Safe Hospitals in Emergencies and Disasters

Structural, Non-structural and Functional Indicators

World Health Organization
Regional Office for the Western Pacific
2009

EUROPEAN COMMISSION
Humanitarian Aid

World Health Organization
Western Pacific Region

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Project supported by the European Commission
through its Humanitarian Aid department
http://ec.europa.eu/echo/index_en.htm

Contents

Part I. Introduction

(1) World Disaster Reduction Campaign on Safe Hospitals

The World Health Organization recognizes the need for making hospitals safe, especially at a time of disasters and emergencies, when they must be ready to save lives and continue providing essential health services to the community. It supports the World Disaster Reduction Campaign on Safe Hospitals (2008-2009), which seeks to raise awareness and effect change that will:

- Protect the lives of patients and health workers by ensuring the structural resilience of health facilities.
- Ensure that health facilities and health services are able to function in the aftermath of emergencies and disasters, when they are most needed.
- Improve the emergency management capacity of health workers and institutions.

(2) Safe Hospitals' Vulnerability Assessment

Hospitals and health facilities play a critical role in times of emergency and disasters. It is imperative that they remain structurally sound and fully operational at such times. To ensure that hospitals and health facilities can withstand emergencies and disasters, an assessment of their vulnerabilities is most significant. These vulnerabilities may be structural (load-bearing system), nonstructural (architectural elements, installation and equipment and (systems and operations).

This document, ***Safe Hospitals in Emergencies and Disasters*****,** began with the initial experience of the Philippines in formulating the sets of structural, nonstructural and functional indicators for safe hospitals. The Department of Health-Health Emergency Management Staff (DOH-HEMS) and the National Centre for Health Facility Development (DOH-NCHFD) of the Philippines, with support from the Association of Hospital Administrators (AHA) Philippines and WHO'S Western Pacific Regional Office, conducted several workshops. They included different technical working groups in health emergency management

and experts in hospital structures and functional operations who proposed a list of indicators for safe hospitals during emergencies and disasters. These indicators were reviewed to make them appropriate not only in the Philippines but also in Cambodia, the Lao People's Democratic Republic and Viet Nam.

(3) Target Users

The ***Safe Hospitals in Emergencies and Disasters*** is intended for people who recognize the important role of hospitals and health care facilities during emergencies and disasters. These people include hospital administrators and managers as primary users of this document, health professionals as advocates and patients as clients whose safety always should be the priority.

(4) Objectives

This document seeks to serve as a guide and reference to:

(a) assess existing hospitals and health facilities in terms of structural, nonstructural and functional vulnerabilities;

(b) advocate for construction of a new hospital or health facility that could withstand any emergency or disaster; and

(c) plan for renovation and retrofit of hospitals and health facilities to ensure their resilience, safety and continuous operations in times of emergency and disaster.

(5) How to use this assessment tool

Countries that intend to use this guide should examine the building, structural code, fire safety and electrical code and other guidelines or regulations related to the structure and function of hospitals and health facilities. This is to ensure that they are familiar with their own rules and regulations based on their country-specific needs. A list of references is provided at the end of this document to give readers additional information.

Countries also are encouraged to form a technical working group that can review the sets of indicators listed, determine whether they are applicable and rationalize the need for more specific indicators in their own setting. This group may

comprise the hospital's health emergency coordinator, architect, engineer, safety officer and administrative officer.

This document explains the reasons for most of the indicators. These rationales appear before the checklist of indicators. Read the rationales carefully to ensure that the indicators are clearly understood. In reading through the checklist, either put a check sign (**Y**) if the specific condition is satisfied or a cross sign (**X**) if not. Use the "Remarks" column if there is a need to explain further. If the indicator is not applicable or useful in the country or local setting, put **N.A.** (not applicable) in the "Remarks" column.

Finally, the checklist in this document is not intended to compare countries or local settings. Rather, this should be used as an internal assessment for improving the structure and functions of hospitals and health facilities for emergency preparedness and response. Some indicators need to be adapted to a local context or setting. For example, basic equipment, treatment guidelines and protocols and emergency kits must be based on country setting and type of hospital. Further refinements on the indicators and tools also are welcome.

The sets of indicators listed in this document need to be reviewed and tested further as to their applicability in different countries and local settings. It also neither provides nor claims to be the definitive and only guide to follow in ensuring safe hospitals and health facilities in emergencies and disasters. This is a work in progress and subsequent revisions will be made accordingly to ensure that hospitals and health facilities are safe in emergencies and disasters.

Part II. Safe Hospitals' Indicators

During emergencies or disasters, hospitals and other health facilities must remain safe, accessible and functioning at maximum capacity in order to help save lives. They must continue providing critical services such as medical and nursing care, laboratory and other health care services as well as respond to increased requirements related to the emergency. A safe hospital must remain organized with contingency plans in place and health personnel trained to keep the network operational.

Making hospitals safe involves knowledge of the many factors that contribute to their vulnerability during an emergency or disaster such as the building's location, design specifications and materials used contribute to the ability of the hospital to withstand adverse natural events. In the advent of emergency or disaster, damage to nonstructural elements can force hospitals to halt operations. Lifelines such as electric power, water and sanitation and waste treatment and disposal also are important for continuous operations. People also are a major concern. It is likely that there will be increased emergency cases that would require hospitals to accommodate more patients. This might be a challenge when medical and support staff also are affected, thus limiting the response capacity of hospitals.

Supporting safe hospitals entails vision and commitment to ensure that they are fully functional, especially during emergencies and disasters. There should be involvement of various sectors such as hospital operations planning, finance, public services and architecture and engineering in determining the vulnerability of hospitals and addressing these concerns. The design in the construction of hospitals and health facilities should follow building codes, fire safety guidelines and other risk-reduction measures. The nonstructural and functional vulnerability of existing facilities should be improved. There should be legislative measures and financial support to renovate and retrofit most critical facilities to increase levels of protection.

(1) Structural Indicators of Safe Hospitals

The structural elements of hospitals and health facilities such as building location, design and structures are important considerations in order for buildings to withstand adverse events. These structural elements should be appropriate to the building location and the natural hazards common in the country. The terrain where the hospital or health facility is located may indicate possible threats such as flooding in valleys or landslides along slopes. Identification of the location and any potential hazards should be addressed by proper measures to minimize damage to structures. There should be a provision for proper rainwater drainage in areas prone to flooding and using lighter and safer roofing material in earthquake zones or sturdier material for typhoon-prone sites. Other standard structures such as access to people with limited mobility also must be in place. Ramps must be located in proper places for transporting patients on beds and in wheelchairs. Failure to do this may compromise the safety of these people, especially if the health facility must be evacuated.

The different considerations in structural elements are some of the reasons why there are various requirements and regulations imposed on the construction of buildings in different countries. Hospital administrators need to be aware of the building code, fire safety code and other structure-related codes and guidelines in their country or area to ensure that these are being followed and implemented properly. Lack of compliance such as the use of substandard materials or selection of an inappropriate site for the hospital or health facility may limit its operation during an emergency and may even lead to a tragedy. Building alterations or remodelling in an attempt to create new spaces or install new structures or equipment also may result in weakened structures if the original designs are not considered. Regulations about building permits and clearance, whether for new or existing structures, are therefore important to ensure the safety of hospital buildings and health facilities.

On the next page is a list of important structural indicators to be considered when planning for new construction or reviewing existing buildings. This can be used as a checklist to identify vulnerabilities of a hospital or health facility.

Structural Indicators of Safe Hospitals

Instructions: *In the second column corresponding to each item, put a **Y** if the condition was satisfied or an **X** if the condition was not satisfied or is lacking. Use the last column for remarks or comments. Put **N.A.** (not applicable) in the last column if the condition does not exist in the country or local setting.*	Y or X	Remarks
A. Location		
1. Building is not located in a hazardous area: a. Not at the edge of a slope b. Not near the foot of a mountain vulnerable to landslides c. Not near creeks, rivers or bodies of water that could erode its foundation d. Not on top of or in proximity to active fault lines (less than 10 meters away) e. Not in tsunami-prone areas f. Not in flood-prone areas g. Not within a typhoon zone h. Not in areas prone to storm surges		
2. Building has appropriate provisions for addressing hazards related to location such as rainwater drainage and dikes		
B. Design		
1. Building has a simple shape and is symmetrical along both the lateral and longitudinal axes (e.g. square or rectangle), making it resilient when subjected to stress such as that produced by an earthquake		
2. Building structural members (foundation, columns, beams, floors, slabs, trusses) and nonstructural members conform with requirements for strong winds (wind importance factor of 1.15) and earthquake (seismic importance factor of 1.25)		
3. Glass walls, doors and windows resist basic wind speeds of 200-250 kph with regional application of secondary covers		
4. Number of building floors (storeys) less than five, especially in areas that are vulnerable to earthquake		
5. Roof angle of 30°-40° (optimum for withstanding wind forces) for buildings in typhoon-prone areas		
C. Structures		
1. No major structural cracks on structural members. Minor or hairline cracks investigated by a qualified civil or structural engineer and determined to be localized and repairable.		
2. Structures built with fire-resistant and nontoxic materials		
3. Structures built with adequate technical competence and proper building inspection and control implemented		
4. Cabinets, shelves, appliances and equipment are properly anchored		
5. Ramps are present in appropriate areas for moving bed patients and for use by people with disabilities		
D. Permit and Clearance		
1. Complete set of as-built construction drawings and readily available for reference purposes		

2. Complete with necessary building permits and occupancy permits		
3. Construction materials thoroughly checked by a materials/quality assurance/quality control engineer during construction for conformance to specifications		
4. Building alterations conducted with proper consultation with engineers and a review of the original plan of the building		

(2) Nonstructural Indicators of Safe Hospitals

Nonstructural elements of a building include architectural elements (such as ceilings, windows and doors), medical and laboratory equipment, lifelines (mechanical, electrical and plumbing installations) and safety and security issues. These elements are crucial to the daily operation of hospitals and health facilities. If these are damaged, they would not be able to function and may even cause physical injury to patients and personnel.

Basic considerations regarding architectural elements are similar to the structural indicators. They share the same goal, that is, the building structure will be able to withstand any physical stress that might be caused by natural hazards such as a typhoon, floods, landslides and earthquakes. As evidence of building structural integrity, hospitals and health facilities should have the following available at all times:

(a) approved construction plans showing that the building has been designed by architecture and engineering professionals who will be liable and responsible for the integrity of the building in all its architectural and engineering aspects;

(b) as-built plans showing the building's interiors, knowledge of which is necessary for maintenance, upgrading and renovation;

(c) updated as-built plans or records of renovations and reference documents for succeeding design changes and renovations; and

(d) an occupancy permit that certifies a building's compliance with applicable building codes and other laws and shows that it is in condition suitable for occupancy.

Considerations related to the equipment and lifelines focus on their location and whether they are anchored properly. The presence of heavy equipment or machines changes the building's structural integrity. These must not be placed on upper floors or on weak floors because it might result in the collapse of structures even at the slightest movement caused by an earthquake or the normal wear and tear of buildings through the years. Heavy equipment and machines also should be firmly anchored to a structural element of the building or its foundation. This is to prevent its moving, sliding or falling, which could cause structural damage or physical injury to patients and personnel.

Safety issues are related to handling and storage of chemicals and potentially hazardous substances. Improper handling and storage of these chemicals and substances may cause injury by virtue of their inherent toxicity or by causing chemical reactions that could lead to fire or explosion. There should be appropriate training for personnel handling these chemicals and hazardous substances. Safety guidelines for proper handling and storage should be disseminated and implemented. For example, the proper arrangement and grouping of chemicals should be followed strictly to prevent accidental chemical reactions. Proper labelling with a manufacturer's warning and providing

appropriate instructions on what to do in the event of accidental contact with these substances are important aspects of safety guidelines. The use of material safety data sheets (MSDS) also should be encouraged, although different countries have different regulations regarding their use. These also should be official documents that are used to disseminate important chemical safety information to workers, emergency responders and the public. Security of the building and the general safety of all of the patients and personnel inside the hospitals and health facilities also should be addressed.

Non-structural Indicators of Safe Hospitals		
Instructions: *In the second column corresponding to each item, put a* ***Y*** *if the condition was satisfied or an* ***X*** *if the condition was not satisfied or is lacking. Use the last column for remarks or comments. Put* ***N.A.*** *(not applicable) in the last column if the condition does not exist in the country or local setting.*	Y or **X**	Remarks
A. Building Documents/Drawings/Plans		
1. Approved construction plans, technical specifications, structural computations signed and sealed by appropriate professionals and submitted to and approved by the building official of the local government		
2. As-built plans prepared by the contractor or builder or as-found plans commissioned by owners to be prepared by architecture and engineering professionals		
3. Updated as-built plans		
4. Occupancy permit		
B. Architectural Elements		
1. Safety of the roofing		
a. roofing designed to withstand wind velocity of 175-250 kph in typhoon-prone areas		
b. roofing materials completely and securely fastened, welded, riveted or cemented		
c. roof's drainage system has adequate capacity and is properly maintained		
d. roof is leak-proof, insulated and sound-proof		
2. Safety of ceilings		
a. concrete ceilings have no cracks and leaks		
b. drop ceilings made of materials other than concrete securely fastened		
c. ceiling materials such as fibre cement board, fibreglass, acoustic/gypsum board, wood materials are coated or treated with fire-retardant paint		
d. ceiling liner or light fixtures properly fastened and supported		

e. underside of arches, balconies or overhangs free from structural cracks and falling cement plasters		
3. Safety of doors and entrances		
a. door materials are wind- and fire-resistant		
b. doors securely attached to jambs		
c. doors in rooms for less than 50 people should be 112 cm wide; doors in rooms for more than 50 people (conference rooms, function rooms) should be 122 cm wide, remotely located from each other and swing out		
d. main doors are double swing; bathroom door is swing out; emergency room doors are swing in and out		
e. fire exit doors fire-resistant; swing out; with self-enclosing device and panic bar		
f. smoke partition doors located along hallways and corridors should be double swing, per groups of rooms or sections, for compartmentalization		
g. power-operated doors can be opened manually to permit exit in the event of power failure		
h. automatic doors have manual overrides		
i. rooms such as the operating room (OR), intensive care unit (ICU), recovery room (RR), delivery room (DR), labour room (LR), isolation rooms (IR) and other sterile areas have manual door closers		
j. in high-rise buildings and structures, the interior vertical exit stairwell or staircase has a pressurized fire exit or smoke-proof fire exit suitably sealed against smoke, heat and fire		
k. locks installed on sleeping rooms can be locked only from the corridor to permit exit from room by a simple operation without a key		
l. a door designed to be kept closed as a way out, such as a door to a stair or horizontal exit, and provided with a reliable self-closing mechanism and one not secured in the open position.		
m. a door designed to be kept closed shall bear a sign such as: FIRE EXIT, KEEP DOOR CLOSED		
4. Safety of windows and shutters		
a. windows have wind and sun protection devices		
b. windows have features to secure the safety of the patient (e.g. grilles, railings) which are also provided with a fire exit or fire protection system		
c. windows are leakproof		
5. Safety of walls, divisions, partitions		
a. exterior walls meet the fire resistance rating of two hours		
b. room partitions made of fire-resistant construction materials		
c. compartments enclosed slab-to-slab (floor-to-floor) and fire-resistant wall-to-wall		

d. rooms may be subdivided provided that the arrangement allows for direct and constant visual supervision by nursing personnel		
6. **Safety of exterior elements (cornices, ornaments, facade, plastering**		
a. exterior elements securely fastened to walls		
b. hanging light fixtures properly anchored		
c. electrical wires and cables properly fastened and secured		
7. Safety of floor coverings		
a. nonslip floor materials without crevices in all clinical and service areas and easy-to-clean floor materials in all other nonclinical areas		
b. reinforced concrete floor slabs		
c. interior finish with fire suppression system		
d. interior finish of walls and ceilings in any room or exit should be “Class A” according to the “Method of Test of Surface Burning Characteristics of Building Materials”		
e. floor finish materials are “Class A” or “Class B” throughout the hospital, nursing home, residential or custodial care facilities.		
C. Lifeline Facilities		
1. Electrical System		
a. emergency generator has the capacity to meet priority hospital demands (provision for backup electrical system to include operating room, intensive care, pathways		
b. higher distribution voltage such as 400/230 v, 3-phase 4-wire system considered to lower initial costs and gain greater long-term efficiency		
c. generator housing or powerhouse protected from natural and man-made disasters; made of reinforced concrete; elevated from the ground line		
d. generators and other vibrating equipment can be fixed by special brackets that allow movement but prevent them from overturning		
e. has nonvibrating and silent generators; exhaust system should be made of critical type silencer or hospital grade and unit provided with vibration isolators if generator is in the hospital building		
f. generator with automatic transfer switch (ATS)		
g. use of inflammable cooling system for transformers (i.e. dry type, epoxy resin or silicon oil or high temperature R-Temp oil)		
h. use of bio-protection system (BPS) certified standard wire, preferably with thermoplastic high heat-resistant nylon (THHN) insulation and electrical cables securely fastened and tightly terminated on CBs or switches or wiring devices		

i. protected control panel, enclosed circuit breakers, magnetic contactors or fused or nonfused switches		
j. ground fault circuit interrupters (GFCIs) provided in outlets in bath and shower rooms and in wet or damp locations		
k. convenience outlets (COs) provided with grounding pole		
l. metallic parts of the electrical system that do not conduct current are adequately grounded, including electrical enclosures, boxes, gutters, ducts and trays		
m. protected control panel, circuit breaker switch and cable follow the National Electrical Manufacturers Association (NEMA) standard and are protected by an electrical surge suppressor		
n. all electrical systems and rooms protected with appropriate chemical automatic fire suppression units		
o. ducting system – polyvinyl chloride (PVC) for power and lighting; rigid steel conduit (RSC) or intermediate metal conduit (IMC) for fire alarm and detection systems; PVC for telephone, intercom, closed-circuit TV (CCTV), cable TV (CATV), computer network data lines		
p. use of energy-saving compact fluorescent lighting (CFL) and mercury bulbs without mercury		
q. adequate lighting in all areas of the hospital, including the grounds		
r. exterior electrical system installed underground		
s. functional electrical and emergency lights with battery backup in all critical areas		
t. exit lights luminous with battery backup		
2. Communications System		
a. antennas and lightning rod protection terminals with bracing and support for safety		
b. lightning protection terminals with proactive operation features preferred		
c. lightning arrester provided		
d. radios have backup direct current power source (battery)		
e. presence of a backup communications system		
f. communications equipment and cables secured with anchors and braces		
g. alarm system that automatically transmits an alarm to the nearest fire station or to such other outside assistance as may be available		
h. exterior communications systems installed underground		
3. Water Supply System		
a. water tank storage has sufficient reserve to satisfy the hospital demand for three days at all times		
b. water storage tank has safe installation and location		
c. alternate water source provided (e.g. deep well, local water utility, mobile water storage tank or fire truck)		
d. use of fusion weld pipes to prevent breakage and leaks		

e. water distribution system (valves, pipes, connections) are free from leaks and harmful agents		
f. wet standpipe shall deliver not less than 132 litres of water per minute at not less than 1.8 kgs per square cm residual pressure from each of any two outlets flowing simultaneously for 30 minutes.		
4. Medical Gas System		
a. medical gases properly stored and secured in well-ventilated areas or compartmented storage areas		
b. safe and appropriate location for storage of medical gases and secured from theft and vandalism		
c. for hospitals using piped-in medical gas, minimum storage of seven days		
d. for hospitals using individual cylinders, minimum storage of three days		
e. tanks bear an intact safety seal from the supplier		
f. medical gas pipes embedded in walls are provided with pipe sleeves		
g. anchors provided for tanks, cylinders and related equipment		
h. safety of medical gas distribution system (valves, pipes, connections) ensured		
i. functional pressure gauge and fittings		
j. use of standard pipes (fireproof, waterproof)		
k. no interchangeable piping connection		
l. undergoes regular testing procedures		
m. with zone shut-off valves in case of leaks (e.g. in case of fire at the OR complex, zone valve can be shut off)		
n. available backup oxygen tanks in case of emergency patient evacuation		
o. industrial gases located outside the building and provided with automatic shut-off device (e.g. LPG)		
p. where activities or storage likely to involve an explosion hazard, explosion venting to outside the building shall be provided by thin glass or other approved vents		
q. all construction activity involving hazardous operations shall have not less than one hour of fire resistance and all openings between any buildings and rooms or enclosures for hazardous operations shall be protected with self-closing or automatic fire doors		
5. Fire Suppression System		
a. alarm, detection and extinguishing systems have interconnected automatic fire alarm system, automatic heat and/or detection system and automatic fire suppression system		
b. fire alarm system can be a combination of automatic and manual		
c. fire alarm system is monitored by fire station or accredited monitoring agency		
d. heat and smoke detection installed in corridors of hospitals, nursing homes and residential-custodial care		

facilities		
e. smoke detectors must not be spaced farther apart than nine meters on centre and more than four and six tenths from any wall		
f. use of extinguishing agents that are environment-friendly, effective and cause less damage to property		
g. each room provided with portable fire extinguishers		
h. recommended fire extinguishers: for electronic and electrical equipment, use carbon dioxide; for general services areas, use ABC fire extinguishers		
i. with wet standpipe system with complete accessories		
j. has fire safety program with following features: • an organized fire brigade that has undergone seminar training on fire drills, fire evacuation drills, earthquake drills • conduct regular fire drills and fire evacuation drills • conduct fire mitigation prevention and suppression training • firefighting equipment available • preventive maintenance of firefighting equipment • available fire exit plan and provision of fire exit evacuation plan in conspicuous places at every floor level		
6. Emergency Exit System		
a. the floors of beams of egress illuminated at all points including angles and intersections of corridors and passageways, landings of stairs and exit doors with bulbs of not less than 0.001 lumens per square centimetre		
b. lighting source is of reasonably assessed reliability, such as public utility electric service		
c. emergency lighting facilities maintain the specified degree of illumination in the event of failure of the normal lighting for a period of at least one hour		
d. illuminated EXIT signs – distinctive in colour, reliable source – 0.005 lumens per square cm		
e. size of signs – plainly legible letters not less than 15 cm high with the principal strokes of letters not less than 19 mm wide		
f. provided luminous directional exit signs located one foot or below floor level		
7. Heating, Ventilation and Air Conditioning (HVAC) Systems in Critical Areas		
a. adequate bracing for ducts and review of the flexibility of the ducts and piping that cross expansion joints		
b. leakproof piping, connections and valves		
c. anchored central heating and/or hot water equipment		
d. anchored central air conditioning equipment		
e. adequate safety provided for enclosures for HVAC		
f. equipment operational at all times (boiler, air conditioning systems, exhaust)		

D. Medical and Laboratory Equipment

1. Equipment in Operating Room and Recovery Room		
a. equipment in the operating room mounted on rollers or roller trolleys must be stable – anchored or fastened near the operating table during surgery and can be removed afterward		
b. equipment on roller trolleys must have proper anchoring system using hooks and chains and may be attached to beds or walls (ECG, monitors, suction units, ventilators, incubators, BP monitors, resuscitation equipment)		
c. lamps, equipment for anaesthesia and surgical tables are secured and tables or cartwheels are locked		
2. Radiological Equipment and Other Support Devices		
a. heavy and movable equipment anchored or bolted on the floor (e.g. X-ray machine) or to the wall (X-ray tubes)		
b. available steel frames for securing equipment (e.g. X-ray units, ultrasound scanners, CT scanners, MRI scanners)		
c. adequately shielded room (protection from radiation, radio frequencies, magnetic fields)		
d. air conditioned room with controlled humidity		
e. safe from flooding		
f. well-secured electrical outlets and safe grounding system		
g. proper segregation and storage of hazardous materials and chemicals		
h. good water supply, plumbing and drainage system		
3. Laboratory Equipment and Other Support Devices		
a. supplies and contents of laboratories secured on shelves and in racks (i.e. anchor the cupboards to the walls and strap the shelves)		
b. floors are without crevices, tiles are grouted (mortar or paste for filling crevices) and sealant regularly maintained		
c. good ventilation, air conditioning and humidity controls		
d. colour-coded bins for proper waste segregation		
e. good water supply, drainage and plumbing systems		
f. safe and well-secured electrical wirings, outlets		
g. safe and secured storage of reagents, culture organisms/media		
h. available standard decontamination area (fixed/mobile)		
i. wastewater disposed of to sewage treatment plant		
j. fume hood provided (depends on level of laboratory)		
4. Medical Equipment in Emergency Rooms/Intensive Care Units/Wards		
a. beds should be secured in place but also can be moved when needed		
b. equipment and accessories needed for treatment and placed near the bed are supported, anchored or fixed;		

available steel frames for securing equipment		
c. anchor bolts are provided on the walls in appropriate locations so that the equipment can be removed and fixed in a safe place when not in use		
d. safe and well-secured electrical wirings and outlets		
e. supplies and contents of medical cabinets secured on shelves/racks which are anchored/strapped to the wall		
f. equipment on roller trolleys have proper anchoring system using hooks and chains and can be attached to beds or walls (ECG, monitors, suction units, ventilators, incubators, BP monitors, resuscitation equipment)		
5. Medical Equipment in Pharmacy Departments		
a. supplies and contents of pharmacy cabinets are secured on shelves/racks that are anchored to the walls		
b. air conditioned or well-ventilated room		
c. safe and well-secured electrical outlets		
d. proper storage for hazardous materials free from leaks		
6. Medical Equipment in Sterilization Units		
a. supplies and contents of sterilization unit cabinets are secured on shelves or racks that are anchored to the walls		
b. heavy and movable equipment anchored or bolted to the floor or to the wall (e.g. autoclave)		
c. safe and well-secured electrical outlets		
d. clean and orderly, free from dirt and infectious materials		
7. Equipment and Other Support Devices in Nuclear Medicine Department and Radiation Therapy Units		
a. adequately shielded from the hazards of radiation		
b. use of proper illumination with backup lighting system in case of power failure		
c. safe from flooding		
d. available standard decontamination area (fixed/mobile)		
e. good ventilation, air conditioning and controlled humidity		
f. adequate power supply (about 24 kW/unit) with independent circuit breaker, grounding systems		
g. beds should be secured in place and can also be moved when needed		
h. equipment and accessories needed for treatment and placed near the bed are supported, anchored or fixed		
i. area monitors complete with alarms; radiation survey meters with audible warning		
j. proper segregation and storage, handling and disposal of chemicals, radioactive and other hazardous materials		
k. separate facility for the processing of the reagents and chemical substances, radio-pharmaceuticals and other diagnostic kits		
l. wastewater disposed of to sewage treatment plant		
m. presence of the following safety equipment: • shields		

• personal protective equipment • tools for remote handling • containers for radioactive materials • dose rate monitors with alarm • contamination meters • signs, labels, records • emergency kits		
E. Safety and Security of People, Equipment and Supplies		
1. Safety and Security of Personnel and Patients		
a. secured entrance and exit points		
b. equipment for inspection such as metal detectors		
c. available roving guard		
d. closed circuit television (CCTV) cameras with recorder		
e. personal protective equipment (PPE) for universal precaution (gloves, masks, gowns)		
f. sterilizing equipment and supplies		
g. information education communication (IEC) materials and information boards for patients and personnel on what to do during emergencies and disasters		
2. Safety of Fixtures, Equipment and Supplies		
a. equipment and accessories needed for treatment and placed near the bed are supported, anchored or fixed; available steel frames for securing equipment		
b. anchor bolts in the walls in appropriate locations so that the equipment can be removed and fixed in a safe place when not in use		
c. supplies in laboratory, pharmacy, general stores in the Central Sterilization Supply Department (CSSD) and OR properly secured on shelves and in racks		
d. safe and well-secured electrical outlets		
e. no dangling fixtures or decorative ornaments; no hanging fixtures by the patient's bed		
f. manual of Instructions, users manual available and accessible for all types of equipment		
g. proper segregation and storage of hazardous materials and chemicals		
h. available Material Safety Data Sheet (MSDS) that contains the following information: • chemical and physical properties • spill and disposal procedures • health hazards • emergency care and first aid • storage and handling • personal protection • reactivity • environmental and registration data		

(3) Functional Indicators of Safe Hospitals

The functionality of hospitals and health facilities during an emergency or disaster is very crucial. There is a need to ensure that health services will continue to be provided when they are most needed. The groups of functional indicators include:

(a) site and accessibility;
(b) internal circulation and interoperability;
(c) equipment and supplies;
(d) emergency standard operating procedures and guidelines;
(e) logistics system and utilities;
(f) security and alarm;
(g) transportation and communication systems;
(h) human resources, and
(i) monitoring and evaluation.

Site and accessibility of the hospital or health facility is an important aspect in determining functional vulnerability. They should be near good roads with an adequate means of transportation. They also should be close to other institutional facilities such as educational, religious and commercial centres. There should be no environmental hazards in the vicinity. For example, if the facility is near a river or creek prone to flooding or near an active fault line, it would be inaccessible by people seeking help or its structural safety would be threatened. Standards specify that a health facility be located near a major roadway that connects developing areas of the city or town and, in some cases, other municipalities. There should be alternative routes to the facility so that it would be easier to establish clear access and evacuation in emergencies.

Another functional aspect is the hospital's or health facility's internal circulation and interoperability. Proper zoning of various areas of the hospital or health facility, considering the interrelationships between them, helps maintain an optimal level of operation during normal conditions and during emergencies or disasters. In adverse conditions, some points of entry may have to be closed off to limit and control the number of people entering the facility. This avoids unnecessary overcrowding, prevents the curious from wandering in and out and protects personnel from external hostile forces. Some areas also may be needed to be converted into spaces for patients if there is an increased number of patients or if there are rooms in the hospital that need to be vacated. These identified areas must have basic utilities such as electricity, water, heating, ventilation or air conditioning units and communications systems. The use of hallways and corridors must be discouraged since this usually impedes the flow of patients, personnel and services.

There also are equipment and supplies vital to the continuous operation of the facility. A system should be set up for regular inventory of these items to ensure that the management of patients will not be delayed by the absence of diagnostic and therapeutic tools. It also is imperative that they be periodically checked to ensure that they are ready for use during emergencies.

Standard operatings procedures and guidelines should include conditions related to emergencies or disasters. These should cover the facility's guidelines and procedures to cope with an influx of patients and, sometimes, limited resources.

Systems also should be in place for estimating supplies and drug requirements, maintaining an inventory, storing and stocking and issuing and controlling. Every health facility at the first referral level should maintain adequate blood bank facilities, with particular attention paid to correct storage and handling of blood and blood products. If a blood bank is not feasible, possible sources of blood products should be identified and a system arranged for quick procurement in emergencies.

Availability of utilities, such as water supply, electricity and medical gases is crucial to the daily operation of hospitals and health facilities. Water supply should be safe and potable and there should be a reliable alternate source of water such as a rural water system, local fire station or storage tank. This is because the daily water consumption in health facilities is estimated to be five litres per outpatient and 60-100 litres per inpatient. Additional litres are needed for laundry, flushing toilets and other utilities.

There also should also be a reliable alternative source of power for emergency lighting and operation of essential equipment in the event of power failures. Ideally, there would be a generator capable of supplying at least 50%-60% of the facility's normal electrical load. This should be located on the premises but not adjacent to the operating and ward areas. Emergency lights should be available for use between the interruption of the power supply and connection to a generator to light important areas inside the health facility such as, stairs and hallways, the operating room, emergency room, nurses' stations and cashier area. They should not be used as substitutes for the generator.

The medical gas supply is vital for the survival of some patients in the health facility but is also a source of danger if not properly maintained. The tanks or medical gas pipes must be inspected regularly to ensure that they are still in good condition. In cases of piped-in gases, there should be safety valves installed to prevent leaks.

Safety issues include the presence of signage inside the health facility that should indicate the location of escape routes and firefighting equipment. This is to prevent confusion and panic during an emergency which subsequently may cause stampedes or trapping of individuals in enclosed spaces. Smoke detectors

and fire alarm systems also are important for the immediate response to fire. There also should be coordination with the local fire department for guidelines regarding proper placement of fire detectors and firefighting equipment. During an emergency, security should be tightened in certain high-risk areas of the facility such as the main entrance and exit points, storage areas for controlled substances and volatile chemicals and areas containing high-value medical equipment.

Communication is vital to the success of all coordination efforts. A public information centre should be established where the public can go to request information concerning family members. The centre should be coordinated by a social worker and staffed by the health facility's personnel or volunteers. The health facility's disaster plan should provide for the continued functioning of the public information centre during disaster situations. Public education is best integrated into the health facility's disaster plan. The public must be informed of the types of possible disasters and told how they should react during those emergencies. This would help the institution to mitigate the effects of the disaster.

Human resources remain the most important among available resources in a hospital or health facility. Personnel should be adequately prepared for emergencies and disasters. There also should be organized groups of people or committees who would be responsible for planning and responding if there is an emergency or disaster. The emergency planning committee should clearly define situations that would warrant activation of a disaster plan. The health facility could create an onsite disaster response team, depending on the availability of physical and human resources. The basic prerequisite for personnel on this team is that they be properly trained in first aid and that they have the necessary means to move immediately to the disaster scene. Other important training includes basic life support, advanced cardiac life support and familiarity with the Incident Command System (ICS) and a mass casualty incident (MCI). There also should be fire drills and simulation exercises once or twice a year.

Proper monitoring and evaluation also is needed, which includes post-incident evaluation of emergencies or disasters that have been responded to and annual fire drill simulation exercises to ensure that hospitals and health facilities are safe for health emergencies.

Functional Indicators of Safe Hospitals		
Instructions: *In the second column corresponding to each item, put a* ***Y*** *if the condition was satisfied or an* ***X*** *if the condition was not satisfied is lacking. Use the last column for remarks or comments. Put* ***N.A.*** *(not applicable) in the last column if the condition does not exist in own country or local setting*	Y or **X**	Remarks
A. Site and Accessibility of Hospital/Health Facility		
1. Site/ Location		
a. located along or near good roads and adequate means of transportation readily accessible to the community		
b. reasonably free from undue noise, smoke, dust, foul odours, floods and shall not be located adjacent to railroads, freight yards, children's playgrounds, airports, industrial plants, disposal plants		
c. complies with all local zoning ordinances		
2. Accessibility		
a. no obstructions on the roads leading to the hospital		
b. has access to more than one road (alternative routes) and has separate entrance and exit routes		
c. has well-paved access roads (cemented or asphalt) that are properly identified and labelled		
d. directional signage is available, properly fastened and readable even in darkness		
e. corridors, hallways and aisles must be 2.4-2.6 meters wide		
f. use of ramps as access to second and higher floors		
g. stairways with safe and adequately secured railings must be at least 112-120 cm wide each step must be less than 17 cm high and made of concrete		
h. any opening in walls protected by fire doors or fixed windows with wire glass		
i. any door to a stairway, ramp, elevator shaft, light and ventilation shaft or chute in a stairway enclosure shall be self-closing and normally shall be kept closed		
j. outdoor stairs must have enclosed and protected openings		
k. available, safe and well-lighted parking lots		
l. available covered walkway to interconnect service areas		
B. Internal Circulation and Interoperability		
1. Internal Circulation		
a. nurses at the stations can oversee the wards and are accessible to the patients		

b. gender-sensitive wards and sanitary toilets		
c. proper zoning of service areas: • departments most closely linked to the community are located nearest to the entrance (OPD, ER, administration, primary health care • departments that receive their workloads from the wards or inner zones should be located closer to these zones (radiology, laboratory) • inpatient departments should be in the inner zones		
d. secured and controlled points of entry with available map of the area		
2. Interoperability		
a. general service areas such as power plant, boilers, water storage facilities, laundry area and pump house are located in separate structures		
b. areas to be converted to spaces for patients during disasters properly identified with adequate lighting, electrical outlets, water supply and lavatories or bathrooms		
c. morgue is located separately from the service areas, preferably with a fence or gate		
d. diagnostic areas with heavy equipment are preferably on the ground floor but are safe from flooding		
e. identified evacuation and holding area		
f. laboratory, radiology and radiotherapy-medicine facilities are restricted areas		
C. Equipment and Supplies		
1. Basic equipment and Supplies		
a. basic equipment should be available in each ward or treatment area		
b. basic diagnostic and therapeutic equipment are functional and properly labelled		
c. stockpile at least a week's supply of medical items		
2. Equipment and Supplies for Emergency		
a. emergency medicines in the emergency room and in the critical service areas (OR, RR, ICU, NICU)		
b. instruments for emergency procedures		
c. medical gases		
d. ventilators, life support equipment		
e. disposable personal protective equipment (PPE) for epidemics		
f. crash cart for cardiopulmonary arrest		
g. triage tags and other supplies for managing mass casualties		
D. Emergency Management Policies, Procedures and Guidelines		
1. Standard Operating Procedures (SOP) and Protocols		
a. SOP on infection control, decontamination procedures		

b. SOP on internal and external referral of patients		
c. SOP admission to emergency department		
d. SOP for collecting and analysing information		
2. Procedures		
a. special administrative procedures for disasters and emergency response		
b. procedures for resource mobilization (funds, logistics, human resources) to include shifting of duties during emergencies and disasters		
c. procedures to expand services, spaces and beds in the event of a surge of patients		
d. procedures to protect patients' records		
e. procedures for regular safety inspection of equipment by the appropriate authority and preventive maintenance		
f. procedures for hospital epidemiologic surveillance		
g. procedures for preparing sites for temporary placement of dead bodies for forensic medicine		
h. procedures for transport and logistic support		
i. procedures for response during evening, weekend and holiday shifts		
3. Guidelines		
a. guidelines for food and supplies of hospital staff during emergencies		
b. guidelines and measures to ensure well-being of additional personnel mobilized during an emergency		
c. treatment guidelines or protocols		
d. guidelines for mental health and psychosocial support		
e. guidelines such as a memorandum or hospital order for all hospital personnel to participate in drills and simulation exercises		
f. guidelines for handling volunteers, especially during emergencies and disasters		
g. guidelines regarding firearms when visiting or going to the hospital or for police visiting friends or relatives in the hospital or conducting official business such as guarding a convicted patient		
E. Logistic System and Utilities		
1. Logistic System		
a. system for estimating drug requirement, maintaining an inventory, storing and stocking and issuing and controlling the use of drugs		
b. stockpile of emergency medicines and supplies		
c. special arrangement with vendors and suppliers for emergency purchases in times of disaster		
d. allotting contingency fund for emergency purposes		
e. system for rotating items that will expire first while placing on hold those with later expiration dates		

f. process for allocating resources and recording their use		
g. emergency kits		
h. adequate blood bank facility with SOP and guidelines for correct storage and handling of blood and blood products and rapid procurement in emergencies		
2. Water Supply System		
a. safe and potable water in emergencies at five litres per outpatient a day and 60-100 litres per inpatient a day and additional litres for laundry, flushing toilets and other utilities		
b. alternate source of water if the main supply is cut off		
c. identified agencies responsible for timely restoration of water service, supplementary pumping system if the system fails or services disrupted or for alternative water supply		
3. Electrical System		
a. system for how electric power is supplied to the hospital, higher distribution voltage such as 400/230 v, use of 3-phase 4-wire system for lower cost and greater efficiency		
b. hospital's electric supply in terms of amperage or cyclage or kilowatts		
c. use of inflammable cooling system for transformers, i.e. dry type, epoxy resin or silicon oil or high temperature R-Temp oil		
d. location of control panels and power distribution lines should be marked in the floor plan		
e. presence of emergency power generator or alternative power for emergency lighting and operation of essential equipment		
f. generator set should be located on the premises but not adjacent to the OR or ward areas		
g. recommended circuits to which emergency power should be provided: Lighting: • all exits, including exit signs, stairways and corridors • surgical, obstetrical, recovery room, emergency room and operating room • nursery, laboratory, recovery room, intensive care units, nursing stations, labour room and pharmacy • generator set location, electrical switchgear location and boiler room • one or two elevators, if needed for emergency • telephone operator's room • computer room Equipment: • nurses' call system • alarm system, including fire alarm • fire pump for central suction system • blood bank refrigerator • equipment in operating, recovery, intensive care and delivery rooms • one electrical sterilizer, if installed • sewage or pump lift system		

• equipment necessary for maintaining telephone service and two-way radio base system Heating, cooling and ventilation system: • operating room, delivery room, labour room, recovery room, intensive care units, nurseries, neonatal intensive care units and patients' rooms		
h. emergency lights with battery backup available for use during the period between the interruption of the power supply and connection to a generator set to light important areas inside the hospital such as stairs, hallways, the operating room, emergency room, intensive care units, recovery room, neonatal intensive care units, nurses' stations and cashier area		
4. Medical Gases Distribution System		
a. properly maintained medical gasoline		
b. gas tanks and medical gas pipes regularly inspected		
c. safety valves installed to prevent leakage in piped-in gases		
d. available leak alarm system and locator		
F. Safety and Security Systems		
1. Safety and Alarm Systems		
a. signs in the hospital indicate the location of escape routes and firefighting equipment		
b. building layout diagram provided for easy identification; designates evacuation site for each hospital ward		
c. smoke detectors at proper intervals covering the entire building		
d. regular checkups of the smoke detectors to ensure they function and have an adequate power supply		
e. visible and accessible equipment for local fire control, including fire hoses and fire extinguishers that should be placed strategically in corridors, at exit routes and at entrances to high-risk rooms such as laboratories		
f. regular maintenance of the fire extinguishers, the contents of which expire over time and must be replaced regularly		
g. compliance with guidelines for proper placement of fire detectors and firefighting equipment		
h. personnel training on use of fire extinguishers		
i. hospital alert in order for hospital to prepare and mobilize resources in response to early warning signs or signals		
j. system of recalling staff and positioning them for possible response to emergencies		
k. system of activating and deactivating the code alert		
2. Security Systems		
a. available security unit (private or organic)		
b. SOP on tightening security in certain high-risk areas such as the main entrance and exit points, storage areas for controlled substances and volatile chemicals		

and areas containing high-value medical equipment		
c. repository for firearms upon entering the hospital (no firearms allowed inside hospital)		
d. provision to recall or call to duty of off-duty guards during emergencies and disasters		
e. coordination with local officials to assist the hospital during emergencies and disasters		
G. Communications, Transportation and Information Systems		
3. Communications and Transportation Systems		
a. backup communications facilities (cellular phone, handheld radios, satellite communication facilities		
b. equipped ambulances for transport of casualties from the field to the hospital, for moving patients to other facilities in cases of referral or overload or for evacuating and relocating a hospital service		
c. list of identified available and capable ambulances for use during emergencies		
d. list of equipment, medical supplies, emergency drugs and training of personnel for ambulances		
4. Public Information Systems		
a. public information centre where people can go to request information concerning family members		
b. public information centre is coordinated by a social worker and staffed by personnel or volunteers		
c. training of public information officer (PIO) in risk communications		
d. public awareness and public education campaign with warning messages or risk communications		
e. procedures for communicating with the public and media		
5. Information Management Systems		
a. preparation of a census of admitted patients and those referred to other hospitals		
b. proper recording and reporting using standard forms		
c. ways of sharing information with proper authorities		
d. information management system during monitoring of events in emergencies or disasters		
H. Plans for Emergency and Disaster		
1. Hospital Emergency Incident Command System		
a. The chief of hospital as the incident commander and other staff to fill the positions of the Incident Command Group (ICG)		
b. system for activating and deactivating the ICG		
c. with uniform, identification and job description sheet (JDS)		
d. available operations centre and an alternate operations		

centre		
2. Contingency Plan		
a. accessible, tested, updated and disseminated hospital emergency preparedness, response and recovery plan that includes a hazard prevention and mitigation plan, vulnerability reduction plan and a capacity development plan. This plan includes the systems, guidelines, SOPs and protocols for emergency management		
b. includes an evacuation plan in emergencies		
c. plan for expansion of services in times of a sudden surge of patients		
d. procedures to activate and deactivate the plan		
e. cooperative arrangements with local emergency plans		
f. contingency plans for needed medical treatment during different types of disasters, including diseases with an epidemic potential		
3. Manuals for the Operation, Preventive Maintenance, and Restoration of Critical Services		
a. electrical supply and backup generators		
b. drinking water supply and alternate source of drinking water		
c. fuel reserves		
d. medical gases		
e. standard and backup communications systems		
f. wastewater treatment		
g. solid waste treatment		
h. fire suppression		
I. Human Resources		
1. Organization of Hospital Disaster Committees and Emergency Operation Centre		
a. a crisis management committee with technical expertise that could advise an executive committee regarding crisis, emergency and disaster management		
b. an emergency response team composed of physicians, nurses, midwives, an emergency management technician-trained staff, paramedics and trained ambulance driver		
c. a health emergency planning group responsible for formulating a health emergency preparedness, response and recovery plan and other hospital response plans		
d. a safety committee headed by an officer in charge of promoting safety in the hospital against all hazards		
e. a hospital operations centre headed by a hospital emergency management coordinator in charge of monitoring emergencies or disasters, dispatching response teams, mobilizing other resources for		

emergencies, operational 24 hours a day, seven days a week. It has a designated office or unit with personnel equipped with communications facilities, a computer system, directories and an alternate communications system if the system fails.		
2. Capability Building of Personnel		
a. All of health workers trained in basic life support, cardiopulmonary resuscitation and standard first aid		
b. emergency room medical staff trained in Advanced Cardiac Life Support and Advanced Pediatric Cardiac Life Support		
c. hospital responders trained in an emergency medical technician course, the Incident Command System (ICS) and for a Mass Casualty Incident (MCI)		
d. hospital managers must be trained in the Hospital Emergency Incident Command System (HEICS)		
3. Drills and Exercises		
a. conduct fire drills at least twice a year		
b. conduct simulation drills or exercises at least annually		
J. Monitoring and Evaluation		
1. Post-incident evaluation of emergencies or disasters for which there has been a response		
2. Evaluations of fire drills at least twice a year		
3. Evaluation of emergency simulation exercise or drill at least once a year		

Part III. Summary and Conclusions

Identification of the structural, nonstructural and functional vulnerabilities is the first step towards reducing risks in hospitals and health facilities and ensuring that they will be resilient, safe and will continue to operate in times of emergency and disaster. This document provided a list of indicators that must be considered in assessing the vulnerabilities of hospitals and health facilities.

Structural indicators are crucial for the building to withstand adverse natural events. These include:

(1) the building location;
(2) design specifications; and
(3) materials used for the hospital or health facility.

Nonstructural indicators are essential for the daily operations of hospitals and health facilities. If these are damaged, they will not be able to function and even may cause physical injury to patients and personnel. These include:

(1) architectural elements such as ceilings, windows and doors;
(2) medical and laboratory equipment;
(3) lifelines (mechanical, electrical and plumbing installations); and
(4) safety and security issues.

Functional indicators are important for the continuous operation of hospitals and health facilities. These include:

(1) site and accessibility;
(2) internal circulation and interoperability;
(3) equipment and supplies;
(4) emergency standard operating procedures and guidelines;
(5) logistic system and utilities;
(6) security and alarm;
(7) transportation and communications systems;
(8) human resources; and
(9) monitoring and evaluation.

After identifying the vulnerabilities, the next step is to plan for possible actions to reduce vulnerabilities, including improving building codes and designs, retrofitting, relocating critical services in a less vulnerable part of the building and use of protective barriers. In nonstructural vulnerabilities, the focus is to ensure the safety of people and equipment, continuity of the delivery of services and emergency rehabilitation measures. These may include mitigating vulnerability, relocating activities, limiting mobility of the equipment, securing the equipment, reinforcement, emergency repair and rehabilitation procedures and contingency plans. In reducing functional vulnerabilities, some possible measures include optimizing the use of various areas and distributing critical services, maintaining quality improvement and quality assurance, an early warning system for risk

identification and management, supervising staff during emergencies, securing delivery of lifelines, maintaining equipment and using special procedures and protocols during emergencies.

Safe hospitals need to remain structurally sound, well-organized and fully operational in emergencies and disasters. Supporting hospitals and health facilities to make them safe in health emergencies involves everyone.

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