SAFE HOSPITALS E-TOOL:
A COMPARATIVE ANALYSIS OF THE DISASTER-READINESS OF PRIVATE TERTIARY HOSPITALS USING A COMPUTER-BASED ASSESSMENT TOOL

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1 INTRODUCTION AND BACKGROUND

1.1 Background of the Problem

When disaster strikes, a community‟ s critical services must be able to protect the lives and well-being of the affected population, particularly immediately following impact. The ability of health services to function without interruption in these situations is a matter of life and death. It is imperative that all health services are housed in structures that can resist the force of natural disasters, that equipment and furnishings are not damaged, that vital connections (such as water, electricity, medical gases, etc.) continue to function, and that health personnel are able to provide medical assistance when they are most needed.

The countries of the Americas, along with more than 160 countries around the world at the 2005 World Conference on Disaster Reduction, adopted "Hospitals Safe from Disasters" as a national risk reduction policy in order to ensure that all new hospitals are built to a level of safety that will allow them to function in disaster situations. „Safe hospitals‟ initiatives also call for the use of mitigation measures to reinforce existing health facilities, particularly those providing primary health care. (Pan American Health Organization, 2008)

Hospitals are safe from disasters when health services are accessible and functioning, at maximum capacity, immediately after a disaster or an emergency. But what are "Safe Hospitals?" A safe hospital will not collapse in disasters; can continue to function and provide its services as a critical community facility when it is most needed; and is organized, with contingency plans in place and health workforce trained to keep the network operational. (Pan American Health Organization, 2008) According to the PAHO Disaster Mitigation Advisory Group (DiMAG), a safe hospital is a facility whose services remain accessible and functioning at maximum capacity and in the same infrastructure, during and immediately following the impact of a natural hazard.

1.2 Statement of the Problem

The Pan American Health Organization (PAHO), a regional office of the World Health Organization (WHO) developed the Hospital Safety Index which is a rapid and low-cost diagnostic tool used to assess the probability of a hospital or health facility remaining operational in emergency situations. From this initiative, the Department of Health (DOH) developed its own localized hospital disaster-readiness assessment tool and applied it to hospitals here in the Philippines. However, these existing tools can still be improved to make them more concise, localized, quantifiable, user-friendly, customizable, scalable, and easily integrated to existing hospital systems.

This thesis recognizes the need for such improvements with the current assessment tools and thus the development of the Hospitals Safe From Disasters Computer-Based Assessment Tool (HSFDCBAT). In order to establish the applicability and effectiveness of this tool, this study carries out a comparative analysis on selected private tertiary hospitals here in the Philippines. From the methodology, the thesis also documents the disaster-readiness of the health facilities as well as the "user-satisfaction" aspect which can be a basis for further advancements of the tool.

1.3. Objectives of the Study
In order to establish the disaster-readiness of the selected hospitals and to attain the goals set for this research study, the following objectives were set:

1.3.1. To develop a concise and quantifiable localized hospital safety index here in the Philippines.

1.3.2. To design and develop a computer-based assessment tool to make this localized hospital safety index more user-friendly, more scalable, customizable, flexible and easily integrated within the hospital system as well as with the built environment.

1.3.3. To use this tool in determining the disaster-readiness of the selected hospitals and to carry out a comparative analysis on the data gathered from this study.

1.3.4. To assess the applicability and effectiveness of this tool as a way to check the hospital‟ s disaster-readiness based on the context of the user for each respective health facility.

This study aimed to develop a tool from an existing concept, then to the advancement and improvement of this concept, then its application and testing, and finally to its evaluation as an effective tool.

This research was done not to criticize, undermine, supersede or claim superiority over another but rather to help improve, simplify, localize and synthesize existing assessment tools.

1.4. Significance of the Study
When health services and hospitals fail due to disaster, people die and suffer needlessly both during the disaster and long into the future. Those who were injured need urgent medical attention but those who escaped injury have not escaped the long term need for medical care and public health after the disaster is forgotten. Deaths of the sick, elderly and children in hospitals during disasters and the failure of emergency services when they are most needed can have a crippling effect on public morale and can ignite political dissatisfaction. (National Center for Health Promotion - DOH, 2009).

The study showed that it may be of value to the practice and to the advocacy on safe hospitals as set by the Department of Health under the wing of the World Health Organization. The body of knowledge that was created in this study will benefit many sectors such as the Department of Health, hospital systems, both private and public, professionals of the built environment specializing on safe hospitals and schools, medical practitioners and most importantly, the patients and the public who will use these hospitals especially in the occurrence of disasters.

1.5. Expected Output
This study is expected to provide an efficient, scalable, customizable, flexible and integrated disaster–readiness evaluation tool which is applicable in the local context, based on the Hospital Safety Index from Pan American Health Organization (PAHO) and the Safe Hospitals in Emergencies and Disasters: Philippine Indicators from the Health Emergency Management Staff of the Department of Health (DOH-HEMS). Its applicability in the private hospitals may then be modified to make it applicable in government hospitals and maybe in the future, as it is designed to be scalable, make the tool web-based for better coordination among hospitals as well as ease of use.

This study showed a comparative analysis of selected private hospitals using the developed computer-based assessment tool, as well as an evaluation of the tool on its relevance to the users. The results gathered from the research work may lead to possible dissemination of findings in a conference or journal and with it as an output, a prototype of the desktop-based application which can then be subsequently modified into a web-based solution which has the potential to benefit more users.

1.6. Scope and Delimitation of the Study

Four (4) private, tertiary level health facilities were identified for this study. The four hospitals were pre-selected according to the following criteria set as study focus/limitations:

1.6.1. Geographic Location. Hospitals selected in this study are located in Luzon, specifically in Central Luzon and Metro Manila. (See Figure 1)

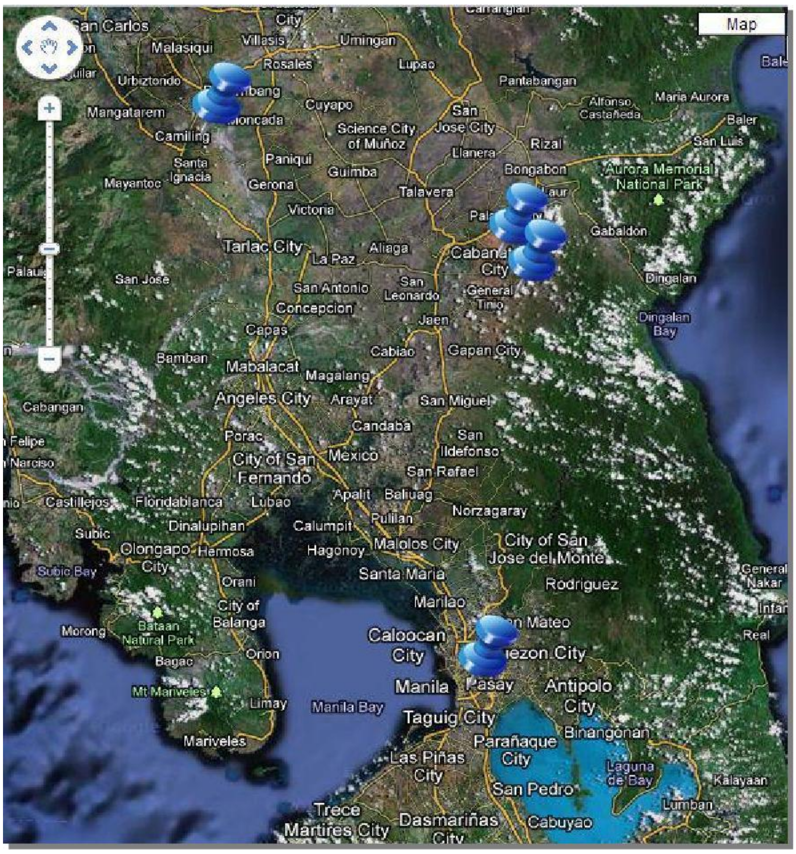


Figure 1 Geographical Location of Selected Hospitals (Source: Google Maps)

1.6.2. Hospital Level.

The DOH classifies hospitals into four (4) levels depending on service capability, as detailed in DOH Administrative Order no. 2005-0029. Each hospital level is briefly described below (Lavado, 2011):

- Level 1, Primary: An emergency hospital that provides initial clinical care and management patients requiring immediate care. Clinical services include general medicine, pediatrics, obstetrics, non-surgical gynecology, primary clinical laboratory, first level radiology and pharmacy.
- Level 2, Secondary: A non-departmentalized hospital that provides clinical services such as general medicine, pediatrics, obstetrics, surgical gynecology, secondary clinical laboratory, first level radiology and pharmacy.
- Level 3, Tertiary: A departmentalized hospital that provides particular forms of treatment, surgical procedure and intensive care. Clinical services provided include general medicine, pediatrics, obstetrics, surgical gynecology, tertiary clinical laboratory, secondary level radiology and pharmacy.
- Level 4, Teaching & Training: A teaching or training hospital that provides clinical care similar to Level 3 as well as sub-special forms of treatment. Clinical care is also similar to level 3 as well as sub-specialty clinical care as well as third level radiology.

1.6.3.Hospital Type.

Hospitals can also be classified as either Government or Public Hospitals such as Provincial Hospitals and Rural Health Units (RHU" s); and Private Hospitals which are categorized as either DOH-retained or locally-owned and controlled. Private hospitals are classified as single proprietorship, partnership, corporation, missionary / religious / civic organization or foundation and cooperative.

1.6.4. Development Time Frame of Hospital. Historical development of the hospitals was also considered with respect to National Structural Code of the Philippines (NSCP) code changes.

1.6.5. Development Size of the Hospital.

Hospital size in terms of its estimated floor area (FA) as well as in terms of its patient bed capacity.

1.6.6. Access to Available Data.
Because of the confidentiality and proprietary nature of certain information, the hospital administration was hesitant to release pertinent information and materials on the project. Certain information was sourced from the hospitals‟ website.

1.6.7. Weighting System.
Due to the considerable effort involved in gathering experts in their respective fields and then assessing which checkpoints are important based on their perception, this was not made part of the scope of this research anymore. Instead, a baseline weight of 1.0 was used for all the checkpoints in the tool (i.e. all checkpoints in suitable sites, structural, non-structural and functional all have equal weights and relevance, at least for this version of the tool). Weighting system can also be based on existing studies if available.

1.6.8. Insurance Companies.
Data from insurance companies which are also concerned with the disaster-readiness of hospital facilities were not collected because of confidentiality and proprietary concerns and thus, no comparison whatsoever with the functionality of the HSFDCBAT was made in this research.

1.6.9. ISO-Certified Hospitals.
Same with the previous limitation and for the same reasons, data from ISO Certifications and ISO-certified hospitals which are concerned with the disaster-readiness of hospital facilities were not collected and thus, no comparison whatsoever with the functionality of the HSFDCBAT was made in this research.

1.7. Definition and Terms

1.7.1. Safe Hospitals

1.7.1.1 A safe hospital will not collapse in disasters; can continue to function and provide its services as a critical community facility when it is most needed; and is organized, with contingency plans in place and health workforce trained to keep the network operational;

1.7.1.2 A safe hospital is a facility whose services remain accessible and functioning at maximum capacity and in the same infrastructure, during and immediately following the impact of a natural hazard.

1.7.1.3 Can also be referred to as “Hospitals Safe From Disasters (HSFD)”

1.7.2 Hospital Safety Index (HSI)
A rapid, reliable and low-cost diagnostic tool which is easy to apply by a trained team of engineers, architects and health professionals. Scores are entered into an Excel spreadsheet (the Index Calculator), and automated formulas tabulate the results. The results take into account the safety level of structural, nonstructural and functional components. There are 145 items or areas assessed and health facilities fall into one of three safety categories: High, Average and Low. It was developed by the Pan American Health Organization (PAHO).

HSI 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.

1.7.3 Safe Hospitals in Emergencies and Disasters: Philippine Indicators
- this Manual emanated from a research concept by the Department of Health-Health Emergency Management Staff (DOH-HEMS) to assess hospitals‟ structural, non-structural and functional elements in times of emergencies and disasters. This eventually became a project entitled, Capacity Assessment of Metro Manila Tertiary Hospitals in Responding to Emergencies and Disasters," which was funded by the Health Policy Development and Planning Bureau (HPDPB), coursed to the National Capital Region, and started in October 2008. An Assessment Team was organized to oversee the implementation of the research project in 25 hospitals in the National Capital Region.

1.7.4 Pan American Health Organization (PAHO) - is an international public health agency with over 100 years of experience working to improve health and living standards of the people of the Americas. It enjoys international recognition as part of the United Nations system, serving as the Regional Office for the Americas of the World Health Organization, and as the health organization of the Inter-American System. PAHO is based in Washington, D.C., and has scientific and technical experts at its headquarters, in its 27 country offices, and its nine scientific centers, all working with the countries of Latin America and the Caribbean in dealing with priority health issues. PAHO Member States include all

35 countries in the Americas.

1.7.5 World Health Organization (WHO) - is a specialized agency of the United Nations (UN) that acts as a coordinating authority on international public health. WHO is the directing and coordinating authority for health within the United Nations system. It is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries and monitoring and assessing health trends.

1.7.6 Department of Health (DOH) - is the principal health agency in the Philippines. It is the executive department of the Philippine Government responsible for ensuring access to basic public health services to all Filipinos through the provision of quality health care and the regulation of providers of health goods and services. The DOH is composed of about 17 central offices, 16 Centers for Health Development located in various regions, 70 hospitals and 4 attached agencies.

1.7.7 Disaster - defined as an occurrence where normal conditions of existence are disrupted and the level of suffering exceeds the capacity of the hazard-affected community to respond to it. (Department of Health Western Pacific Region, 2010)

1.7.8 Emergency - defined as a state in which normal procedures are suspended and extra-ordinary measures are taken in order to avert the impact of a hazard on the community. Authorities should be prepared to effectively respond to an emergency. If not properly managed, some emergencies will become disasters. (Department of Health Western Pacific Region, 2010)

1.7.9 Hazard - any phenomenon that has the potential to cause disruption or damage to the community, e.g. earthquake, flood, typhoon, and cyclone. Some hazards may cause emergencies; not all become disasters. (Department of Health Western Pacific Region, 2010)

1.7.10 Computer-Based Assessment (CBA) - also known as Computer-Based Testing (CBT), e-assessment, computerized testing and computer-administered testing, is a method of administering tests in which the responses are electronically recorded, assessed, or both. As the name implies, Computer-Based Assessment makes use of a computer or an equivalent electronic device such as a cell phone or PDA. CBA systems enable educators and trainers to author, schedule, deliver, and report on surveys, quizzes, tests and exams. Computer-Based Assessment may be a stand-alone system or a part of a virtual learning environment, possibly accessed via the World Wide Web.

1.7.11 Computer-Based Assessment Tool (CBAT) - shall mean a tool whose main function is to execute a Computer-Based Assessment (CBA).

1.7.12 Health Emergency Management Staff (HEMS) - is an organization created under the Department of Health to ensure a comprehensive and integrated health sector emergency management system

1.7.13 Scalability - in information technology, (including hardware, communication and software), is the ability of a system, network, or process, to handle growing amounts of work in a graceful manner or its ability to be enlarged to accommodate that growth.. For example, it can refer to the capability of a system to increase total throughput under an increased load when resources are added.

1.7.14 Hospital Bed Capacity - the number of beds which a hospital has been designed and constructed to contain. It may also refer to the number of beds set up and staffed for use.

1.7.15 Database - is an organized collection of data for one or more purposes, usually in digital form

1.7.16 Graphic User Interface (GUI) - is a type of user interface that allows users to interact with electronic devices with images rather than text commands. GUIs can be used in computers, hand-held devices such as, portable media players or gaming devices, household appliances and office equipment.

1.7.17 Database Query – a piece of code (a query) that is sent to a database in order to get information back from the database. It is used as the way of retrieving the information from database. A database "query" is basically a "question" that you ask the database. The result of the query is the information that is returned by the database management system.

1.7.18 Infographic - Information graphics or infographics are graphic visual representations of information, data or knowledge. These graphics present complex information quickly and clearly, such as in signs, maps, journalism, technical writing, and education.

1.7.19 Disaster Management Advisory Group (DiMAG) - a group which provides advice to the Pan American Health Organization (PAHO) and its members in a variety of themes related to disaster mitigation and risk reduction in the health sector. The group was set up in 2003 as a way of dealing with three important facts: new hospitals are being built in the region without taking risks and natural hazards into consideration; many existing hospitals show unsatisfactory performance in emergency and disaster situations; and countries and health facilities need to be able to ensure access to independent, technical advice.

1.7.20 Disaster Management Committee (DMC) – a committee formed from an interdisciplinary field dealing with the strategic organizational management processes used to protect critical assets of an organization from hazard risks that can cause disasters or catastrophes, and to ensure the continuance of the organization within their planned lifetime

1.7.21 Emergency Operations Center (EOC) - is a central command and control facility responsible for carrying out the principles of emergency preparedness and emergency management, or disaster management functions at a strategic level in an emergency situation, and ensuring the continuity of operation of a company, political subdivision or other organization.

1.7.22 Hospitals Safe From Disasters Computer-Based Assessment Tool (HSFDCBAT) – refers to a computer-based assessment tool designed and developed by the researcher to carry-out the assessment of the disaster-readiness of health facilities similar to the Hospital Safety Index. For this research, it may also be referred to as an e-Tool or an e-Index.

1.8 Historical Background

In 2005, the Hyogo Framework for Action (HFA) was endorsed by 168 countries on the World Conference on Disaster Reduction in Kobe, Japan. This provides a global footprint for disaster risk reduction and calls on nations to promote the goal of risk reduction.

Three years later, in 2008, actions on hospital disaster preparedness became more extensive here in the Philippines. The conceptualization of research on hospital preparedness in emergencies was pioneered by the Department of Health – Health Emergency Management Staff (DOH-HEMS) and the Health Policy Department and Planning Bureau (HPDBD) but there were no available tools yet early on. As the development went on, a steering committee was created and hospital assessment tools were drafted. On August 2008, the launch of the World Safe Hospitals Campaign and discussion of tools was held at the Pan Pacific Hotel in Makati City, Philippines.

The manual “Safe Hospitals in Emergencies and Disasters: Philippine Indicators” from the DOH-HEMS to assess Philippine hospitals‟ structural, non-structural and functional elements in times of emergencies and disasters was then developed. On October 2008, the research project called “Capacity Assessment of Metro Manila Tertiary Hospitals in responding to Emergencies and Disasters” was started. It was funded by the HPDPB, coursed to the Center for Health Development-National Capital Region (CHD-NCR). An assessment team was organized to oversee the implementation of the project in 25 hospitals in the National Capital Region. (Banatin, 2009) The set of indicators in the manual have since been revisited and revised through several write-shops and with the Technical Working Groups. National codes, policies and guidelines were also included in this manual as resource material. (Department of Health - Health Emergency Management Staff (DOH-HEMS), 2009)

January 2009 kicked off the start of the assessments for other hospitals and three months later in April, World Health Day was celebrated with the theme, “Save Lives: Make Hospitals Safe in Emergencies” which was marked by the launch of the displaying of lanterns in all hospitals as symbols of “Safe Hospitals”. The Manual on Safe Hospitals was also officially launched during this month at the Traders Hotel in Manila. Trainings on Safe Hospitals continued and the presentation of Capacity Assessment of Metro Manila Hospitals, which was done on sixteen (16) DOH hospitals, two (2) Local Government Unit (LGU) Hospitals and seven (7) private hospitals by six teams of experts was held. The year was capped off by the “International Conference on Safe Hospitals” - Philippine Convention on Health Emergency Management held at the Shangri-La Hotel, Mandaluyong, Philippines on December 2 and 3.

Up to the present, there are still continuing workshops on addressing critical issues on Safe Hospitals where concerned groups review gaps, explore solutions, document and consolidate these gaps and solutions and then identify next steps for action.

2 REVIEW OF RELATED STUDIES AND LITERATURE

2.1 UN International Strategy for Disaster Reduction (UN/ISDR)

The WHO Western Pacific Region states that the following publications were made from 2008 to 2009 specifically for the Safe Hospitals Campaign: Assessment Tools for Hospital Safety; Indicators for Safe Hospitals; Guidance on Conducting Hospital Drills/Exercises; Guidance on Hospital Disaster Management Planning; Guidance on Designing Disaster Resilient Health Facilities; Structural and Functional Indicators for Safe Hospitals; and Guidance on Advocacy and Awareness Raising. (WHO Western Pacific Region, 2009)

The UN International Strategy for Disaster Reduction (UN/ISDR) and WHO have embarked on the 2008-2009 World Campaign on Hospitals Safe from Disasters. This reflects one of the five priorities of the Hyogo Framework of Action 2005-2015. A bi-regional launch was conducted in January of 2008 in Bangkok and the regional launch for the Western Pacific was organized August 2008 in Manila.

The Safe Hospitals Project aims to provide tools that enable government, communities and institutions to reduce their hospitals' and health facilities‟ risks from natural hazards and disasters. It aims to develop, test and publish tools and resources for the health sector to assess and address risks arising from natural hazards. Specifically, it aims to accomplish the following:

- Publish tools for mapping the vulnerabilities of health sector's infrastructure
- Tools and guidelines of health sector disaster management
- Enhance capacity for disaster preparedness and response
- Assess structural and functional integrity of selected health facilities
- Raise awareness of the campaign for community leaders, private sector health staff, planners, decision makers, policy makers, and the general public.

Several gaps have been identified. Local health managers, hospitals and other health facilities identified that natural hazard-prone areas around the countries in the region lack the capacity to respond to emergencies and are vulnerable to the negative impact of disasters themselves. Essential health services are usually disrupted after a disaster when health facilities are damaged or destroyed. Impact on the people is great when lack of knowledge, skills, and tools on disaster preparedness and emergency management is combined with safe hospital and hospital preparedness was developed in early part of 2009.

As a component for capacity development, a training course was developed which is a take-off from the Public Health and Emergency Management for Asia and the Pacific (PHEMAP) training courses offered at the international and national levels. This is a "special" training course on safe hospitals. (UN International Strategy for Disaster Reduction (UN/ISDR), 2009)

2.2 Applicability of the Hospital Safety Index by PAHO in the Philippine Context

This researcher studied the applicability of the Hospital Safety Index by PAHO in the Philippine context by applying the index to a private tertiary hospital in Tarlac and then comparing it to the locally-used Philippine Indicators. After applying the Hospital Safety Index on a local tertiary hospital and then getting trusty and reliable results, it was concluded that the Hospital Safety Index, which is specifically made for Latin America and the Caribbean, is also applicable in the Philippine context. Most if not all of the elements in the checklist are applicable, except for hazards like hurricanes which are not evident here in our country.

Comparing the Hospital Safety Index to its local counterpart, The Philippine Indicators for Safe Hospitals in Emergencies and Disasters, it can be seen that most of the indicators are just specific and locally-customized versions of the checklist points in the former. It should be noted, though, that the structural indicators in the Philippine Indicators are more complete and are more pertinent for local use. Also, the additional non-structural and functional indicators for hospitals with highly infectious diseases are present in the local hospital disaster readiness tool and absent in the PAHO evaluation tool. This may have a definite use in the local context but these additional indicators should be condensed to have a more relevant approach as far as safe hospitals are concerned. (See Figure 19)

2.3 Personal Accounts of Hospital Disaster Victims in the Philippines (from DOH-Hospitals Safe From Disasters Video

Presentation)

Hospitals have become victims of disasters of the past. Some examples are the super typhoon that battered Bicol Regional Training and Teaching Hospital (BRTTH) in the Bicol Region, Fire at Lung Center of the Philippines, Earthquake causing cracks on hospital walls, floods on hospital floors and more. These were some personal accounts of the people from hospitals directly affected by these disasters (National Center for Health Promotion - DOH, 2009):

2.3.1 Dr. Noel Roy Gigare (Chief of Hospital, Federico Ramon Tirador, Sr. Memorial Hospital, FRTSMH in Iloilo) on typhoon Frank hitting Iloilo in 2008 – "like a tsunami…waist deep to neck deep floods almost 6 ft.

…after less than 3 hours, it subsided…it was just a flash flood. All equipment were damaged and only the ceiling was left. Most patients and staff evacuated as fast as they can to save their own lives…they escaped by passing through ceiling."

2.3.2 Dr. Michael I. Terrencio (Chief of Clinics, Dr. Rafael S. Tumbokon Memorial Hospital, DRSTMH in Aklan) on typhoon Frank hitting Aklan.

"first time water reached the inside of the hospital. More than 2 ft of flood water crept into the hospital. Mudflow came with flood…Immediately ordered evacuation of the patients at ground floor…they were not able to have 2nd round of evacuation because in 30 min, the water level rose another foot. Equipment were not saved because people were rescued first. New CT-scan (less than a year of usage) was submerged in water…Aklan was worst damaged in province…Immediately sent a team of doctors and nurses to augment…to operate, admit patients."

Figure 2 Emergency Room of DRSTMH in Aklan (Source: Screen Capture from DOH Video)

2.3.3 Mr. Rudel M. Jaranilla (Nurse VI, Western Visayas Medical Center) –

"In dialysis, you need water. Not only ordinary water but treated water.

What will happen to patients that will be dialyzed if we don‟ t have water? So there are contingency stocks of water as well as stock of diesel fuel for generator to supply electricity to the hospital. The machines should be taken cared of. In that aspect, we have anticipated all those things. Many parts of ceiling were damaged (like waterfalls); Some of the windows were broken; With regards to facilities, computers were saved. X-ray machine was damaged due to water from ceiling."

2.3.4 Dr. Mary Jean A. Gelito (OIC, Ibajay District Hospital) – "waist deep floodwater, patients were brought literally to the ceilings, providing airways by punching holes through the roof. 16 patients, 49 people in the hospital during typhoon Frank. Unprecedented flood water level in the hospital. Damage of equipment and documents were aplenty. Beds, mattresses, tables and chairs, cabinets, furniture and fixtures were all damaged."

2.3.5 Dr. Antonio S Ludovice, Jr. (Chief of Hospital Josefina Belmonte Duran Memorial District Hospital, Tuburan, Ligao City) –

"Consecutive typhoons, Typhoon Milenyo and Typhoon Reming. During typhoon Milenyo, the Operating Room was already detached. During typhoon Reming, 80% of hospital facility and building was destroyed. Two tents were set-up, one from AFP and the other from United Nations Children‟ s Fund (UNICEF). One used as Out Patient Department (OPD) Emergency Room (ER) and the other one for Surgery. The staff was on a 24-hour on-call touring duty."

Figure 3. JBDMDH in Ligao City without a roof because of Typhoon Reming and Milenyo (Source: Screen Capture from DOH Video)

2.3.6 Dr. Edgardo Esplana (Chief of Hospital, Bicol Medical Center, BMC) "Initally, we assess our own facility regarding the damages that were wrought by the typhoon. Upon assessment, and seeing that there was not much damage, we dispatched our Health Emergency Management Team to roam the different areas in the nearby towns if they can extend any help…There was 15-M worth of damage."

2.3.7 Dr. Rogelio Rivera (Chief of Hospital Bicol Regional Training and Teaching Hospital) - "250-bed tertiary hospital located in Legazpi City, Province of Albay. Nov 30, 2006, Typhoon Reming brought havoc to region…Nov 29 weather update said typhoon will not hit Albay province, however Code White was raised and HEMS was mobilized. The next day, the typhoon changed its course and directly hit Albay province thus Code Red was raised and HEICS, Hospital Emergency Incidence Command System was put in place. More than 50 % of facilities were damaged including the ER. Electrical and water system were cut off, aggravating the situation. Because personnel were limited because of impassable roads, and they themselves were victims, the hospital had a very limited staff. On first two days of operation after disaster, hospital was limited only to emergency situations only. After typhoon, influx of more than 200 patients was treated at our damaged ER. Succeeding days became difficult because of depletion of supplies."

Figure 4 Aftermath of Typhoon Frank in a Bicol hospital. (Source: Screen Capture from DOH Video)

2.3.8 A personal account of a hospital patient - “Saddest, most disheartening experience during typhoon Reming, two of my kids got injured from the landslide, but when we rushed them to the hospital, we lost hope.
Because even the hospitals are victims to the disaster. It‟ s dysfunctional, it couldn‟ t treat patients. If there was any functioning hospital that time, my kids could have been revived.”

2.3.9 Another personal account of a hospital patient - “When I got injured during the typhoon Milenyo (typhoon Xangsane), I was confined in a hospital. I thought being in a hospital was safe. But one morning, I woke up, I saw the roofs of the hospital being blown away. It was a stressful, traumatic even. And it didn‟ t help in my recovery. It‟ s just so sad and so frustrating that what you thought could be the safest place can actually be dangerous too.”

Figure 5 Typhoon Ondoy's effect on hospitals (Luis, 2009)

Figure 6 UERMMMC hospital during Typhoon Ondoy (Luis, 2009)

Figure 7 Ondoy's effect on Mission Hospital in Rosario, Pasig (Luis, 2009)

Figure 8 Effect of floods and landslides on hospital supplies and equipment (Luis, 2009)

Figure 9 Effect typhoons on transportation and logistics. (Luis, 2009)

2.4 Recent Developments on the Hospitals Safe From Disasters (HSFD) Initiative

2.4.1 The Emergency and Humanitarian Action (EHA) unit of the WHO Regional Office for the Western Pacific (WPRO), in partnership with the University of the Philippines Open University (UPOU), conducted the midterm review of the second phase of the Hospitals Safe from Disasters (HSFD) campaign on 2-4 March 2011 in Manila. The second phase of the project aims to expand mapping and assessment of different levels of hospitals in small and medium sized cities, integrate HSFD concepts in national development plans and policies, and support further development and adaptation of tools and resources. This will mainstream disaster risk reduction in the health sector within the framework of the global campaign for safer cities in 2010-2011.

Through several workshops and group discussions, the review team evaluated the accomplishments of the past seven months against the proposed program of activities in terms of outputs, target dates and budget. Issues, experiences and views from different perspectives were shared between participants. From these in-depth discussions, recommendations and strategies for the effective continuation of the project were then developed.

“The project has achieved a lot of progress,” said Dr. Arturo.

Pesigan, EHA Technical Officer. “But we must continue to work together as we move toward the achievement of goals that go beyond the project. Eventually, countries should be able to implement and integrate safe hospitals concepts in and through their own initiatives and national disaster preparedness plans.” (WHO Western Pacific Region Emergency and Humanitarian Action, 2011)

During one of the WHO workshops, an Association of Structural Engineers in the Philippines (ASEP) structural engineer discussed the analogy that new building costs PHP 20,000 to PHP 25,000 per square meter to build and the structural cost of this alone is around 50% or PHP 10,000 to PHP 12,500 per square meter already. If the structure requires rehabilitation, the rehabilitation cost is around 15% for the structure only. This amounts to 3,000 to 3,750 PHP per square meter. Soft cost can be estimated at about one third of the rehabilitation cost or around 1,000 to 1,200 PHP per square meter, with a minimum of 500 PHP per square meter. This includes soil tests, X-rays, project management, consumables and overhead costs. He suggested that if you will exceed 30% of the total cost for a new hospital for rehabilitation, better build a new hospital. This just goes to show how costly compliance to structural requirements could be, especially for health facilities.

2.4.3 To emphasize how serious one of the health facilities is in complying with the functional capacity requirements, a hospital representative shared that a week ago from the interview, seven of their team members attended a disaster preparedness summit and that several days later they attended a Metro Manila Earthquake Impact Reduction Study (MMEIRS) seminar. During the interview, their team was undergoing training for safety preparedness which was according to him, a weekly routine for them as safety and fire brigade volunteers of the hospital. He said that security is also one of the main concerns of the team as well as terrorism, not only earthquake, fire, etc.

For a change, one of the interviewees for the research study, who was involved with the One Million Safe Schools and Hospitals Project of the DOH and the WHO, was more concerned with functional aspects of the HSFDCBAT. He further discussed that these functional requirements are community-based, community-wide and has a tie up with the Local Government Units (LGU‟ s), the Red Cross, other hospitals and other networks, but the main problem is funding. The concern of private hospitals, according to him is that they generate their own funds while government hospitals can wait for budget (continuous funding). He also stressed that it is difficult to ask for budget because of the value of money, and the immediate needs of hospitals weighed against the cost implications of having a disaster-safe health facility.

As with any other institution, he said, when it comes to responses, the main concern is still funding. People in the response community will always think of “saving lives”, but saving lives incur costs. One of solutions he mentioned is what he and his team are doing. They volunteer. He said that in convincing others to volunteer, one way to look at it is to “don‟ t think of it as another job but think of it as protecting your job” since volunteering in making health facilities safe from disasters is in effect, also protecting their own livelihood.

3 METHODOLOGY

3.1 Flow of Study

The data collection was done by first acquiring the Hospital Safety Index from PAHO (Pan-American Health Organization) and the local version which is the Philippine Indicators on Safe Hospitals in Emergencies and Disasters. These assessment tools were then evaluated on what are applicable in the local context and what should be added or modified from the existing checkpoints. These are then applied to the localized version of the tool which is currently more qualitative than quantitative.

From the data gathered, a computer-based assessment tool was developed and used to assess disaster-readiness of selected private hospitals here in the Philippines. This in turn will produce data, this time, quantifiable, which will be a better gauge in determining whether a hospital is indeed disaster-ready based on its structural, non-structural (including architectural) and functional characteristics. Limitation of this computer-based assessment tool, though, is that it will first be desktop-based (i.e not yet web-based) for computers within the hospital network system. But further development can convert this into a web-based application which will make it more accessible and interactive among participating hospitals and organizations through the web.

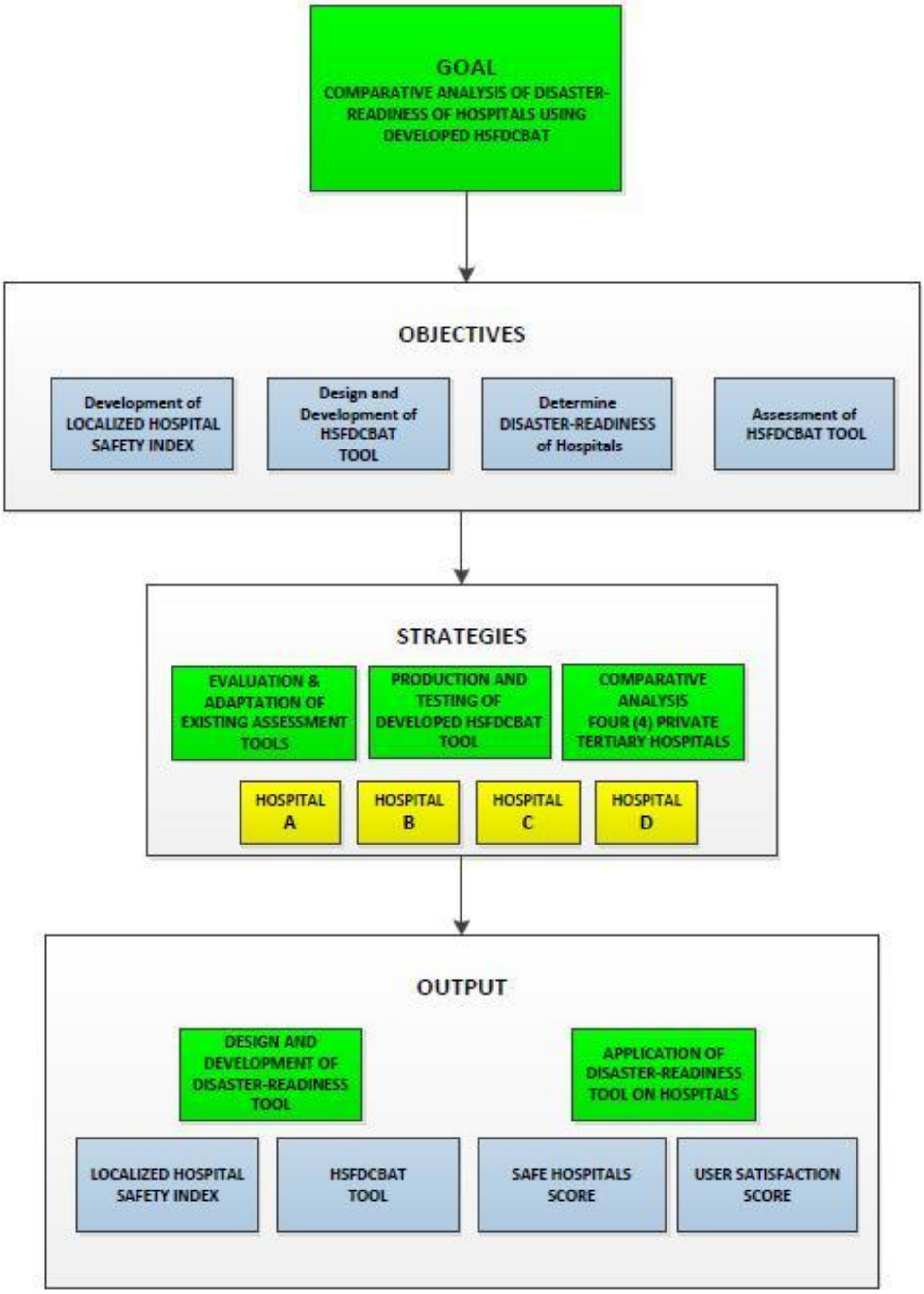


Figure 10 Flow of Study

The disaster-readiness of the sample hospitals will be established from the comparative analysis, documentation and interpretation of the HSFDCBAT results. Surveys and interviews were also conducted on those who used the software for recommendation or disapproval of the developed tool. (See Figure 10)

3.2 Data Collection

Primary references for the research work were acquired through electronic files from the website of the Pan-American Health Organization (PAHO) including the Hospital Safety Index Evaluation Form and the Hospital Safety Index Guide for Evaluators. The Hospital Safety Index Calculator, though, was acquired through direct communication via email with the Regional Adviser for Emergency Preparedness and Disaster Relief of PAHO and the World Health Organization (WHO). This calculator was supposed to be given only to those who attended seminars and workshops on Safe Hospitals in the Americas in data discs but the Director was kind enough to send this researcher a copy given the condition that it will be for academic purposes only and that it will remain confidential.

For the Department of Health (DOH) documents, hard copies of the research materials were acquired from the DOH themselves through the help of individuals who were involved with the Safe Hospitals initiative of the said government agency. Also, references from PowerPoint presentations, videos and lectures in workshops as well as advertisement campaigns organized and produced by the DOH and the WHO were also vital in the data gathering process.

For the comparative analysis, all of the pertinent data were acquired from the HSFDCBAT tool, generated reports from the system and interviews with the respective individuals from the hospital who are knowledgeable in the subject matter and the actual participants who used the system. First hand data were also gathered from site photography and direct inspection of the hospitals. These four (4) health facilities were selected as areas for study based on the scope and delimitations earlier mentioned. It should be noted that purposive, convenient, non-probability sampling was used to get the sample hospitals.

3.3 Plan of Analysis

In line with the study's objective of primarily developing a simple, concise and efficient localized hospital safety index based on mathematical models, the existing assessment tools (PAHO HSI and DOH-HEMS Philippine Indicators) were reviewed and compared, then the relevant and locally-appropriate checkpoints were analyzed and consolidated. These checkpoints were then used as the basis for the development of the HSFDCBAT, which subsequently, would be the basis for the analysis of the disaster-readiness of the hospitals.

Due to the agreed upon confidentiality of the hospital data that were gathered, the hospital names were neither divulged nor mentioned in this paper but instead, represented as Hospitals A, B, C and D. Each health facility was analyzed individually in terms of their *site location*, *structural safety*, *non-structural safety* and *functional capacity*. Their strengths and weaknesses were also assessed based on the HSFDCBAT tool report. The health facilities were compared with each other on which common areas or checkpoints are susceptible to high risks during disasters. From this analysis, recommendations were also given for each hospital for the next steps to be done. After each assessment, a survey, which is also a part of the tool, is carried out to evaluate the usability and relevance of the tool. (See Figure 11a & 11b)

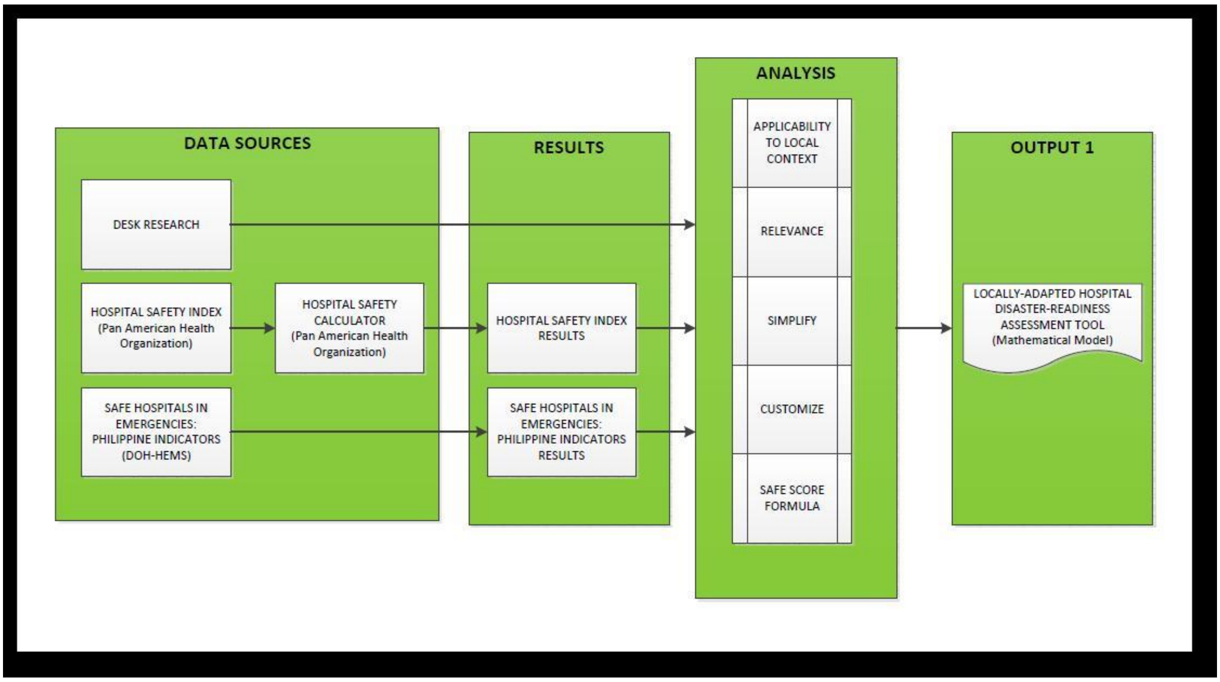


Figure 11a Data Collection

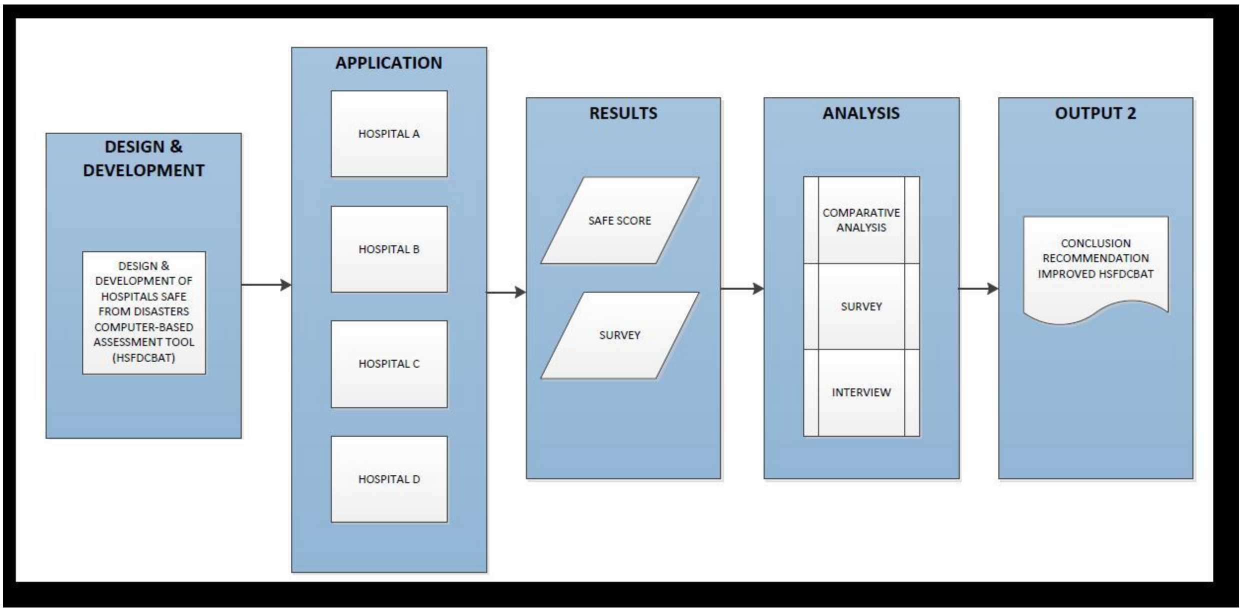


Figure 11b Data Collection

4 DISCUSSION OF "SAFE HOSPITALS"

4.1. Discussion of Hospitals Safe from Disasters (HSFD)

The factors that put hospitals and health facilities at risk are the buildings, equipment, health workforce and basic lifelines and services. Upon construction, the building should be checked by an expert who knows the norms in building conditions like location, design, materials used, etc. Hospital equipment must always be kept functional by an authorized person to avoid a halt to hospital operations. The loss or unavailability of health workers compromises care for the injured. Lastly, basic lifelines and services such as electrical power, water and sanitation should always be maintained by authorized people because a hospital's functionality relies on them. In other words, people are key in reducing such risks. For after all, people build hospitals, people keep them safe, people protect the facilities, and in the end, people save lives.

The difference in expense between building a safe and an unsafe hospital can be negligible but it can be a matter of life and death when disasters strike. Therefore, we can say that the most expensive hospital is the one that fails. What then is a disaster-safe hospital? A safe hospital will not collapse in disasters, killing patients and staff. It continues to function and provide its services as a critical community facility when it is most needed. It is organized with contingency plans in place and essential health workforce trained to keep the network operational.

The importance of hospitals and all kinds of health facilities extends beyond the direct life-saving role they play. They are home to critical health services such as public health laboratories, blood banks, rehabilitation facilities or pharmacies. They are the setting where health workers work tirelessly to ensure the highest level of service and availability. They safeguard public health in the aftermath of disasters. Health facilities have a symbolic social and political value and contribute to a community's sense of security and well-being. Because of this, the World Health Organization, along with the secretariat of the International Strategy for Disaster Reduction with the support of the World Bank is dedicating the 2008-2009 World Disaster Reduction Campaign to Hospitals Safe from Disasters.

According to Dr. Dean Shuey, Regional Adviser in Health Sector Development, WHO Western Pacific Region, the WHO in cooperation with the secretariat of the UN ISDR with the help of the World Bank aims to help protect the lives of patients and health workers by ensuring the structural resilience of health facilities. Making sure health facilities and health services are able to function in the aftermath of emergencies and disasters when they are most needed and improving the risk reduction capacity of health workers and institutions including emergency management.

Protecting health facilities from disasters is possible through the WHO's Emergency and Humanitarian Principles – Action, Preparedness and Collaboration.

ACTION - In order to protect our hospitals in times of emergencies, first of all, we must include risk reduction in the design and construction of all new health facilities and reduce vulnerability in existing health facilities through selecting and retrofitting the most critical facilities. Health workers are also central to identifying potential health risks from natural hazards and promoting personal and community risk reduction measures. WHO also encourages preventive medicine and attracts health research and innovation but in times of emergencies, WHO deploys workforce in devastated areas during emergencies and supports rapid health assessment of affected areas.

PREPAREDNESS – Dr. Ezekiel Nukuro (Regional Adviser in Human Resource Development – WHO Western Pacific Region) – "But acting during times of disasters may not be enough. We need to prepare. For instance, we avoid functional collapse through proper planning, improved localization and staff training. We encourage community based initiatives for emergency-preparedness. And we provide technical material and training modules on health and emergency management.

COLLABORATION – the WHO has played a pivotal role in collaborating with national and international partner agencies to maximize appropriate use of limited resources and collective efforts in emergency management.

When disasters happen, all the attention are normally focused on its victim. But how can assistance be fully provided if medical facilities also become victims? When hospitals and medical services fail due to catastrophes, countless will suffer and die, not only during calamities, but long into the future as well, because it will take time for calamity-stricken hospitals to recover and fully function again. But such tragedies can be prevented if we build hospitals with physically safer structures and foundations that can withstand typhoons, earthquakes, floods, and fires.

Emergency rooms of hospitals and medical centers get chaotic from receiving victims with different degrees of bruising and pain. In times of tragedies, most of us get overwhelmed attending to victims and survivors that we tend to forget the other possible victims of disasters.

The Philippines is reportedly the 4th most-hazard prone country in the world. Typhoons visit a dozen or more times yearly. Earthquakes wreck the country from time to time. Floods leave countless people homeless periodically. Fires destroy lives, buildings and properties all year round especially during summer time. Disasters in any form usually leave scores of victims for emergency workers to assist and be take care of.

According to Dra. Carmencita Banatin, Director of DOH-HEMS, the hospital is the most important facility in a community because this is where all victims of disaster are brought in. Purpose of health facilities is to decrease morbidity and mortality in relation to disaster and also psycho-social. When we talk of risk-reduction, it talks about Hazard, Vulnerability and Capacities. Hospitals should have policies in place and based on these policies, there should be plans which we call the Health Emergency Preparedness Response and Rehabilitation Plan where skills and training should be learned. There should be increased awareness through drills, networking, etc. and awareness should also be heightened that the purpose of a safe hospital is that it should function and be safe because it will be the last facility that should stand during a disaster. "We should build hospitals that can bear up with the atrocities of natural catastrophes, endure man-made disasters and survive the test of time". (National Center for Health Promotion - DOH, 2009)

According to the International Red Cross and Red Crescent Societies, the Philippines was the fourth most accident prone country in the world. The two institutions arrived at this conclusion after finding out that some 5,809,986 Filipinos were killed or injured as a result of disasters or man-made calamities over a ten-year period (1992-2001). In another report, the World Risk Report 2011 of the German Alliance Development Works ranks the Philippines as the third most disaster-prone country.

Top 10 Natural Disasters in Philippines
for the period 1900 to 2011
sorted by numbers of killed:

Disaster	Date	No Killed
Earthquake (seismic activity)	16-Aug-1976	6,000
Storm	5-Nov-1991	5,956
Earthquake (seismic activity)	16-Jul-1990	2,412
Storm	29-Nov-2004	1,619
Storm	13-Oct-1970	1,551
Storm	1-Sep-1984	1,399
Storm	30-Nov-2006	1,399
Volcano	31-Jan-1911	1,335
Mass movement wet	17-Feb-2006	1,126
Storm	3-Nov-1984	1,079

Figure 12 Top 10 Natural Disasters in the Philippines (1900-2011) by no. of fatalities

Top 10 Natural Disasters in Philippines
for the period 1900 to 2011
sorted by numbers of total affected people:

Disaster	Date	No Total Affected
Storm	12-Nov-1990	6,159,569
Storm	24-Sep-2009	4,901,763
Storm	21-Jun-2008	4,785,460
Storm	29-Sep-2009	4,478,491
Storm	21-Oct-1998	3,902,424
Storm	27-Sep-2006	3,842,406
Storm	20-Nov-1973	3,400,024
Storm	21-Oct-1988	3,250,208
Flood	Jul-1972	2,770,647
Storm	17-May-1976	2,700,000

Figure 13 Top 10 Natural Disasters in the Philippines sorted by no. of affected people

Top 10 Natural Disasters in Philippines
for the period 1900 to 2011
sorted by economic damage costs:

Disaster	Date	Damage (000 US$)
Flood	4-Sep-1995	700,300
Storm	29-Sep-2009	585,379
Storm	12-Nov-1990	388,500
Earthquake (seismic activity)	16-Jul-1990	369,600
Storm	21-Jun-2008	284,694
Storm	18-Oct-2010	275,745
Storm	3-Nov-1995	244,000
Storm	21-Oct-1988	240,500
Storm	24-Sep-2009	237,489
Flood	Jul-1972	220,000

Figure 14 Top 10 Natural Disasters in the Philippines sorted by economic damage costs

Source: "EM-DAT: The OFDA/CRED International Disaster Database, www.emdat.be - Université catholique de Louvain,Brussels,Belgium". See Appendix on "Summarized Table of Natural Disasters in Philippines from 1900 to 2011"

4.2 Discussion Of Paho Hospital Safety Index

4.2.1 Hospital Safety Index

The Hospital Safety Index is an easy-to-apply evaluation tool that helps hospital directors or administrators determine the likelihood that their hospital or health facility can remain operational in emergency situations. It was developed by the Pan American Health Organization (PAHO/WHO), Regional Office for the Americas of the World Health Organization, with the support of the Disaster Mitigation Advisory Group. It is the result of a lengthy process of dialogue, testing and revision with PAHO/WHO Member States. The Hospital Safety Index provides a snapshot in time of a hospital's level of safety. The Index can and should be reapplied a number of times, over an extended period, in order to continuously monitor safety levels. In that way, safety is not seen as an absolute state of „yes-or-no' or 'all-or-nothing', but rather as something that can be improved gradually. The Hospital Safety Index is not designed to replace detailed vulnerability studies. However, because these can be very costly and time consuming, the Hospital Safety Index is a cost-effective first step.

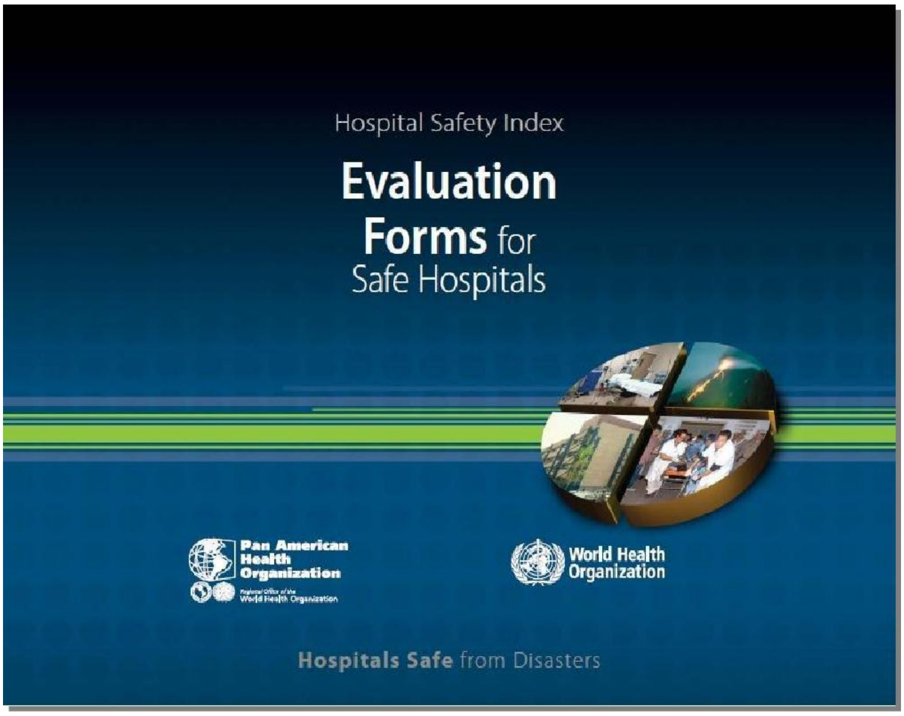


Figure 15 Hospital Safety Index Evaluation Form

The Hospital Safety Index is made up of three components: a safe hospitals checklist, a guide for evaluators, and a safety index calculator.

Determining a hospital's safety index begins with applying the safe hospitals checklist. This standardized checklist examines the level of safety of 145 items or areas that have an impact on a health facility's level of safety. The safety level of each area is rated as low, medium or high. The areas assessed are grouped into four categories: the hospital's geographical location in relation to natural hazards; its structural and non-structural safety; and items that affect its functional capacity - issues such as whether a hospital has a disaster committee, an emergency plan, or if maintenance is performed regularly.

The Hospital Safety Index alone will not transform a vulnerable health facility into one that is disaster-resilient, with well-trained staff. Nor will applying the Hospital Safety Index replace costly vulnerability studies, which can run into tens of thousands of dollars. However, hospital administrators will get a solid overview of where the facility stands in terms of safety, helping them decide where to invest to maximize return. Sometimes very small or low-cost improvements (relative to the overall cost of the facility) will go a long way towards improving safety.

It is important that hospital administrators and health managers view the safety score in positive light – which is why this instrument is called the "Safety" Index rather than the "Vulnerability" Index. The final score should not be viewed as a failing grade, but rather as a starting point for gauging how a health facility is likely to respond to major emergencies and disasters. This first but critical step is the cornerstone to ensuring that hospitals are safe from disasters. (Brittner, 2009)

Although the Hospital Safety Index is just getting off the ground, it has proved to be a powerful instrument for rallying country support around the issue of safe hospitals. Rating the safety of a health facility (as opposed to focusing on vulnerability) requires striking an appropriate balance between providing a secure environment for the patients, making health care accessible and factoring in economic considerations. This is a complex process and the Hospital Safety Index is only one of a variety of tools that managers can use to gather the information they need for sound decision making. (Cruz, 2009)

4.2.2 Hospital Safety Index Checklist

The Safety Index comprises of two forms, Form1: "General Information of the Health Facility" and Form 2: "Safe Hospitals Checklist". Form 1 includes general information about the health facility being evaluated and its treatment capacity while Form 2 is the checklist 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 namely, Geographic location of the health facility; Structural safety; Non-structural safety and Functional capacity.

The first module allows for a rapid description of hazards or dangers and geotechnical properties of soils at the site of the health facility. For the second module, evaluating structural safety of the facility involves assessment of the type of structure, materials, and previous exposure to natural and other hazards. The 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. For the third module, 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. This 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, fire protection systems, false ceilings, and other components. Lastly, for the functional capacity, the 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. (Pan American Health Organization - World Health Organization, 2008)

SAFE HOSPITALS CHECKLIST

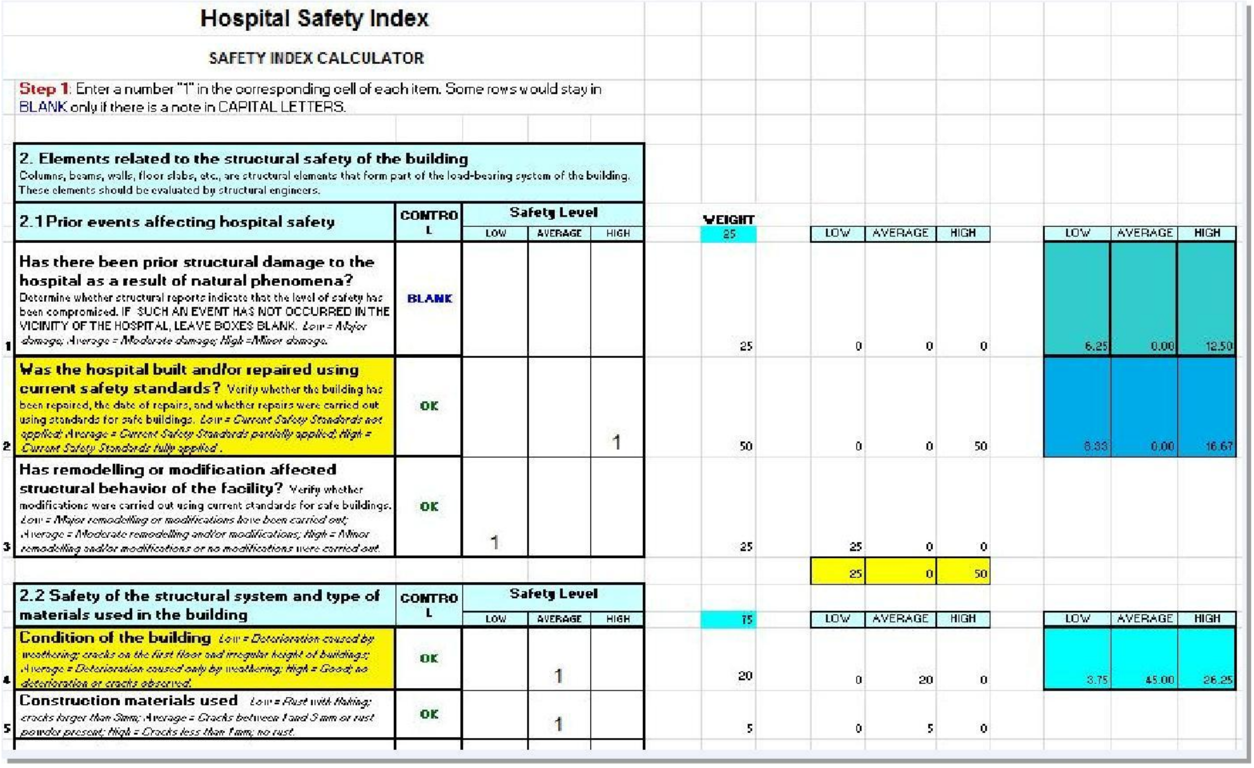
1. Elements relating to the GEOGRAPHIC LOCATION of the health facility (mark with an X where applicable).

1.1 Hazards Refer to hazard maps. Request the Hospital Disaster Committee to provide the map(s) showing safety hazards at the site of the building.	Hazard Level				OBSERVATIONS
	No hazard	Hazard level			
		LOW	AVERAGE	HIGH	
1.1.1 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.	☐	☐	☐	☐	
Others (specify) .... Refer to hazard maps to identify other geological phenomena not listed above. Specify the hazard and rate the corresponding hazard level for the hospital.	☐	☐	☐	☐	
1.1.2 Hydro-meteorological phenomena					
Hurricanes Refer to hazard maps to rate the hazard level of the hospital in terms of hurricanes. 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 soil.	☐	☐	☐	☐	
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.	☐	☐	☐	☐	

Figure 16 Safe Hospitals Checklist

4.2.3 Hospital Safety Index Calculator

The scores or values obtained for each component on the Checklist are recorded into an Excel spreadsheet that uses formulas to automatically calculate a numerical score for each of the 145 assessed components. The results place the facility into one of three safety categories: high, medium, or low. It is important to note that the values given to each component are weighted according to an agreed upon formula, which has been endorsed in Latin America and the Caribbean, but may not be applicable worldwide.



Hospital Safety Index

SAFETY INDEX CALCULATOR

Step 1: Enter a number "1" in the corresponding cell of each item. Some rows would stay in BLANK only if there is a note in CAPITAL LETTERS.

2. Elements related to the structural safety of the building
Columns, beams, walls, floor slabs, etc., are structural elements that form part of the load-bearing system of the building. These elements should be evaluated by structural engineers.

	2.1 Prior events affecting hospital safety	CONTROL	Safety Level			WEIGHT						
			LOW	AVERAGE	HIGH	25	LOW	AVERAGE	HIGH	LOW	AVERAGE	HIGH
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. IF SUCH AN EVENT HAS NOT OCCURRED IN THE VICINITY OF THE HOSPITAL, LEAVE BOXES BLANK. Low = Major damage; Average = Moderate damage; High = Minor damage.	BLANK				25	0	0	0	6.25	0.00	12.50
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.	OK			1	50	0	0	50	8.33	0.00	16.67
3	Has remodelling or modification affected structural behavior of the facility? Verify whether modifications were carried out using current standards for safe buildings. Low = Major remodelling or modifications have been carried out; Average = Moderate remodelling and/or modifications; High = Minor remodelling and/or modifications or no modifications were carried out.	OK	1			25	25	0	0			
							25	0	50			

	2.2 Safety of the structural system and type of materials used in the building	CONTROL	Safety Level									
			LOW	AVERAGE	HIGH	75	LOW	AVERAGE	HIGH	LOW	AVERAGE	HIGH
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.	OK		1		20	0	20	0	3.75	45.00	26.25
5	Construction materials used Low = Rust with flaking; cracks larger than 5mm; Average = Cracks between 1 and 3 mm or rust powder present; High = Cracks less than 1 mm; no rust.	OK		1		5	0	5	0			

Figure 17 Hospital Safety Index Calculator

4.3 Discussion Of Doh-Hems Philippine Indicators

The Hospital Assessment Tool from DOH-HEMS and CHD-NCR is comprised of five sections, (1) General Information about the hospital, (2) Structural Indicators, (3) Non-Structural Indicators, (4) Non-Structural Indicators Highly Infectious Disease and (5) Functional Indicators. The checklist has four columns, YES, NO, N/A and Remarks. (DOH-HEMS, CHD-NCR, Dr. Noel R. Juban, 2009)

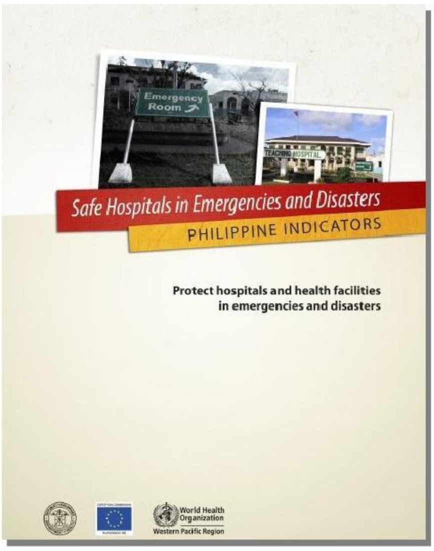
The set of indicators in the manual is a YES (complies completely) or NO (does not comply completely) questionnaire (with a thumbs-up and thumbs-down sign to be encircled). It also has a remarks column to write essential observations when doing the assessment, especially when the result is NO. The DOH-HEMS manual for safe hospitals has three main sections – Structural indicators, non-structural indicators and functional indicators. Two additional sections in the manual are additional non-structural indicators for hospitals with highly infectious diseases and additional functional indicators for hospitals with highly infectious diseases.

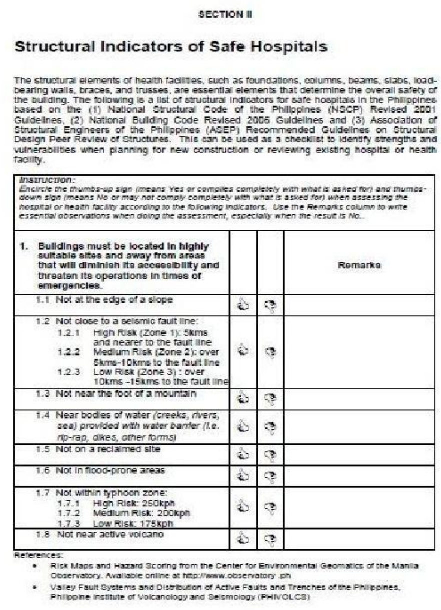
The structural elements of health facilities, such as foundations, columns, beams, slabs, load-bearing walls, braces, and trusses are essential elements that determine the overall safety of the building. The following is a list of structural indicators for safe hospitals in the Philippines based on the (1) National Structural Code of the Philippines (NSCP) Revised 2001 Guidelines,

(2) National Building Code Revised 2006 Guidelines and (3) Association of Structural Engineers of the Philippines (ASEP) Recommended Guidelines on Structural Design Peer Review of Structures. The Department of Health – Health Emergency Management Staff developed a checklist that can be used to identify strengths and vulnerabilities when planning for new construction or reviewing an existing facility. (Department of Health - Health Emergency Management Staff (DOH-HEMS), 2009)

Main sections in the Structural Indicators are the 1) location of the building (whether it is in a suitable site or not); 2)conformity to the requirements of the National Structural Code of the Philippines (NSCP, 2001) especially for wind and earthquake design; 3) shape and form of the hospital building; 4) continuing check and review of hospital structural system during construction and the entire period of occupancy; 5) investigation of cracks on the building; 6) as-built plans of all hospital building for reference purposes; and 7) building permit and occupancy permits. For the location of the building, specific indicators are that the hospital is not on a landslide-prone area, not close to a seismic fault line, not near the foot of a mountain, not near bodies of water, not on a reclaimed site or in areas at risk of liquefaction, not in flood-prone areas, not within typhoon zone, not near an active volcano and not in storm-surge-prone area. Section 2 (conformity to NSCP 2001) indicators include foundations, columns, beams, floors and slabs, trusses, walls and partitions, shear walls, roof systems and gutters and downspouts. Indicators taken into consideration for the shape and form of a hospital are that it has simple and symmetrical shape in both the lateral and longitudinal axes, the number of building floors, the building form, whether they are not top-heavy, there are no cantilevers, balanced massing and loading. For section 4, the indicators are peer review using Association of Structural Engineers of the Philippines (ASEP) guidelines, evaluation using Department of Public Works and Highways (DPWH) guidelines and structural certification by a qualified structural engineer. Also, cracks on the hospital system must be immediately investigated and addressed especially if they appear after an earthquake. Cracks on the following structural members are evaluated: foundation, column, floor slabs, trusses, walls and partitions and shear walls. For section 6, as built plans of all hospital buildings must be available for reference and must contain the architectural plans, structural plans including structural computations, electrical plans including electrical computations, sanitary plans, mechanical plans and electronics and communications plans. Lastly, permits such as building permits, occupancy permits, fire safety permit, elevator permit, generator permit and other permits as needed must also be readily available to satisfy the indicators.

Non-structural elements are all other elements that, without forming part of the resistance systems, enable the facility to operate. These include architectural elements, equipment and contents, and services of lifelines. Nearly 80% of the total cost of building a hospital is spent on non-structural components (World Health Organization, 2008). Non-structural indicators include safety of ceilings; safety of door entrances; safety of windows and shutters; safety of walls, divisions and partitions; safety of exterior elements (cornices, ornaments, façade, plastering, etc; safety of floor coverings, safety of lifeline facilities; communication system; domestic water supply system; medical and industrial gases system; fire suppression system; emergency exit system; HVAC systems in critical areas; medical and laboratory equipment and supplies used for diagnosis and treatment; and safety of personnel and patients. Functional Indicators include site and accessibility; internal circulation and interoperability; hospital emergency preparedness, response and recovery plan; hospital emergency management systems, procedures and protocols; availability of back-up system for critical services; human resources; and monitoring and evaluation.





SECTION II

Structural Indicators of Safe Hospitals

The structural elements of health facilities, such as foundations, columns, beams, slabs, load-bearing walls, braces, and trusses, are essential elements that determine the overall safety of the building. The following is a list of structural indicators for safe hospitals in the Philippines based on the (1) National Structural Code of the Philippines (NSCP) Revised 2001 Guidelines, (2) National Building Code Revised 2005 Guidelines and (3) Association of Structural Engineers of the Philippines (ASEP) Recommended Guidelines on Structural Design Peer Review of Structures. This can be used as a checklist to identify strengths and vulnerabilities when planning for new construction or reviewing existing hospital or health facility.

Instruction:
Encircle the thumbs-up sign (means Yes or complies completely with what is asked for) and thumbs-down sign (means No or may not comply completely with what is asked for) when assessing the hospital or health facility according to the following indicators. Use the Remarks column to write essential observations when doing the assessment, especially when the result is No.

1. Buildings must be located in highly suitable sites and away from areas that will diminish its accessibility and threaten its operations in times of emergencies.			Remarks
1.1 Not at the edge of a slope			
1.2 Not close to a seismic fault line: 1.2.1 High Risk (Zone 1): 5kms and nearer to the fault line 1.2.2 Medium Risk (Zone 2): over 5kms-10kms to the fault line 1.2.3 Low Risk (Zone 3) : over 10kms -15kms to the fault line			
1.3 Not near the foot of a mountain			
1.4 Near bodies of water *(creeks, rivers, sea) provided with water barrier (i.e. rip-rap, dikes, other forms)*			
1.5 Not on a reclaimed site			
1.6 Not in flood-prone areas			
1.7 Not within typhoon zone: 1.7.1 High Risk: 250kph 1.7.2 Medium Risk: 200kph 1.7.3 Low Risk: 175kph			
1.8 Not near active volcano			

References:

- Risk Maps and Hazard Scoring from the Center for Environmental Geomatics of the Manila Observatory. Available online at http://www.observatory.ph
- Valley Fault Systems and Distribution of Active Faults and Trenches of the Philippines, Philippine Institute of Volcanology and Seismology (PHIVOLCS)

Figure 18 Safe Hospitals in Emergencies and Disasters - Philippine Indicators

Aside from these main indicators, additional non-structural indicators for hospitals with highly infectious disease consist of wards; operating room and recovery room; laboratory room; emergency room; security and safety.

For the additional functional indicators for hospitals with highly infectious disease, it consists of site and accessibility; internal circulation and interoperability; equipment and supplies; hospital emergency management policies, guidelines, procedures and protocols; hospital systems; operational plan and contingency plans for internal or external disasters; plans for the operation, preventive maintenance, and restoration of critical services; human resources; and availability of medicines, supplies, instruments, and other equipment dedicated to control of highly infectious diseases (SARS, Avian Influenza); and Monitoring and Evaluation.

The codes, policies and guidelines on which the indicators are based are the National Building Code of the Philippines (PD 1096), The National Structural Code of the Philippines (5th ed, 2001), Philippine Electrical Code of 2000, Fire Code of the Philippines (PD 1185), Republic Act 8495 – Philippine Mechanical Code of 1998, Republic Act 344 – Accessibility Law, Republic Act 9275 – Philippine Clean Water Act of 2004, Republic Act 9003 – Ecological Solid Waste Management Act of 2001 and Administrative Order No. 2008 - 0021.

Also, a post-assessment questionnaire is accomplished, indicating the date and time the assessment was started and completed, evaluating team members, required documents availability and a general assessment of the visit including problems encountered and possible solutions.

After the initial assessment of the 25 hospitals was done, the group found out that it was an eye opener for the hospitals. The questions and issues of ease of use, relevance, effectiveness, scoring system and the effectiveness and accuracy of the indicators were raised. They were also able to recognize the significance of the tool as a guide to hospital renovations and constructions, planning and fund allocation. These findings led to the formulation of the next steps to be done which are to finalize the indicators for all hospital levels, the assessment of all hospitals, conducting of the Hospital Emergency Awareness and Response Training (HEART) which includes awareness for "Safe Hospitals" as well, the integration of the tool with licensing requirements for coursed through the Department of Health and lastly, to develop a better "Safe Hospitals" policy. (Department of Health Western Pacific Region, 2010)

Safe Hospitals Checklist **HOSPITAL SAFETY INDEX (HSI)**	**Safe Hospitals in Emergencies and Disasters:** **PHILIPPINE INDICATORS (PI)**		
Columns, beams, walls, floor slabs, etc., are structural elements that form part of the load-bearing system of the building. These elements should be evaluated by structural engineers.			
2.1 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. IF SUCH AN EVENT HAS NOT OCCURRED IN THE VICINITY OF THE HOSPITAL, LEAVE BOXES BLANK. *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 the 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.*	**The design of the hospital structural system must strictly conform with the requirements of the National Structural Code of the Philippines (NSCP, 2001); especially for wind and earthquake design (per structural computations).**		
	2.1	Foundation - resistant to floods, winds and earthquake	
	2.2	Columns - resistant to floods, wind and earthquake	
	2.3	Beams	
		2.3.1	Underside of arches, balconies or overhangs free from structural cracks and falling cement plasters
		2.3.2	Other fixtures such as ceiling liner are properly fastened or attached
	2.4	Floor and Roof Slabs - Soffit or the underside of floor slab has no cracks and leaks	
	2.5	Trusses - resistant to wind and earthquake	
	2.6	Walls and Partitions - resistant to wind and earthquake	
	2.7	Shear Walls - resistant to wind and earthquake	
	2.8	Roof System:	
		2.8.1	Roofing completely and securely fastened, welded, riveted, or cemented
3. **Has remodelling or modification affected structural behavior of the facility?** Verify whether modifications were carried out using standards for safe buildings. *Low = Major remodelling or modifications have been carried out; Average = Moderate remodelling and/or modifications; High = Minor remodelling and/or modifications or no modifications were carried out.*		2.8.2	materials, slope, type of connection, condition, thickness at least gauge 24 or 26
		2.8.3	Considered regional location, e.g. in typhoon-prone areas it should be heavily fastened or anchored
	2.9	Gutters and Downspout - resistant to wind and cannot be easily blown off	
2.2 Safety of the structural system and type of materials used in the building			

Figure 19 Comparative Analysis of Hospital Safety Index and Philippine Indicators

5 DISCUSSION OF HSFDCBAT

The role of HSFDCBAT on hospitals is first assessment, then recommendations for the modules of Suitable Sites, Structural, Non-Structural and Functional aspects of the hospitals in the event of disasters. This tool has seventy seven (77) checkpoints and is divided into these modules. The checkpoints are identified for each module in this section but the details of these checkpoints can be referred to in the appendix. (See APPENDIX A: HSFDCBAT CONTENT DETAILS TABLE)

5.1 Content

5.1.1 Suitable Sites

This section was included as an independent module to isolate it from the Structural module for the reason that other checkpoints such as epidemic, contamination, pest infestation, hazardous material spills, radioactivity and social phenomena have no direct relation to the structural safety of the health facility.

For the Suitable Sites module, eighteen (18) checkpoints were used:

5.1.1.1 EARTHQUAKE

5.1.1.2 TYPHOON

5.1.1.3 VOLCANO

5.1.1.4 TSUNAMI

5.1.1.5 LANDSLIDE

5.1.1.6 TORRENTIAL RAINS

5.1.1.7 STORM SURGE

5.1.1.8 LIQUEFACTION

5.1.1.9 UNSTABLE SLOPES

5.1.1.10 EPIDEMIC

5.1.1.11 CONTAMINATION

5.1.1.12 FIRE

5.1.1.13 PEST INFESTATION

5.1.1.14 TERRORISM

5.1.1.15 EXPLOSION

5.1.1.16 HAZARDOUS MATERIAL SPILLS

5.1.1.17 SOCIAL PHENOMENA

5.1.1.18 RADIOACTIVITY

5.1.2 Structural Safety

For hospitals to be safe from the effects of natural disasters, the following are recommended structural design indicators: (National Center for Health Promotion - DOH, 2009)

- Design of building structural and non-structural elements conform with NSCP 2001 for wind and earthquake design
- Seismic importance factor of 1.25 and wind importance factor of 1.15 should be used for structural design

- Immediate occupancy category as may be required by the client
- No major cracks on structural members. Minor or hairline cracks are localized and repairable
- Buildings are designed up to Maximum Moment Magnitude 7 for those near active earthquake fault lines.
- Located at least ten (10) meters away from both sides of a fault line
- Readily available as-built construction drawings for reference purposes
- Complete with necessary building and occupancy permits
- Curtain glass walls conform with NSCP requirements for wind design
- Glass doors and windows resist basic wind speed of 200-250 kph with regional application of secondary covers.
- Structural design of buildings have undergone review using ASEP guidelines and issued with structural certification.
- For existing buildings, rapid evaluation has been performed to determine structural vulnerability and cross-checked with hazard maps. Buildings highly vulnerable subjected to detailed structural evaluation
- Construction materials have been thoroughly checked by a Quality Control Engineer during construction
- All existing buildings should be certified by a qualified civil/structural engineer. All buildings that do not conform to the present code should be analyzed and strengthened or retrofitted

Based on these, the Structural Safety module used these fourteen (14) checkpoints:

5.1.2.1 STRUCTURAL HISTORY

5.1.2.2 STRUCTURAL SYSTEM

5.1.2.3 STRUCTURAL STANDARDS

5.1.2.4 CONDITION OF BUILDING

5.1.2.5 CONSTRUCTION MATERIALS

5.1.2.6 FORM IRREGULARITIES

5.1.2.7 HOSPITAL SIZE (PHYSICAL)

5.1.2.8 FOUNDATIONS

5.1.2.9 ADJACENT STRUCTURES

5.1.2.10 STRUCTURAL REDUNDANCY

5.1.2.11 STRUCTURAL RESILIENCE

5.1.2.12 CONTINUING CHECK

5.1.2.13 AS-BUILT PLANS

5.1.2.14 PERMITS

5.1.3 Non-Structural Safety

In Non-Structural Safety, architectural elements and non-load bearing components of the structure are evaluated. Their conditions before, during and after a disaster are being assessed. There are thirty six (36) checkpoints in this module and they are the following:

PRE, DURING and POST-DISASTER

5.1.3.1 ELECTRICAL SYSTEMS

5.1.3.2 TELECOMMUNICATIONS SYSTEMS

5.1.3.3 WATER SUPPLY SYSTEM

5.1.3.4 FUEL STORAGE

5.1.3.5 MEDICAL GASES

5.1.3.6 HVAC SYSTEMS

5.1.3.7 FURNISHINGS AND EQUIPMENT

5.1.3.8 MEDICAL AND LABORATORY EQUIPMENT

ARCHITECTURAL ELEMENTS

5.1.3.9 ROOF SYSTEM

5.1.3.10 BUILDING ENVELOPE

5.1.3.11 INTERIOR WALLS

5.1.3.12 FIRE PROTECTION SYSTEM

5.1.3.13 MOVEMENT INSIDE BUILDING

5.1.3.14 MOVEMENT OUTSIDE THE BUILDING

5.1.3.15 LIGHTING SYSTEM

5.1.3.16 REDUNDANT OPEN SPACES

5.1.3.17 REFUGE ROOMS

5.1.3.18 HAZARDOUS WASTES

5.1.3.19 INFECTION CONTROL

5.1.3.20 PEST CONTROL

5.1.4 Functional Capacity

The Functional Capacity module focuses on the disaster-readiness of a health facility based on the organization and plans in place in case such emergencies occur. This module has nine (9) checkpoints:

5.1.4.1 ORGANIZATION OF HOSPITAL DISASTER COMMITTEE

5.1.4.2 ORGANIZATION OF EMERGENCY OPERATION CENTER

5.1.4.3 OPERATIONAL PLANS FOR DISASTERS

5.1.4.4 EPIDEMIOLOGICAL SURVEILLANCE COMMITTEE

5.1.4.5 TRANSPORT & LOGISTICS

5.1.4.6 CONTINGENCY PLAN FOR MEDICAL TREATMENTS IN DISASTERS

5.1.4.7 PLANS FOR OPERATION, PREVENTIVE MAINTENANCE AND RESTORATION OF CRITICAL SERVICES

5.1.4.8 AVAILABILITY OF MEDICINES, SUPPLIES, INSTRUMENTS OR EQUIPMENTS FOR USE IN DISASTERS

5.1.4.9 HIGHLY INFECTIOUS DISEASES

5.1.5 Survey

HSFDCBAT has a Survey module to get the users‟ assessment in using the tool and has these checkpoints as survey areas:

5.1.5.1 USABILITY/EASE OF USE

5.1.5.2 RELIABILITY

5.1.5.3 EFFICIENCY

5.1.5.4 REUSABILITY/SCALABILITY

5.1.5.5 COMPLETENESS

5.1.5.6 FUNCTIONALITY

5.1.5.7 ERRORS/BUGS/CRASHES

5.1.5.8 SIGNIFICANCE/RELEVANCE

5.1.5.9 SECURITY/DATA INTEGRITY

5.1.5.10 OVERALL RATING

5.2 HSFDCBAT TOOL

5.2.1 OVERVIEW

Hospitals Safe From Disasters Computer-Based Assessment Tool (HSFDCBAT) is a comprehensive computer-based assessment tool aimed to provide a means to assess the disaster-readiness of health facilities using Microsoft VB.NET (Visual Basic .NET) (see Figure 20) as the developing software for the graphical user interface (GUI) or the front-end and Microsoft Access 2007 for the database or back-end (see Figure 21).

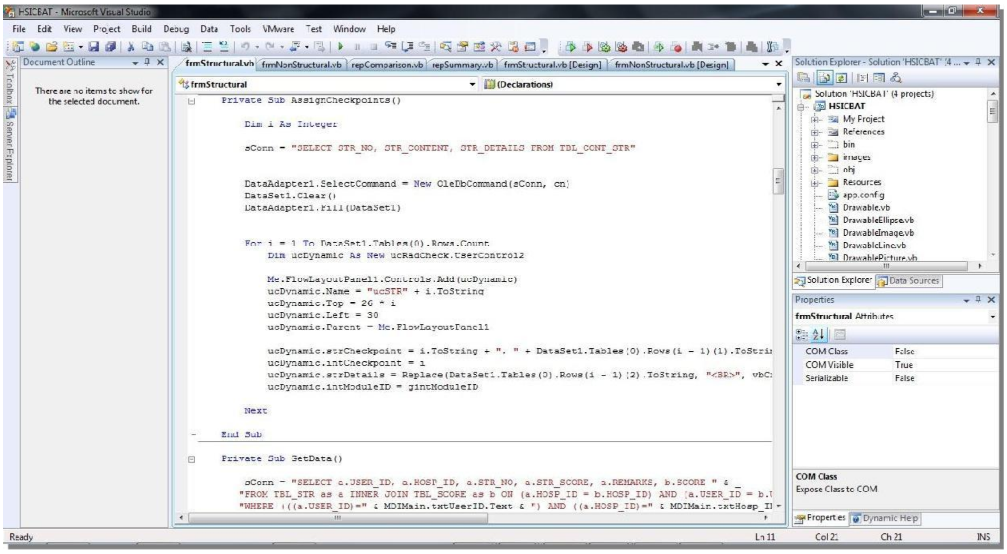


Figure 20 Code-behind of HSFDCBAT in Microsoft Visual Studio.NET

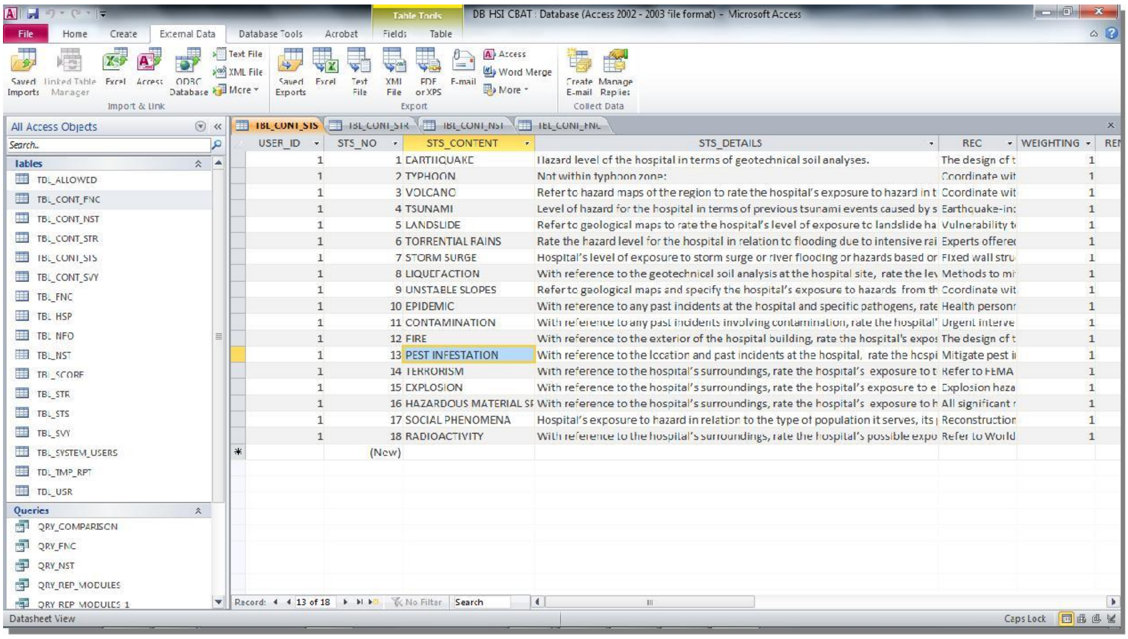


Figure 21 Database of HSFDCBAT using Microsoft Access

It is composed of six (6) modules – General Information, Suitable Sites, Structural Safety, Non-Structural Safety, Functional Capacity and Survey. The General Information module serves as the module where relevant information on the health facility like the name of the facility, address, contact details, etc. are entered and saved while the Survey module serves as a survey at the end of the assessment which evaluates the user experience. The other four (4) remaining modules are the main modules used for the assessment of the health facility's disaster-readiness.

The system also has maintenance functionalities as well as reporting capabilities. For the maintenance, users are created by the system administrator for each hospital and are given access rights and encrypted passwords for security and authorization. The content, checkpoint weights and images for the assessment modules can also be modified within this functionality. Reports for each hospital's assessment, comparison with other facilities and recommendations for the hospital on their next action plan can be generated after each evaluation.

Some of HSFDCBAT" s salient features are the following:

- For this version, weighting system used is same across the board (i.e. weight = 1.0 for all checkpoints)

- Formula for "SAFE SCORE" is:

$$\text{SAFE SCORE} = \frac{\left(\frac{\sum SCORE * WEIGHT}{\sum ITEM * WEIGHT}\right)}{5} * 100 = \_\_\_\ \%$$

- The lower the percentage risk, the better for the hospital facility, meaning it has a lower probability of failure or risk for the corresponding checkpoint or module.

- The HSFDCBAT system has links to guides and references for the users to help them in answering the tool. This can be seen in the "Details" and "Recommendations" button for each checkpoint.

- Descriptive "Observation" or "Remarks" column is provided to input additional information for the checkpoint being assessed

- Documents and reports generated from the HSFDCBAT will be visible to concerned DOH parties. Authorization is part of the system wherein users can only view their hospital data while the administrator/DOH Representative will be able to access all the data and have the capability to compare notes and generate reports.

- The “Recommendations” button appears for “High Risk” or “Highest Risk” checkpoints to guide the user in their next action plans for the implementation of disaster-readiness in the hospital
- Non-structural elements are grouped into pre-, during and post-disasters with pre as the usual compliance and regular checks based on the Building codes as well as the hospital’s procedures based on their respective bench books. During is how these elements will behave during disasters, most important of which is the anchorage and stability. Lastly, the post-disaster is whether these elements can still function and at what capacity or level after the disaster and after the damage has been done
- Images are used for visual representation of checkpoints (i.e use of infographics)
- Advantages of HSFDCBAT (VB.NET over Microsoft Excel) are customizable reports, scalability, data is generated based on the database; transfer and analysis of data between authorized personnel is faster and more convenient.
- This is similar to “expert systems” although a simpler and more user-friendly interface.
- Since this is just a prototype of a computer-based assessment tool, a complete team is not needed yet as in full-fledged software. It was also kept in mind that developing full-fledged software is difficult and that even if a complete software development team is formed, the time needed to develop such software would not be enough, given the time to finish this thesis. The researcher acted as the programmer as well.
- PAHO/DOH assessment tools are too long and have too many items (145 for PAHO, 222+ for DOH-HEMS, 77 for HSFDCBAT)
- The HSFDCBAT system will make the assessment of disaster-readiness here in the Philippines quantifiable as opposed to the thumbs-up, thumbs down rating system wherein the question being answered is compliance or not, without having a degree of risk for each checkpoint
- The checkpoints are grouped and the final scores or ratings for these groups or modules are independent of each other versus general rating for other assessment systems. Through this method, the weakness of the hospital is emphasized and corresponding action plans are suggested to the users versus just a general recommendation for other assessment tools
- With these methodologies, there would be more focus on which checkpoints should be worked at and the possible problem areas will be pin-pointed and then eventually addressed
- The system also has computations and corresponding weights for the “Suitable Sites” module as opposed to descriptive evaluation only. The module is also being tallied and given a score, depending on the site and climate conditions here in the Philippines
- Instant reports can be generated after completing the assessment tool.
- Comparative analysis of hospitals based on “Safe Scores” can be generated.
- Recommendation reports can be immediately generated for the hospital‟ s next action plan.
- Assessment will be on a per category/grouping basis
- Different Philippine codes are used as references such as National Structural Code of the Philippines (NSCP), Building Code, Fire Code, DOH Requirements, etc. to assess the compliance of the hospitals
- Proposed schedule of assessment with HSFDCBAT is if new construction, it can be used during the design stage. If existing, health facilities will have cyclic checking preferably yearly which will coincide with other license renewals.

5.2.2 User's Guide

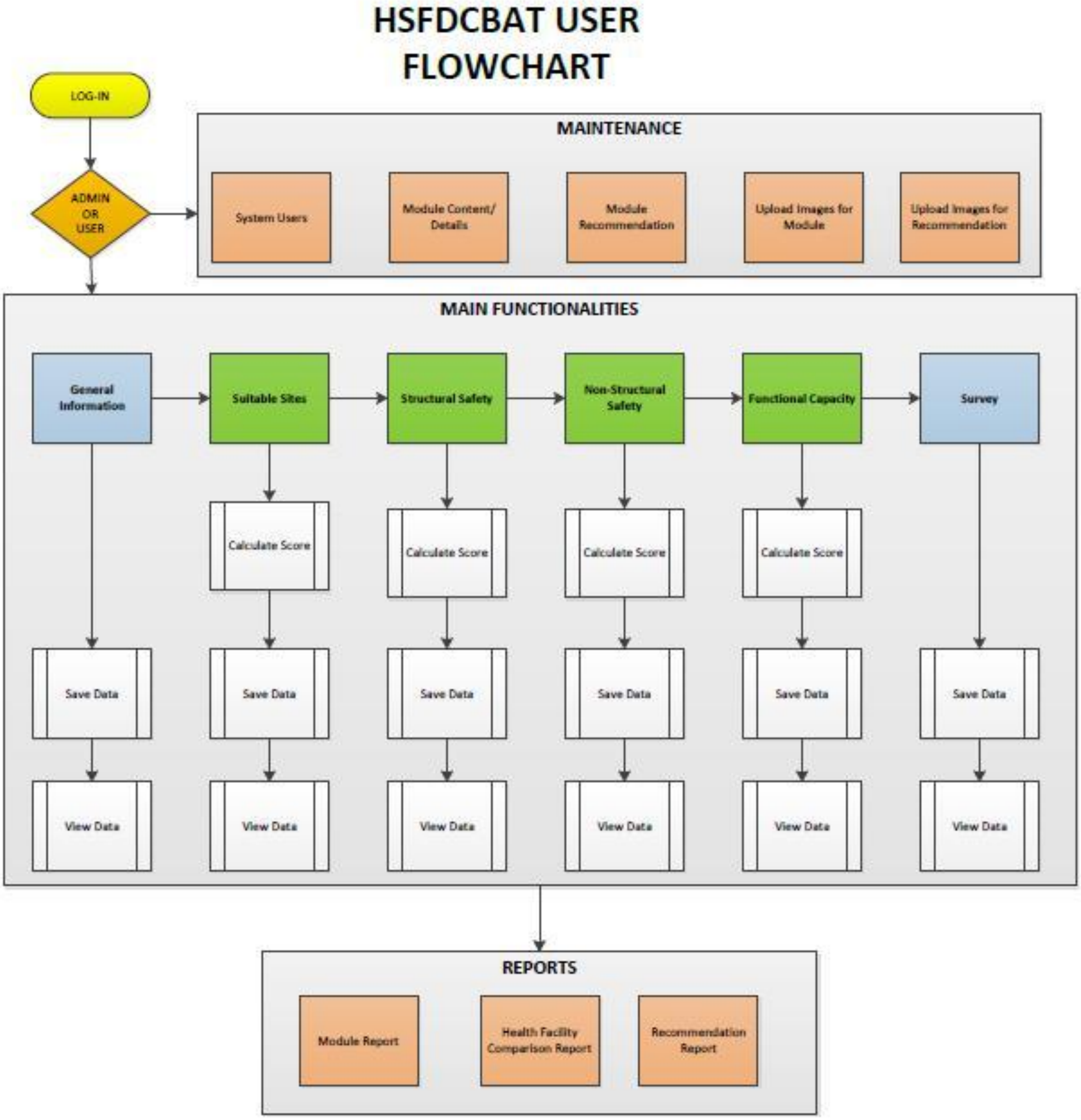


Figure 22 HSFDCBAT User's Flowchart

In using the HSFDCBAT, the user logs in first, depending on whether he is an ADMIN or just a normal USER. There are certain functionalities that the user is authorized to do depending on the user access assigned to him.

If the user is a normal USER created and given user access by the administrator to have access only on his corresponding hospital, he can log-in with his credentials on the Log-in Module (see Figure 24). The user will then be brought to the Main Menu screen (see Figure 23) where he is supposed to accomplish all the modules in a particular order.

The first module to complete is the General Information module (see Figure 35). In this module, information like name of facility, address, contact details, and other pertinent hospital information is filled up by the user. After completing the module he can now save the data and then proceed to the next module which is the Suitable Sites module (see Figure 36). In this module, the user is tasked to select whether a certain checkpoint is at lowest risk, low risk, medium risk, high risk, highest risk or not applicable based on his assessment with respect to their hospital. The user can click on the "Show Details" button to see the details of a certain checkpoint. He will then be shown a dialog (see Figure 40) with a brief explanation of the checkpoint as well as an accompanying image or infographic for a clearer idea on what the checkpoint is about. He can then close this dialog and then proceed with the other checkpoints.

After going through all the checkpoints and identifying their risk ratings, the user can now click on the “Calculate Score” button to show the risk rating or the “safe score” for the current module. Once the score is already computed, the user can now save the data for the accomplished module, in this case, the Suitable Sites Module. The lower the percentage risk, the better for the hospital, meaning it is able to comply with the Hospitals Safe from Disasters requirements.

The user can then do the same steps for the following disaster-readiness modules, namely Structural Safety, Non-Structural Safety and Functional Capacity (Figure 37-39). It should be noted, though, that the succeeding modules will not be enabled if the previous module has not been completed yet (i.e. Calculate Score and Save)

If all the disaster-readiness modules are already accomplished, the user can now proceed to the Survey module (see Figure 42) where he can assess the HSFDCBAT tool he just used by rating the system for each criteria with a score from 1 to 5, with 1 being the highest (Very Much) and 5 being the lowest (Not at All) similar to UP‟ s grading system. After finishing all the criteria, he can now save his inputs for the survey. This completes the assessment of the health facility for the normal USER of the HSFDCBAT. If the user wants to view the data for his respective hospital, he can just click on any of the module tabs and the corresponding module dialog will be shown with all the saved data and scores but with disabled controls so that it cannot be edited anymore. (Only the ADMIN has this capability for this version of the tool). In the View state, checkpoints with a “High Risk” or “Highest Risk” rating will have a “Recommendations” button enabled so that the user can click on it and see what action plan is needed to fix the checkpoint in question. A “Recommendations” dialog will be shown similar to the “Details” dialog showing the recommendation explanation as well as accompanying images if applicable. (see Figure 41)

On the other hand, if the user is logged in as an ADMIN. He can view and edit and delete any of the hospital’s data and generate reports from them (see Figure 25). Reports that can be generated from the HSFDCBAT tool are the HSFDCBAT Score report for all modules (see Figure 43), Comparison Report among health facilities (see Figure 45), and Recommendation Reports (see Figure 46), for any health facility. In the recommendation reports, checkpoints which have “High Risk” and “Highest Risk” ratings are highlighted in red and have corresponding recommendations or action plans for the user’s reference.

Other maintenance functions that can be done by the ADMIN are to create System Users with their corresponding username and encrypted passwords (see Figure 26); change the contents and weight of each checkpoint or survey criteria depending on which module is being edited (both “Details” and “Recommendations” content can be edited) (see Figure 27) and to upload informative images for these content as well. (see Figure 33-34)

5.2.3 Graphical User Interface (Gui):

Figure 23 Main Menu

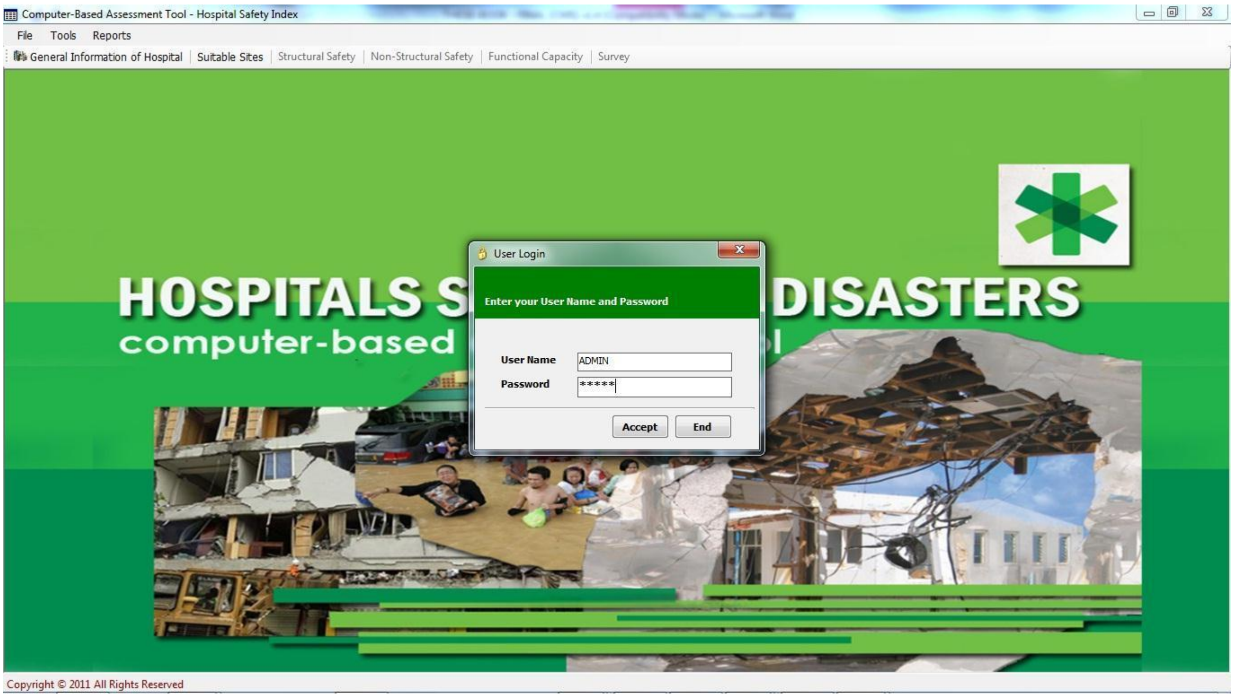


Figure 24 User Log-In Module

MAINTENANCE MODULES

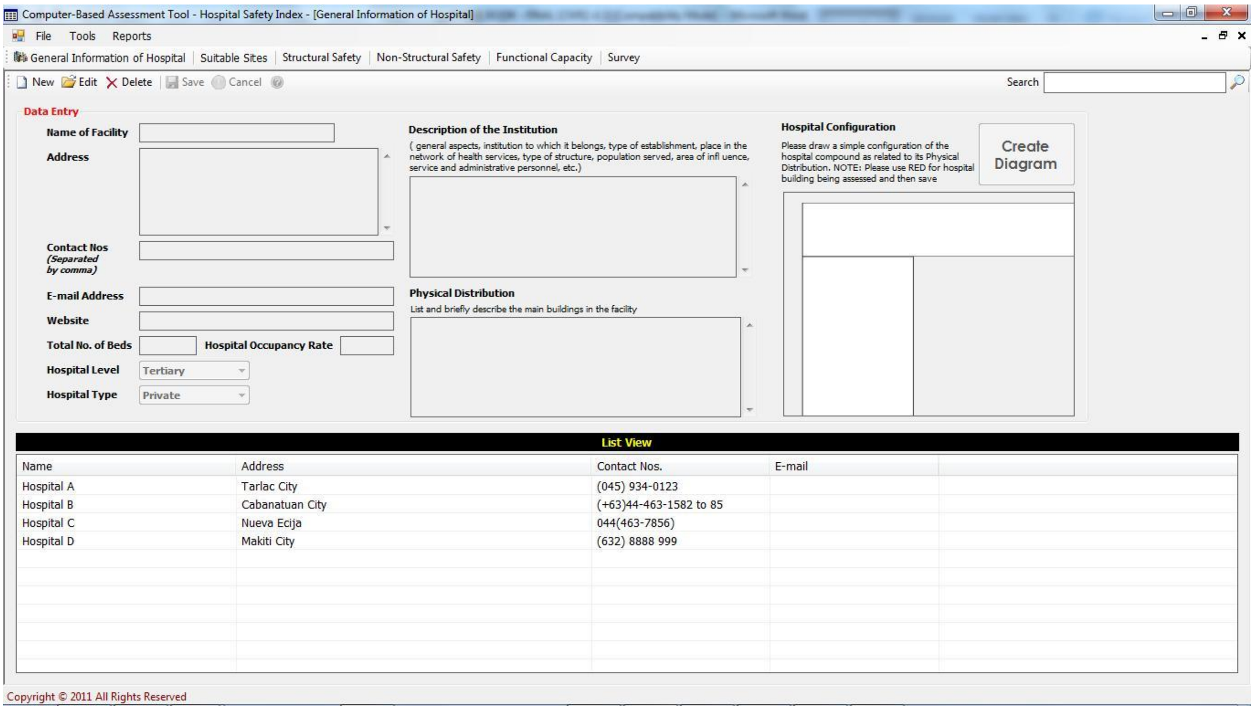


Figure 25 General Information Maintenance Module

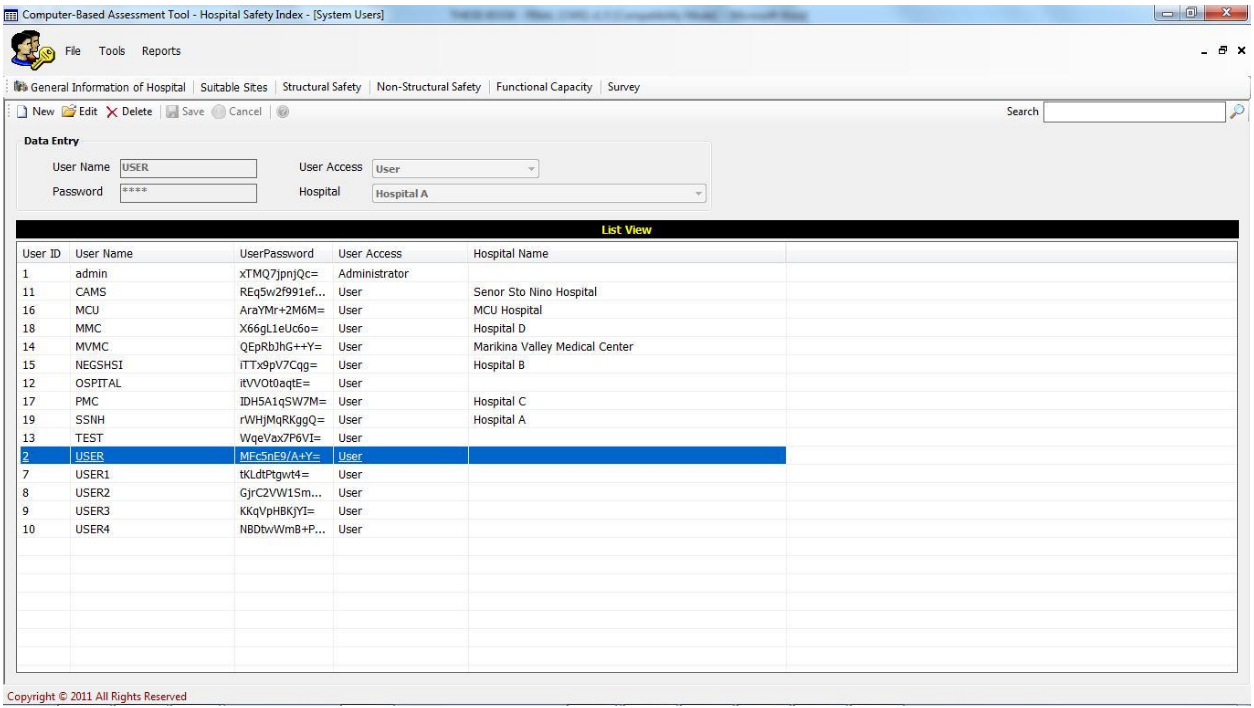


Figure 26 System Users Maintenance Module

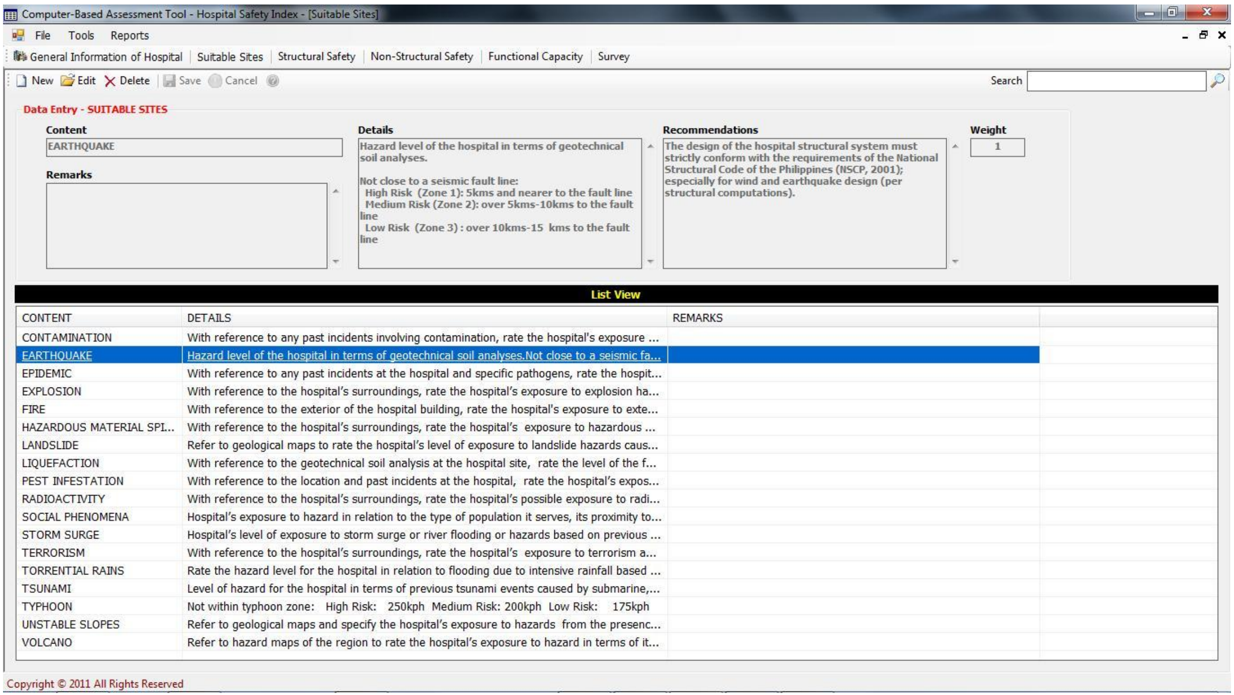


Figure 27 Suitable Sites Maintenance Module

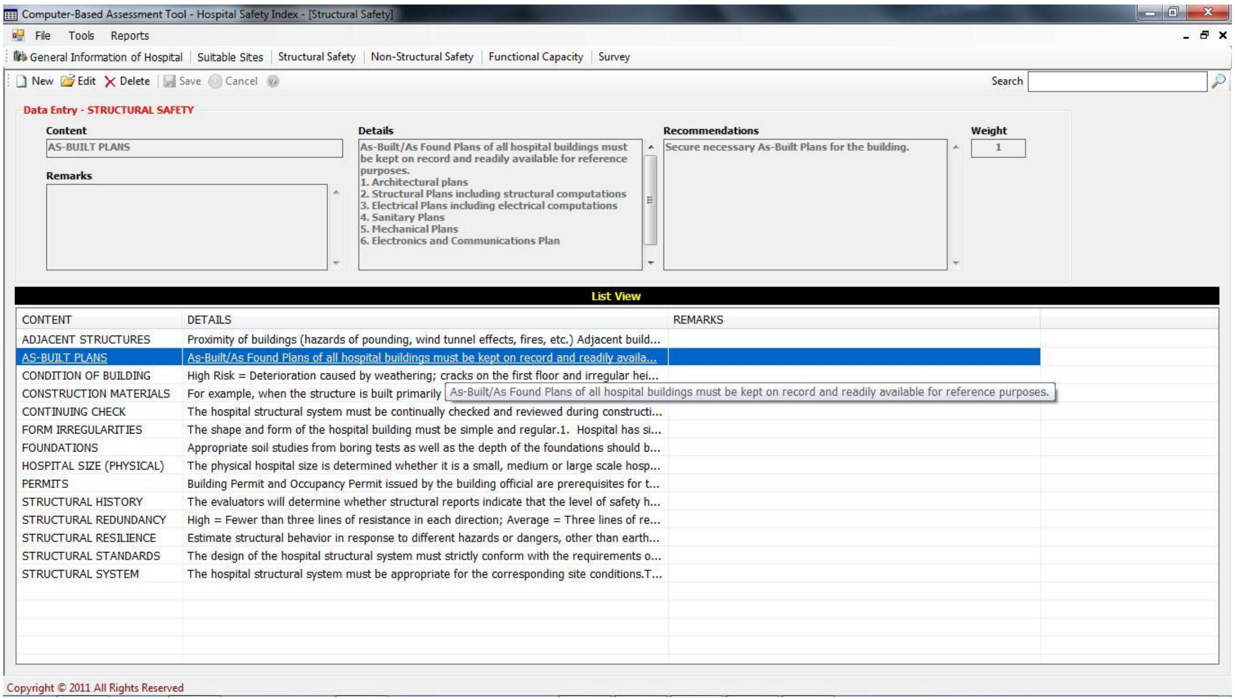


Figure 28 Structural Safety Maintenance Module

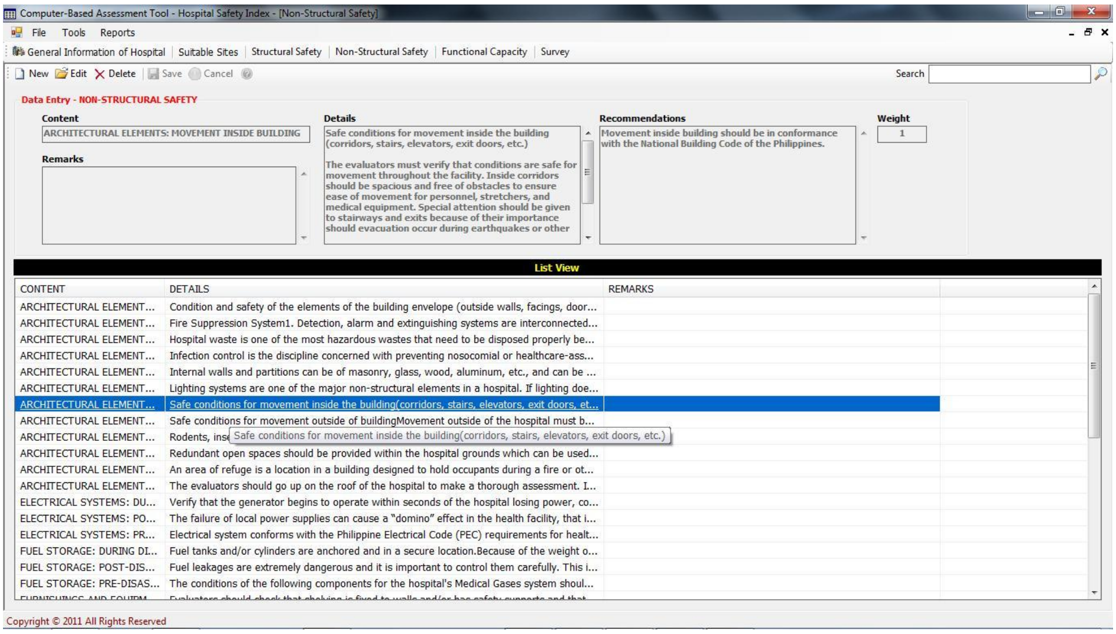


Figure 29 Non-Structural Safety Maintenance Module

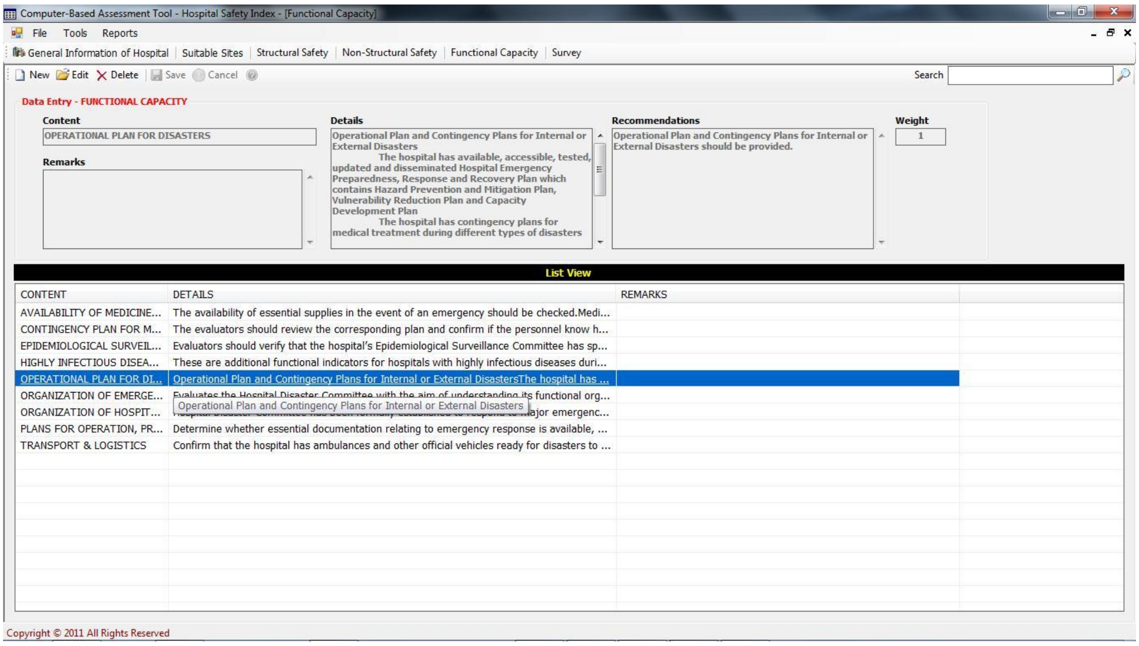


Figure 30 Functional Capacity Maintenance Module

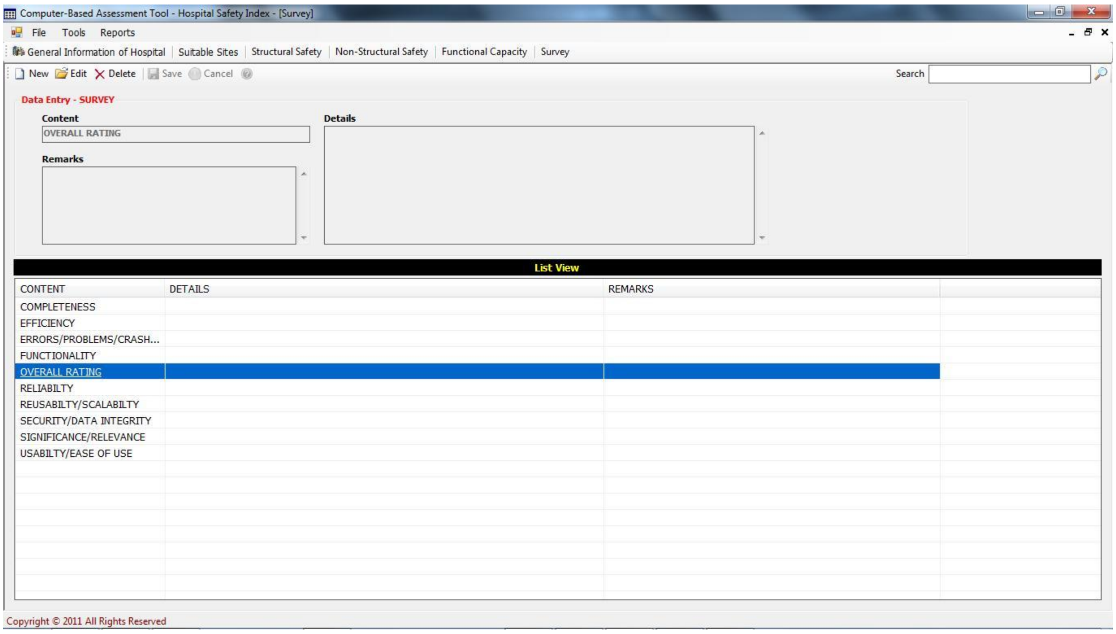


Figure 31 Survey Maintenance Module

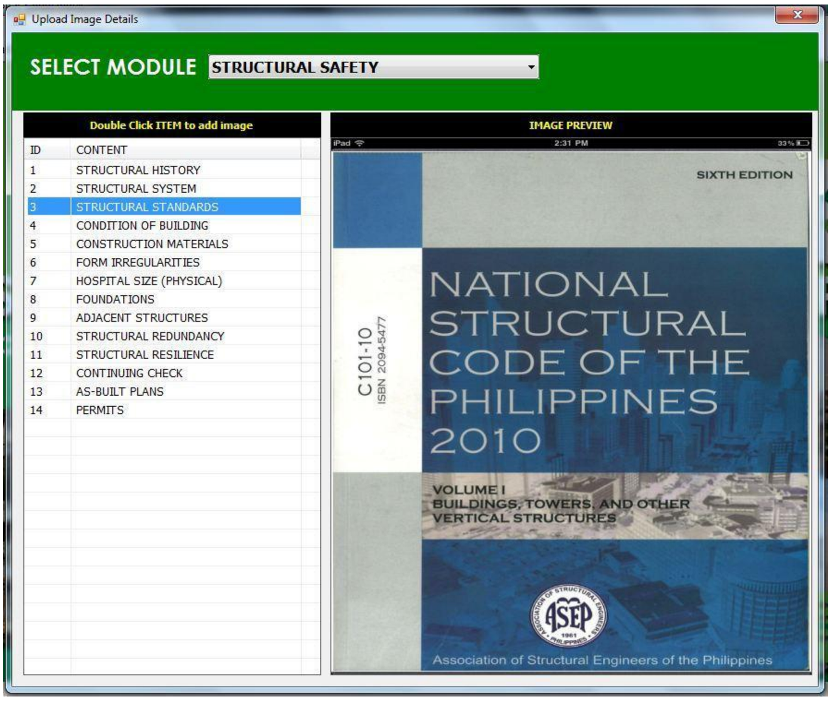


Figure 32 Upload Image - Details Maintenance Module (STRUCTURAL)

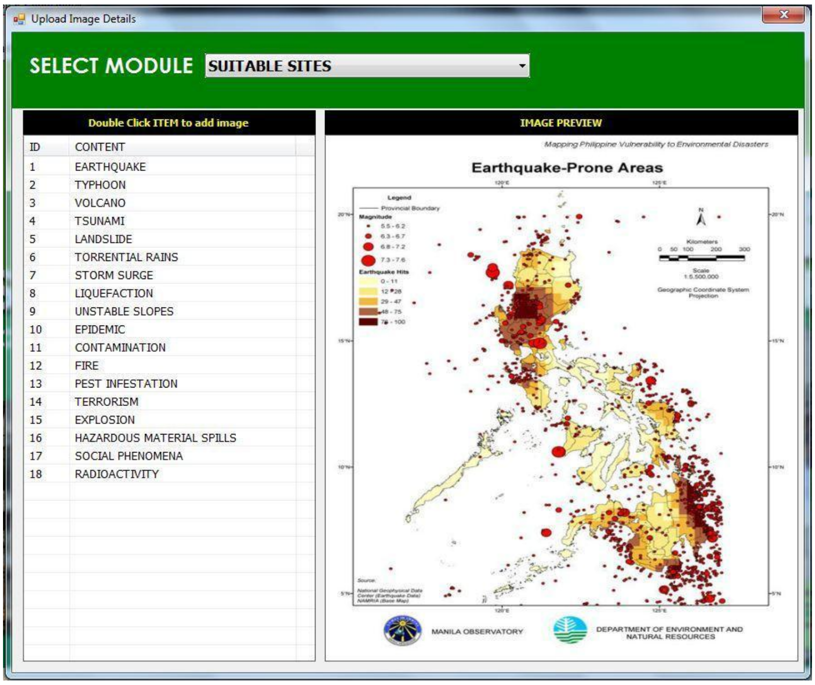


Figure 33 Upload Image - Details Maintenance Module (SUITABLE SITES)

Figure 34 Upload Image - Recommendations Maintenance Module

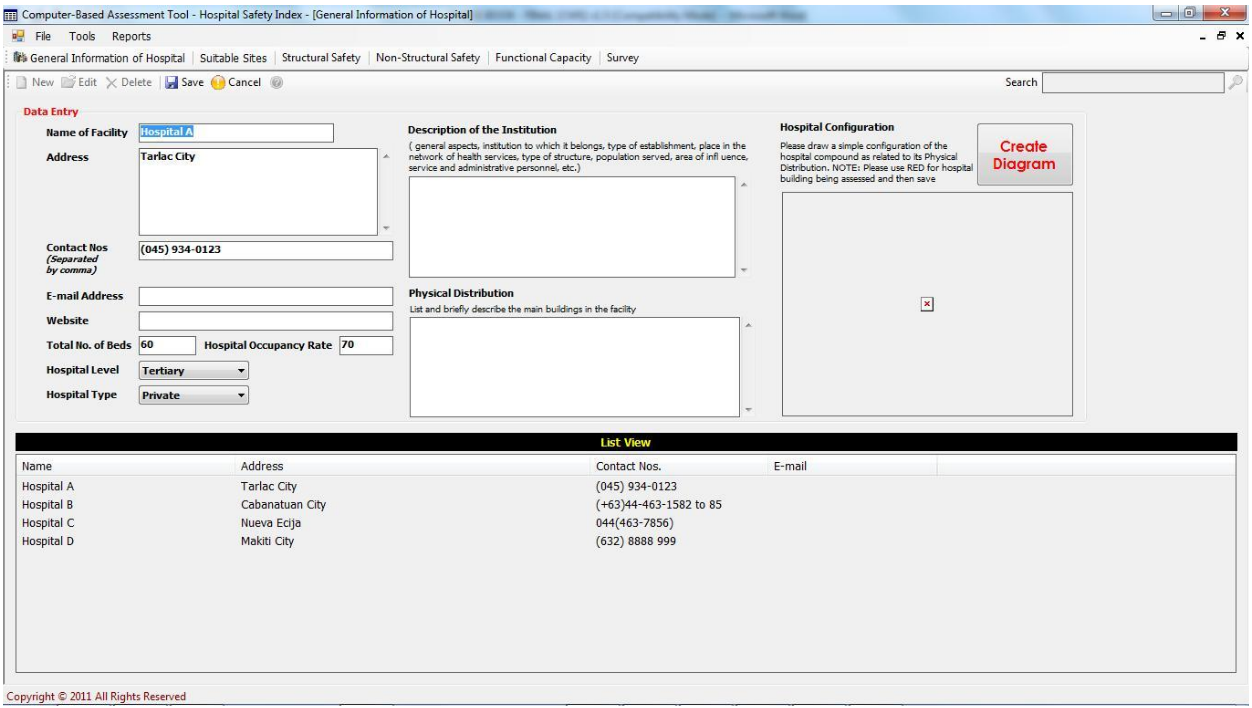


Figure 35 General Information Module

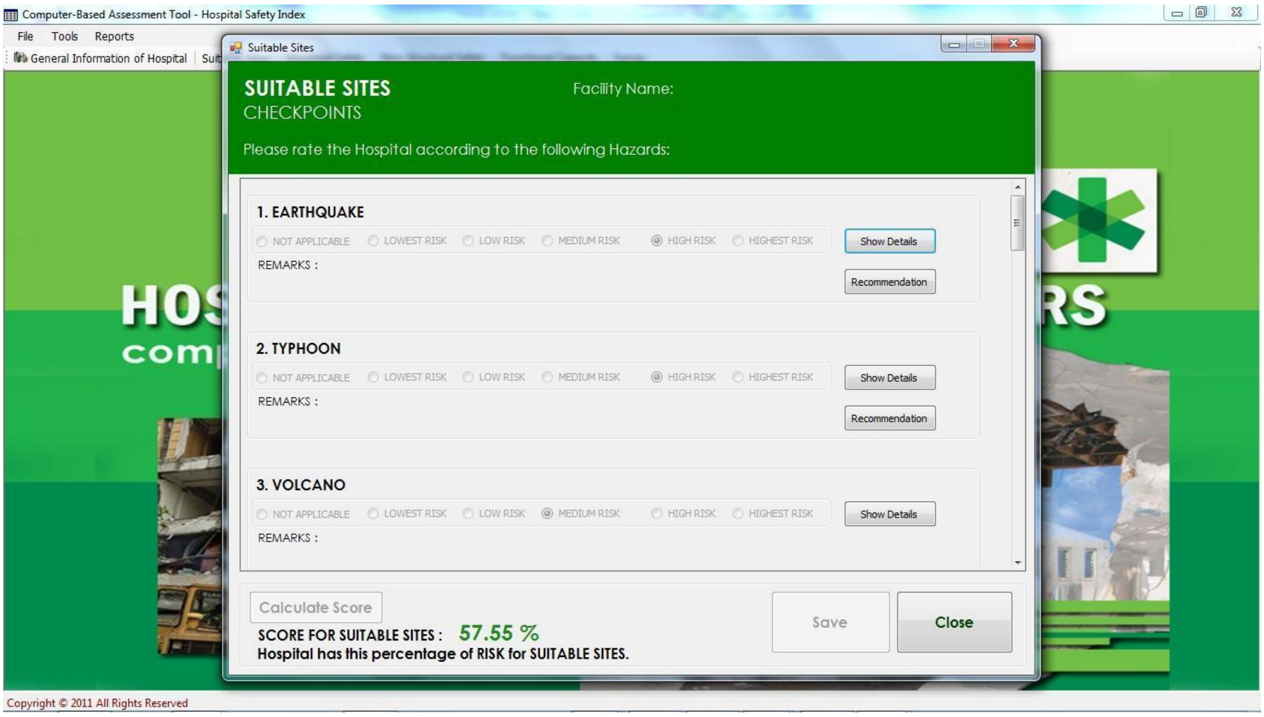


Figure 36 Suitable Sites Module

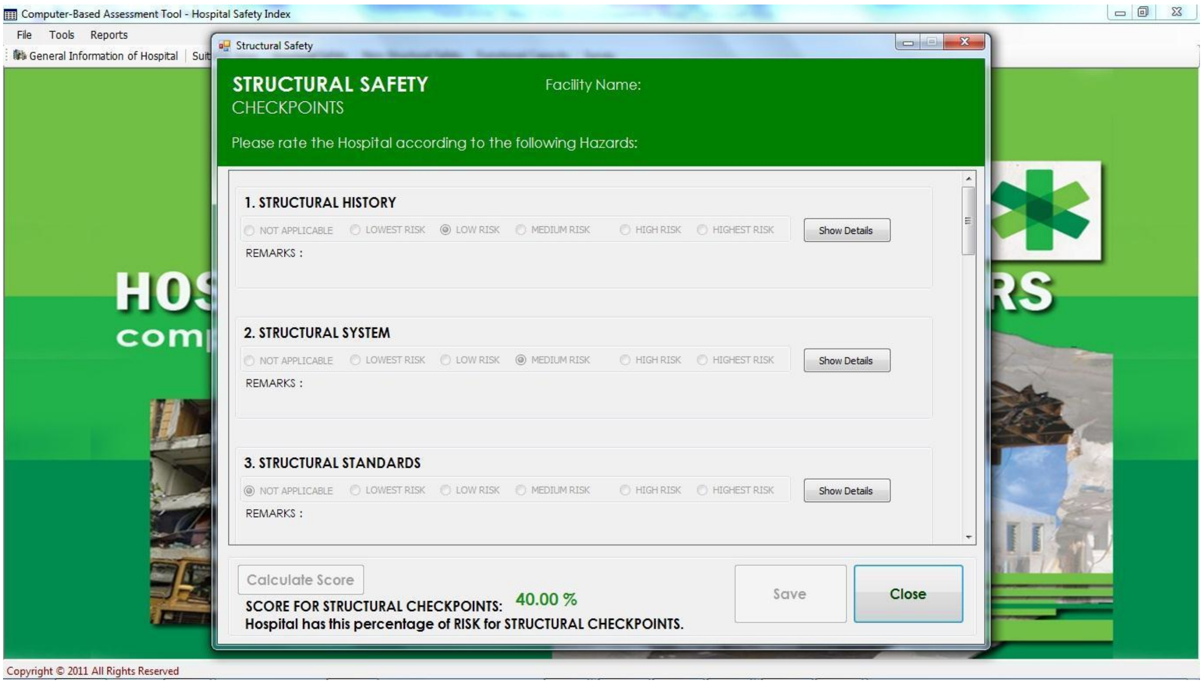


Figure 37 Structural Safety Module

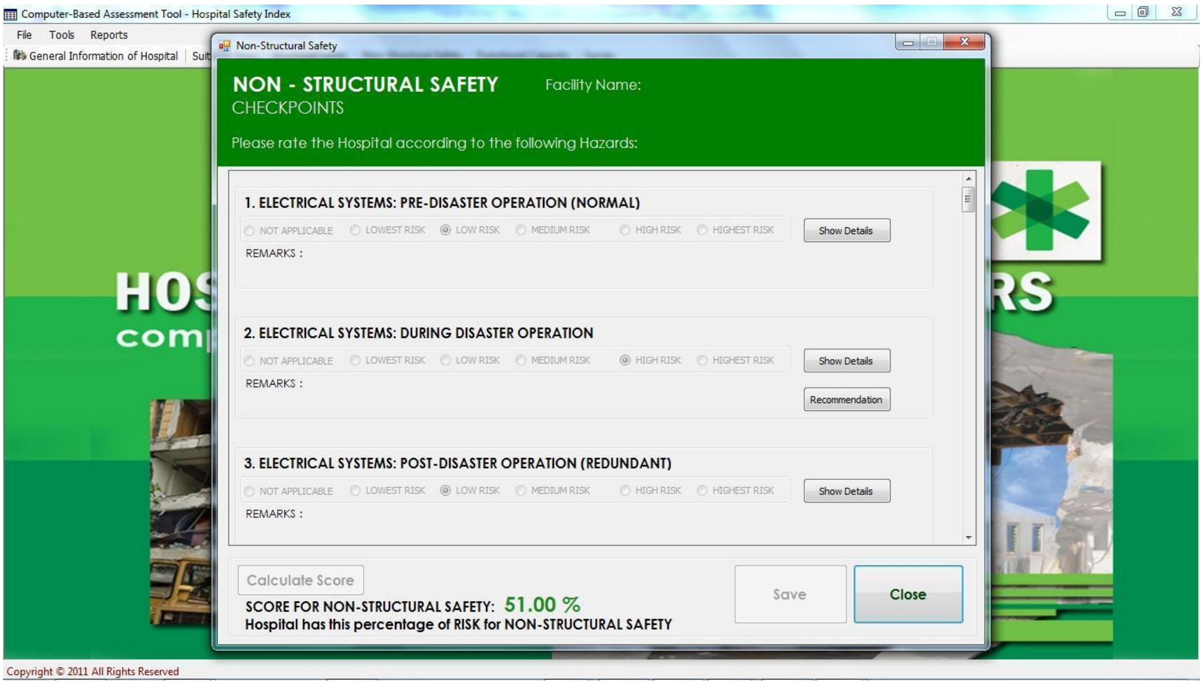


Figure 38 Non-Structural Safety Module

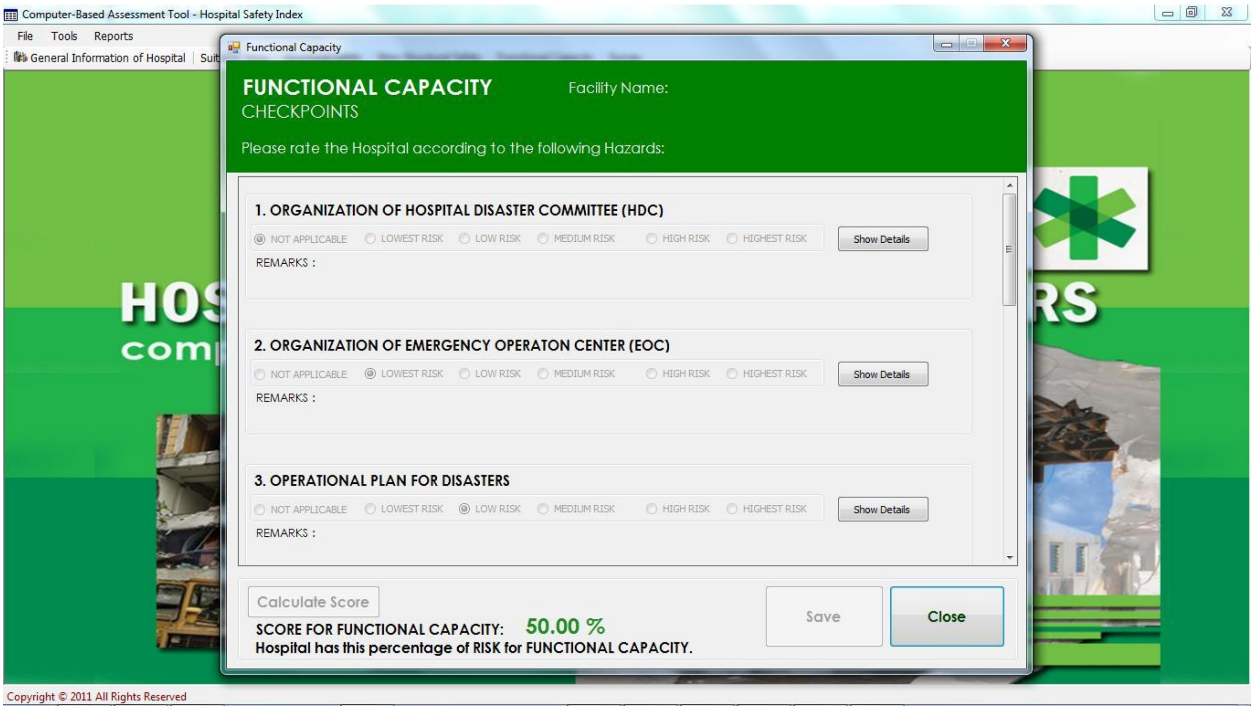


Figure 39 Functional Capacity Module

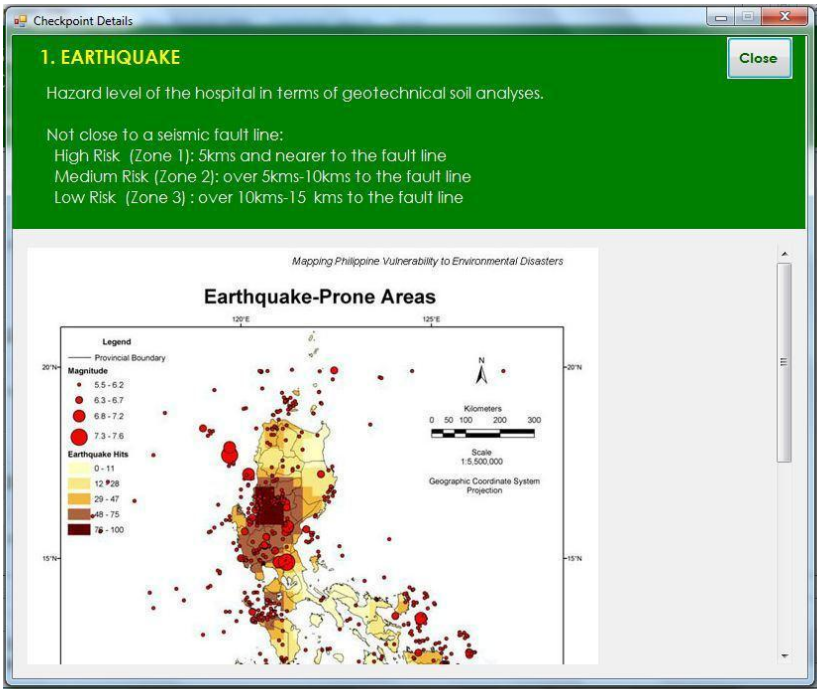


Figure 40 Details Dialog

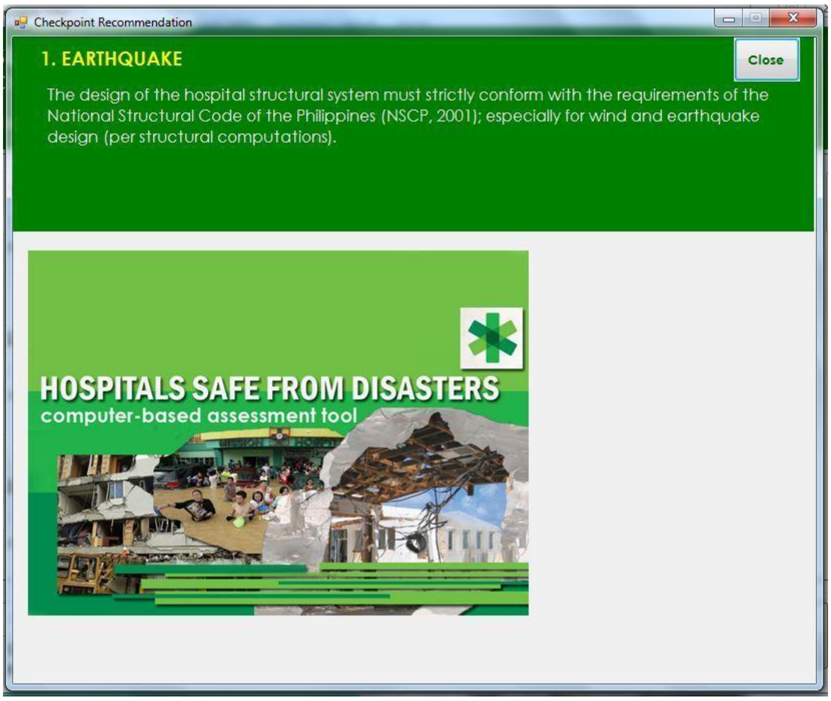


Figure 41 Recommendations Dialog

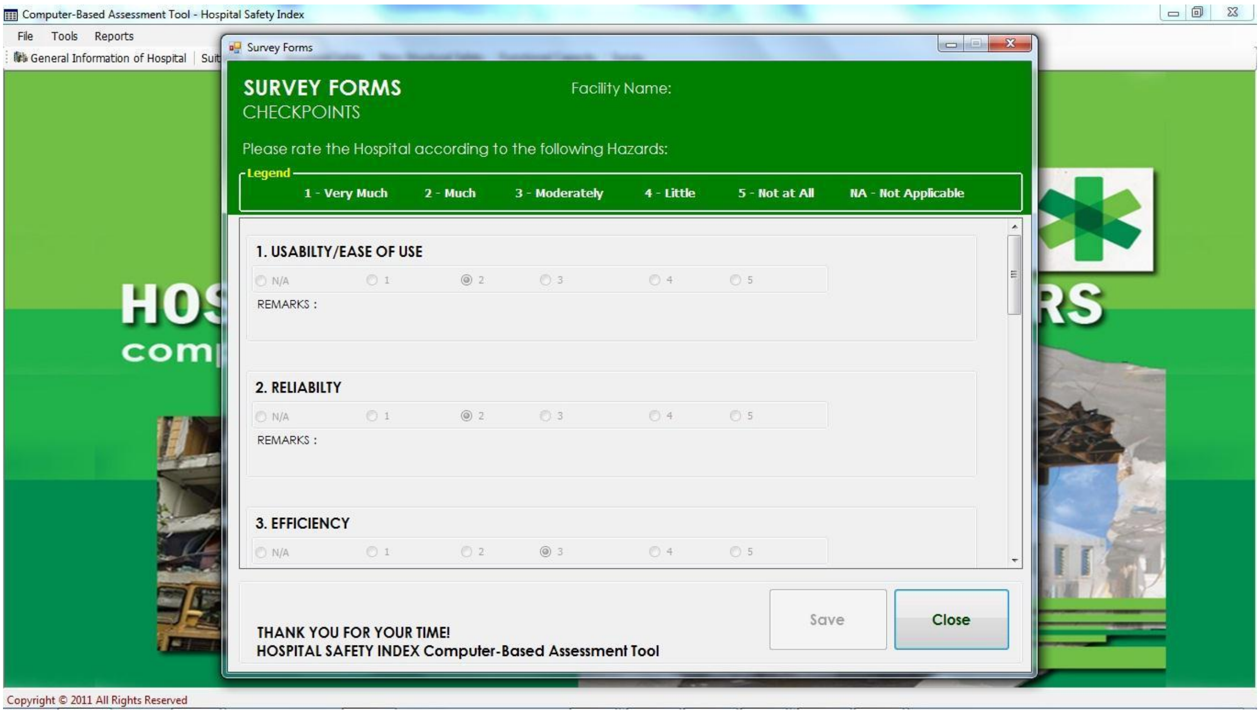


Figure 42 Survey Module

REPORT MODULES

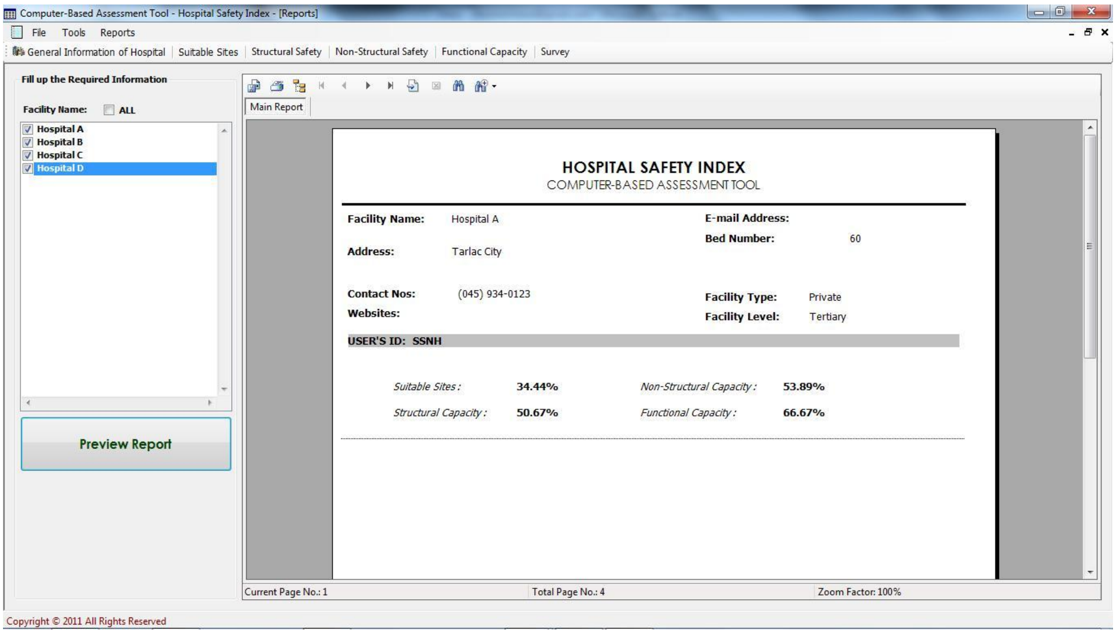


Figure 43 Report - Modules (Hospital “Disaster-Safe Scores”)

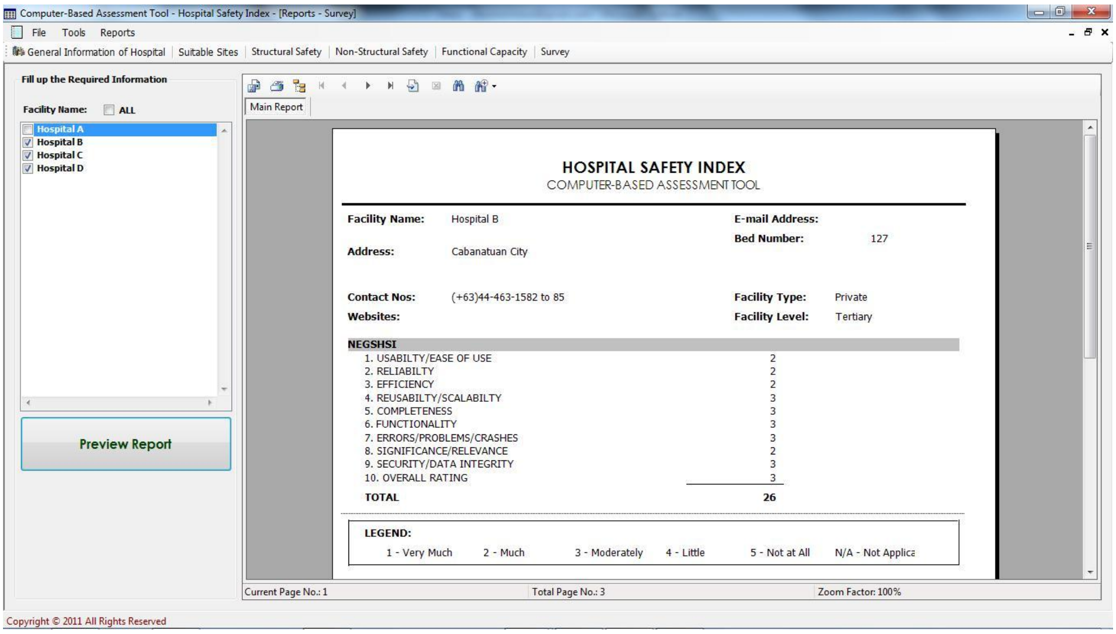


Figure 44 Report - Survey

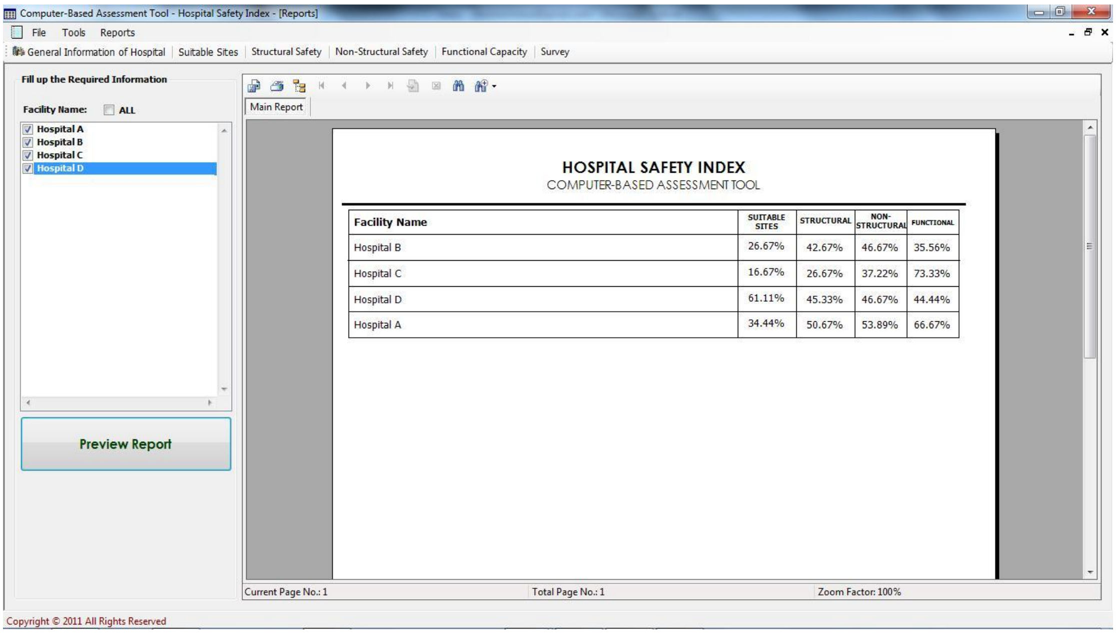


Figure 45 Report - Facility Comparison

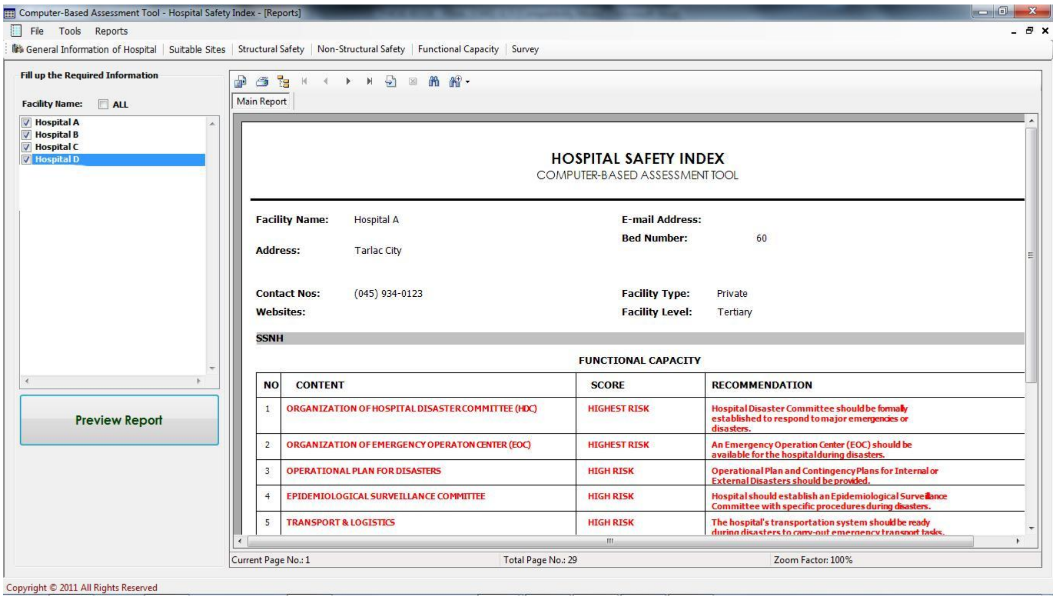


Figure 46 Report - Recommendation Report

5.2.4 Database Structure:

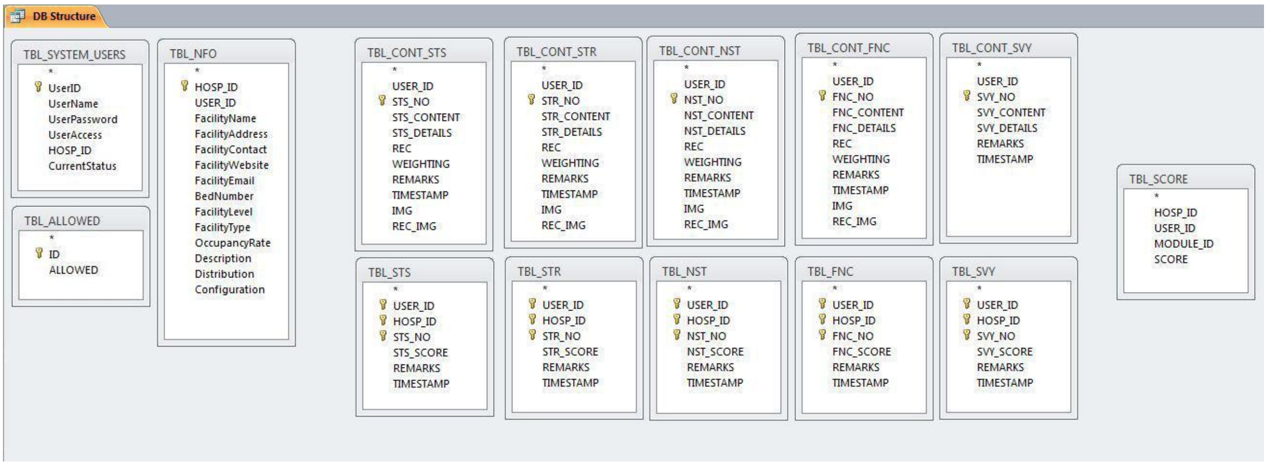
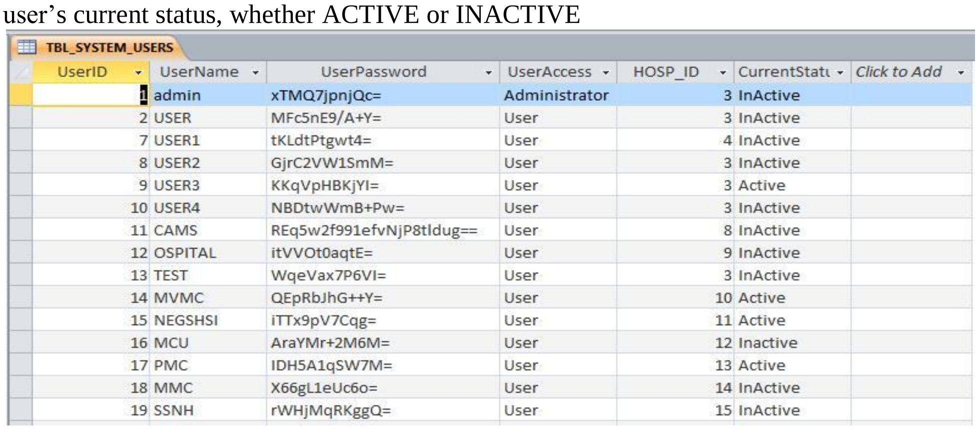


Figure 47 HSFDCBAT Database Structure

TABLES:

- System Users Table (TBL_SYSTEM_USERS) – this table contains the user information, user name and encrypted password, user access whether ADMIN or normal USER, the hospital the user is affiliated with and the user's current status, whether ACTIVE or INACTIVE



TBL_SYSTEM_USERS

UserID	UserName	UserPassword	UserAccess	HOSP_ID	CurrentStatu	Click to Add
1	admin	xTMQ7jpnjQc=	Administrator	3	InActive	
2	USER	MFc5nE9/A+Y=	User	3	InActive	
7	USER1	tKLdtPtgwt4=	User	4	InActive	
8	USER2	GjrC2VW1SmM=	User	3	InActive	
9	USER3	KKqVpHBKjYI=	User	3	Active	
10	USER4	NBDtwWmB+Pw=	User	3	InActive	
11	CAMS	REq5w2f991efvNjP8tIdug==	User	8	InActive	
12	OSPITAL	itVVOt0aqtE=	User	9	InActive	
13	TEST	WqeVax7P6VI=	User	3	InActive	
14	MVMC	QEpRbJhG++Y=	User	10	Active	
15	NEGSHSI	iTTx9pV7Cqg=	User	11	Active	
16	MCU	AraYMr+2M6M=	User	12	Inactive	
17	PMC	IDH5A1qSW7M=	User	13	Active	
18	MMC	X66gL1eUc6o=	User	14	InActive	
19	SSNH	rWHjMqRKggQ=	User	15	InActive	

Figure 48 System Users Table

- Allowed Users Table (TBL_ALLOWED) - this table stores the authorized type of user access for the system

- Table for General Information of Hospital (TBL_NFO) – this table stores the general information on the hospital composed of the facility name, address, contact details, email address, website, number of beds, facility level, facility type, occupancy rate, description and hospital configuration

TBL_NFO

HOSP_ID	USER_ID	FacilityName	FacilityAddress	FacilityContact
11	1	Hospital B	Cabanatuan City	(+63)44-463-1582 to 8
13	1	Hospital C	Nueva Ecija	044(463-7856)
14	1	Hospital D	Makiti City	(632) 8888 999
15	1	Hospital A	Tarlac City	(045) 934-0123
(New)				

Figure 49 General Information Table

- Content Table for Suitable Sites (TBL_CONT_STS) – stores the checkpoint contents for Suitable Sites, including the details, recommendations and the weight of the checkpoint

TBL_CONT_STS

USER_ID	STS_NO	STS_CONTENT	STS_DETAILS	REC	WEIGHTING
1	1	EARTHQUAKE	Hazard level of the hospital in terms of geotechnical soil analyses.	The design of t	1
1	2	TYPHOON	Not within typhoon zone:	Coordinate wit	1
1	3	VOLCANO	Refer to hazard maps of the region to rate the hospital's exposure to hazard in t	Coordinate wit	1
1	4	TSUNAMI	Level of hazard for the hospital in terms of previous tsunami events caused by s	Earthquake-inc	1
1	5	LANDSLIDE	Refer to geological maps to rate the hospital's level of exposure to landslide ha	Vulnerability t	1
1	6	TORRENTIAL RAINS	Rate the hazard level for the hospital in relation to flooding due to intensive rai	Experts offere	1
1	7	STORM SURGE	Hospital's level of exposure to storm surge or river flooding or hazards based or	Fixed wall stru	1
1	8	LIQUEFACTION	With reference to the geotechnical soil analysis at the hospital site, rate the le	Methods to mi	1
1	9	UNSTABLE SLOPES	Refer to geological maps and specify the hospital's exposure to hazards from th	Coordinate wit	1
1	10	EPIDEMIC	With reference to any past incidents at the hospital and specific pathogens, rate	Health person	1
1	11	CONTAMINATION	With reference to any past incidents involving contamination, rate the hospital'	Urgent interve	1
1	12	FIRE	With reference to the exterior of the hospital building, rate the hospital's expo	The design of t	1
1	13	PEST INFESTATION	With reference to the location and past incidents at the hospital, rate the hospi	Mitigate pest i	1
1	14	TERRORISM	With reference to the hospital's surroundings, rate the hospital's exposure to t	Refer to FEMA	1
1	15	EXPLOSION	With reference to the hospital's surroundings, rate the hospital's exposure to e	Explosion haza	1
1	16	HAZARDOUS MATERIAL SI	With reference to the hospital's surroundings, rate the hospital's exposure to h	All significant r	1
1	17	SOCIAL PHENOMENA	Hospital's exposure to hazard in relation to the type of population it serves, its	Reconstruction	1
1	18	RADIOACTIVITY	With reference to the hospital's surroundings, rate the hospital's possible expo	Refer to World	1
	(New)				

Figure 50 Content Table for Suitable Sites

- Content Table for Structural Safety (TBL_CONT_STR) - stores the checkpoint contents for Structural Safety, including the details, recommendations and the weight of the checkpoint

TBL_CONT_STR

USER_ID	STR_NO	STR_CONTENT	STR_DETAILS	REC	WEIGHTING
1	1	STRUCTURAL HISTORY	The evaluators will determine whethe	Historical accou	1
1	2	STRUCTURAL SYSTEM	The hospital structural system must be	Adequate struc	1
1	3	STRUCTURAL STANDARDS	The design of the hospital structural sy	Refer to Natior	1
1	4	CONDITION OF BUILDING	High Risk = Deterioration caused by we	Regularly checl	1
1	5	CONSTRUCTION MATERIALS	For example, when the structure is bui	Construction M	1
1	6	FORM IRREGULARITIES	The shape and form of the hospital bui	If hospital shap	1
1	7	HOSPITAL SIZE (PHYSICAL)	The physical hospital size is determine	Structural prop	1
1	8	FOUNDATIONS	Appropriate soil studies from boring te	Geotechnical s	1
1	9	ADJACENT STRUCTURES	Proximity of buildings (hazards of pou	Refer to Natior	1
1	10	STRUCTURAL REDUNDANCY	High = Fewer than three lines of resist	Refer to Natior	1
1	11	STRUCTURAL RESILIENCE	Estimate structural behavior in respon	Refer to Natior	1
1	12	CONTINUING CHECK	The hospital structural system must be	Hospital admin	1
1	13	AS-BUILT PLANS	As-Built/As Found Plans of all hospital	Secure necessa	1
1	14	PERMITS	Building Permit and Occupancy Permit	Permits as requ	1
	(New)				

Figure 51 Content Table for Structural Safety

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- Content Table for Non-Structural Safety (TBL_CONT_NST) - stores the checkpoint contents for Non-Structural Safety, including the details, recommendations and the weight of the checkpoint

TBL_CONT_NST

USER_ID	NST_NO	NST_CONTENT	NST_DETAILS	REC	WEIGHTING
1	1	ELECTRICAL SYSTEMS: PRE-DISASTER OPERATION (NORMAL)	Electrical system conforms with t	Refer to the Ph	1
1	2	ELECTRICAL SYSTEMS: DURING DISASTER OPERATION	Verify that the generator begins	Refer to Philip	1
1	3	ELECTRICAL SYSTEMS: POST-DISASTER OPERATION (REDUNDANT)	The failure of local power suppli	Redundant pov	1
1	4	TELECOMMUNICATION SYSTEMS: PRE-DISASTER OPERATION (NOR	The conditions of the following c	Proper check o	1
1	5	TELECOMMUNICATION SYSTEMS: DURING DISASTER OPERATION	The evaluators should confirm th	Anchorage for	1
1	6	TELECOMMUNICATION SYSTEMS: POST-DISASTER OPERATION (REI	The evaluator will check the con	Alternative cor	1
1	7	WATER SUPPLY SYSTEM: PRE-DISASTER OPERATION (NORMAL)	The conditions of the following c	Conditions of v	1
1	8	WATER SUPPLY SYSTEM: DURING DISASTER OPERATION	Water tank has permanent reser	Water supply s	1
1	9	WATER SUPPLY SYSTEM: POST-DISASTER OPERATION (REDUNDAN	Alternative water supply to majc	Alternative wa	1
1	10	FUEL STORAGE: PRE-DISASTER OPERATION (NORMAL)	The conditions of the following c	The conditions	1
1	11	FUEL STORAGE: DURING DISASTER OPERATION	Fuel tanks and/or cylinders are a	Anchorage for	1
1	12	FUEL STORAGE: POST-DISASTER OPERATION (REDUNDANT)	Fuel leakages are extremely dan	Fuel tanks/stor	1
1	13	MEDICAL GASES: PRE-DISASTER OPERATION (NORMAL)	The condition of the following cc	Condition of th	1
1	14	MEDICAL GASES: DURING DISASTER OPERATION	Gas tanks and cylinders are locat	Anchorage for	1
1	15	MEDICAL GASES: POST-DISASTER OPERATION (REDUNDANT)	Availability of alternative source	Alternative sou	1
1	16	HVAC SYSTEMS: PRE-DISASTER OPERATION (NORMAL)	Conditions for the following com	The hospital's I	1
1	17	HVAC SYSTEMS: DURING DISASTER OPERATION	Anchorage for HVAC equipment	Provide afficie	1
1	18	HVAC SYSTEMS: POST-DISASTER OPERATION (REDUNDANT)	Because they are critical elemen	Redundant sys	1
1	19	FURNISHINGS AND EQUIPMENT: PRE-DISASTER OPERATION (NORI	Condition of office furnishings ar	Condition of of	1
1	20	FURNISHINGS AND EQUIPMENT: DURING DISASTER OPERATION	Evaluators should check that she	Anchorage of f	1
1	21	FURNISHINGS AND EQUIPMENT: POST-DISASTER OPERATION (REC	Furnishings and equipment shou	Provide furnish	1
1	22	MEDICAL AND LABORATORY EQUIPMENT: PRE-DISASTER OPERATI	Condition and safety of the equi	Regularly checl	1
1	23	MEDICAL AND LABORATORY EQUIPMENT: DURING DISASTER OPER	Evaluators should verify that she	Proper anchora	1
1	24	MEDICAL AND LABORATORY EQUIPMENT: POST-DISASTER OPERAT	Medical and laboratory equipme	Medical and lal	1

Figure 52 Content Table for Non-Structural Safety

- Content Table for Functional Capacity (TBL_CONT_FNC) - stores the checkpoint contents for Functional Capacity, including the details, recommendations and the weight of the checkpoint

TBL_CONT_FNC

USER_ID	FNC_NO	FNC_CONTENT	FNC_DETAIL	REC	WEIGHTING
1	1	ORGANIZATION OF HOSPITAL DISASTER COMMITTEE (HDC)	Hospital Disast	Hospital Disast	1
1	2	ORGANIZATION OF EMERGENCY OPERATON CENTER (EOC)	Evaluates the H	An Emergency	1
1	3	OPERATIONAL PLAN FOR DISASTERS	Operational Pl	Operational Pl	1
1	4	EPIDEMIOLOGICAL SURVEILLANCE COMMITTEE	Evaluators sho	Hospital shoul	1
1	5	TRANSPORT & LOGISTICS	Confirm that th	The hospital's t	1
1	6	CONTINGENCY PLAN FOR MEDICAL TREATMENTS IN DISASTERS	The evaluators	Contingency pl	1
1	7	PLANS FOR OPERATION, PREVENTIVE MAINTENANCE AND RESTORATION OF CRI	Determine wh	Plans for opera	1
1	8	AVAILABILITY OF MEDICINES, SUPPLIES, INSTRUMENTS OR EQUIPMENTS FOR USE	The availability	The availability	1
1	9	HIGHLY INFECTIOUS DISEASES	These are addi	Highly infectio	1
*	(New)				

Figure 53 Content Table for Functional Capacity

- Content Table for Survey (TBL_CONT_SVY) – this table contains the items for evaluation in the survey for HSFDCBAT user satisfaction rating

TBL_CONT_SVY

USER_ID	SVY_NO	SVY_CONTENT	SVY_DETAILS	REMARKS
1	1	USABILTY/EASE OF USE		
1	2	RELIABILTY		
1	3	EFFICIENCY		
1	4	REUSABILTY/SCALABILTY		
1	5	COMPLETENESS		
1	6	FUNCTIONALITY		
1	7	ERRORS/PROBLEMS/CRASHES		
1	8	SIGNIFICANCE/RELEVANCE		
1	9	SECURITY/DATA INTEGRITY		
1	10	OVERALL RATING		
*	(New)			

Figure 54 Content Table for Survey

- Safe Score Table for Suitable Sites (TBL_STS) – storage table for the scores selected by the user for the Suitable Sites module

TBL_STS

USER_ID	HOSP_ID	STS_NO	STS_SCORE	REMARKS	TIMESTAMP
1	3	1	5		
1	3	2	5		
1	3	3	4		
1	3	4	4		
1	3	5	4		
1	3	6	3		
1	3	7	4		
1	3	8	4		
1	3	9	3		
1	3	10	4		
1	3	11	3		

Figure 55 Safe Score Table for Suitable Sites

- Safe Score Table for Structural Safety (TBL_STR) – storage table for the scores selected by the user for the Structural Safety module

TBL_STR

USER_ID	HOSP_ID	STR_NO	STR_SCORE	REMARKS	TIMESTAMP
1	3	1	3		
1	3	2	4		
1	3	3	1		
1	3	4	2		
1	3	5	4		
1	3	6	3		
1	3	7	3		
1	3	8	5		
1	3	9	4		
1	3	10	3		
1	3	11	1		
1	3	12	2		

Figure 56 Safe Score table for Structural Safety

- Safe Score Table for Non-Structural Safety (TBL_NST) – storage table for the scores selected by the user for the Non-Structural Safety module

TBL_NST

USER_ID	HOSP_ID	NST_NO	NST_SCORE	REMARKS	TIMESTAMP
1	3	1	3		
1	3	2	5		
1	3	3	3		
1	3	4	3		
1	3	5	2		
1	3	6	1		
1	3	7	3		
1	3	8	4		
1	3	9	5		
1	3	10	6		
1	3	11	5		
1	3	12	4		

Figure 57 Safe Score Table for Non-Structural Safety

- Safe Score Table for Functional Capacity (TBL_FNC) – storage table for the scores selected by the user for the Functional Capacity module

TBL_FNC

USER_ID	HOSP_ID	FNC_NO	FNC_SCORE	REMARKS	TIMESTAMP
1	3	1	1		
1	3	2	2		
1	3	3	3		
1	3	4	4		
1	3	5	5		
1	3	6	6		
1	3	7	5		
1	3	8	4		
1	3	9	3		
1	3	10	2		
2	3	1	3		
2	3	2	2		
2	3	3	3		

Figure 58 Safe Score Table for Functional Capacity

- Safe Score Table for Survey (TBL_SVY) – storage table for the scores selected by the user for the Structural Safety module

TBL_SVY

USER_ID	HOSP_ID	SVY_NO	SVY_SCORE	REMARKS	TIMESTAMP
1	3	1	3		
1	3	2	3		
1	3	3	4		
1	3	4	5		
1	3	5	6		
1	3	6	5		
1	3	7	4		
1	3	8	3		
1	3	9	2		
1	3	10	1		
2	3	1	3		
2	3	2	3		

Figure 59 Safe Score Table for Survey

- Safe Score Summary Table (TBL_SCORE) – contains the User ID, Hospital ID, Module ID and the corresponding score for that module.

TBL_SCORE

HOSP_ID	USER_ID	MODULE_ID	SCORE
3	1	STS	57.55
3	1	STR	40.00
3	1	NST	51.00
3	1	FNC	50.00
3	2	STS	59.00
3	2	STR	51.00
3	2	NST	48.00
3	2	FNC	46.00
3	8	STS	38.06
4	7	STS	47.00
4	7	STR	47.00
4	7	NST	53.00

Figure 60 Safe Score Summary Table

QUERIES

- Query for Suitable Sites Safe Score (QRY_STS) – a database query in getting the disaster-readiness rating (% risk) for the Suitable Sites module

- Query for Structural Safety Score (QRY_STR) - a database query in getting the disaster-readiness rating (% risk) for the Structural Safety module

- Query for Non-Structural Safety Safe Score (QRY_NST) - a database query in getting the disaster-readiness rating (% risk) for the Non-Structural Safety module

- Query for Functional Capacity Safe Score (QRY_FNC) - a database query in getting the disaster-readiness rating (% risk) for the Functional Capacity module

- Query for Survey (QRY_SVY) - a database query in getting the user satisfaction rating based on the use of HSFDCBAT

- Query for Module Safe Score Reports (QRY_STS) – a database query to retrieve the data for the Module Reports from the database

- Query for Comparison Reports (QRY_COMPARISON) – a database query to retrieve the data for the Comparison Reports from the database

Query for Recommendation Reports (QRY_REP_MODULES) – a database query to retrieve the data for the Recommendation Reports from the database

6 DISCUSSION OF HEALTH FACILITIES

Due to the sensitivity of the data gathered and the agreed upon confidentiality and anonymity with the health facilities involved in this research work, only some minor information and minimal, non-specific data relevant to the study are divulged in this paper.

6.1 Hospital A

6.1.1 Bed Capacity. The bed capacity for Hospital A is forty (40) beds with 85% occupancy rate.

6.1.2 Area. Approximate Gross Floor Area for Hospital A is around 2,000 square meters

6.1.3 Shape & Size. Relatively small tertiary hospital with a basic L-shaped footprint including annex. It has four (4) storeys with roof deck.

6.1.4 Building History. Main building was constructed in 1992 and the annex building was completed on January 2006

6.1.5 Location. Hospital A is located at the Northern part of Tarlac (Central Luzon)

6.1.6 Contact Person/User Designation. HSFDCBAT was used and assessed by the Hospital Administrator together with its Head of Engineering and Maintenance.

6.1.7 DOH/WHO Workshop. Hospital personnel involved in the study have not attended any workshop on Safe Hospitals at the time of study.

Figure 61 Sample Floor Plan of Hospital A

Figure 62 Facade of Hospital A

Figure 63 Hospital A Annex Building

6.2 Hospital B

6.2.1 Bed Capacity. The hospital bed capacity for Hospital B is 127 beds with a 70% occupancy rate.

6.2.2 Area. Approximate Gross Floor Area for Hospital A is around 5,400 square meters

6.2.3 Shape & Size. Medium-sized, 2-storey hospital which is mostly rectangular and slightly L-shaped.

6.2.4 Building History. Original structure was built in 1978 and renovation of Hospital B started after 20 years in 1998 and then in 2009 up to present

6.2.5 Location. Hospital B is located at Nueva Ecija, Central Luzon.

6.2.6 Contact Person/User. Contact for this hospital is a Maintenance Officer/Pollution Control Officer.

6.2.7 DOH/WHO Workshop. Attended WHO/DOH Workshop on March 2011 at Angeles City, Pampanga

Figure 64 Facade of Hospital B (Building 1)

Figure 65 Facade of Hospital B (Building 2)

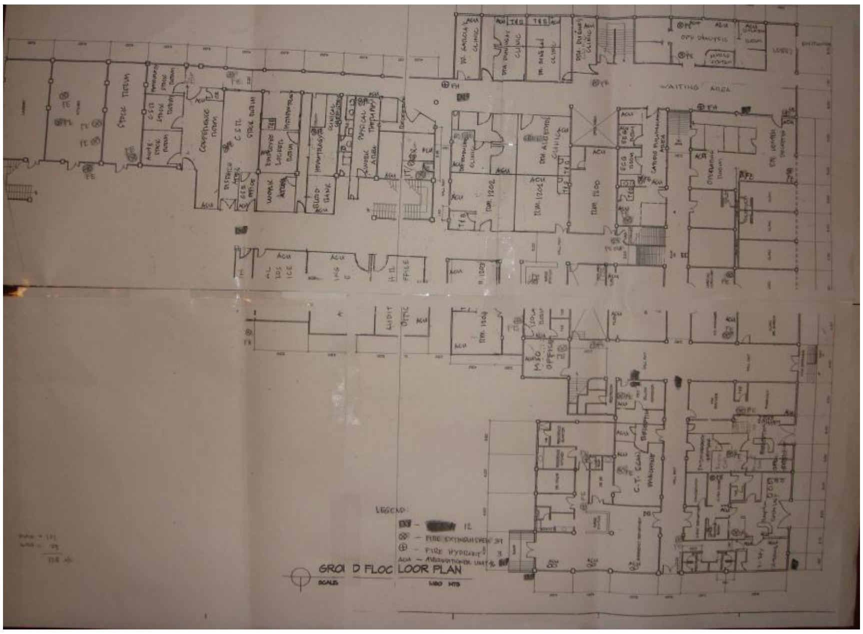

Figure 66 Sample Floor Plan of Hospital B

6.3 Hospital C

6.3.1 Bed Capacity. Hospital C has a 150-bed capacity with occupancy rate ranging from 60 to 70%.

6.3.2 Area. Approximate Gross Floor Area for Hospital C is around 4,800 square meters

6.3.3 Shape & Size. Hospital C has a basic rectangular configuration with front façade having a semi-circle shape and has four (4) storeys.

6.3.4 Building History. Original structure was erected in 1996 and expansion was done in 2006

6.3.5 Location. Hospital C is located at Nueva Ecija, Central Luzon.

6.3.6 Contact Person/User. Safety Officer/Security and Facilities Head

6.3.7 DOH/WHO Workshop. Hospital personnel involved in the study have not attended any workshop on Safe Hospitals at the time of study.

Figure 67 Hospital C

Figure 68 Facade of Hospital C

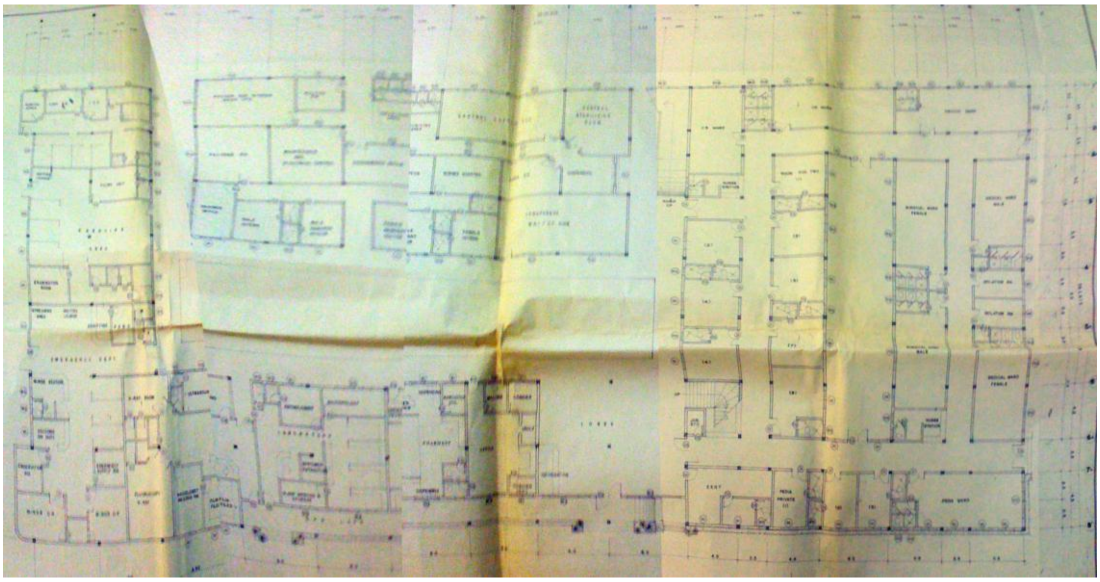

Figure 69 Sample Floor Plan of Hospital C (Main)

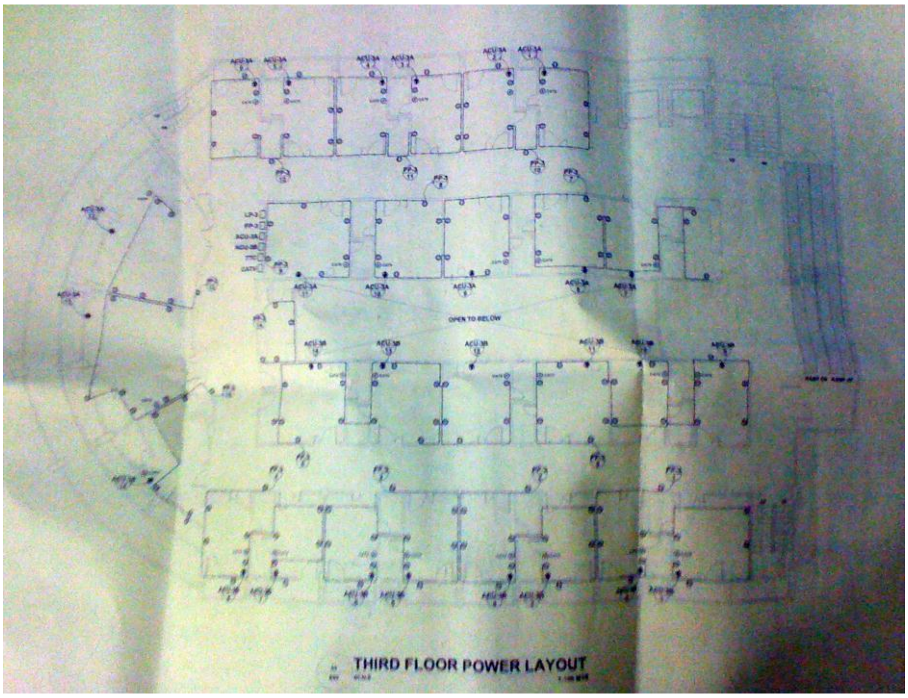

Figure 70 Sample Floor Plan of Hospital C (Front)

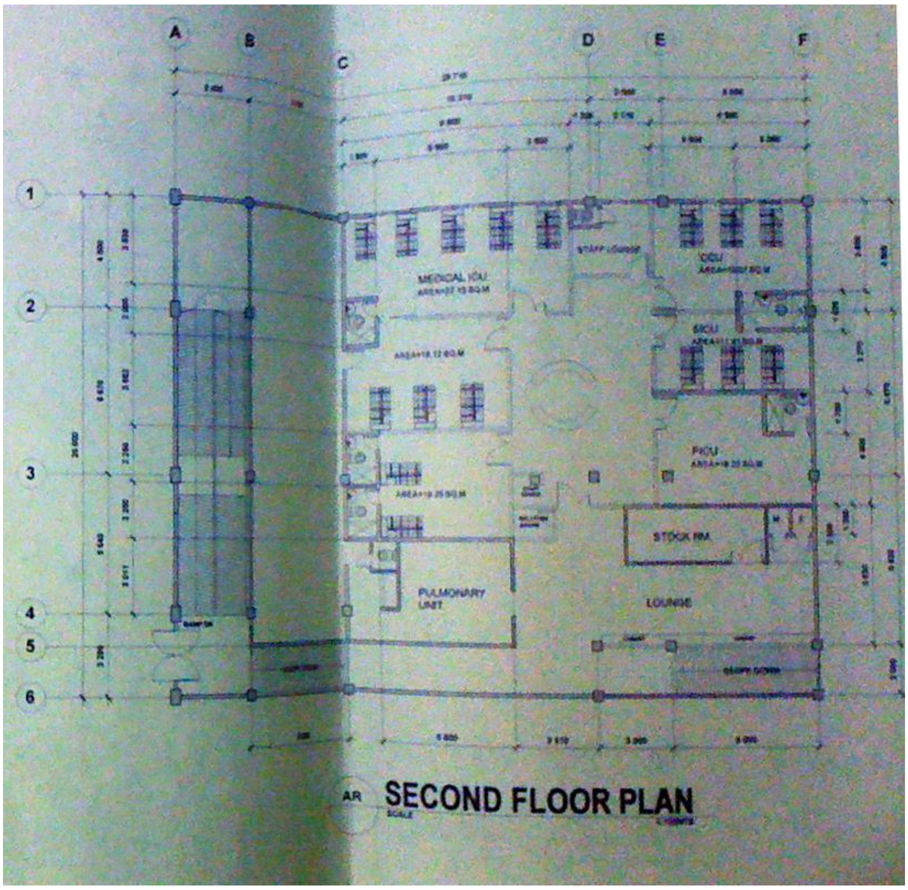

Figure 71. Sample Floor Plan of Hospital C (Rooms)

6.4 Hospital D

6.4.1 Bed Capacity. Hospital D has a 500-bed capacity with occupancy rate of 84 %.

6.4.2 Area. Approximate Gross Floor Area for Hospital D is around 3 hectares.

6.4.3 Shape & Size. Hospital D is a relatively large hospital with a basic rectangular shape for its main building and one in a cylindrical shape within the compound, having two towers, one with ten (10) floors and the other with eight (8) floors. The health facility also has five (5) basement levels for parking.

6.4.4 Building History. Original structure was erected in 1969, continuous improvements, retrofitting and expansions were done up until 2008 when latest expansion was occupied.

6.4.5 Location. Hospital D is located in Metro Manila

6.4.6 Contact Person/User. Safety Officer - Facility Management & Engineering Division

6.4.7 DOH/WHO Workshop. Hospital personnel involved in the study are continuously attending workshop on Safe Hospitals and other seminars on fire and emergencies at the time of study.

Figure 72 Hospital D (Side**)**

Figure 73 Hospital D (New Building)

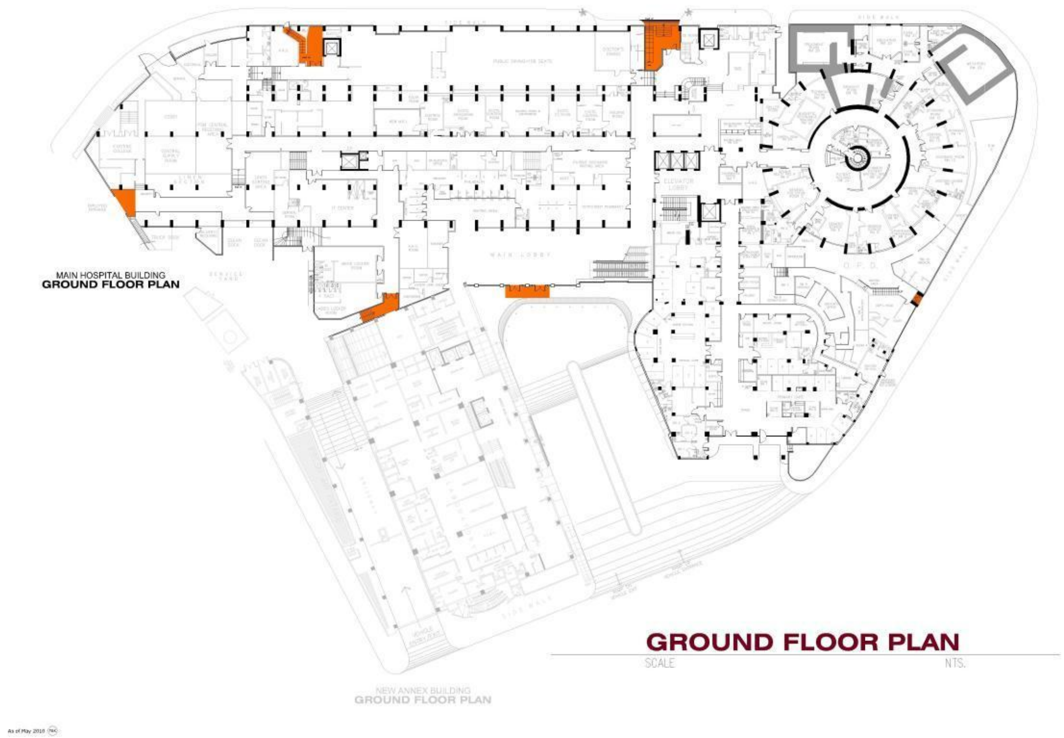

Figure 74 Sample Floor Plan Hospital D

7 FINDINGS & ANALYSIS

7.1 Hospital A

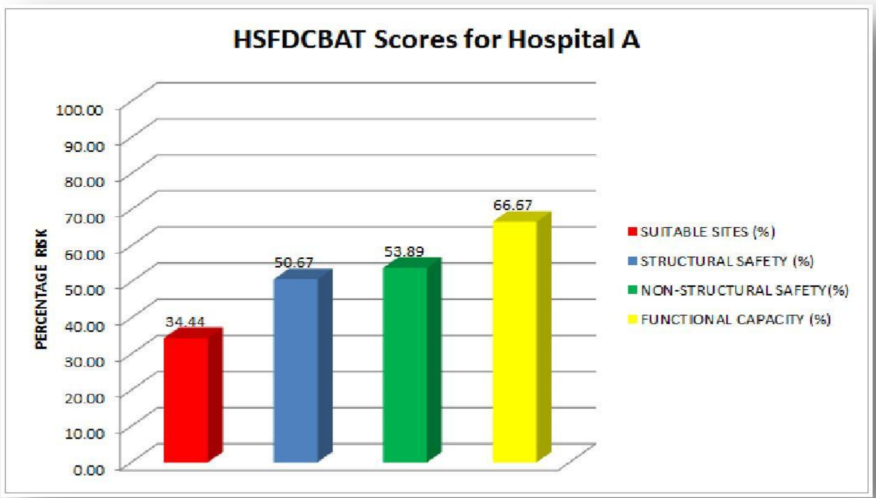

Figure 75 HSFDCBAT Scores for Hospital A

7.1.1 Suitable Sites

Hospital A had a **34.44%** risk for Suitable Sites and its high risk areas include Storm Surge, Fire and Social Phenomena. Being near a river, when the river swells up due to storms, typhoons and torrential rains, the hospital has a high risk of being flooded. Fire is also a concern for the hospital because of inefficient fire exits and non-functional dry stand pipes. For social phenomena, its location being near the plaza and the municipal hall, several cases of untoward incidents have happened within the vicinity of the hospital especially during town fiestas.

7.1.2 Structural

For the structural module**, Hospital A** had a **50.67 %** risk rating. This is mainly because of the high risk areas such as Structural History, Form Irregularities, Adjacent Structures, Continuing Check, As-Built Plans and Permits. The main building of this hospital was built in 1992 and its four-storey annex building was connected to it in 2005, giving it an L-shaped form. This made the hospital's form more irregular and thus, leaving it more susceptible to lateral forces. On its left side is an adjacent church which clearly didn't follow the easement regulations in the National Building Code, posing a major threat to the hospital should disasters like earthquake and fire happen.

After the hospital's numerous renovations and revisions throughout the years, an up-to-date as-built plan is not available in the hospital's records. Also, it has not been checked yet by ASEP or DPWH representatives through rapid evaluation or any other form of structural assessment.

7.1.3 Non-Structural

For the non-structural module, **Hospital A** has a **53.89 %** risk rating. Areas for concern include Telecommunication Systems, Water Supply System, Fuel Storage, Furnishings and Equipment, Medical and Laboratory Equipment, Fire Protection System, Movement outside the Building, Refuge Rooms, Redundant/Open Spaces and Infection Control.

The hospital is not convinced enough that these architectural elements within their hospital can withstand the damage and destruction brought about by disasters. Its water supply system already has leaks, the reserve storage capacity of the overhead water tanks are not enough in case water supply is cut, fuel storage reserve capacity is not enough for the generators and other equipment, fire protection system is not up-to-date and networked, the dry stand pipe is not functional, entrance to the building is too narrow and ends in a cul-de-sac, the hospital has no refuge rooms and redundant/open spaces big enough to accommodate patients in case there will be an influx of disaster-related victims and because of this, infection control cannot be contained by the hospital. These are just some of the major concerns of the hospital in terms of its non-architectural elements.

7.1.4 Functional

Hospital A has a relatively high **66.67%** risk rating for its functional capacity. High risk areas are the Organization of Hospital Disaster Committee (HDC), Organization of Emergency operations Center (EOC) and Contingency Plan for Medical Treatments in Disasters. This high risk is evident because of the absence of the documents, organizations and plans pertaining to the checkpoints mentioned above. The representative of the hospital said that these are still in process for compliance and are still parts of their future action plans.

7.1.5 Survey

The **Hospital A** representative rated the HSFDCBAT with an effective overall rating of **1.40** (with 1.00 being the highest and 5.00 being the lowest, similar to UP" s grading system). The only concern of the user is the occurrence of minor glitches/bugs when the module is being saved. Other than that, the user commended the innovation of the tool, its versatility as well as its ease of use.

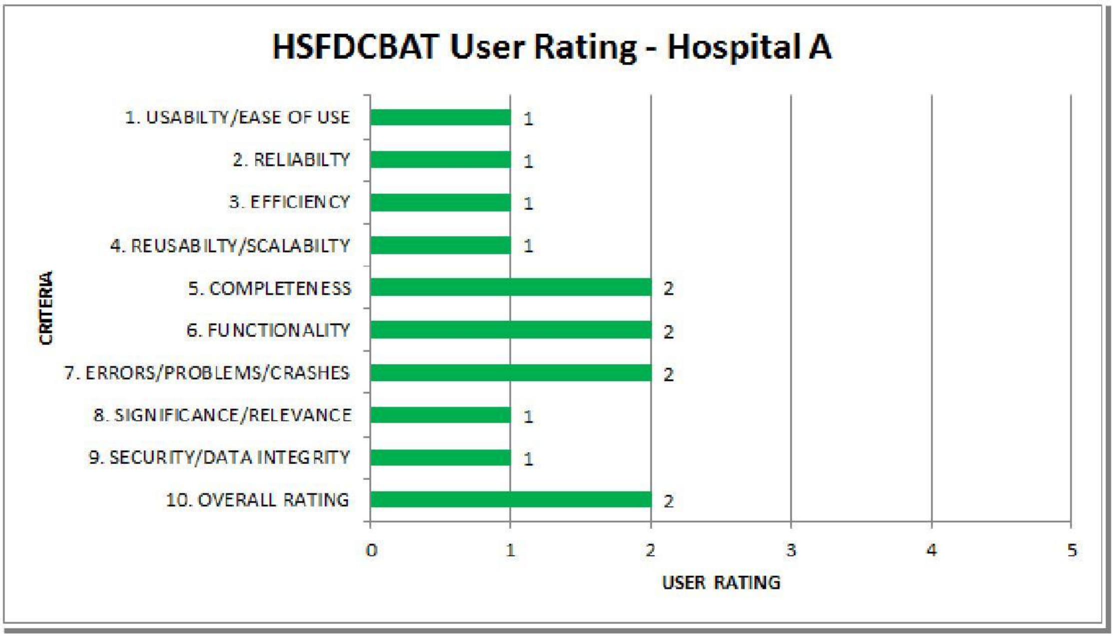

Figure 76 HSFDCBAT User Rating - Hospital A

7.2 Hospital B

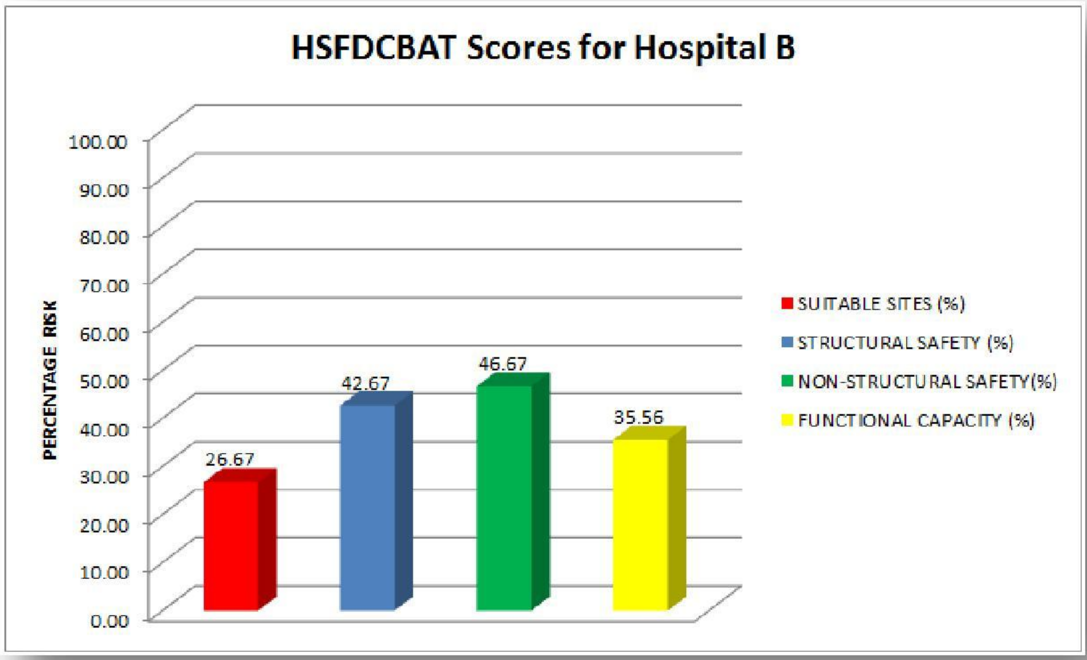

Figure 77 HSFDCBAT Scores for Hospital B

7.2.1 Suitable Sites

Hospital B had a **26.67%** risk for Suitable Sites and its areas for concern include Earthquake, Typhoon, Torrential Rains and Epidemic. The province already experienced a major earthquake in 1990 and this is the main concern for the hospital. Typhoons and torrential rains are also frequently cutting across the region so the threat of floods has always been a cause for alarm. Also, epidemics such as A(H1N1) and Swine Flu have been reported in the area and thus measures are being done to avert these threats.

7.2.2 Structural

For the structural module, **Hospital B** had a **42.67 %** risk rating. This is mainly because of the high risk areas such as Structural Standards, Hospital Size, Foundations, Adjacent Structures and Continuing Checks. Like Hospital A, it has not been checked yet by ASEP or DPWH representatives through rapid evaluation or any other form of structural assessment. The hospital is also surrounded by adjacent structures and buildings that prove to be major threats especially during earthquakes.

For the other areas for concern, the hospital representative was not sure if the foundations for the hospital where sufficient enough to support the building based on the revised structural codes and standards considering its expansion and renovations.

7.2.3 Non-Structural

For the non-structural module, **Hospital B** has a **46.67 %** risk rating. Areas for concern include Telecommunication Systems, Medical Gases, Furnishings and Equipment, Medical and Laboratory Equipment, Movement outside the Building, Refuge Rooms and Redundant/Open Spaces.

Hospital B doesn't have refuge rooms or redundant spaces which are important during disasters. The anchorage for furnishings and laboratory equipment during disasters are also some of the causes for concern as well as the reliability of the telecommunication conduits. Construction materials used based on fire-rated products as advised by the Bureau of Fire Protection (BFP).

7.2.4 Functional

Hospital B has a relatively low **35.56%** risk rating for its functional capacity. Having attended workshops on safe hospitals organized by WHO and DOH, the hospital is already aware of these functional requirements and is already practicing and implementing them. Action plans were developed and then introduced to the hospital management and staff. They already have operational plans for disasters for earthquakes and fire, but for typhoons, it is still in progress. The only concerns for this module are the presence of Epidemiological Surveillance Committee which is not yet fully functional, Transport & Logistics and Highly Infectious Diseases.

7.2.5 Survey

The **Hospital B** representative rated the HSFDCBAT with an effective overall rating of **1.60** (with 1.00 being the highest and 5.00 being the lowest, similar to UP" s grading system). Some of the concerns of the user are completeness, functionality and bugs. The significance and relevance as well as the usability of the system were also lauded by the user.

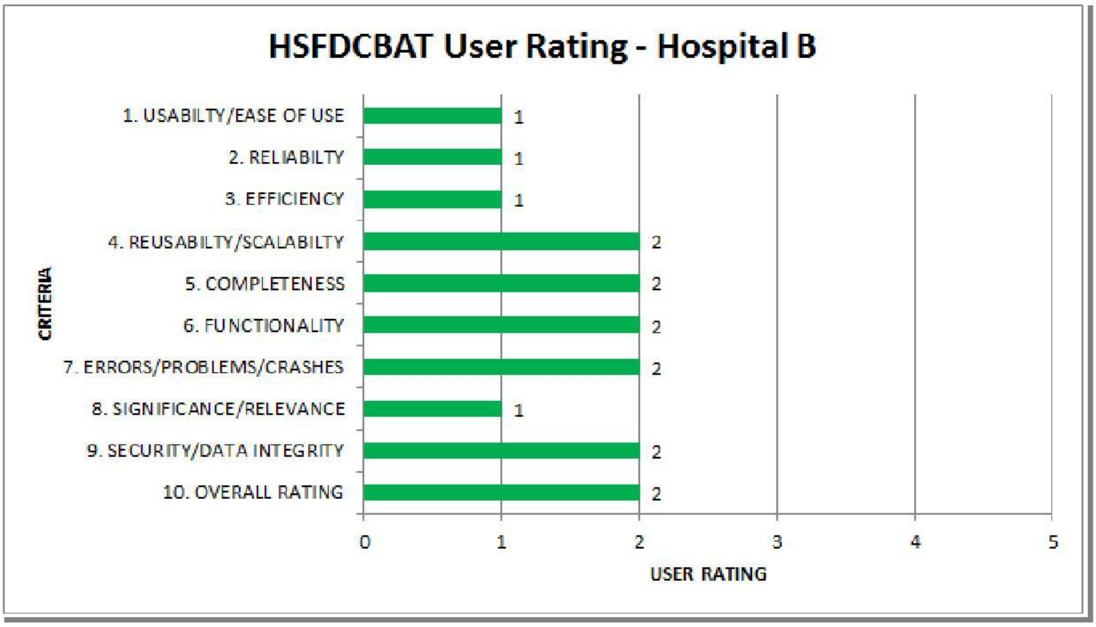

Figure 78 HSFDCBAT User Rating - Hospital B

7.3 Hospital C

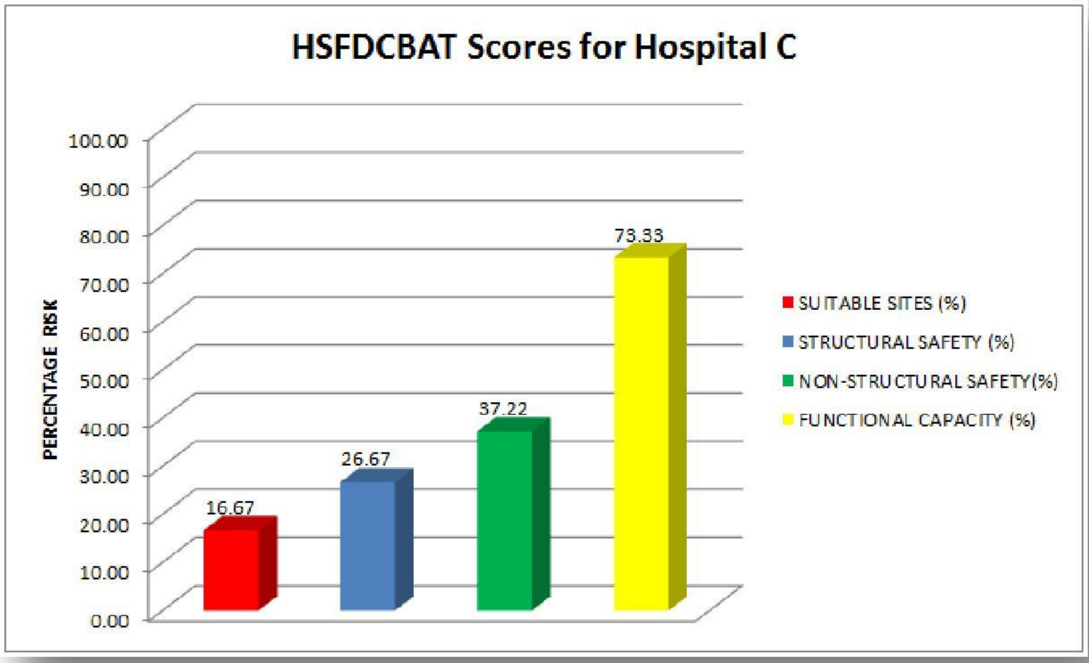

Figure 79 HSFDCBAT Scores for Hospital C

7.3.1 Suitable Sites

Hospital C had a **16.67%** risk for Suitable Sites and its areas for concern from the perception of the hospital representative are Epidemic and Social Phenomena. It can also be noted that Hospital C is within the same location as Hospital A, in the Nueva Ecija Area. So it can also be added that Earthquake, Typhoon and Torrential Rains which cause flash floods in the vicinity are also some points of concern. It can be remembered that on July 16, 1990, Luzon was hit by a 7.8 Magnitude earthquake and Nueva Ecija was one of the most severely affected. On social phenomena, the study showed that patient visitors are usually the cause of problems.

7.3.2 Structural

For the structural module, **Hospital C** had a **26.67 %** risk rating. Similar to the previous hospitals studied, Structural Standards and Continuing Check are the areas of risk for the same reasons. Other areas of concern are Hospital Size and Structural Resilience.

In the study, it was mentioned that cracks are not evident and that there are many revisions but no as-built plan

7.3.3 Non-Structural

For the non-structural module, **Hospital C** has a **37.22 %** risk rating. Areas for concern include Fuel Storage and Water Supply

System. Hospital C also doesn’t have refuge rooms or redundant spaces which are noticeably absent in most of the sample hospitals. It can also be noted that the hospital representative claimed that the hospital is ready for fires because it was his expertise, being a former fire safety officer. On the other hand, he admitted that he was not adept with engineering info because he was newly-installed in position and it was not his expertise but he asked the help of other more knowledgeable reference persons in the hospitals.

According to the hospital representative, early on before his time, requirements on safety were not met by the administration. Then they provided secondary exit based on the Bureau of Fire Protection requirements. He also stressed the importance of fire escapes/fire exits.

Other notable points during the assessment regarding non-structural safety were that the open field surrounding the hospital may act as a redundant space during emergencies; main and standby generator with ATS are available; the hospital has a very limited communication network but with internet. The hospital has no cistern tank and the dry stand pipes are not functional but for compliance only. They have two (2) 5000-gallons reserve tank water capacity and 14 drums of fuel reserve. Medical gases have piping and are regularly delivered, consume 1000 tons per month. They are concerned with leaks, polycarbonate roofs and canopies. Parking and ambulance ingress and egress are also a concern. Pest control is being outsourced. Lastly, medical equipment are provided with locks.

7.3.4 Functional

Hospital C has a very high **73.33%** risk rating for its functional capacity. Similar to Hospital A, this high risk is evident because of the absence of the documents, organizations and plans pertaining to the checkpoints such as the Hospital Disaster Committee (HDC) and Emergency Operations Center (EOC) as well as disaster preparedness plans. These are still in process for compliance and are still parts of their future action plans.

7.3.5 Survey

The **Hospital C** representative rated the HSFDCBAT with an effective overall rating of **1.80** (with 1.00 being the highest and 5.00 being the lowest, similar to UP‟ s grading system). Some of the concerns of the user are completeness, functionality and bugs. The significance and relevance as well as the usability of the system were also lauded by the user. Its reliability and some bugs encountered during the assessment were some of the issues raised by the user.

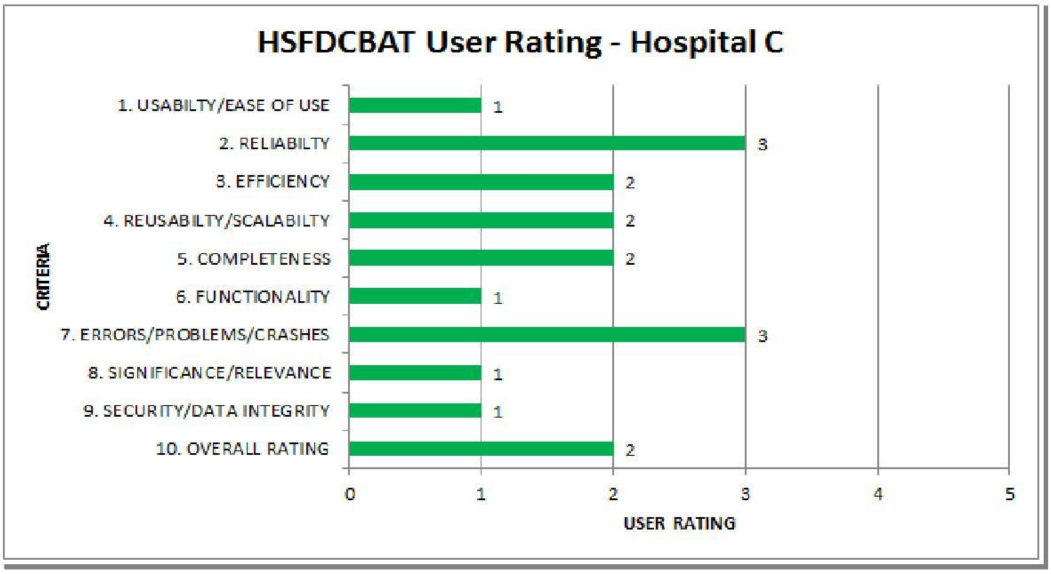

Figure 80 HSFDCBAT User Rating - Hospital C

7.4 Hospital D

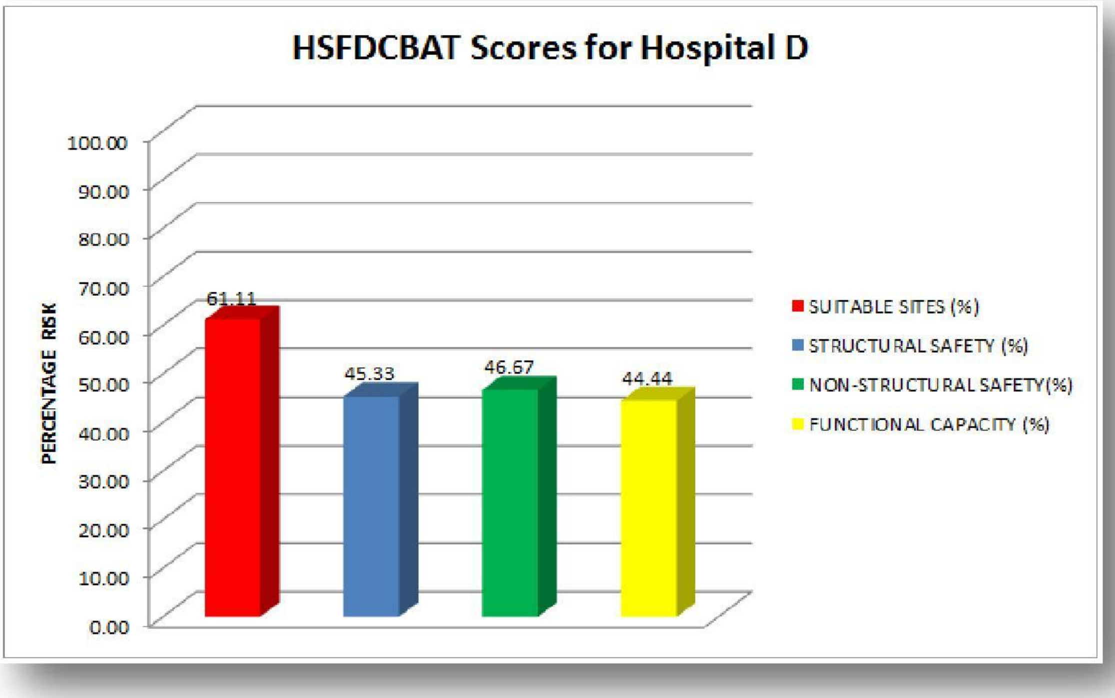

Figure 81 HSFDCBAT Scores for Hospital D

7.4.1 Suitable Sites

Hospital D had a **61.11 %** risk for Suitable Sites. Most of the checkpoints were considered high risk by the hospital representative because of the following explanations:

- Based on Metro Manila Earthquake Impact Reduction Study (MMEIRS), Earthquake: Hospital area is at High Risk, Pasig at Highest Risk
- Typhoons: whole of Philippines at risk with typhoon
- Tsunamis, 5-6 km from Manila Bay, at risk but not much impact
- No liquefaction potential for hospital foundation
- Epidemic, high risk – hospital because of influx of patients with diseases
- Fire – highest risk because of several occurrences of incipient fires in the hospital
- Hazardous wastes - medium risk because of chemicals in hospitals
- Hazardous material spills – high risk
- Terrorism – Explosion, bomb threats, security concerns because of VIP patients

7.4.2 Structural

For the structural module, **Hospital D** had a **45.33 %** risk rating. These were the points raised during the assessment to explain the score:

- Hospital is certified by structural engineers
- No history of structural defects
- Retrofitted old building to meet building code, fire code, structural code, new building was occupied 2008, complies with most of codes
- Minimal cracks
- Irregular shaped with two towers
- Tower 1, 10 floors, Tower 2, 8 floors with 5 basements for parking
- Continuing check – for scheduling
- As built plans –exist
- Permits – PME permit, only Fire Permit is available.

7.4.3 Non-Structural

For the non-structural module, **Hospital D** has a **46.67 %** risk rating. These were some of the points raised by the hospital representative:

- Electrical: 100% back-up system
- Telecom: risk with movement of conduit systems during disasters
- Water: standby water supply system (deep well)
- Fuel storage: 9 days supply, though hospital is near Pandacan area
- Medical gases: 1 week supply of reserve medical oxygen (supplied) and back-up tanks.
- Stable HVAC systems
- Furnitures are movable, Anchored equipment
- Fire protection system not yet fully networked, partial compatibility with other systems. The hospital has no ramp, but as per Bureau of Fire, compartmentalization was used to compensate. In less than 2 years, 4 incipient fires (beginning stage) in the hospital from records of Bureau of Fire.
- Photoluminiscent lights, 100 % backup power
- Refuge rooms – two towers, similar to Petronas Towers in Malaysia
- Redundant space – parking area, agreement with open lot owner
- Strict infection control and pest control

7.4.4 Functional

For the functional module, **Hospital D** has a **44.44 %** risk rating. These were some of the points raised by the hospital representative:

- The hospital is very much prepared when it comes to functional. It has a fire brigade & disaster preparedness committee
- Operational plans are contained in manual
- The hospital has third party ambulances (AeroMed) because according to them, it is difficult to maintain motor pool

- The hospital has contingency plans – tie up with Red Cross, SHAP, tie up with LGU‟ s
- availability of medicines – existence of warehouse
- planning phase in coordination with infection control center
- All staff were trained to respond to emergencies
- Hospital was already surveyed by DOH, headed by Dr. Pesigan of the Emergency and Humanitarian Action (EHA) unit of the WHO Regional Office for the Western Pacific (WPRO) \

7.4.5 Survey

The **Hospital D** representative rated the HSFDCBAT with an effective overall rating of **2.10** (with 1.00 being the highest and 5.00 being the lowest, similar to UP‟ s grading system). Some of the concerns of the user are completeness, functionality and relevance. General comments were to make the tool more detailed and more specific. Security of the tool and the readily available reports as well as the recommendations was commended by the user.

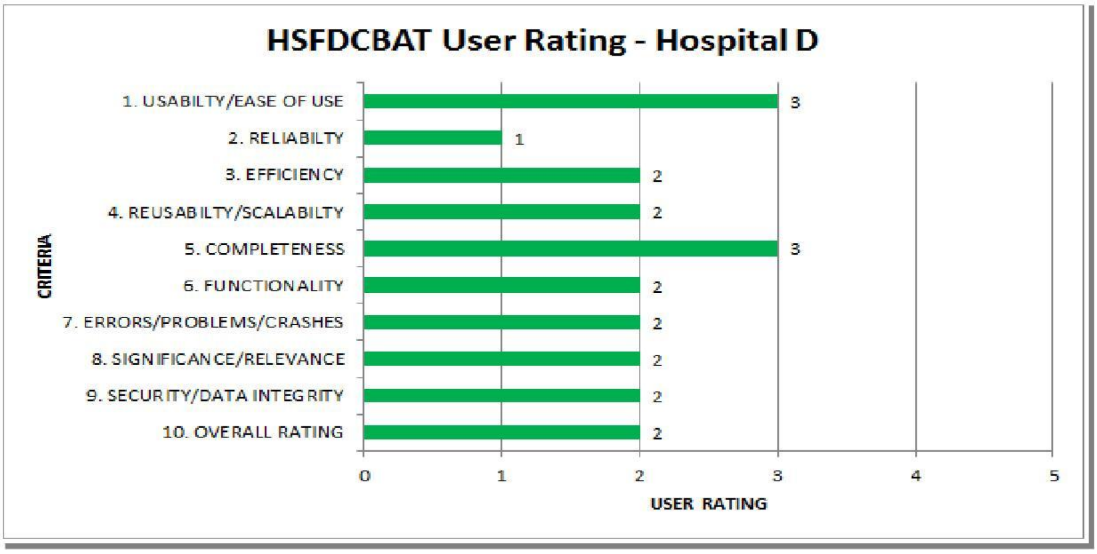

Figure 82 HSFDCBAT User Rating - Hospital D

7.5 Comparative Analysis

COMPARISON AREAS	Hospital A	Hospital B	Hospital C	Hospital D
SUITABLE SITES (%)	34.44	26.67	16.67	61.11
STRUCTURAL SAFETY (%)	50.67	42.67	26.67	45.33
NON-STRUCTURAL SAFETY(%)	53.89	46.67	37.22	46.67
FUNCTIONAL CAPACITY (%)	66.67	35.56	73.33	44.44
SURVEY RESULTS	1.40	1.60	1.80	2.10
BED CAPACITY	40	127	150	497
OCCUPANCY RATE (%)	85.00	70.00	60.00	84.00
AREA (SQ M)	2000	5400	4800	30000
SHAPE	L-SHAPE	REGULAR	REGULAR	COMBINATION
SIZE	SMALL	MEDIUM	MEDIUM	LARGE
NO.OF STOREYS	4	2	4	10
YEARS OF EXISTENCE	19	33	15	42
LOCATION	Tarlac	Nueva Ecija	Nueva Ecija	Metro Manila
DOH/WHO WORKSHOP (Y/N)	N	Y	N	Y
RENOVATION (Y/N)	Y	Y	Y	Y
EXPANSION (Y/N)	Y	Y	Y	Y

Figure 83 Tabulated Comparative Analysis of Hospitals

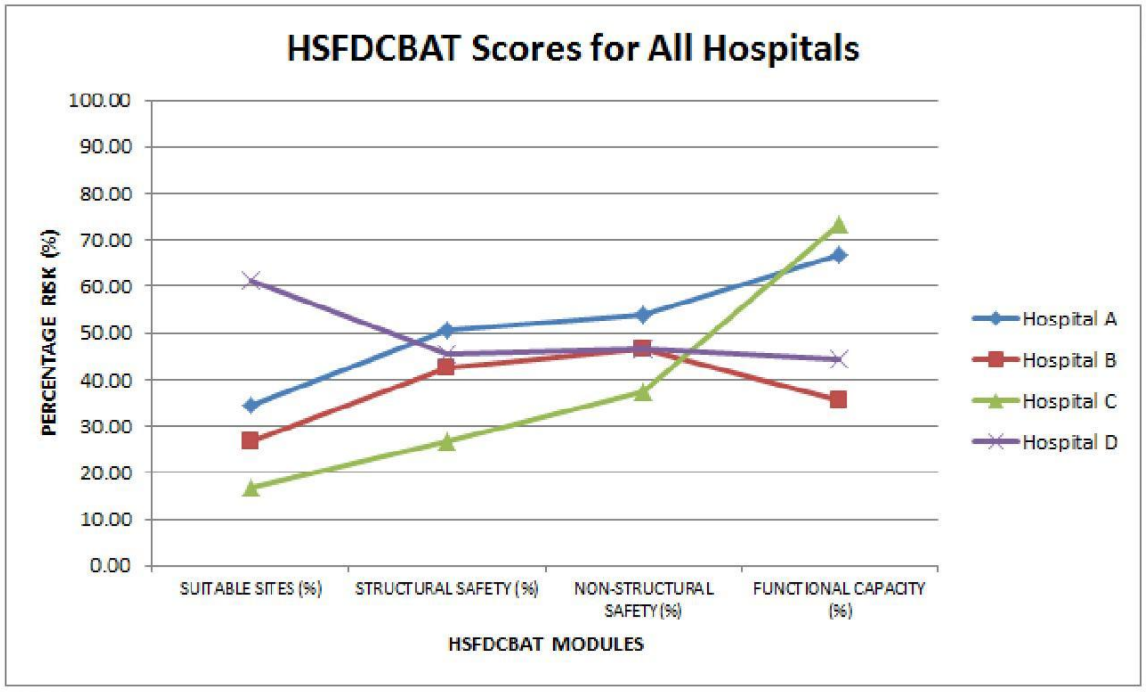

Figure 84 HSFDCBAT Scores for All Hospitals

The study highlighted the common high risk areas for all the hospitals based on their HSFDCBAT scores. For the Suitable Sites module, the common high risk areas are EARTHQUAKE, TYPHOON, TORRENTIAL RAINS, STORM SURGE, SOCIAL PHENOMENA and EPIDEMIC. The last checkpoint mentioned was evident among all hospitals, showing that they are all highly at risk when an epidemic occurs after a disaster.

For the Structural Safety module, high risk areas are different for each hospital with ADJACENT STRUCTURES and CONTINUING CHECK having the most vulnerability. Some of the other checkpoints in high risk that are distributed among the health facilities are STRUCTURAL HISTORY, STRUCTURAL STANDARDS, CONSTRUCTION MATERIALS, FORM IRREGULARITIES, AS-BUILT PLANS and PERMITS. This shows the substantial concern of the health facilities regarding their structures. Some key points raised here were retrofitting of their old buildings as well as the needed funds for its implementation.

For the Non-Structural module, the TELECOMMUNICATION SYSTEMS, anchorage of FURNISHINGS & EQUIPMENT, MOVEMENT OUTSIDE THE BUILDING, FIRE PROTECTION SYSTEM, REFUGE ROOMS, REDUNDANT / OPEN SPACES are the high risk checkpoints. The last two areas showed that the absence of accessible areas during disasters is a foremost concern for most of the hospitals.

High Risk Functional Capacity is evident for Hospitals A & C because of non-existent or in-process Hospital Disaster Committee and Emergency Operations Center. TRANSPORT AND LOGISTICS, absence of EPIDEMIOLOGICAL SURVEILLANCE COMMITTEE and concerns on HIGHLY INFECTIOUS DISEASES during and after a disaster complete the high risk areas for their Functional Capacity.

7.5.1 Safe Score vs. Bed Capacity

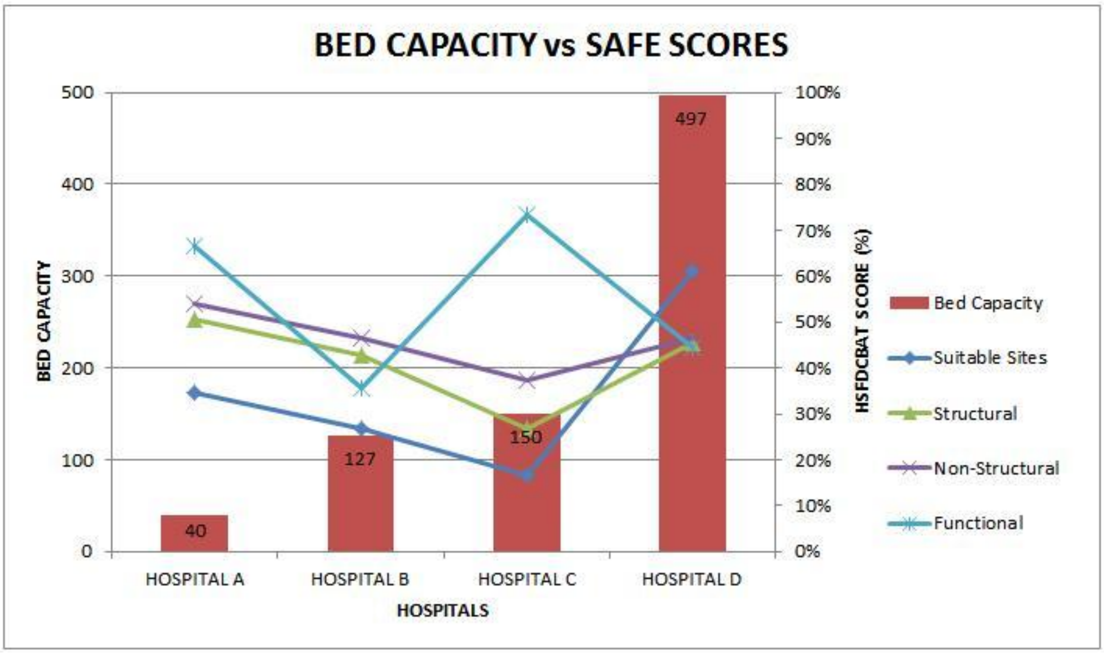

Figure 85 Safe Score vs Bed Capacity

The study showed that for Hospital A, Hospital B and Hospital C, their Structural, Non-Structural and Suitable Sites scores are inversely proportional with the health facility's bed capacity. As the hospital bed capacity increases, their HSFDCBAT scores decrease as well.

7.5.2 Safe Score vs Floor Area

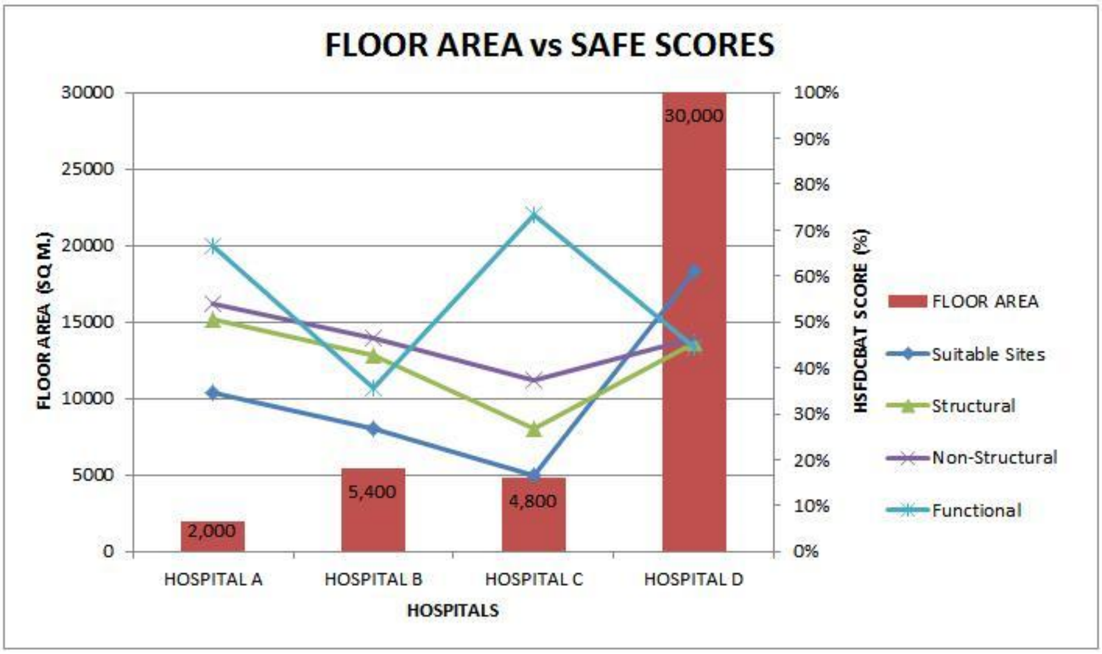

Figure 86 Safe Score vs Floor Area

No conclusion can be derived from this relationship because the trend of the floor area is also varying compared to the HSFDCBAT scores for all modules so pinpointing a direct relationship between these two factors would be non-conclusive, at least for this study.

7.5.3 Safe Score vs Occupancy Rate

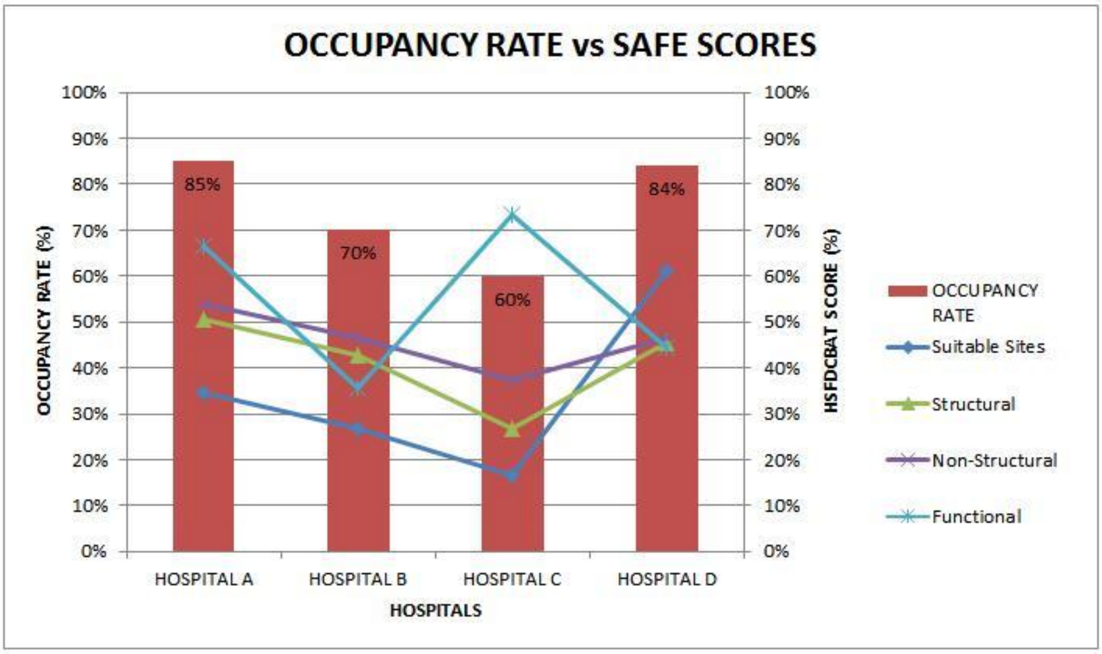

Figure 87 Safe Score vs Occupancy Rate

The study showed that for all the hospitals, the occupancy rates of the building follows the trend of their Structural and Non-Structural components. The trend line was also evident for Suitable Sites except for Hospital D. This may mean that patient occupancy depends on the health facility's structural and architectural (non-structural) soundness as well as if it's at a suitable location.

7.5.4 Safe Score vs. Max. No. of Storeys

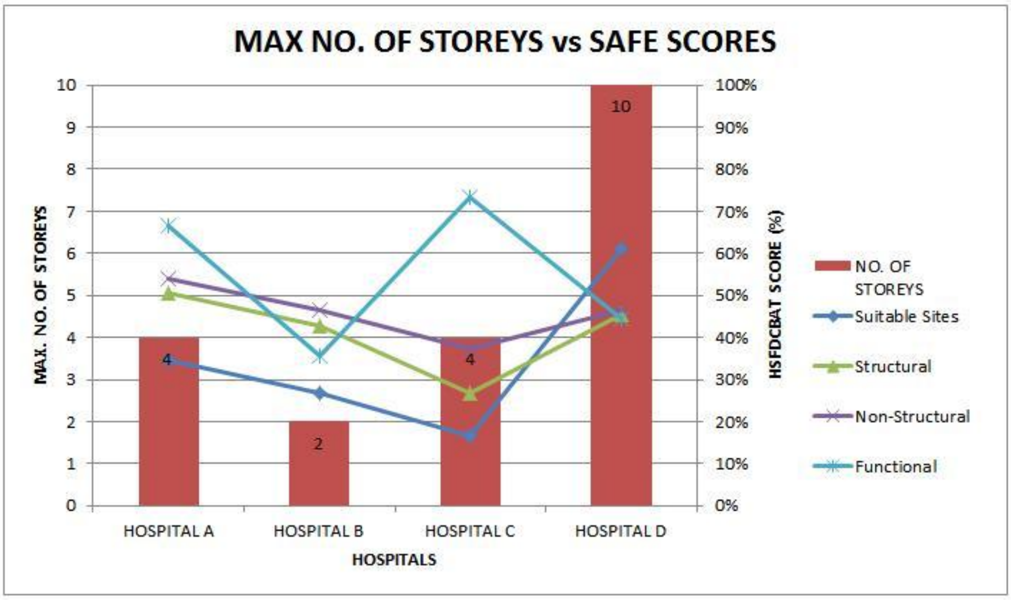

Figure 88 Safe Score vs Maximum No. of Storeys

Hospital A and Hospital C have consistent trend lines for Structural and Non-Structural Capacity with both having four (4) storeys. HSFDCBAT Scores for the health facilities are 50.67% and 53.89% for Hospital A and 26.67% and 37.22% for

Hospital C. They have the same maximum floors so this physical aspect (height) of the structure shows a relationship with the Structural and Non-Structural aspects of the health facilities.

7.5.5 Safe Score vs. Years of Existence

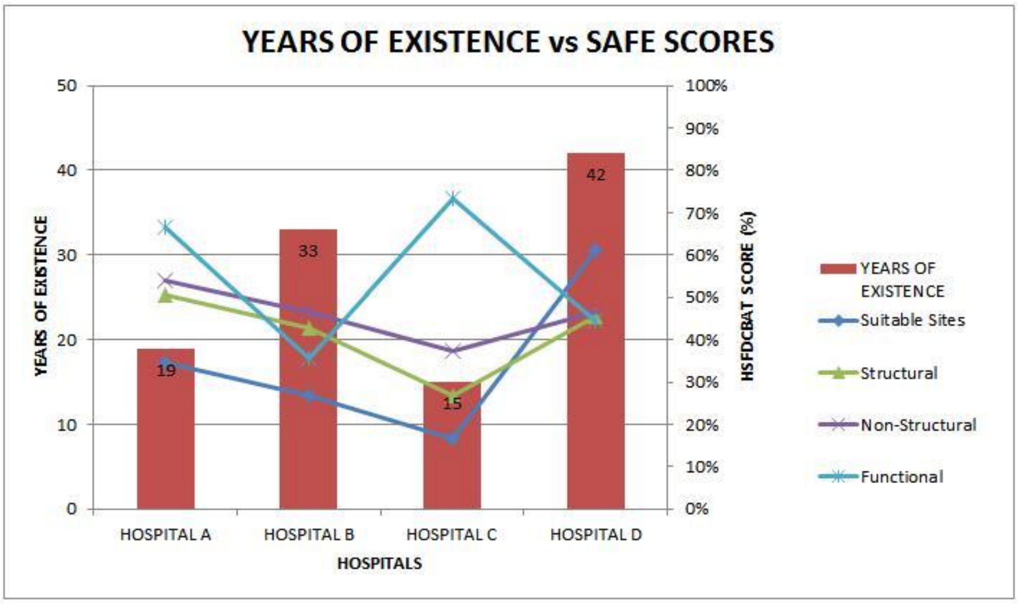

Figure 89 Safe Scores vs Years of Existence

Hospital A and Hospital C have consistent trend lines for Structural and Non-Structural Capacity having been constructed 19 years and 15 years ago respectively. HSFDCBAT Scores for the health facilities are 50.67% and 53.89% for Hospital A and 26.67% and 37.22% for Hospital C. They have about the same age so the deterioration as well the expansion and renovation that is closely related with the Structural and Non-Structural modules are evident in this graph.

7.5.6 Safe Score vs. Relative Size & Shape

The study showed that both Hospital B and Hospital C, having a medium sized foot print and regular shape have the lowest Structural Safety risk rating with scores of 42.67% and 26.67% respectively. The reason for this may be the basic structural principle that the regularity of size and form will produce less structural stresses when lateral forces and other forces for that matter act on them.

7.5.7 Safe Score vs. Location

The study showed that the health facilities from Nueva Ecija have the lowest risks rating on the Suitable Sites module. Hospital B has a 26.67% score while Hospital C has a 16.67% score on this module. Hospital A in Tarlac also has a relative low risk rating of 34.44% but not as low as the ones in Nueva Ecija. This could be due to the fact that these hospitals are located in the Central Luzon Area where natural risks are not that high. Hospital D has a relatively high risk of 61.11% mainly because of its proximity to the West Valley Fault. Location of the hospital can be an important aspect in its disaster-readiness because the conditions and environment on where it is situated defines what type of disasters the health facility will be susceptible to.

7.5.8 Safe Score vs. DOH Workshop

The study showed that Hospital B and Hospital D, who both attended the WHO/DOH-HEMS workshop on Hospitals Safe from Disasters have the lowest risks on the Functional Capacity Module with scores of 35.56% and 44.44% respectively. This is due to the fact that the requirements for the Functional Capacity of the hospital were thoroughly discussed in those workshops so the planning and implementation of checkpoints like the Disaster Management Committee and the Emergency Operations Center were effectively delegated.

7.5.9 Safe Score vs. Renovation/Expansion

No conclusion can be derived from this relationship because all the hospitals underwent renovation and expansion in recent years but they have varying HSFDCBAT scores for all modules so pinpointing a direct relationship between these two factors would be non-conclusive, at least for this study.

7.6 HSFDCBAT and the Localized Hospital Safety Index

7.6.1 Suitable Sites

From the interviews and outputs of the study, it was established that for Suitable Sites, hospital owners and developers should keep in mind that before building new hospitals, it should be ascertained that a structure is away from active faults and flood-prone areas. They have to make sure that the design is feasible, within the budget required and planned for the long-term. The risk vulnerability of each hospital should also be mapped to arrive at solutions for their specific risk.

For existing hospital buildings, a detailed evaluation should be conducted to determine whether it complies with the codes as well as the risk requirements. From this evaluation, an exclusion criterion for when to retrofit or relocate should be created because of hospitals serving as catchment areas during disasters. Relocation could deprive persons in those areas of medical services but if the risk is very high, relocation may be the only option.

7.6.2 Structural Safety

The study also brought about hospital administration concerns regarding Structural Safety. One of the legitimate concerns is the absence of structural certification from qualified structural engineers from either the Association of Structural Engineers of the Philippines (ASEP) or the Department of Public Works and Highways (DPWH) who must also be accredited by the Department of Health (DOH).

Some of the action plans in response to these concerns as suggested by the hospital representatives are to request and invite qualified structural consultants for their proposal and costing for the project and to request for structural plan and structural analysis computation. After consulting the engineers, request for funds and the request to fast-track the procurement procedure for retrofitting should then be part of their next steps. This is similar to the situation of government hospitals who are more concerned about structural and retrofitting (i.e. costs, funding, government support, etc.) when it comes to the structural disaster-readiness of the hospital.

The improvement of existing facilities, risk reduction in design and construction of new facilities, as well as the search for legislation and financial measures to retrofit critical facilities are also some of the other major concerns.

Since retrofitting is the most prevalent solution seen for structural safety concerns in hospitals, health facility engineers suggested furthermore that more detailed assessments of hospital structural risks should be made to arrive at feasible retrofitting solutions. In line with this, the drafting of generic terms of reference for structural assessment of hospitals as well as post-emergency rapid assessments should be done. Currently, a Memorandum of Agreement (MOA) is already in place and structural engineers are already being tasked in response to these measures.

Some of the other action plans suggested from this study in terms of government action, on the other hand, are to prioritize hospitals with higher risk scores in retrofitting, to raise awareness of the importance of retrofitting to policy makers and to disseminate public warnings on unsafe buildings. In terms of engineering and technologies, the funding and installation of accelerometers to assess seismic building performance is one of the suggestions being asked from the government. In terms of permits and compliance, old buildings lack space to comply with some building code requirements so alternative solutions are being sought. One of the problems is that hospitals are built without DOH approval. Authorities should adhere to existing policies and enforce it. Sanctions should be imposed on non-compliant institutions.

7.6.3 Non-Structural Safety

The study showed that based on the HSFDCBAT users‟ interviews, Non-Structural safety is easier to comply with as opposed to structural safety because most of these are already complied with and are being implemented in compliance with the National Building Code as well as the DOH requirements. These are more visible and are easier to mitigate since it is a major part of the Facilities, Engineering and Maintenance Head’s job responsibility in his day to day tasks.

7.6.4 Functional Capacity

Essentials during disaster emergencies are buildings (location, design specifications, materials), patients (increase during disasters), hospital beds, medical and support staff, equipment and facilities and basic lifelines and services. During disasters, demand for emergency care increases, while availability and supply of necessities and services decreases.

It was also noted during the interviews that there are more garbage, corpses, infections and diseases after a disaster and understandably so. This is one of the main reasons why a disaster management committee, an emergency operations center and operational plans for disasters are vital points in Functional Capacity.

7.7 HSFDCBAT Score

The study showed that data gathered from the sample hospitals using the HSFDCBAT served as a wake-up call and an eye-opener for the hospital representatives involved in the research study. Seeing numbers as ratings for the disaster-readiness of their hospitals made an impact on how they viewed the importance of being ready for disasters. Having a safe score report and recommendation report immediately after the assessment using the tool encouraged them as heads of their teams or departments to be proactive on the action plans to mitigate the checkpoints which were flagged as high risk areas.

The study also showed the common high risk areas among the health facilities based on their HSFDCBAT scores. In terms of location, being in Luzon where earthquakes, typhoons, storm surges and torrential rains are frequent, this was apparent as having the high risk checkpoints for all the sample hospitals although social phenomena and epidemics also passed as areas for concern.

Structurally, hospitals have different concerns. Most of the checkpoints in the module like structural history, structural standards and as-built plans and permits were all distributed across the lot as the major concerns for the hospitals. The most common high risk areas for them are adjacent structures and continuing check from ASEP and DPWH. Retrofitting as well as funds for it was also a major point of discussion during the assessment.

Telecommunication systems, equipment, movement outside the building and fire protection are causes of concern for the hospital representatives in terms of non-structural safety. But the absence of refuge rooms and redundant/open spaces are the most obvious high risk checkpoints among the sample hospitals.

Finally, the absence of Hospital Disaster Committee and Emergency Operations Center as well as operational plans for disasters highlights the Functional Capacity module. Other concerns are transport and logistics, absence of epidemiological surveillance committee and concerns on highly infectious diseases during and after a disaster.

7.8 User Satisfaction Score

Overall, the hospital representatives who used the HSFDCBAT Tool gave good reviews for the system. There were mixed reactions on the use of the tool but most of them are positive. The system had an average rating of **1.73**, with 1.00 being the highest, and 5.00 being the lowest, similar to UP‟ s grading system which is a relatively high rating. Security of the tool, together with the readily available reports and the recommendations was commended by the user. Also, the significance and relevance as well as the usability of the system were also lauded by the user. Other facets of the HSFDCBAT that were commended by the user are the innovation of the tool and its versatility and customizability.

Some of the concerns of the users, though, are completeness, functionality and relevance. General comments were to make the tool more detailed and more specific. There were also issues raised on errors or bugs encountered but these were just minimal. Concerns were also raised on the occurrence of minor glitches/bugs when the module is being saved and the comprehensiveness of the report.

7.9 Future Releases Of HSFDCBAT

For future releases of the HSFDCBAT, experts for each field/module can be surveyed and consulted so that the importance and relevance of each checkpoint can be correctly assessed and combined, and then come-up with mathematical models which will eventually result into accurate weight assignments. For now, all checkpoints are assigned a weight = 1.0, meaning all checkpoints have the same baseline weights. Involvement of these professionals is crucial in establishing these weight assignments. (An example of this would be to rate a checkpoint from 1 to 10 on what is more important/relevant based on the perception of the expert. But the concern here is to get a considerable sample population for the experts such as structural engineers, architects, doctors, hospital administrators, etc. which the researcher was not able to do in this study, thus the weight of 1.0 for all checkpoints. This would add another step to the methodology). The importance of checkpoints is based on experience, expertise and significance to the hospital site.

By using HSFDCBAT, designers will be guided and the design criteria will be more detailed in terms of making the hospital disaster-ready. Results are empirical, quantifiable and similar to expert systems. It can be noted from the research study that findings and analysis can be affected by perception of the interviewee, consciousness to the presence of the researcher and the interruption of the researcher from time to time.

HSFDCBAT can have commercial value (i.e. Hospitals, DOH, etc) and DOH can be the primary beneficiary and specific recipient of this system. It should be emphasized that the HSFDCBAT is for academic purposes only and that the quality of data being divulged by hospital representatives vary.

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusion

The Hospitals Safe From Disasters Computer-Based Assessment Tool (HSFDCBAT) took off from existing assessment tools developed by PAHO/WHO and the DOH and addressed the need for a concise and quantifiable localized hospital safety index here in the Philippines whose primary goal is hospital disaster-preparedness and disaster-resiliency.

The execution of HSFDCBAT on selected private tertiary hospitals showed the disaster-readiness of these hospitals in terms of their location, structural safety, non-structural safety and functional capacity. Each health facility‟ s strengths and weaknesses were emphasized based on their scores acquired from the tool. The study showed that data gathered from the sample hospitals using the HSFDCBAT served as a wake-up call and an eye-opener for the hospital representatives involved in the research study. Seeing numbers as ratings for the disaster-readiness of their hospitals made an impact on how they viewed the importance of this initiative. Having a safe score report and recommendation report immediately after the assessment using the tool encouraged them as heads of their teams or departments to be proactive on the action plans to mitigate the checkpoints which were flagged as high risk areas.

The comparative analysis of the sample health facilities with the aid of the HSFDCBAT showed the common high risk areas among the health facilities based on their HSFDCBAT scores. Relationships between these scores and different aspects of the hospitals such as bed capacity, occupancy rate, location, trainings as well as their physical and structural characteristics were also established.

The applicability of such a tool in producing potential results which merit the same effects as the Hospital Safety Index initiative and the acceptability of such a disaster-readiness tool to the users in an effort to advocate safe hospital design and construction was also established from user satisfaction survey included in the HSFDCBAT.

The primary goal of HSFDCBAT is for hospital disaster-preparedness. Attaining the goal of safe hospitals requires the combined effort of all concerned agencies. Compared to other assessment tools, it is possible that they will have similar results but the difference is in the process and in the time these data were acquired. Aside from this, the potential in which these data can be analyzed would cover a lot more ground because of the filtering capability of the system and since all the data for all the hospitals are stored in a database. Time element of HSFDCBAT assessment and implementation of recommendations are very crucial based on the fact that much more can be improved with regards to hospitals safe from disasters.

8.2 Recommendations

For future releases of the HSFDCBAT, provisions for Green Hospitals can be added as another module. It should be incorporated in the Hospital Management System (HMS) for efficient data management. Provisions for HSFDCBAT to be web-based for further expansion and accessibility to other hospitals thru the web would also be beneficial to the users.

Also, other recommendations for the HSFDCBAT tool are to include specific Hospital Capacity details in the General Information module. Icons should be used and more “Infographics” should be incorporated in the system to have a more visual rather than text-based interface. In terms of the checkpoints, other disasters like ones caused by heat wave and extreme temperatures should also be considered.

In disaster mitigation, some key recommendations are to increase public awareness, have better warning systems, and better urban planning and facilities management.

8.3 Areas for Further Study

Areas for further study include some of the items which were discussed in the scope and limitations. The weighting system of HSFDCBAT, data from insurance companies and data from ISO certified hospitals can be considered. Experts from their respective fields can be gathered to assess which checkpoints are important and which can be given higher weight equivalents to give a much more comprehensive HSFDCBAT score.

Arrangements with insurance companies and ISO certification firms or ISO-certified hospitals can be made to gather data concerned with the disaster-readiness of hospitals which were not collected in this research because of confidentiality and proprietary concerns. Data gathered here can be compared to the data within the HSFDCBAT for further improvement based on their existing baselines and guidelines.

Lastly, comparative analysis can be further expanded to other types and other levels of hospital to have a wider range of data. Government hospitals would be a good jump off point for further studies in the utilization of the HSFDCBAT tool as a disaster-readiness assessment tool.

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