratings for item No. 69 are: Low =Subject to damage and damage to element(s) would impede the performance of this and other components, systems, or operations; Average = Subject to damage but damage to element(s) would not impede function; High

= No or minor potential for damage that would impede the performance of this and other components, systems, or operations.

70. Condition and safety of roofing

The evaluators should go up on the roof of the hospital to make a thorough assessment. It is advisable to begin with the roofing on the highest part of the hospital, since from this vantage point it is possible to get a general idea of the condition of lower areas. The evaluators can then concentrate on a more detailed evaluation where problems are obvious. Impermeability, equipment located on the roof, and drainage are among the aspects that need the evaluator's attention. Leakage from water systems on the roof can put a hospital or sections of the hospital out of service. When the affected areas are the most critical ones, consequences are major. The locations of equipment can affect the roof's vulnerability to different natural forces.

Safety ratings for item No. 70 are: Low = Subject to damage and damage to element(s) would impede the performance of this and other components, systems, or operations; Average = Subject to damage but dam- age to element(s) would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.

71. Condition and safety of parapets (wall or railing placed to prevent falls on roof, bridges, stairs, etc.)

This item is comparable to item 69 (elements of building envelope) in significance and the same criteria should be used to review these elements. Evaluators should keep in mind the importance of these elements in protecting stairways and passages in the hospital, considering whether their failure could endanger occupants of the hospital. Attention should be focused on areas where there is the highest con- centration of people.

Safety ratings for item No. 71 are: Low = Subject to damage and damage to element(s) would impede the performance of this and other components, systems, or operations; Average = Subject to damage but damage to element(s) would not impede function; High

= No or minor potential for damage that would impede the performance of this and other components, systems, or operations.

72. Condition and safety of perimeter walls and fencing

Security of the hospital can be affected by the poor condition of walls and fencing that define the hospital grounds. Without some level of control at the perimeter, disaster conditions will bring so many people from the outside that it will make it difficult for the health services to function. The evaluators should check this aspect in detail when surveying the hospital grounds. Evaluators will be able to see fencing and areas neighboring the hospital when they are on the upper floors of the building, which will help them to make a determination about problems in this area.

Safety ratings for item No. 72 are: Low = Subject to damage and damage to element(s) would impede the performance of this and other components, systems, or operations; Average = Subject to damage but damage to element(s) would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.

73. Condition and safety of other outside elements (cornices, ornaments, etc.)

The same criteria outlined in items 69 and 71 can be used to evaluate these elements. Special attention should be given to the condition of anchors and supports of exterior architectural elements. Seismic shaking can cause them to fall, resulting in considerable damage and even deaths. It is not advisable to use window boxes on the exterior of buildings, since besides the risk posed by falling; these elements can increase seismic loads.

Safety ratings for item No. 73 are: Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.

74. Safe conditions for movement outside of building

Movement outside of the hospital must be ensured so that pedestrians, ambulances, and supply trans- port can access the facility with the speed required during disasters. External obstacles to access can severely disrupt the function of the facility. Evaluators should observe whether there are trees and lamp posts that could fall because of natural forces and obstruct pedestrian and vehicle access to the facility. The condition of pavement within the hospital grounds should be checked for potholes or other obstacles that could interrupt pedestrian and vehicle traffic.

Safety ratings for item No. 74 are: Low = Damage to structure or road and walkways will impede access to buildings or endanger pedestrians; Average = Damage to structure or road and walkways will not impede pedestrian access, but will impede vehicle access; High = No or minor potential for slight damage which will impede pedestrian or vehicle access.

75. Safe conditions for movement inside the building (corridors, stairs, elevators, exit doors, etc.)

The evaluators must verify that conditions are safe for movement throughout the facility. Inside corridors should be spacious and free of obstacles to ensure ease of movement for personnel, stretchers, and medical equipment. Special attention should be given to stairways and exits because of their importance should evacuation occur during earthquakes or other emergencies. Adequate signage must be present to facilitate movement of staff, patients, and visitors. Areas with restricted access should be under the surveillance of hospital security personnel.

Safety ratings for item No. 75 are: Low = Subject to damage and damage to element(s) will impede movement inside building and endanger occupants; Average = Damage to element(s) will not impede movement of people but will impede movement of stretchers, wheeled equipment; High = No or minor potential for slight damage which will impede movement of people or wheeled equipment.

76. Condition and safety of internal walls and partitions

Internal walls and partitions can be of masonry, glass, wood, aluminum, etc., and can be a combination of these materials. The evaluators should review technical and construction aspects of these elements to ensure they are not cracked, deformed, or loose. 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 rooms, operating theaters, laboratories, etc.

Safety ratings for item No. 76 are: Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.

77. Condition and safety of false or suspended ceilings

There are a wide variety of false or suspended ceilings used in buildings. Those made of metal are the heaviest and cause the greatest damage should they fall. Because the bracing usually is not visible, evaluators will request maintenance personnel to take some ceiling sections apart so the condition of the anchors can be checked. In seismic zones both angled and vertical bracing should be used to brace ceilings from horizontal seismic forces. In areas where these elements can be subjected 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 passageways in the hospital, thus affecting its functional capacity.

Safety ratings for item No. 77 are: Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would not impede the performance of this and other components, systems, or operations.

78. Condition and safety of external and internal 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. Evaluators should ensure that both internal and external lighting is operational, correctly designed, and that any area that needs lighting, has it. Evaluators should work with maintenance staff to determine whether there is sufficient lighting supplies stock (for example, flashlights, light bulbs) in case of disaster. They should ensure that emergency lighting systems are adequate for the level and type of use of an area, especially in the critical units of the hospital.

Safety ratings for item No. 78 are: Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would not impede the performance of this and other components, systems, or operations.

79. Condition and safety of fire protection system

The hospital must be completely protected against fire, since this type of hazard can stop services in a hospital when they are most needed. Protection of patients and staff when there is a building fire is of utmost concern. Evaluators will determine whether the hospital design incorporates fire walls, which provide a high level of safety. They will also review the fire protection measures in areas at highest risk for fire, including boiler rooms, fuel tank storage, medical gases, electrical panel, documents, pharmacy, etc. Fire extinguishing devices should be accessible and in usable condition. Expiration dates on extinguishers should be checked. There must be a sufficient number of functional water hydrants, and evaluators should confirm that these hydrants have a permanent supply of water so that they can be used effectively in case of fire. Evaluators should confirm that personnel responsible for using the equipment actually know how to use it.

Safety ratings for item No. 79 are: Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High =

No or minor potential for damage that would impede the performance of this and other components, systems, or operations.

80. Condition and safety of elevator system

While elevators should not be used during a disaster, they play an important role after the event. Evaluators will verify that the elevators function properly and can meet their load capacity. They should take into account that they are the main means of transport for many patients, the elderly, and disabled. When more than one elevator is out of service, especially in multi-storied structures, the functional capacity of the facility is seriously affected.

Safety ratings for item No. 80 are: Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.

81. Condition and safety of stairways

Special attention should be given to the safety of stairways because of their importance in the case of evacuation, for example, during an earthquake or in the case of a toxic gas leak. Evaluators should ensure that they are free of obstacles or of items that could fall and obstruct them. They should have railings so that they can be used safely at their maximum capacity, keeping in mind that hospital patients will be more vulnerable than typical users.

Safety ratings for item No. 81 are: Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.

82. Condition and safety of floor coverings

Floors can be of a variety of materials, including terrazzo, ceramic or clay tile, linoleum, wood, etc. They might be attached with adhesives, be laid over a membrane (such as a floating floor), or suspended. The evaluator should verify that the flooring is watertight, anti-skid, and free of cracks or loose sections especially in critical and high traffic areas. 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 or cables and suspended floors are used, evaluators should ensure that the flooring is braced to resist lateral seismic loads.

Safety ratings for item No. 82 are: Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.

83. Hospital access routes

Access is essential if the hospital is to function properly. Evaluators need a detailed understanding of the main access routes to the facility. Plans showing micro- and macro-locations of the hospital are helpful. The evaluators should determine the effectiveness of the hospital's security and protection system in terms of vehicle and pedestrian access. Interviews with hospital employees, patients, and, where possible, people living near the facility, can provide information about the types of routes and at what hour's routes are congested. Evaluators should be observant of trees and structures along the access routes that would impede traffic if they fell during a seismic event or hurricane. Alternative routes should be identified in case major access routes are obstructed. It is important to determine whether alternative routes are taken into account in the hospital's disaster preparedness and reduction plan. Evaluators should note the presence and condition of storm drains that service the area, and determine whether storm runoff would flood certain routes, making them impassable.

Safety ratings for item No. 83 are: Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.

84. Other architectural elements, including emergency sigs

For this item, the evaluator will check any other architectural elements of the hospital that have not been taken into account in previous items. For example, the chimneys for the facility's incinerator should be structurally sound, be capable of resisting seismic or wind loads, and have the stability required for their height, whether they are self-supporting or braced. The evaluator should examine signs inside the hospital that could fall and harm occupants or damage the facility. At this point, the evaluator will confirm that evacuation routes are indicated both inside and outside of the hospital. The hospital's security and protection personnel are responsible for directing and protecting everyone on hospital grounds in an emergency, and must be fully aware of the hospital's emergency signage.

Safety ratings for item No. 84 are: Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.

IV. Safety based on functional capacity of hospital

This module considers to what degree hospital personnel are prepared for major emergencies and disasters how the hospital disaster plan has been put to use.

Evaluation objectives for this module are to determine:

- What physical aspects of the hospital should be considered for functional safety, and

- Describe the relevant content of the Hospital Safety Index.

The standard that evaluators apply when looking at a facility is that the facility is organized and ready to respond to major emergencies and disasters, and to manage mass casualties. Disaster response should be detailed in the hospital's existing contingency plan and procedures. Prior to an evaluation, it is advisable for a hospital to conduct a self-evaluation, using the "Safe Hospitals Checklist."

Organization of the Hospital Disaster Committee and the Emergency Operations Center

Sub-module 4.1 evaluates the Hospital Disaster Committee with the aim of understanding its functional organization and the Committee's role in the Emergency Operations Center. The Committee defines levels of authority, roles, and responsibilities within a facility, so activities are in line with the institution's goals and efforts are not duplicated. It promotes collaboration between individuals in the group and improves efficiency and effectiveness of communications. This module addresses hospital procedures used in major emergencies and disasters, evaluating efficiency (for example, as provided by the action cards).

85. Committee has been formally established to respond to major emergencies or disasters

Evaluators will obtain a copy of the Committee's terms of reference and verify that the list of members corresponds to current personnel.

Low = Committee does not exist; Average = Committee exists but is not functioning; High = Committee exists and is functioning.

86. Committee membership is multi-disciplinary

Evaluators will verify that the positions on the Committee are occupied by personnel from diverse disciplines (for example, hospital director, chief of nursing, maintenance engineer, head of emergency services, medical director, chief of surgery, chief of laboratory and support services, among others).

Low = Three or less disciplines represented; Average = four or five disciplines represented; High = six or more disciplines represented.

87. Each member is aware of his/her specific responsibilities

Evaluators will verify that members' assigned responsibilities are in writing, describing their specific roles. Low = Responsibilities not assigned; Average = Responsibilities have been officially assigned; High = All members know and comply with their responsibilities.

88. Space is designated for the hospital Emergency Operations Centre (EOC)

Evaluators will verify that a room has been designated for operational command and that all means of communication are installed (telephone, fax, Internet, etc.).

Low = Nonexistent; Average = Space has been officially assigned; High = EOC exists and is functional.

89. The EOC is in a protected and safe location

Evaluators should take into account accessibility, safety, and protection when checking the room used for the EOC.

Low = The room for the EOC is not in a safe location; Average = The EOC is in a safe location but it is not easily accessible; High =The EOC is in a safe, protected, and easily accessible location.

90. The EOC has a computer system and computers

Evaluators will ensure that the EOC has internet and intranet connections.

Low = No; Average = Incomplete; High = The EOC has all computer system requirements.

91. Both internal and external communications systems in the EOC function properly

Evaluators will determine whether the switchboard (telephone central for re-routing calls) has a paging or a public address system and that the operators know the emergency codes and how to use them.

Low = Does not function or is nonexistent; Average = partly functional; High = Complete and functional.

92. The EOC has an alternative communications system

Evaluators will determine whether, besides the switchboard, there is an alternative communications system (e.g. cellular, two-way radio, etc.).

Low = Nonexistent; Average = Incomplete; High = Yes.

93. The EOC has adequate equipment and furnishings

Evaluators should verify that there are desks, chairs, power outlets, lighting, water supply, and drainage.

Low = No; Average = Incomplete; High = Yes.

94. An up-to-date telephone directory is available in the EOC

Evaluators will confirm that the directory includes all support services needed in an emergency (they should randomly check telephone numbers).

Low = No; Average = Directory exists but is not up-to-date; High = Available and current.

95. "Action Cards" available for all personnel

Evaluators should check that action cards describe the assigned duties of each hospital staff member in case of an internal or external disaster.

Low = No; Average = Insufficient (numbers and quality); High = All staff members have cards.

Operational plan for internal or external disasters

This section evaluates the operational plan for internal or external disaster events.

This module evaluates whether the hospital disaster plan accomplishes the following:

- Integrates the hospital plan with the community plan;
- 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 for the type of organization and complexity of the facility.

Evaluators should ensure that the plan addresses activities in different phases of the disaster cycle:

- Before: Plan, carry out risk reduction measures, and train.
- During: Activate the plan.
- After: Return to normal activities; evaluate the effectiveness of the plan.

The purpose of the disaster plan is to identify measures that should be put into practice before, during, and after a disaster so that essential hospital services continue to function.

96. Strengthen essential hospital services

Evaluators should verify that the plan specifies actions to be taken before, during, and after a disaster in the hospitals critical services (emergency room, intensive care unit, sterilization unit, operating theater, among others).

Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.

97. Procedures to activate and deactivate the plan

Evaluators should appraise procedures for how, when, and by whom the plan is activated/deactivated. In particular, they should determine:

- what type of signal is used and the criteria for activating the plan;
- whether the hospital director is responsible for activating the plan, and
- Whether activation is requested by civil defense and public safety agencies, a central agency responsible for medical emergencies, or other outside entities.

These requesting bodies would typically provide information on the type of disaster, the number and type of victims, and estimated time of arrival at the hospital.

Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the procedures.

98. Special administrative procedures for disasters

Evaluators should verify that the plan includes procedures for contracting personnel and for procurements in case of disaster. This would include staffing in essential services for the first 72 hours after an event. The plan should take into account costs for overtime, double shifts, weekend, night, and holiday pay.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the procedures.

99. Financial resources for emergencies are budgeted and guaranteed

The evaluators should verify that the hospital has a specific budget for use in disaster situations. Evaluators should confirm the following:

- the budget is sufficient to implement measures outlined in the plan;

- Cash is available for immediate purchases, and there is a list of suppliers that will extend credit to the hospital;
- Quantity and availability of electrical-medical equipment is known;
- Additional financial resources are calculated annually for emergencies, based on local vulnerability, potential hazards for the hospital, and prior experience with disasters.

Low = Not budgeted; Average = Funds will cover less than 72 hours; High = Funds are guaranteed for 72 hours or more.

100. Procedures for expanding usable space, including the availability of extra beds

Evaluators should confirm that the plan identifies physical spaces that can be equipped to treat mass casualties.

Low = Space for expansion has not been identified; Average = Space has been identified and personnel have been trained to carry out the expansion; High = Procedures exist, personnel have been trained, and resources are in place to carry out expansion of space.

101. Procedures for admission to the emergency department

Evaluators should verify that the plan specifies the places and personnel responsible for carrying out triage.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exists, personnel have been trained, and resources are in place to implement them.

102. Procedures to expand emergency department and other critical services

Evaluators should verify that the plan includes measures for expanding hospital services (for ex- ample, providing drinking water supply and power, managing wastewater).

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exists, personnel have been trained, and resources are in place to implement them.

103. Procedures to protect patients' medical records

Evaluators will determine how the plan deals with safely moving medical and other critical records for patients. It should be kept in mind that these are medical-legal records and are the source for clinical progression of a patient.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

104. Regular safety inspections are conducted by the appropriate authority

Evaluators should note the expiration and/or refill dates of fire extinguishers and of flow tests for fire hydrants. Logbooks recording equipment tests and dates of inspections by civil defense personnel should be examined.

Low = Inspections do not occur; Average = Incomplete or outdated inspection; High = Inspections are complete and up-to-date.

105. Procedures for hospital epidemiological surveillance

Evaluators should verify that the hospital's Epidemiological Surveillance Committee has specific procedures for disaster incidents or treatment of mass casualties.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

106. Procedures for preparing sites for temporary placement of dead bodies and for forensic medicine

Evaluators should confirm that the plan includes specific arrangements for pathology and a site for the placement of multiple cadavers.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

107. Procedures for triage, resuscitation, stabilization, and treatment

Evaluators should confirm the existence of procedures, level of training of the personnel and availability of the necessary resources for the classification, resuscitation, stabilization, and treatment of victims in cases of disasters.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

108. Transport and logistics support

Evaluators should verify that the hospital has ambulances and other official vehicles available for patient transport and logistics support.

Low = Ambulances and vehicles for logistic support are not available; Average = There are insufficient vehicles; High = Appropriate vehicles in sufficient numbers are available.

109. Food rations for hospital staff during the emergency

Evaluators should confirm that there are measures for supplying food during the emergency and that funds for food are included in the budget. They should consider requirements of ambulance staff, the availability of extra rations for patients, staff, and people mobilized for the emergency. Evaluators should also examine other measures in place for the general welfare of the personnel.

Low = Nonexistent; Average = Covers less than 72 hours; High = Guaranteed for at least 72 hours.

110. Duties assigned for additional personnel mobilized during the emergency

The plan includes specific instructions for assigning duties to the personnel external to the hospital that is mobilized during the emergency in order to provide assistance, managerial, or administrative support.

Low = Assignments do not exist or exist only in a document; Average = Duties are assigned and personnel have been trained; High = Duties are assigned, personnel have been trained, and resources are in place to mobilize the personnel.

111. Measures to ensure the well-being of additional personnel mobilized during the emergency

Evaluators will confirm that the plan identifies where emergency personnel can rest, drink, and eat.

Low = Nonexistent; Average = Measures cover less than 72 hours; High = Measures are ensured for at least 72 hours.

112. Cooperative arrangements with local emergency plan

Evaluators will review written arrangements regarding cooperation between the hospital and com- munity authorities.

Low = No arrangements exist; Average = Arrangements exist but are not operational; High = Arrangements exist and are operational.

113. Mechanism to prepare a census of admitted patients and those referred to other hospitals. Evaluators will review specific forms that facilitate the listing of patients during emergencies.

Low = Mechanism does not exist or exists only as a document; Average = Mechanism exists and personnel have been trained; High = Mechanism exists, personnel have been trained, and resources are in place to carry out the census.

114. System for referral and counter-referral of patients

The plan includes specific procedures for the transfer and reception of patients to and from other health facilities inside and outside of the geographical area where the evaluated hospital is located.

Low = System does not exist or exists only as a document; Average = System exists and personnel have been trained; High = System exists, personnel have been trained, and resources are in place to carry out the plan.

115. Procedures for communicating with the public and media

Evaluators will appraise who is responsible for communicating with the public and media in case of disaster (generally the person who is highest in the chain of command at the time of the event).

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

116. Procedures for response during evening, weekend, and holiday shifts

Evaluators should verify that there are response procedures for nights, weekends, and holidays in case of emergencies and disasters.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

117. Procedures for the evacuation of the facility

Evaluators will examine plans to evacuate patients, visitors, and staff from the facility.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

118. Emergency and other exit routes are accessible

Evaluators will verify that exit routes are clearly marked and free of obstacles.

Low = Exit routes are not clearly marked and many are blocked; Average = Some exit routes are marked and most are clear of obstacles; High = All exit routes are clearly marked and free of obstacles.

119. Simulation exercises and drills

Evaluators will confirm that the plan is tested regularly through simulations and drills which are evaluated and modified as appropriate.

Low = Plans are not tested; Average = Plans are tested, but not each year; High = Plans are tested annually and updated according to the results of the exercises.

Contingency plans for medical treatment in disasters

120. Earthquakes, tsunamis, volcanoes, and landslides

The evaluators should review the corresponding plan and confirm if the personnel know how to carry out its functions and if the hospital has the necessary resources to implement the plan.

Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.

121. Social conflict and terrorism

The evaluators should review the corresponding plan and confirm if the personnel know how to carry out its functions and if the hospital has the necessary resources to implement the plan.

Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.

122. Floods and hurricanes

The evaluators should review the corresponding plan and confirm if the personnel know how to carry out its functions and if the hospital has the necessary resources to implement the plan.

Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.

123. Fires and explosions

The evaluators should review the corresponding plan and confirm if the personnel know how to carry out its functions and if the hospital has the necessary resources to implement the plan.

Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.

124. Chemical accidents or exposure to ionizing radiation

The evaluators should review the corresponding plan and confirm if the personnel know how to carry out its functions and if the hospital has the necessary resources to implement the plan.

Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.

125. Pathogens with epidemic potential

The evaluators should review the corresponding plan and confirm if the personnel know how to carry out its functions and if the hospital has the necessary resources to implement the plan.

Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.

126. Psycho-social treatment for patients, families, and health workers

The evaluators should review the corresponding plan and confirm if the personnel know how to carry out its functions and if the hospital has the necessary resources to implement the plan.

Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.

127. Control of infections acquired during hospitalization

Evaluators should request the corresponding hospital manual and verify whether infection control measures are in force.

Low = Manual does not exist or exists only as a document; Average = Manual exists and personnel have been trained; High = Manual exists, personnel have been trained, and resources are available to implement measures.

Plans for the operation, preventive maintenance, and restoration of critical services

This sub-module aims to determine whether essential documentation relating to emergency response is available, accessible, and relevant.

128. Electric power supply and back-up generators

Evaluators should review the operations manual for the back-up electric generator as well as preventive maintenance records.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

129. Drinking water supply

Evaluators should review the operations manual for the water supply system as well as records on preventive maintenance and water quality control.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

130. Fuel reserves

Evaluators should review the operations manual for fuel supplies, as well as preventive maintenance records.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

131. Medical gases

Evaluators should review the operations manual for medical gases supply, as well as the preventive maintenance records.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

132. Standard and back-up communications systems

The evaluators should review standards and procedures to maintain operation of routine and alternate communication systems in case of emergencies and disasters.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

133. Wastewater systems

Evaluators should confer with the maintenance division to ensure that hospital wastewater drains into the public sewage system and does not contaminate drinking water.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

134. Solid waste management

Evaluators should review the operations manual for solid waste management, as well as records showing waste collection and subsequent disposal.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

135. Maintenance of the fire protection system

The maintenance division should provide the operations manual for the fire protection systems, as well as records showing preventive maintenance on fire extinguishers and fire hydrants. It should be verified that the following is complied with:

- A manual and 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 brigade has been established.
- There are trained personnel and drills have been carried out.
- A plan of action is available.
- The material or inflammable liquids are stored in safe places used exclusively for these substances.

It is necessary to check that activities assigned to the brigade for controlling and mitigating fires are carried out in accordance with plans. In general, the maintenance service is responsible for this brigade and it is made up of at least 10 people from different shifts. This brigade draws up bulletins with basic recommendations to avoid fires and carries out visits to area of risk and identifies evacuation routes.

Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.

Availability of medicines, supplies, instruments, and other equipment for use in emergency

The availability of essential supplies in the event of an emergency should be checked.

136. Medicines

Evaluators should verify the availability of medicines for emergencies. The WHO list of essential drugs can be used as a reference.

Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.

137. Items for treatment and other supplies

Evaluators should confirm that the sterilization unit has a supply of sterilized materials for surgical use in an emergency (evaluators can check the supply prepared for the following day).

Low = Nonexistent; Average = Supply cover less than 72 hours; High = Supply is guaranteed for at least 72 hours.

138. Instruments

Evaluators should verify the stock and maintenance of specific instruments used in emergencies.

Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.

139. Medical gases

Evaluators should check the phone numbers and addresses of medical gas suppliers and ensure that the supplier can provide gases in an emergency.

Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.

140. Mechanical volume ventilators

The Hospital Disaster Committee should provide the evaluators with documentation on quantity and conditions of use of this equipment and rate the safety level according with their availability in disasters.

Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.

141. Electro-medical equipment

The Hospital Disaster Committee should provide the evaluators with documentation on quantity and conditions of use of this equipment and rate the safety level according with their availability in disasters.

Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.

142. Life-support equipment

The Hospital Disaster Committee should provide the evaluators with documentation on quantity and conditions of use of this equipment and rate the safety level according to their availability in disasters.

Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.

143. Personal protection equipment for epidemics (disposable)

Evaluators should check the hospital's stocks of personal protection equipment for staff working in areas of initial contact and treatment.

Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.

144. Crash cart for cardiopulmonary arrest

The Hospital Disaster Committee should provide documentation on quantity, conditions of use, and locations of crash carts for treatment of cardiopulmonary arrest and rate the safety level according to their availability in disasters.

Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.

145. Triage tags and other supplies for managing mass casualties

The emergency department distributes and uses triage tags in case of mass casualties. Evaluators should check the supply in terms of the maximum capacity of the hospital.

Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.

Chapter 4

Results

Table 4.1: Safe Hospitals Checklist

Hazards	LOW	AVERAGE	HIGH
Geological phenomena			
Earthquakes Rate the hazard level of the hospital in terms of geotechnical soil analyses.		✓	
Tsunamis Refer to hazard maps to rate the level of hazard for the hospital in terms of previous tsunami events caused by submarine seismic or volcanic activity.	✓		
Cyclones Refer to hazard maps to rate the hazard level of the hospital in terms of cyclones. It is helpful to take into account the history of such events when rating the hazard level of the facility	✓		
Torrential Rains Rate the hazard level of the hospital in relation to flooding due to intensive rainfall, based on history of such events.	✓		
Storm surge or river flooding Rate the hospitals level of exposure to storm surge or river flooding hazards based on previous events that did or did not cause flooding in or around the hospital.	✓		
Population Gatherings Rate the hospitals exposure to hazard in relation to the type of population it serves, its proximity to population gatherings and prior events that have affected the hospital.		✓	
Displaced population Rate he hospital's exposure to hazard in terms of people who have been displaced as a result of war, socio political circumstances, or due to immigration and emigration.	✓		
Environmental Phenomena **Epidemics** With reference to any past incidents at the hospital and specific pathogens, rate the hospital's exposure to hazards related to epidemics.			

Contamination (systems) With reference to any past incidents involving contamination, rate the hospital's exposure to hazards from contamination of its systems.			
Explosions With reference to the hospital's surroundings, rate the hospital's exposure to explosion hazards.		✓	
Fires With reference to the exterior of the hospital building, rate the hospital's exposure to external fi res.		✓	
Hazardous material spills With reference to the hospital's surroundings, rate the hospital's exposure to hazardous material spills.	✓		
Geotechnical properties of soils			
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.	✓		
Clay soils With reference to soil maps, rate the hospital's exposure to hazards from clay soil.		✓	
Unstable slopes Refer to geological maps and specify the hospital's exposure to hazards from the presence of slopes.	✓		
Prior events affecting hospital safety			
1. Has there been prior structural damage to the hospital as a result of natural phenomena? Determine whether structural reports indicate that the level of safety has been compromised. Low = Major damage; Average = Moderate damage; High =Minor damage.			✓
2. Was the hospital built and/or repaired using current safety standards? Verify whether the building has been repaired, the date of repairs, and whether repairs were carried out using standards for safe buildings. Low = Current safety standards not applied; Average = Current safety standards partially applied; High = Current safety standards fully applied.		✓	

3. Has remodeling or modification affected structural behavior of the facility? Verify whether modifications were carried out using standards for safe buildings. Low = Major remodeling or modifications have been carried out; Average = Moderate remodeling and/or modifications; High = Minor remodeling and/ or modifications or no modifications were carried out.			✓
Safety of the structural system and type of materials used in the building			
4.Condition of the building Low = Deterioration caused by weathering; cracks on the first floor and irregular height of buildings; Average = Deterioration caused only by weathering; High = Good; no deterioration or cracks observed.		✓	
5.Construction materials used Low = Rust with flaking; cracks larger than 3mm; Average = Cracks between 1 and 3 mm or rust powder present; High = Cracks less than 1 mm; no rust.			✓
6. Interaction of non-structural elements with the structure. Low = separation of less than 0.5% of the height of the partition/joint; Average = separation between 0.5 and 1.5% of the height of the partition/joint; High = separation above 1.5% of the partition/joint.		✓	
7. Proximity of buildings (hazards of pounding, wind tunnel effects, fires, etc.) 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.		✓	
8.Structural redundancy 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.			
9.Structural detailing, including connections Low = Built before 1970; Average = Built between 1970 and 1990; High = Built after 1990 and according to standards.		✓	

10. Safety of foundations Low = Information is lacking or foundation depth is less than 1.5 m; Average = Plans and soil studies are lacking but foundation depth is more than 1.5 m; High = Plans, soil studies are available and foundation depth is more than 1.5m.		✓	
11. Irregularities in the plan (rigidity, mass, and resistance) Low = Shapes are irregular and structure is not uniform; Average = Shapes are irregular but structure is uniform; Average = Shapes are regular, structure has uniform plan, and there are no elements that would cause torsion.		✓	
12. Irregularities in height (rigidity, mass, and resistance) Low = Height of storeys differs by more than 20% and there are significant discontinuous or irregular elements; Average = Storeys have similar heights (they differ by less than 20% but more than 5%) and there are few discontinuous or irregular elements; High = Storeys of similar height (they differ by less than 5%); there are no discontinuous or irregular elements.		✓	
13. Structural resilience to various phenomena (meteorological, geological, among others) Estimate structural behavior in response to different hazards or dangers, other than earthquakes. Low = Low structural resilience to natural hazards present at the site of the hospital; Average = Satisfactory structural resilience; High = Excellent structural resilience.			✓
Elements related to non-structural safety Nonstructural elements do not form part of the load bearing system of the building. They include architectural components, equipment's and systems that are necessary for the operation of the building			
critical systems			
Electrical system			
14. Generator has capacity to meet 100% of demand Verify that the generator begins to operate within seconds of the hospital losing power, covering power demands for the entire hospital, particularly in the emergency department, intensive care unit, sterilization unit, operating theatres, etc. Low = Generator can only be started manually or covers			✓

0–30% of demand; Average = Generator starts automatically in more than 10 seconds or covers 31%–70% of demand; High = Generator starts automatically in less than 10seconds and covers 71%–100% of demand.			
15. Regular tests of generator performance are carried out in critical Areas Determine the frequency of generator performance tests that have satisfactory results. Low = Tested every 3 months or more; Average = Tested every 1 to 3 months; High = Tested at least monthly.		✓	
16. Generator protected from damage due to natural phenomena Low = No; Average = Partially; High = Yes.		✓	
17.Safety of electrical equipment, cables, and cable ducts Low = No; Average = Partially; High = Yes.		✓	
18.Redundant system for local electric power supply Low = No; Average = Partially; High = Yes.		✓	
19. Protection for control panel, overload breaker switch, and cables Check the accessibility as well as condition and operation of the central electrical control panel. Low = No; Average = Partially; High = Yes.		✓	
20. Lighting system for critical areas of the hospital Review lighting for emergency unit, intensive care unit, operating theatres, etc., testing the level of lighting in rooms and function of lighting fixtures. Low = No; Average = Partially; High = Yes.			✓
21. External electrical systems installed on hospital grounds Verify the existence and capacity of external substations that provide power to the hospital. Low = No electrical substations installed on hospital's grounds; Average = Substations installed but do not provide enough power to hospital; High = Electrical substations installed and provide enough power to the hospital.	✓		
Telecommunications systems			
22. Condition of antennas and antenna bracing Verify the condition of antennas and their bracing/supports.			

Low = Poor or does not exist; Average = Satisfactory; High = Good.		✓	
23.Condition of low-voltage systems (Internet and telephone connections/cables) Verify that cables are properly connected in strategic areas to avoid system overload. Low = Poor or does not exist; Average = Satisfactory; High = Good.			✓
24. Condition of alternative communications systems Verify the condition of other communications systems: radio communications, satellite telephone, Internet, etc. Low = Poor or does not exist; Average = Satisfactory; High = Good.	✓		
25.Condition of anchors and braces for telecommunications equipment and cables Verify that telecommunications equipment (radios, satellite telephone, video conferencing system, etc.) is anchored for increased security. Low = Poor; Average = Satisfactory; High = Good.			✓
26.Condition of external telecommunications systems installed on hospital grounds Verify that external telecommunications systems do not interfere with communications of the hospital. Low = External telecommunications systems cause major interference with hospital communications; Average = External telecommunications systems cause moderate interference with hospital communications; High = External communications cause no interference with hospital communications.			✓
27. Site has adequate conditions for telecommunications systems Low = Poor or does not exist; Average = Satisfactory; High = Good.		✓	
28. Safety of internal communications systems Verify the condition of loudspeakers, public address system, speaker systems, etc. Low = Poor or does not exist; Average = Satisfactory; High = Good.			✓

water supply system			
29. Water tank has permanent reserve that is sufficient to provide at least 300 liters daily, per bed, for 72 hours Verify that water storage is sufficient to satisfy user demand for three days. Low = Sufficient for 24 hours or less; Average = Sufficient for more than 24 hours but less than 72 hours; High = Guaranteed to cover at least 72 hours.			✓
30. Water storage tanks are protected and in secure locations Visit the water tanks to determine the safety of the installations and of the site. Low = The site is susceptible to structural or non-structural failure; Average = Failure would not cause collapse of tank; High = Low possibility of functional failure.		✓	
31. Alternative water supply to major distribution network Identify the agency or mechanism to supply or restore water service to the hospital should the public water system fail. Low = Provides less than 30% of demand; Average = Provides 30% to 80% of demand; High = Provides more than 80% of daily demand.	✓		
32. Condition of water distribution system Verify condition and proper performance of water distribution system, including storage tanks, valves, pipes, and connections. 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.		✓	
33. Supplementary pumping system Identify the existence and operation of the supplementary pumping system in case water supply is interrupted. Low = There is no back-up pump and operational capacity does not meet daily demand; Average = All pumps are in satisfactory condition; High = All pumps and back-up systems are operational.			✓

Fuel Storage(gas, gasoline, diesel)			
34. Fuel tanks have at least 5-day capacity Verify that the hospital has fuel storage tanks of adequate size and safety. Low = Fuel storage is not secured and has less than 3-day fuel capacity; Aver-age =Fuel storage has some security and has 3-5 days fuel capacity; High = Fuel storage is secure and has capacity for 5 or more days.	✓		
35. Fuel tanks and/or cylinders are anchored and in a secure location Low = There are no anchors and the tank enclosure is unsafe; Average = Anchors are inadequate; High = Anchors are in good condition and the tank enclosure is adequate.	✓		
36. Safe location of fuel storage Verify that the tanks containing combustible liquids are accessible but at a safe distance from the hospital. Low = There is risk of failure and that tanks are not accessible; Average = One of the two conditions have been met; High = The fuel storage tanks are accessible and they are located in a secure site.	✓		
37. Safety of the fuel distribution system (valves, hoses, and connections) Low = Less than 60% of system is in good operational condition; Average = between 60% and 80% of system is in good operational condition; High = More than 80% of system is in good operational condition.	✓		
Medical gases (oxygen, Nitrogen, etc.)			
38. Sufficient medical gas storage for minimum of 15-day supply Low = Less than 10-day supply; Average = Supply for between 10 and 15 days; High = Supply for at least 15 days.			✓
39. Anchors for medical gas tanks, cylinders, and related equipment Low = Anchors are lacking; Average = Quality of anchors is inadequate; High = Anchors are of good quality.	✓		
40. Availability of alternative sources of medical gases Low = Alternative sources are lacking or are below standard; Average = Alternative sources exist and are in satisfactory condition; High = Alternative sources exist and are in good condition.		✓	

41. Appropriate location for storage of medical gases Low = Storage is not accessible; Average = Storage is accessible but hazards exist; High = Storage is accessible and there are no hazards.		✓	
42. Safety of medical gas distribution system (valves, pipes, connections) Low = Less than 60% of system is in good working condition; Average = Between 60% and 80% of system is in good working condition; High = More than 80% of system is in good working condition.			✓
43. Protection of medical gas tanks and/or cylinders and related Equipment Low = No areas are used exclusively for this equipment and there are no qualified personnel to operate it; Average = Areas are used exclusively for this equipment but personnel are not trained to operate it; High = There are areas used exclusively for this equipment AND it is operated by qualified personnel.		✓	
44. Adequate safety in storage areas Low = No areas are reserved for storage of medical gases; Average = Areas are reserved for storage of medical gases but safety measures are inadequate; High = There are areas reserved for storage of medical gases and the site does not present risks.		✓	
Heating, ventilation, and air-conditioning(HVAC) systems in critical areas			
45. Adequate supports for ducts and review of flexibility of ducts and piping that cross expansion joints Low = Supports are lacking and connections are rigid; Average = Supports are present or connections are flexible; High = Supports are present and connections are flexible.			✓
46. Condition of pipes, connections, and valves Low = Poor; Average = Satisfactory; High = Good			✓
47.Condition of anchors for heating and/or hot water equipment Low = Poor; Average = Satisfactory; High = Good.			✓
48.Condition of anchors for air-conditioning equipment Low = Poor; Average = Satisfactory; High = Good.			✓
49.Location of enclosures for HVAC equipment Low = Poor; Average = Satisfactory; High = Good.	✓		

50. Safety of enclosures for HVAC equipment Low = Poor; Average = Satisfactory; High = Good.	✓		
51. Operating condition of HVAC equipment (boiler, air-conditioning systems, exhaust, etc.) Low = Poor; Average = Satisfactory; High = Good.	✓		
Office and storeroom furnishings and equipment and supplies used for diagnosis and treatment			
52.Anchors for shelving and safety of shelf contents Verify that shelves are anchored to the walls and/or are braced and that contents are secured. Low = Shelving is not attached to walls; Average = Shelving is attached but contents are not secured; High = Shelving is attached and contents are secured.			✓
53. Safety of computers and printers Verify that computer tables are anchored and table wheels are locked. Low = Poor; Average = Satisfactory; High = Good or does not require anchor.			✓
54. Condition of office furnishings and other equipment Check anchors and/or bracing on furnishings in offices. Low = Poor; Average = Satisfactory; High = Good or does not require anchor.			✓
55. Medical equipment in operating theaters and recovery rooms Verify that lamps, equipment for anesthesia, and surgical tables are operational and that table or cart wheels are locked. Low = The equipment is in poor condition or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.		✓	
56. Condition and safety of radiology and imaging equipment Verify that the X-ray and imaging equipment is in good condition and is secured. Low = The equipment is in poor condition or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.			✓
57. Condition and safety of laboratory equipment Low = The equipment is in poor condition or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.			✓

58.Condition and safety of medical equipment in emergency services unit Low = The equipment is in poor condition or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.		✓	
59.Condition and safety of medical equipment in intensive or intermediate care unit Low = The equipment is in poor condition or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.			✓
60.Condition and safety of equipment and furnishings in the pharmacy Low = The equipment is in poor condition or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.			✓
61.Condition and safety of equipment in the sterilization unit Low = The equipment is in poor condition or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.		✓	
62.Condition and safety of medical equipment for neonatal care Low = The equipment is lacking, is in poor condition, or is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.			✓
63.Condition and safety of medical equipment and supplies for burn management Low = The equipment is lacking, is in poor condition, or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.			✓
64.Condition and safety of medical equipment for nuclear medicine and radiation therapy Low = The equipment is lacking, is in poor condition, or it is not secured; Average = The equipment is in fair condition or not properly secured; High = Equipment is in good condition and is secured.		✓	

65.Condition and safety of medical equipment in other services Low = More than 30% of equipment is at risk of material or functional failure and/or equipment puts the entire service's operation at direct or indirect risk; Average = Between 10% and 30% of equipment is at risk of loss; High = Less than 10% of equipment is at risk of loss.		✓	
66.Anchors for shelving and safety of medical contents Low = Shelves are anchored or shelf contents are secured in less than 20% of cases; Average = Shelves are anchored or shelf contents are secured in 20% to 80% of cases; High = More than 80% of shelves are anchored and the contents of shelves are secured (or shelving and contents do not require anchors).			✓
Architectural Elements			
67. Condition and safety of doors and entrances Low =Subject to damage and damage to element(s) would impede the performance of this and other components, systems, or operations; Average = Subject to damage but damage to element(s) would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.			✓
68. Condition and safety of windows and shutters Low =Subject to damage and damage to element(s) would impede the performance of this and other components, systems, or operations; Average = Subject to damage but damage to element(s) would not impede function; High =No or minor potential for damage that would impede the performance of this and other components, systems, or operations.			✓
69. Condition and safety of other elements of the building envelope (Outside walls, facings, etc.) Low =Subject to damage and damage to element(s) would impede the performance of this and other components, systems, or operations; Average = Subject to damage but damage to element(s) would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.			✓
70. Condition and safety of roofing Low =Subject to damage and damage to element(s) would			

impede the performance of this and other components, systems, or operations; Average = Subject to damage but damage to element(s) would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.			✓
71. Condition and safety of parapets (wall or railing placed to prevent falls on roofs, bridges, stairs, etc.) Low =Subject to damage and damage to element(s) would impede the performance of this and other components, systems, or operations; Average = Subject to damage but damage to element(s) would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.		✓	
72. Condition and safety of perimeter walls and fencing Low =Subject to damage and damage to element(s) would impede the performance of this and other components, systems, or operations; Average = Subject to damage but damage to element(s) would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.			✓
73. Condition and safety of other outside elements (cornices, ornaments, etc.) Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.	✓		
74. Safe conditions for movement outside of building Low = Damage to structure or road and walkways will impede access to buildings or endanger pedestrians; Average = Damage to structure or road and walkways will not impede pedestrian access, but will impede vehicle access; High = No or minor potential for slight damage which will impede pedestrian or vehicle access.			✓

75. Safe conditions for movement inside the building (corridors, stairs, elevators, exit doors, etc.) Low = Subject to damage and damage to element(s) will impede movement inside building and endanger occupants; Average = Damage to elements will not impede movement of people but will impede movement of stretchers, wheeled equipment; High = No or minor potential for slight damage which will not impede movement of people or wheeled equipment.			✓
76. Condition and safety of internal walls and partitions Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.			✓
77. Condition and safety of false or suspended ceilings Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.			✓
78. Condition and safety of internal and external lighting systems Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.			✓
79. Condition and safety of fire protection system Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High =	✓		

No or minor potential for damage that would impede the performance of this and other components, systems, or operations.			
80. Condition and safety of elevator system Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.		✓	
81. Condition and safety of stairways Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.	✓		
82. Condition and safety of floor coverings B= Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.			✓
83. Hospital access routes Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the performance of this and other components, systems, or operations.			✓
84. Other architectural elements, including emergency signs Low = Element(s) subject to damage and damage would impede the performance of this and other components, systems, or operations; Average = Element(s) subject to damage but damage would not impede function; High = No or minor potential for damage that would impede the	✓		

performance of this and other components, systems, or operations.			
Safety Based on functional capacity of hospital The level of preparedness of hospital staff for major emergencies and disasters as well as the level of implementation of the hospital disaster plan.			
4.1 Organization of the hospital Disaster Committee and the emergency operations center. Assess the level of organization achieved by the hospital disaster committee			
85.Committee has been formally established to respond to major emergencies or disasters Low = Committee does not exist; Average = Committee exists but is not functioning; High = Committee exists and is functioning.	✓		
86. Committee membership is multi-disciplinary Verify that the positions on the Committee are occupied by personnel from diverse disciplines (for example, hospital director, chief of nursing, maintenance engineer, head of emergency services, medical director, chief of surgery, chief of laboratory and support services, among others). Low = 0–3 disciplines represented; Average = 4–5 disciplines represented; High = 6 or more disciplines represented.	✓		
87.Each member is aware of his/her specific responsibilities Verify that members' assigned responsibilities are in writing, describing their specific roles. Low = Responsibilities not assigned; Average = Responsibilities have been officially assigned; High = All members know and comply with their responsibilities.	✓		
88.Space is designated for the hospital Emergency Operations Centre (EOC) Verify that a room has been designated for operational command and that all means of communication are present (telephone, fax, Internet, etc.). Low = Nonexistent; Average = Space has been officially assigned; High = EOC exists and is functional.	✓		
89. The EOC is in a protected and safe location Take into account accessibility, safety, and protection when checking the room used for the EOC. Low = The room for the EOC is not in a safe location;			

Average = The EOC is in a safe location but it is not easily accessible; High =The EOC is in a safe, protected, and easily accessible location.	✓		
90.The EOC has a computer system and computers Verify that the EOC has Internet and intranet connections. Low = No; Average = Incomplete; High = The EOC has all computer system requirements	✓		
91.Both internal and external communications systems in the EOC function properly Determine whether the switchboard (telephone central for re-routing calls) has a paging or a public address system and the operators know the emergency codes and how to use them. Low = Does not function or is nonexistent; Average = Partly functional; High = Complete and functional.	✓		
92. The EOC has an alternative communications system Determine whether, besides the switchboard, there is an alternative communications system (e.g. cellular, two-way radio, etc.). Low = Nonexistent; Average = Incomplete; High = Yes.	✓		
93. The EOC has adequate equipment and furnishings Verify that there are desks, chairs, power outlets, lighting, water supply, and drainage. Low = No; Average = Incomplete; High = Yes.	✓		
94.An up-to-date telephone directory is available in the EOC Confirm that the directory includes all support services needed in an emergency (randomly check telephone numbers). Low = No; Average = Directory exists but is not up-to-date; High = Available and current.	✓		
95."Action Cards" available for all personnel Verify that action cards describe the assigned duties of each hospital staff member in case of an internal or external disaster. Low = No; Average = Insufficient (numbers and quality); High = All staff members have cards.	✓		

Operational plan for internal or External Implementation Disasters			
96. Strengthen essential hospital services The plan specifies actions to be taken before, during, and after a disaster in the hospital's essential services (emergency room, intensive care unit, sterilization unit, operating theatre, among others). Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.	✓		
97. Procedures to activate and deactivate the plan Verify that there are procedures for how, when, and by whom the plan is activated/deactivated. Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the procedures.	✓		
98. Special administrative procedures for disasters Verify that the plan includes procedures for contracting personnel and for procurements in case of disaster. Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the procedures.	✓		
99. Financial resources for emergencies are budgeted and Guaranteed. Verify that the hospital has a specific budget for use in disaster situations. Low = Not budgeted; Average = Funds will cover less than 72 hours; High = Funds are guaranteed for 72 hours or more.	✓		
100. Procedures for expanding usable space, including the availability of extra beds The plan identifies physical spaces that can be equipped to treat mass casualties. Low = Space for expansion has not been identified; Average = Space has been identified and personnel have been trained to carry out the expansion; High = Procedures exist, personnel have been trained, and resources are in place to carry out expansion of space.		✓	

101. Procedures for admission to the emergency department The plan specifies the places and personnel responsible for carrying out triage. Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.			✓
102. Procedures to expand emergency department and other critical services The plan should indicate actions needed to expand hospital services (for example, drinking water supply, power, and wastewater). Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.		✓	
103. Procedures to protect patients' medical records The plan indicates how medical and other critical patient records can be safely moved. Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.			✓
104. Regular safety inspections are conducted by the appropriate authority Note the expiration and/or refill dates of fi re extinguishers and of flow tests for fi re hydrants. Examine logbooks that record equipment tests and dates of inspections by civil Defense personnel. Low = Inspections do not occur; Average = Incomplete or outdated inspection; High = Inspections are complete and up-to-date.		✓	
105. Procedures for hospital epidemiological surveillance Verify that the hospital's Epidemiological Surveillance Committee has specific procedures for disaster incidents or treatment of mass casualties. Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.		✓	

106. Procedures for preparing sites for temporary placement of dead bodies and for forensic medicine Verify that the plan includes specific arrangements for pathology and a site for the placement of multiple cadavers. Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.			
107. Procedures for triage, resuscitation, stabilization, and treatment Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.			✓
108. Transport and logistics support Confirm that the hospital has ambulances and other official vehicles. Low = Ambulances and vehicles for logistic support are not available; Average = There are insufficient vehicles; High = Appropriate vehicles in sufficient numbers are available.		✓	
109. Food rations for hospital staff during the emergency The plan specifies actions for supplying food during the emergency and funds for these supplies are included in the budget. Low = Nonexistent; Average = Covers less than 72 hours; High = Guaranteed for at least 72 hours.		✓	
110. Duties assigned for additional personnel mobilized during the emergency Low = Assignments do not exist or exist only in a document; Average = Duties are assigned and personnel have been trained; High = Duties are assigned, personnel have been trained, and resources are in place to mobilize the personnel.	✓		
111. Measures to ensure the well-being of additional personnel mobilized during the emergency The plan identifies where emergency personnel can rest, drink, and eat. Low = Nonexistent; Average = Measures cover less than	✓		

72 hours; High = Measures are ensured for at least 72 hours.			
112. Cooperative arrangements with local emergency plan There are written arrangements regarding cooperation between the hospital and community authorities. Low = No arrangements exist; Average = Arrangements exist but are not operational; High = Arrangements exist and are operational.		✓	
113. Mechanism to prepare a census of admitted patients and those referred to other hospitals Low = Mechanism does not exist or exists only as a document; Average = Mechanism exists and personnel have been trained; High = Mechanism exists, personnel have been trained, and resources are in place to carry out the census.			✓
114. System for referral and counter-referral of patients Low = System does not exist or exists only as a document; Average = System exists and personnel have been trained; High = System exists, personnel have been trained, and resources are in place to carry out the plan.			✓
115. Procedures for communicating with the public and media The hospital disaster plan specifies who is responsible for communicating with the public and media in case of disaster (generally the highest person in the chain of command at the time of the event). Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.	✓		
116. Procedures for response during evening, weekend, and holiday shifts Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.			✓
117. Procedures for the evacuation of the facility Verify procedures to evacuate patients, visitors, and staff. Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been	✓		

trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.			
118. Emergency and other exit routes are accessible Verify that exit routes are clearly marked and free of obstacles. Low = Exit routes are not clearly marked and many are blocked; Average = Some exit routes are marked and most are clear of obstacles; High = All exit routes are clearly marked and free of obstacles.	✓		
119. Simulation exercises and drills The plan is tested regularly through simulations and drills, which are evaluated and modified as appropriate. Low = Plans are not tested; Average = Plans are tested, but not each year; High = Plans are tested annually and updated according to the results of the exercises.	✓		
Contingency plans for medical treatment in Implementation disasters			
120. Earthquakes, tsunamis, volcanoes, and landslides Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.	✓		
121. Social conflict and terrorism B= Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.	✓		
122. Floods and hurricanes Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.	✓		
123. Fires and explosions. Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.	✓		
124. Chemical accidents or exposure to ionizing radiation Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.	✓		

125. Pathogens with epidemic potential Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.	✓		
126. Psycho-social treatment for patients, families, and health workers Low = Plan does not exist or exists only as a document; Average = Plan exists and personnel have been trained; High = Plan exists, personnel have been trained, and resources are in place to carry out the plan.	✓		
127. Control of hospital-acquired infections Request the corresponding hospital manual and verify whether control procedures are in force. Low = Manual does not exist or exists only as a document; Average = Manual exists and personnel have been trained; High = Manual exists, personnel have been trained, and resources are available to implement measures.	✓		
128. Electric power supply and back-up generators The maintenance division should provide the operations manual for the back-up electric generator as well as preventive maintenance records. Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.		✓	
129. Drinking water supply The maintenance division should provide the operations manual for the water supply system as well as records on preventive maintenance and water quality control. Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.		✓	
130. Fuel reserves The maintenance division should provide the operations manual for fuel supplies, as well as preventive maintenance records. Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been		✓	

trained, and resources are in place to implement them.			
131. Medical gases The maintenance division should provide the operations manual for medical gases supply, as well as preventive maintenance records. Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.		✓	
132. Standard and back-up communications systems Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.	✓		
133. Wastewater systems The maintenance division should ensure that hospital wastewater drains into the public sewage system and does not contaminate drinking water. Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.			✓
134. Solid waste management The maintenance division should provide the operations manual for solid waste management, as well as records showing waste collection and subsequent disposal. Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.			✓
135. Maintenance of the fire protection system The maintenance division should provide the operations manual for the fi re protection systems, as well as records showing preventive maintenance on fire extinguishers and fire hydrants. Low = Procedures do not exist or exist only in a document; Average = Procedures exist and personnel have been trained; High = Procedures exist, personnel have been trained, and resources are in place to implement them.	✓		

Availability of medicines, supplies, instruments, and other equipment for use in emergency (verify the availability of essential supplies in the event of an emergency)			
136. Medicines Check the availability of emergency medicines. The WHO list of essential drugs can be used as a reference. Low = Nonexistent; Average = Supplies cover less than 72 hours; High = Supply is guaranteed for at least 72 hours.			✓
137. Items for treatment and other supplies Check that the sterilization unit has a supply of sterilized materials for use in an emergency (check the supply prepared for the following day). Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.			✓
138. Instruments Verify the existence and maintenance of specific instruments used in emergencies. Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.		✓	
139. Medical gases Verify the phone numbers and addresses of medical gas supplier and ensure availability in an emergency from the supplier. Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.			✓
140. Mechanical volume ventilators The Hospital Disaster Committee should provide documentation on quantity and conditions of use of this equipment. Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.			✓
141. Electro-medical equipment The Hospital Disaster Committee should provide documentation on quantity and conditions of use of this equipment. Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.			✓
142. Life-support equipment Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.			✓

143. Personal protection equipment for epidemics (disposable) Verify the hospital's stocks of personal protection equipment for staff working in areas of initial contact and treatment. Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.			✓
144. Crash cart for cardiopulmonary arrest The Hospital Disaster Committee should provide documentation on quantity, conditions of use, and locations of crash carts for treatment of cardiopulmonary arrest. Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.			✓
145. Triage tags and other supplies for managing mass casualties The emergency department distributes and uses triage tags in case of mass casualties. Evaluate the supply in terms of the maximum capacity of the hospital. Low = Nonexistent; Average = Supply covers less than 72 hours; High = Supply guaranteed for at least 72 hours.	✓		

Table 4.2: Hospital Location with respect to geographic Features

1.3.1 Hospital Location	LOW	MEDIUM	HIGH
Geological Hazards			
Earthquakes		1	
Volcanic Eruptions	1		
Landslides	1		
Tsunami	1		
Others		1	
Hydro Meteorological hazards			
Cyclones	1		
Torrential rains	1		
Storm surges and Waves	1		
Landslides	1		
Social Unrest			
Population Concentrations		1	
Displaced persons	1		
Others		1	
Sanitary – Ecological Hazards			
Epidemics		1	
Contamination (Systems)	1		

	LOW	MEDIUM	HIGH
Infestation	**1**		
Chemical-Technological Hazards			
Explosions		1	
Fires		1	
Hazardous Material Spills			
Others(Specify)	1		
1.3.2 Soil – Geotechnical Properties			
Liquefaction	1		
Sensitive Clays		1	
Unstable Slopes	1		

Table 4.3:- Structural Safety of the building

4.3.1	Safety due to the history of the establishment	SAFETY DEGREE			CHECK
	Was the hospital exposed to a significant hazardous event in the last 30 years?	**LOW**	**MEDIUM**	**HIGH**	
1	Did the hospital suffer any significant structural damage?			1	YES
2	Did the hospital suffer any minor structural damage?			1	YES
3	Was the hospital repaired using appropriate standards?		1		YES
4.3.2	**Safety due to architect configuration**				
4	Separation joints (existence and condition)			1	YES
5	Proximity of buildings		1		YES
6	Plan irregularities		1		YES
7	Elevation irregularities		1		YES
8	Road Access			1	YES
9	External circulation within the complex			1	YES
10	Internal Circulation (including stairs and elevators)		1		YES
11	Remodeling and adaption of buildings			1	YES
4.3.3	**Safety due to structural systems and building materials used?**				
12	Soil structure interaction		1		YES
13	Foundations		1		YES
14	Short Columns		1		YES

15	Spacing of Columns			1	YES
16	Beam Column relationship			1	YES
17	Beam Configuration			1	YES
18	Shear walls			1	YES
19	Influence of partitions on structures			1	YES
20	Soft storeys(different heights between floors or free space from the ground floor)			1	YES
21	Structural irregularities		1		YES
22	Mass concentration by location: Water tanks or heavy equipment on the upper floors of the building.		1		YES
23	Construction Materials			1	YES
	Total Structural	0	10	13	YES

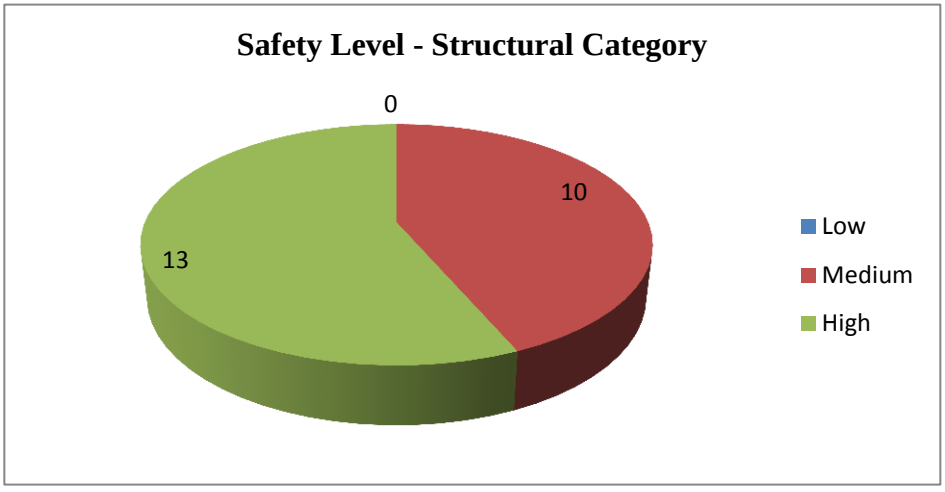

Figure 4.1 :- Safety Level – Structural Category

Table 4.4 :- Nonstructural Safety of the Building

4.4.1	Utilities (Installation)	LOW	MEDIUM	HIGH	CHECK
	Electric system				
1	Standby generator can supply 100% of demand and is tested regularly.			1	YES
2	Redundancy in Municipal power supply		1		YES
3	Systems have a control panel with an overload switch and duly protected electrical wiring			1	YES
4	Lighting systems in key hospital locations			1	YES
5	Underground external Electrical distribution system within the perimeter of the hospital site			1	YES
	Telecommunication system				
6	Condition of Antenna and supporting frames			1	YES
7	Check Internet connections/Cables			1	YES
8	Check anchorage of equipment and support of cables			1	YES
9	Underground communication systems within the perimeter of the hospital			1	YES
	Water storage system				
10	Onsite water storage capacity for 3 days (2000 liters per bed per day			1	YES
11	Outdoor tanks are in a secured and protected location			1	YES
12	Underground storage with protection			1	YES

13	Redundant main water supply			1	YES
	Fuel storage (Gas, gasoline or Diesel)				
14	Capacity of fuel tanks for at least five days	1			YES
15	Bolted and well protected permanent tanks	1			YES
16	Location of gas cylinder storage		1		YES
17	Secure storage and for cylinders		1		YES
	Medical gases				
18	Sufficient storage for at least 15 days			1	YES
19	Alternative source for medical gases is available			1	YES
20	Secure storage for cylinders		1		YES
21	Appropriate safety valves		1		YES
4.4.2	**Heating , Ventilation and air- conditioning systems for critical areas**				
22	Adequate duct supports and check for accommodation of movement where ducts and pipes traverse separation joints			1	YES
23	Check couplings and water pipes for potential leaks			1	YES
24	Check safety valves and medical gases pipes for potential leaks		1		YES
25	Check anchorage of central heating and/or hot water equipment			1	YES
26	Check support for tubes, ducts and cables			1	YES
27	Check anchorage for central air conditioning equipment			1	YES

4.4.3	**Furniture and fixed and movable office equipment**				
28	Check anchorage of shelving and restraints for contents			1	YES
29	Office furniture			1	YES
30	Computer and printing equipment fixed			1	YES
4.4.4	**Medical equipment used for diagnosis and treatment**				
31	Fixed medical equipment in operating room			1	YES
32	Fixed medical equipment of Diagnostic Imaging			1	YES
33	Fixed medical Equipment			1	YES
34	Movable medical equipment is bolted to the walls/floors			1	YES
4.4.5	**Architectural Elements**				
35	Check envelope/perimeter of building including external doors, windows and eaves soffits for water ingress/leakage and flying objects			1	YES
36	Check lamination or poly carbonation glazing of partitions, windows and doors			1	YES
37	Check anchorage of cornices, False ceilings, lighting fixtures		1		YES
38	Check anchorage for external finish			1	YES
39	Check anchorage for appendage			1	YES
40	Check stability of partitions			1	YES
	Total Non-Structural	2	7	31	40

Table 4.5:- Functional Safety of the building

4.5.1	**Internal Organization for actions during serious disasters**	**LOW**	**MEDIUM**	**HIGH**	**CHECK**
1	Task force to respond to major emergencies and disasters	1			YES
2	The committee is multidisciplinary	1			YES
3	Each Members has specific responsibilities assigned	1			YES
4	The hospital has established and staffed a command center	1			YES
5	The center is located in a safe and secure location	1			YES
6	The centers information systems and computers are operational and have internet access	1			YES
7	Internal and external communication systems work properly	1			YES
8	Alternate communication systems are in place	1			YES
9	Center is properly furnished and equipped	1			YES
10	Updated telephone contact lists are available	1			YES
11	Action Cards are available		1		YES
4.5.2	**Operational plan for Internal/External serious hazardous events**				
12	Strengthening of the institution essential services	1			YES
13	Procedures for plans activation and de-activation	1			YES
14	Emergency administration procedures	1			YES
15	Emergency Financial resources budgeted and guaranteed	1			YES
16	Space identified for emergency uses including bed capacity		1		YES
17	Procedures to implement emergency admissions policies			1	YES

S.No	Operational plan for Internal/External serious hazardous events	LOW	MEDIUM	HIGH	CHECK
18	Procedures to prepare emergency room and other critical areas			1	YES
19	Procedures for securing medical records			1	YES
20	Regular inspection by fire authorities	1			YES
21	Regular inspection by the national emergency authorities	1			YES
22	Procedures for epidemiological surveillance		1		YES
23	Procedures for temporary body storage sites and forensic medicine location	1			YES
24	Procedures for management of hazardous or infectious materials	1			YES
25	Transportation and logistics support		1		YES
26	Dietary rations for staff during emergency situations		1		YES
27	Emergency accommodation's for staffs	1			YES
28	Contingency plan covers measures to ensure wellbeing of staff	1			YES
29	Operational plan is linked to community emergency plan	1			YES
30	Plan includes measures to keep track of admitted patients and those referred to others hospitals.	1			YES
31	Plan includes steps to hire additional personnel during disasters	1			YES
4.5.3	**Specific guidelines and procedures for contingency cases including triage, stabilization and treatment**				
32	Casualty management during geological disasters	1			YES
33	casualty management for hydro meteorological disasters	1			YES
34	Casualty management for public health emergencies	1			YES
35	casualty management during social unrest or terrorism	1			YES

36	Casualty management during chemical or technological disasters	1			YES
37	Management of burn victims	1			YES
38	Management and care of ionizing radiation victims	1			YES
39	Casualty management of infectious agent in epidemics and/or potential pandemic	1			YES
40	Psychological support for disaster victims and hospital staff	1			YES
41	Space equipment and procedures for decontamination and disinfection		1		YES
42	Emergency Resuscitation Room		1		YES
4.5.4	**Guidelines and manuals for planned preventive maintenance and repair of vital services**				
43	Electric power supply and auxiliary energy plants	1			YES
44	Portable water supply		1		YES
45	Fuel reserves		1		YES
46	Medical Gases			1	YES
47	Regular and alternate communication systems	1			YES
48	Common radio frequency with response agencies	1			YES
49	Building equipment's and Grounds			1	YES
50	Sewage systems			1	YES
51	Waste disposal		1		YES
52	System maintenance against fires	1			YES
4.5.5	**Emergency medicines, medical supplies and equipment**				
53	Essential drugs are inventoried and updated regularly			1	YES
54	Medical supplies/materials are inventoried and updated regularly.			1	YES

55	Basic equipment for handling emergencies			1	YES
56	Medical gases			1	YES
57	Mechanical ventilation equipment			1	YES
58	Electro-medical equipment			1	YES
59	Life support equipment			1	YES
60	Protective equipment for epidemics			1	YES
61	Cardiac arrest trolley			1	YES
62	Triage tags and others mass casualty		1		YES
4.5.6	**Staff education and training programs for emergency and disaster management**				
63	Education and training programs are provided regularly		1		YES
64	Programs are accredited by the appropriate entities		1		YES
65	Simulations and drills at least once a year	1			YES
66	Staff is trained in using fire response systems		1		YES
67	Team development trainings	1			YES
68	Emergency maintenance teams for medical gases and utilities	1			YES
69	Firefighting teams	1			YES
70	Security teams		1		YES
71	Evacuation support team	1			YES
72	Basic life support teams			1	YES
73	Psycho-social support team	1			YES

74	Personnel trained in advanced course s(cardiac, trauma, pediatric and prehospital life support courses			1	YES
4.5.7	**Security and safety plan**				
75	Staff identification procedures are in place			1	YES
76	Building surveillance and security teams			1	YES
77	Procedures for public and press communications	1			YES
78	Specific action plan in case of fire	1			YES
79	Hospital evacuation routes are marked, lighted and unobstructed	1			YES
80	Assembly area is safe and previously identified.	1			YES
	Total Functional	45	15	20	80
	Overall total	47	34	64	145

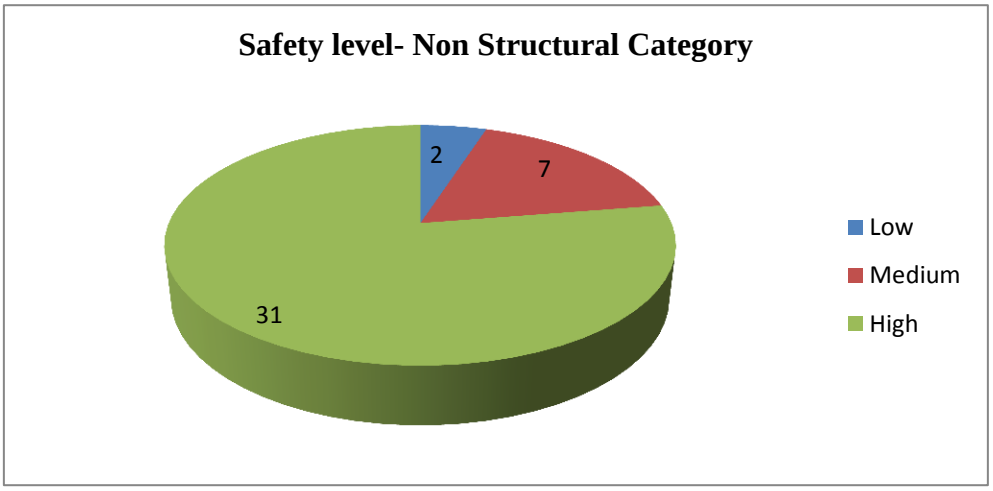

Figure 4.2:- Safety Level – Nonstructural Category

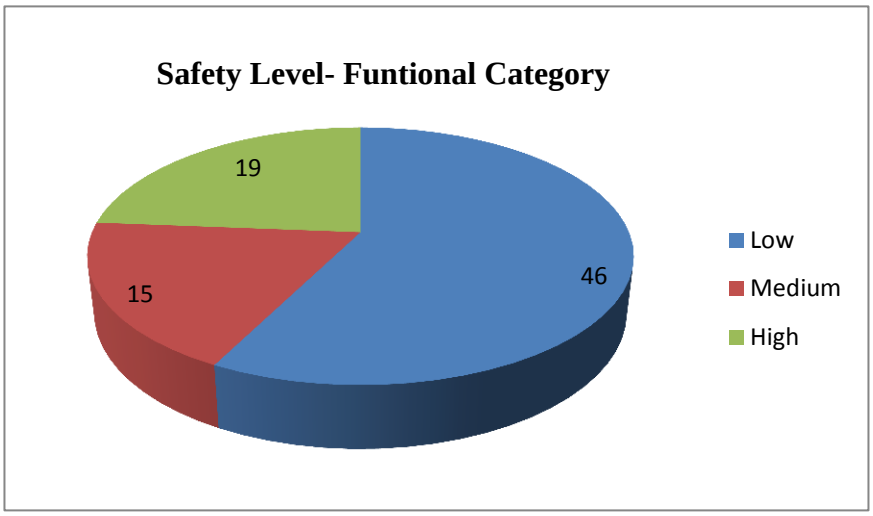

Figure 4.3:- Safety Level – Functional Category

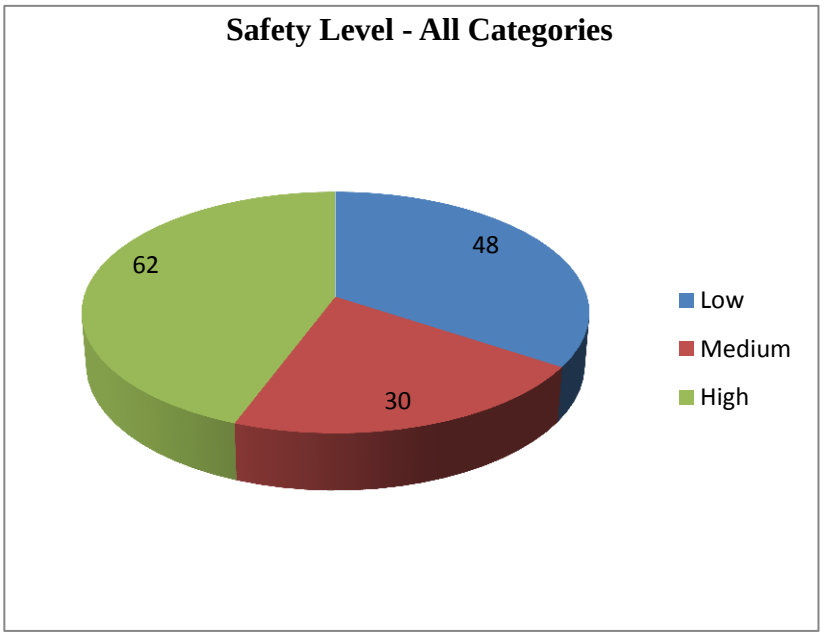

Figure 4.4:- Safety Level – All Categories

Table 4.6

Step 3: Tabulate responses according to category

Category	Unlikely to function		Likely to function		Highly likely to function		Total
Structural	0	0%	10	43%	13	57%	23
Non structural	2	4%	7	18%	31	78%	40
Functional	46	57%	15	19%	19	24%	80

Table 4.7
Step 4: Input vertical weights to be used.

Vertical weight	
Structural	0.5
Non structural	0.3
functional	0.2

Category	Unlikely to function		Likely to function		Highly likely to function		Total
Structural	0	0%	10	22%	13	29%	51%
Non structural	2	1%	7	5%	31	23%	29%
Functional	45	11%	17	4%	18	5%	20%
Total		12%		31%		57%	100%

Table 4.8
Step 5: Input horizontal weights to be used

Horizontal weight		Safety factors
Unlikely to function	1	0.120
Likely to function	2	0.620
Highly likely to function	4	2.280

Overall Safety Factor: 3.02

Step 6:

Calculate Range to be used in safety/ unsafety index formulas

Range = Upper horizontal weight factor – Lower Horizontal Factor = 4-1 = 3

Step 7:

Calculate safety index and unsafety index

Safety index: safety factor – lower range limit / range = 3.020 – 1 / 3 = 0.652

Unsafety index: upper range limit – safety factor / range = 4 – 3.02 / 3 = 0.326

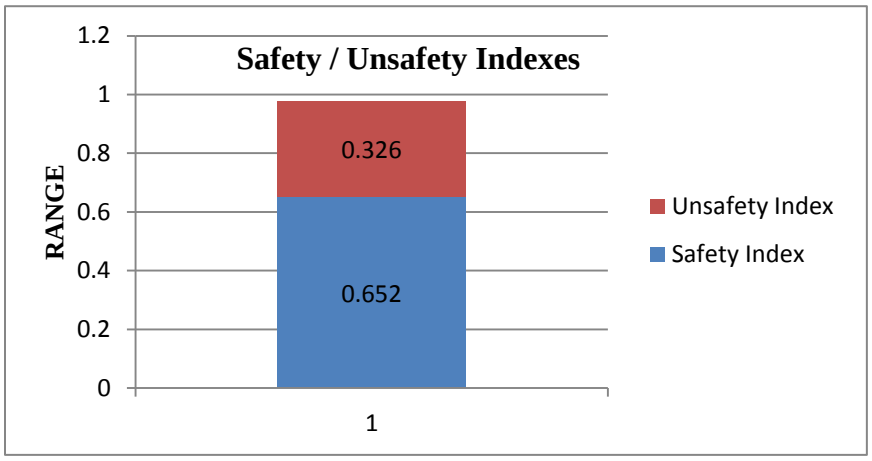

Figure 4.5: - Safety/Unsafety Indexes

Table 4.9:- Safety / Unsafety Index

Safety index	2.04	62%
Unsafety index	0.96	38%

Chapter 5

Summary and Conclusion

	Low Safety	Medium Safety	High Safety
Structural	0%	43%	57%
Non - structural	4%	18%	78%
Functional capacity	57%	19%	24%
Overall	48%	21%	44%

5.1 Location

Generally the site was identified as vulnerable to hazards such as earthquakes and fires.

5.2 Structural

The structure of the building was safe particularly in relation to the layout, the circulation within the buildings and the foundations and construction materials.

The condition of the building with respect to the deterioration caused by the weathering; cracks on the building are some areas, which require some measures to improve safety, and inspected regularly.

5.3 Nonstructural

With the expectation of redundancy in the mains water supply, electrical and water system were rated as safe.

Anchorage of telecommunication system and fixed medical equipment were also identified as safe.

5.4 Functional

Attention is required to basic aspects of emergency planning including the information and communication system for emergency operation plan particularly procedures to access financial resources.

The plan needs to address the management of the hazards through Guideline's for all aspects of mass casualty management need to be developed and also for planned preventive maintenance of essential services

Major safety concerns were identified in areas of staff education and training programmes for emergency and disaster management.

5.5 Safety Index and Comments

Safety index for the hospital was calculated as 0.65 placing the facility in the range of 0.35 – 0.65 as a category “B” Institution. This indicates that the facilities current standard level can potentially put patients and staff at risk after a disaster event.

The detailed analysis above indicates the safety of the institution would be improved significantly by attention to some non-structural factors but mainly to functional factors of the hospital

5.6 Specific Recommendations

- Review whether the building is repaired using standards for safe buildings
- Establish an alternative communication system within the hospital premises which would be helpful during the time of emergencies in case of failure of the existing telecommunication system.
- Identify a mechanism to supply or restore water services to the hospital should the existing water distribution system fail.
- Fuel storage tanks of adequate size and safety, their storage in a secured location with proper anchors such that the liquids are accessible and is at a safe distance from the hospital.
- Fire hydrants, smoke detectors and sprinklers must be installed and the maintenance division should provide the operations manuals for the fire protection systems as well as records showing preventive maintenance on fire extinguishers fire hydrants, smoke detectors and sprinklers.
- Emergency operations center with particular attention to information and communication systems and furniture and equipment.
- Procedures must be documented to access funds in an emergency, plans for emergency and security paying special attention to mass casualty management and the items identified as low safety in the assessment instrument must be identified implemented and reviewed regularly.
- Procedures for planned preventive maintenance of essential services and implement new measures are required
- Staff must be trained and plans must be trained and plans must be tested with simulations and drills

REFERENCES

1. Pan American Health Organization. Guidelines for vulnerability reduction in the design of new health facilities. Washington, D. C.: OPS; 2004.
2. Pan American Health Organization. Safe Hospitals. A Collective Responsibility. A Global Measure of Disaster Reduction. Washington, D. C.: OPS; 2005.
3. Pan American Health Organization. Principles of Disaster Mitigation in Health Facilities. Washington, D. C.: PAHO; 2000.
4. WHO. Geneva. Save Lives, Make Hospitals Safe In Emergencies: World Health Day 2009.
5. WHO Regional Office for Western Pacific. Manila. Safe Hospitals in Emergencies and Disasters: Structural, Non-structural and Functional Indicators. 2009
6. Hospital safety index (HSI) analysis in confronting disasters: A case study from Iran, Katayoun Jahangiri, Yasamin O. Izadkhah, Azam Lari, Jun 2014.
7. Evaluation and Analysis of Hospital Disaster Preparedness in Jeddah, Nidaa A. Bajow[1], Shahnaz M. Alkhalil[2] , November 2014
8. Evacuation and sheltering of hospitals in emergencies: a review of international experience, Bagaria J[1], Heggie C, Abrahams J, Murray V, 2009 Sep-Oct;24(5):461-7.
9. Hospitals Safety from Disasters in I.R.Iran: The Results from Assessment of 224 Hospitals, Ali Ardalan,[*] Maryam Kandi, Mohammad Taghi Talebian, Hamidreza Khankeh,[*] Gholamreza Masoumi, Reza Mohammadi, Samaneh Maleknia, Jafar Miadfar, Atieh Mobini, and Sara Mehranamin[*],28 February 2014
10. Evaluation of Hospital safety in the Republic of Moldova, Mihail Pisla, Silviu Domente ,Leonid Chetraru, Radu Ostaficiuc, 2010