HOSPITALS DON'T BURN!

Hospital Fire Prevention and Evacuation Guide

Pan American Health Organization

World Health Organization
REGIONAL OFFICE FOR THE Americas

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This publication was made possible through the contributions and collaboration of the following persons:

Pan American Health Organization

Eng. Shalini Jagnarine (Principal Author)

Dr. Dana Van Alphen (Project Coordinator)

Structural Engineers

Eng. Tony Gibbs

Dr. Judith Harvey

Dr. Luigi DiSarno

Hospital Personnel

Eng. Hugo Martinez

Dr. Haresh Thani

Mr. Gary Thomas

Dr. Elizabeth Ferdinand

Disaster Specialists

Mr. Ron Mobley

Ms. Sharleen Dabreo

Mr. Peter Burgess

INTRODUCTION

This guide was created to address the vulnerability of hospitals to fires. All possible steps should be taken to minimize the hazard of fires in hospitals and to stress the need for evacuation. *Hospitals Don't Burn! Hospital Fire Prevention and Evacuation Guide* is applicable to existing hospitals that can be retrofitted to improve safety against fires as well as proposed or newly built facilities. The document is formatted into four main sections, namely:

- Prevention
- Suppression
- Evacuation
- Evacuation Training Drills

The primary aim of a hospital facility is to **not** evacuate patients unless absolutely necessary. Hence, special attention should be focused on proper prevention and suppression techniques to avoid this worst-case scenario. That being said, evacuation training and preparedness is of paramount importance to avoid and/or minimize loss of life.

Section 3 provides a guide on hospital evacuation. It is not a fixed plan that completely details the tasks and responsibilities of each member of the evacuation team. Indeed, the components and personnel suggested in this guide may vary depending on the particular hospital for which the evacuation plan is being developed.

GUIDING PRINCIPLES

One of the critical considerations in the safety design for all facilities is the prevention of fire, particularly with respect to the combustibility of construction and furnishing materials and the spread of fire and smoke.

In the event of either accidental or malicious fires, suppression equipment needs to be readily accessible to combat these fires. Staff members of the health facility need to have working knowledge of how to use the equipment and to avoid panic.

The last resort, failing the ability to completely suppress the fire, is to evacuate the facility. Moving all patients, visitors, and staff out of dangerous and/or damaged facilities as safely as possible is always the goal of an evacuation. It is important to recognize that people's attention to detail and processes will not be optimal in an evacuation scenario. To that end, understanding key principles will help staff members make good decisions during a chaotic event.

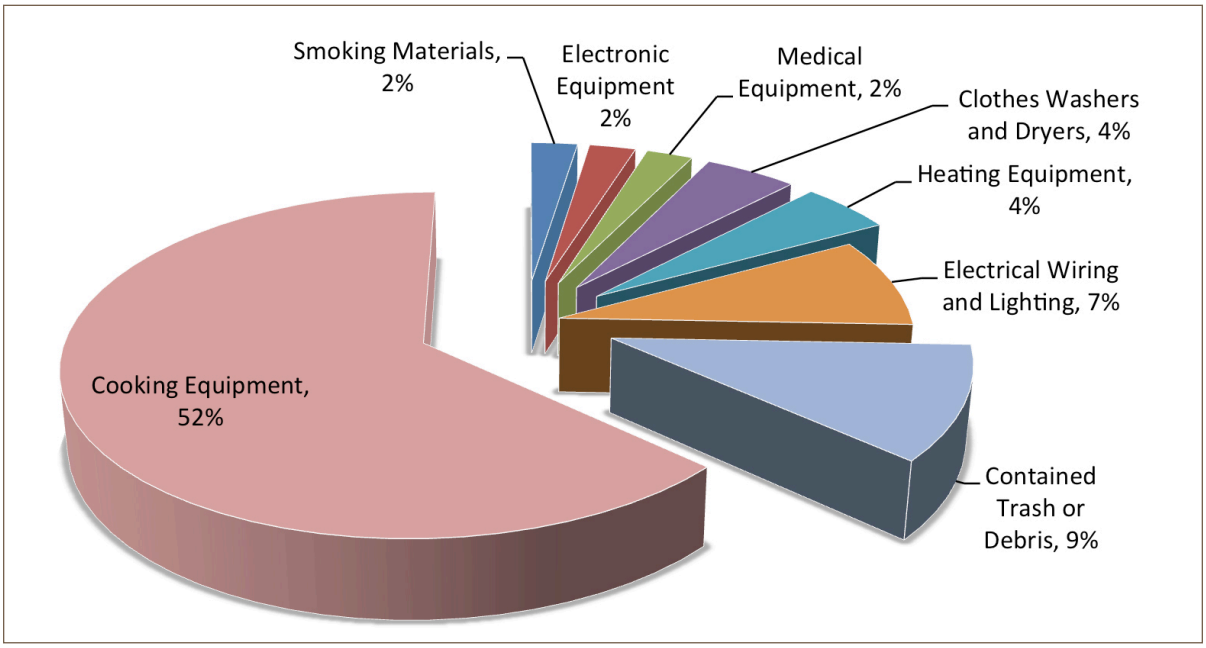
- Every effort should be made to include evacuation considerations when designing or retrofitting hospital facilities.
- Full evacuation of a hospital should generally be considered as a last resort when mitigation or other emergency response efforts are not expected to maintain a safe care environment.
- Safety is always the primary concern.
- Simplicity is key; the staff will need a simple plan to follow in an emergency.
- Flexibility is vital because the procedures must be adaptable to a variety of situations.
- Self-sufficiency at the unit level is important because timely communication from hospital leaders may be difficult or even impossible; employees at every level must know immediately what to do in their area.
- It may be necessary to evacuate patients to holding sites before transportation resources and/or receiving destinations are available. If the medical facility cannot accommodate a horizontal safe site (a location on the same floor safe from danger), then assembly points located away from the main clinical areas should be identified and designated.
- Individual patient care units should stay together at the assembly points whenever possible (instead of the patients in these units being divided into separate groups according to their ambulatory status). This is because the unit teams familiar with their patients will be better able to manage them in a chaotic situation away from the care unit.
- Emergency medical system (EMS) personnel and other external patient transporters should generally not be asked to come into the hospital to load patients because of the risks, time delays, and inefficiency associated with this process when large numbers of patients are involved. Instead, evacuating patients should be taken to meet their transporting ambulances and other vehicles in rapid-throughput staging areas.
- When difficult choices must be made, leaders and staff must focus on the "greatest good for the greatest number."

REMEMBER: The initial steps to protect hospitals against fires are prevention and suppression. Complete evacuation of patients should be avoided unless absolutely necessary.

CASE STUDIES OF HOSPITAL FIRES

A number of different materials and types of equipment are major contributors to hospital fires. The eight leading causes of hospital fires in the United States of America are shown in the chart below (these figures are based on data from the National Fire Protection Association).[1]

Figure 1: Main Causes of Hospital Fires



Data on selected hospital fires in the Latin American and Caribbean region and around the world are presented in Table 1.

Table 1: Selected Examples of Hospital Fires

May 1929: Cleveland Clinic, Cleveland, Ohio, USA—125 Fatalities	
	• The fire started in the clinic's basement, caused by improper storage and ventilation of 70,000 sheets of X-ray films. • Toxic fumes from burnt film spread rapidly throughout the hospital's vents. • Although no one died directly from the fire, people died as a result of the toxic fumes released.

(Continued on next page)

1. Source: http://www.fiercehealthcare.com/story/eight-leading-causes-hospital-fires/2009-10-20.

Table1 (continued)

April 1949: St. Anthony's Hospital, Effingham, Illinois, USA—at least 74 Fatalities	
	• This 100-bed hospital served 8,000 residents. • Combustible furnishings led to the rapid spread of fire and smoke, preventing access to fire escapes and slides. • The hospital's chief engineer died trying to put out the fire at the laundry chute. • One nurse in the pediatric ward could not save the babies and stayed to die with them. • The fire chief, who arrived on the scene two minutes after the call and saw smoke pouring out the fire exits, later said that "we didn't stand a chance."
January 1950: St. Elizabeth's Women's Psychopathic Building of Mercy Hospital, Davenport, Iowa, USA—41 Fatalities	
	• This incident was almost an exact replica of the St. Anthony's Hospital fire: rapid spread of fire and smoke because of the hospital's combustible interior. • Locked doors and barred windows in the psychiatric hospital made evacuation extremely difficult. • Due to the condition of patients, some refused to leave their rooms and wanted to go back into the burning hospital once they were outside.
May 2003: Hospital Barros Luco, Santiago, Chile—0 Fatalities	
	• The hospital serves approximately 10,000 persons daily. • The fire started on the highly congested mechanical floor; the fire alarm did not pinpoint the exact location of the fire. • 334 firefighters responded, and it took 5 hours to extinguish the blaze. • The hospital's staff was trained in fire evacuation procedures, and the facility had adequate numbers of fire doors, fire walls, and extinguishers.
July 2005: Calderón Guardia Hospital, San José, Costa Rica—19 Fatalities	
	• This 62-year-old hospital is one of the busiest in San Jose. • The fire started on the fifth floor; patients in the neurosurgery ward and the intensive care unit (ICU) were trapped. • Fire escapes extended only to the third floor. Patients tied bed sheets together and used them as ropes to climb out of the windows. • The fire alarm did not signal that there was a fire; also, the facility had no evacuation plan and had insufficient signage and lighting.
September 2009: St Jude Hospital, Vieux Fort, St. Lucia—3 Fatalities	
	• This hospital is the second largest in St. Lucia. • One of the three buildings on the compound, containing the surgical and recovery wards, was destroyed by the fire, which spread rapidly in the old wooden structure. • The fire caused asbestos from the roof to spread throughout the hospital, and a specialist contractor was required to clean the facility.
May 2010: St. Joseph Mercy Hospital, Georgetown, Guyana—0 Fatalities	
	• The operating theater and administrative departments, located in the historic "Colonna House" wooden structure, were completely destroyed. • 66 years of medical records were lost in the fire. • As soon as the fire started, hospital staff evacuated all 37 patients and four babies.

(Continued on next page)

Table1 (continued)

December 2011: AMRI Hospital, Kolkata, India—91 Fatalities	
	• The fire in this private hospital started in the basement, where highly flammable medical equipment was illegally stored. • Hospital staff abandoned the hospital when the fire started and did not try to rescue any patients. • The fire service arrived 90 minutes after the start of the fire. Windows and doors were locked; windows had to be broken to gain access. • Most deaths were a result of smoke inhalation.
April 2013: Psychiatric Hospital No. 14, Ramensky, Russia—38 Fatalities	
	• 41 people were in the hospital at the time of the fire. Most patients were heavily sedated for sleep. • Most windows and doors were locked and barred. • The old wooden structure, without adequate fire suppression and prevention procedures, had almost completely burned down when the fire service arrived.
October 2013: Orthopedic Hospital, Fukuoka, Japan—10 Fatalities	
	• 17 patients were in the hospital when the fire started at 2:20 a.m. • The fire doors on the second and third floors were not closed, resulting in rapid spread of smoke. • The fire station noted that staff did not attempt to put out the fire when it started and that the call was received late.

Several questions arise out of these incidents:

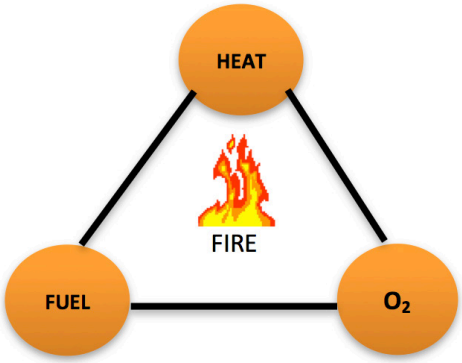
1. How combustible were the structure and the interior furnishings?
2. What provisions were in place for limiting the spread of the fire?
3. What provisions were in place for early discovery of the fire?
4. What provisions were in place for notification of the fire service and hospital personnel? Are regular fire drills conducted for staff members and the fire service?
5. What provisions were in place for prompt extinguishing of the fire and prompt evacuation of patients?

This document is intended to address these questions and provide practical solutions that should be adopted in all health care facilities. The first section on fire prevention deals with Questions 1 and 2, Section 2 (suppression) addresses Questions 3 and 4, and Question 5 is dealt with in Section 3 (evacuation).

Section 1: PREVENTION

This section considers aspects of fire prevention as it relates to materials that are resistant to combustion or burning and materials that are highly flammable and require special care if they are to be used in a hospital. The objectives of these preventative strategies are to limit the occurrence and magnitude of fires and to delay their spread in medical facilities.

Before we undertake fire prevention, we first need to understand the three main ingredients that constitute a fire: heat, fuel, and oxygen. The paradigm below, referred to as the "fire triangle," shows how these three components interact to create a fire.



- **Fuel** is any combustible material that can be used as the source of ignition of the fire, as well as to keep it burning.
- **Oxygen** is an oxidizing agent that reacts with the fuel to start and continue the fire. Lower concentrations of oxygen result in slower fuel combustion.
- **Heat:** Fires require oxygen and fuel reacting with each other at a temperature exceeding a threshold temperature, referred to as the "flash point." Different materials and chemicals have different flash points, some at low temperatures and some high. The lower the flash point temperature of a compound, the more easily the compound ignites.

There are **five classes of fires** that are categorized based on the types of contributing fuel/combustion materials. These classes are as follows:

- **Class A:** Fires that involve ordinary combustible materials such as wood, cloth, paper, rubber, and many plastics.
- **Class B:** Fires that involve flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.
- **Class C:** Fires that involve energized electrical equipment, such as power tools, wiring, fuse boxes, appliances, TVs, computers, and electrical motors.
- **Class D:** Fires that involve combustible metals such as magnesium, potassium, titanium, zirconium, lithium, and sodium.
- **Class K:** Fires that involve combustible cooking oils and fats used in commercial cooking equipment.

1.1 Planning Considerations for New and Existing Hospitals

One of the primary considerations in preventing hospital fires is to prohibit the use of combustible structural (e.g., floors, walls, roofs, stairwells, fire escapes) and nonstructural (e.g., doors, windows, ceilings, fixtures, façade, insulation, mechanical and electrical conduits) components in the hospital facility.

- New facilities should be designed using building codes and guidelines for fire prevention, and the materials used should have adequate fire resistance ratings. (These ratings refer to the duration, usually in hours, that a given material can withstand a fire at a specific maximum temperature before losing its integrity, including its strength and insulation capabilities.) In the case of both structural and nonstructural components, fire resistance ratings/durations can vary from 30 minutes to over 4 hours.
- As-built drawings or plans for existing facilities are required in order to determine the fire-retardant retrofitting needs of the facility. As-built drawings should also be produced for new facilities for future reference, for example in the case of renovations or refurbishments. These drawings should be submitted to the fire service so that, in the event of an emergency at the medical facility, first responders will have a good knowledge of the layout and location of emergency exits, fire compartments, and so forth, allowing for a more efficient response in saving lives.
- Retrofitting plans for fire prevention (and suppression) should be submitted with an associated price tag for the medical facility's overall operating and maintenance budget. However, the following important questions should be considered: *What is the associated "price tag" of a person's life? What is the cost of not providing protection against fires?*

1.2 Construction and Design Considerations

1.2.1 New Medical Facilities

Materials used in the design and construction of hospitals must be noncombustible/nonflammable, must have adequate fire resistance ratings, and should not emit toxic gases/smoke during a fire. Fire resistance ratings are usually dependent on the layout, occupancy, and usage of the facility.

Some examples of materials that emit toxic fumes during a fire and should be avoided are:

- Polystyrene (for example, polystyrene decorative moldings)
- Insulation spray foams, polyurethane and isocyanate foams

In newly built facilities, the design engineers should account for the required fire rating of the structural components of the building, guided by building code standards. Building codes differ depending on the country. Table 2 below provides general information on the fire resistance ratings of some common types of building materials.

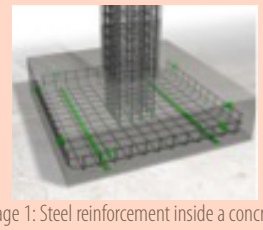
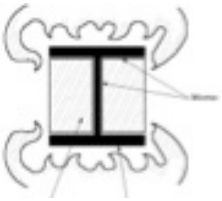
Table 2: Fire Resistance Properties of Selected Structural Materials[2]

Material	Fire Resistance
Timber	Although timber is a combustible material, large sections of timber can perform better than equivalently sized steel or aluminum. Timber has a low thermal conductivity, and the charred surface helps to protect the interior section from burning. Most types of timber have charring rates of 20 mm (0.8 inches) in 30 minutes and 40 mm (1.6 inches) in 60 minutes. Some hardwoods such as oak, teak, and greenheart have slower char rates ranging from 15 mm in 30 minutes to 30 mm in 60 minutes.
Masonry Units	Solid units tend to be more fire resistant than hollow units of equivalent thickness. Solid units 100 mm (3.9 inches) in thickness can provide up to 2 hours of fire resistance if they are load bearing and 4 hours if they are not load bearing. Detailed information on fire resistance should be obtained from the manufacturer.

(Continued on next page)

2. Source: International Building Code, Chapter 7, "Fire Resistance Rated Construction."

Table 2 (continued)

Material	Fire Resistance
Reinforced Concrete  Image 1: Steel reinforcement inside a concrete footing. The spacers shown in green allow for the concrete cover to reinforcement.	The fire resistance provided by different structural components depends on their minimum dimension and the concrete cover to reinforcement[3] distance; 25 mm (1 inch) cover to reinforcement can provide between 60 minutes and 90 minutes of protection, and up to 45 mm can provide 2 hours of protection depending on the structural element. It is important to note that special detailing of the reinforced concrete is required to prevent spalling (breaking off, flaking, or pitting of the concrete) if the cover is greater than 35 mm. Concrete cover requirements are dependent on the lifespan durability of the structural elements and not just fire protection.
Structural Steel  Image 2: Flexible blanket fire insulation.  Image 3: Block-filled column web.	This material has very low resistance to fires, and as such several methods are available. Up to 3 hours of fire protection can be achieved with boards[4] and vermiculite[5] concrete spray. Up to 2 hours can be achieved with "intumescent"[6] paint and flexible blankets (although the latter are not optimal aesthetically). The durability of intumescent paint in tropical areas is not guaranteed, and a decorative hardtop may be needed to protect the intumescent layer in humid environments. Steel elements may also be concrete encased, which is very expensive and time consuming (as well as space consuming). Other less popular forms are concrete filled columns, water-filled columns, and block-filled column webs. (Note: Lifespan durability should also be considered with respect to the protection specified for structural steel elements.)
Stainless Steel	Stainless steel normally functions better than mild steel, which has a low carbon content (0.1% to 0.25%), because it retains more of its strength and stiffness when exposed to fire. However, since stainless steel structures are typically exposed, their inherent fire resistance needs to be calculated as part of a facility's engineering scheme.
Structural Glass	Fire-resistant types of glass, such as wire interlayer glass, intumescent laminated glass, and pre-stressed borosilicate (as known as Pyrex) glass, can achieve a fire rating of up to 60 minutes.

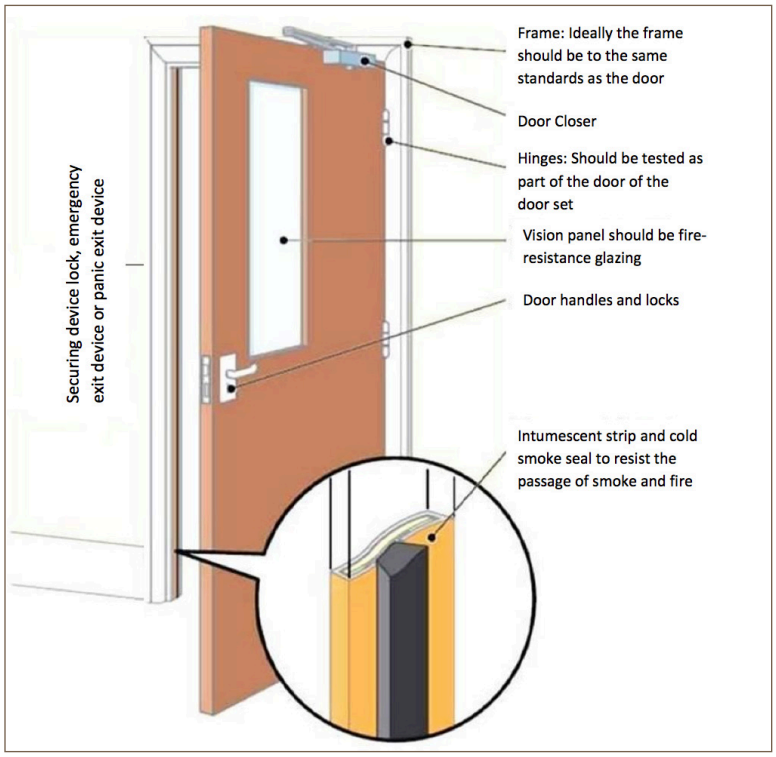
1.2.2 Existing Medical Facilities

- Existing facilities may be retrofitted to increase their fire resistance. For example, light-framed wooden walls and floors can be removed and replaced with or faced with boards such as gypsum or concrete board, which can have a fire rating of 60 minutes depending on board thickness.
- Boards should intersect with solid concrete floors, walls, and so forth to create continuous fireproof partitions, also known as fire compartments. Fire compartments, which typically should have a 2-hour fire rating, are separated by fire walls and fire doors.
- Flammable materials should be protected with fire-retardant paint or other forms of fire-insulating, noncombustible materials or removed altogether. Flammable materials include wood, combustible liquids, electrical equipment and wiring, combustible metals, medical gases (particularly oxygen), and cooking equipment. (Refer to the above discussion of classes of fires for a more detailed list of combustible materials.)
- Glass doors and windows should be fire retardant and shatterproof.

3. Cover to reinforcement (referring to the steel bars or "rebars") is the distance between the edge of the rebar and the nearest external face of the concrete.
4. Boards can be gypsum boards, also known as wallboard, plasterboard, or gyprock, or concrete boards.
5. Vermiculite is a hydrous, silicate material, classified as a phyllosilicate, that expands greatly when heated.
6. Intumescent refers to a substance that swells when exposed to heat.

- Ceiling tiles and wall and floor finishes (e.g., carpets) should be fire retardant.
- Fire doors and frames should be installed between each fireproof compartment or room and at each landing level of stairwells and fire escapes. It is imperative that fire doors with a minimum fire rating of 20 minutes to 1.5 hours separate each room and section. Fire doors should be self-closing.

Figure 2: Typical Standard Fire Door



1.2.3 Number of Floors

- The greater the number of floors, the more complicated the evacuation plan, in terms of both horizontal and vertical movement.
- If land space is not a restriction,[7] the aim in the design of a new medical facility should be to reduce the vertical height and number of floors of the building. Single-story, low-rise buildings spread across the site are preferable, as they are easier and quicker to evacuate.
- ICUs and accident and emergency units should be located on the ground floor or first-floor level with dedicated access ramps. Typically, high-traffic units (e.g., diagnostics) are located on the lower/ground floors. (Note: The configuration of an ICU ward is completely different from that of other wards.)

1.2.4 Egress

- Each stairwell needs to have fire doors at each landing, as mentioned above.
- There must be a minimum of two independent egress routes and exits for every location on every floor. The ratio of floor area to exits required is based on building occupancy. It is recommended that any room or suite of rooms (other than patient sleeping rooms) of 230 square meters (2,500 square feet) or more have at least two independent exits.

7. The SMART Hospitals Toolkit recommends design strategies that limit the building footprint and disturbance of green spaces.

- Exit routes should be located as far away from each other as possible so that if one exit route is blocked with smoke or fire, the alternate route can be used.
- The width of the corridor leading to the emergency exits (unobstructed) should be at least 2.4 m (7.9 feet). This will permit the transportation of hospital beds, mattresses, and so forth in the evacuation of non-ambulatory patients.
- Doors should be of the minimum width necessary to accommodate a stretcher (typically 1.25 m).
- Access for firefighters: In the United States, some hospitals have designated stairwells for firefighters to access the building, to avoid congestion between people evacuating and fire service personnel. In Brazil, some medium- to high-rise buildings provide window access for firefighters to enter the building.
- Evacuation maps should be posted at the hospital's main access points to clearly identify egress routes. It is important to note that the evacuation may not necessarily involve patients and personnel exiting the building; they may be required to move to an upper floor.
- Egress routes and exits should be clearly identified. Below are the internationally accepted identifying signs:

Section 2: SUPPRESSION

Fire suppression is critical in order to circumvent/minimize damage or the loss of property and life. The ability to quickly detect and extinguish fires is a key factor in avoiding the worst-case scenario, which is evacuation of the hospital.

2.1 Fire Alarm System

There are several ways in which fires can be detected. The traditional and obvious method of detection is a person seeing the fire and/or smelling smoke, at which point a fire alarm should be activated or a notification issued. In some cases, a designated "runner" relays the notification to others through word of mouth. In other instances, manual fire alarm pulls or manually activated alarm-initiating devices are used to sound the fire alarm.

According to the National Fire Protection Association in the United States, suggested requirements for installing and locating manual fire alarm–initiating devices are as follows:

- Manual pull boxes should be securely mounted on a background of contrasting color.
- The operable part of the fire alarm box should not be more than 1.07 m (42 inches) to 1.22 m (48 inches) above floor level.
- Manual pull boxes should be located so that they are conspicuous, unobstructed, and accessible.
- Manual pull boxes should be located so that the horizontal travel distance between boxes on any floor is not more than 61 m (200 feet).
- Additionally, manual pull boxes should be located within 1.52 m (5 feet) of either side of a grouped opening (e.g., a bank of elevators and staircases located together) that is over 12.2 m (40 feet) in width.

REMEMBER: A fire alarm system is established to (i) enhance the safety of building occupants and (ii) to minimize damage to the property.

2.1.1 Smoke and Heat Detectors

A variety of smoke and heat sensors can be installed as part of a fire alarm system to detect fires that begin in low-traffic areas away from personnel/staff. These sensors should ideally trigger an automatic alert system with visible (flashing lights/strobe lights) and audible bells or voice alerts to indicate that a fire was detected. The sensors should also be able to pinpoint the location at which the fire was detected, through a remote annunciator panel that lights up to indicate the area where the fire detection device was triggered.

- Smoke detectors will generally detect a fire faster than heat detectors. However, personnel responsible for the specific siting of smoke and heat detectors should consider the possibility of any false or unwanted alarms. For instance, smoke detectors should likely not be used in the facility's kitchen. Instead, opt for fixed-temperature heat detectors in cases where a sudden rise in temperature is expected in a fire.
- Smoke and heat from fires will tend to accumulate in the highest parts of the enclosed spaces of the building. This is where the detectors should be located.

- The location of smoke and heat detectors depends on the type of detector being used and the geometry and occupancy of the space. Typically, the maximum coverage areas for smoke and heat detectors are 100 square meters (1,076.4 square feet) and 50 square meters (538.2 square feet), respectively.
- There are three types of smoke detectors: ionized, photoelectric, and combined ionized/photoelectric. Ionized smoke detectors are relatively inexpensive, while photoelectric detectors tend to cost more.

2.2 Fire Suppression

Once a fire has been detected, a suppression system to extinguish the fire is required to minimize damage and avoid evacuation. A variety of firefighting equipment can be installed in different locations in the hospital to combat specific types of fires, with special consideration to the patients occupying each area and the medical equipment housed in those areas.

2.2.1 Fire Extinguishers

Fire extinguishers are labeled with standard symbols and letters representing the classes of fires that they are equipped to fight.

Table 3: Types of Fire Extinguishers

	**ABC Dry Chemical** These extinguishers, rated for Class A, B, and C fires, contain 2.3 to 9.1 kg (5 to 20 pounds) of monoammonium phosphate. Monoammonium phosphate is a finely ground extinguishing agent similar in appearance to yellow talcum powder. Nitrogen gas is used for the propellant. Dry chemical extinguishers, which have a range of about 4.6 m (15 feet), are easy to use but extremely messy. They are typically found in hallways and occasionally in labs.
	**Carbon Dioxide (CO2)** These high-pressure vessels are filled with either 2.3 or 4.5 kg (5 or 10 pounds) of liquid CO2. They are to be used only on flammable liquid or electrical fires. Because the CO2 is expelled as a gas, the extinguisher has a very limited operation range of about 1.2 m to 1.8 m (4 to 6 feet). These extinguishers, easily identifiable because they do not have a pressure gauge, are found mostly in labs or mechanical rooms.
	**Halon** Halon fire extinguishers, which have a range of about 4.6 m (15 feet), are rated for Class B and Class C fires but are also effective in fighting Class A fires. They use bromochlorodifluoromethane (halon 1211) as their extinguishing agent. Halon is an extremely clean agent that leaves no residue, making it effective for use around computers and other sensitive equipment. However, halon 1211 was deemed environmentally unsafe in 1995, and its use is being phased out in many countries.
	**Dry Powder** These extinguishers are intended for Class D (metal) fires. The fire is extinguished by isolating and smothering it with either a copper-based or sodium chloride–based powder. Dry powder extinguishers are mounted on two-wheel carts and have a range of 0.9 m to 1.8 m (3 to 6 feet). (Continued on next page)

Table 3 (continued)

	**Class K Extinguisher** These extinguishers are rated to combat Class K (grease) fires. In recent years, many commercial kitchens have begun to use more efficient cooking appliances and unsaturated cooking oils that operate at much higher temperatures than the previous oils and appliances. The Class K extinguisher was developed to combat this new hazard. This extinguisher uses a wet-potassium-acetate-based, low-pH agent that has a greater firefighting and cooling effect for this type of hazard. Most of these extinguishers can safely be used to fight Class A, B, or C fires as well (although the label should be checked first). Their range is 3 m to 3.6 m (10 to 12 feet). Class K extinguishers can be found in kitchens where deep-fat fryers are in use.

2.2.2 How to Use Fire Extinguishers

The following are important considerations before you attempt to fight a fire:

- Make sure that everyone else is leaving the area, someone has sounded the alarm, and someone has called the fire department.
- Ensure that you have an unobstructed escape route at your back.
- Verify that the fire is small, confined, and not spreading.
- Make sure that you know what is burning and that you have the appropriate type of extinguisher to fight the fire.
- You are knowledgeable regarding the use of the extinguisher.
- Make sure that you keep your back to a clear exit and stand 2 to 3 meters (6 to 8 feet) away from the fire.
- Your safety is paramount; if the fire is out of control, leave the area immediately.

Fire wardens (or health and safety officers) and hospital staff should be trained on how to use fire suppression devices. Regular training sessions should be undertaken as part of the medical facility's scheduled safety and evacuation simulations.

The four steps in using a fire extinguisher can be remembered through a simple acronym: **PASS**.

		**P – Pull the pin** This unlocks the operating lever.
		**A – Aim low** Point the extinguisher nozzle or hose at the base of the fire.
		**S – Squeeze** Squeeze the lever above the handle to discharge the extinguishing agent. Release the lever to stop.
		**S – Sweep** Sweep the nozzle or hose from side to side. If the fire is going out, move toward the flames; keep the extinguisher aimed at the base of the fire and sweep back and forth. Watch the fire area once the fire is extinguished and be prepared to repeat the process if it reignites.

REMEMBER: To use a fire extinguisher:

P - Pull the pin
A - Aim low
S - Squeeze
S - Sweep

The minimum requirement, and the least expensive option, for a firefighting system is a fire alarm system with smoke detectors and a fire suppression system with fire extinguishers. There are other fire suppression devices that can be installed in a hospital to improve the facility's resilience to fire hazards. These include water sprinkler and mist sprinkler systems, water hose reels, and smoke extractors.

2.2.3 Water Sprinkler Systems[8]

- These systems have a water droplet diameter greater than 1 mm, and the cumulative surface area coverage for 1 liter of water is approximately 3 square meters.
- Typically, in fire sprinkler systems, the full network of pipes is constantly charged with water.
- The sprinkler head is a heat-sensitive valve that releases water once the temperature exceeds a fixed temperature, generally 30oC above the ambient temperature.
- Each sprinkler head operates independently and will activate only once sufficient heat reaches the valve. Therefore, only the sprinklers closest to the fire will operate, maximizing the available water pressure to the location of the fire.
- Sprinkler systems cause less water damage than the hoses used by the fire service to combat a fire.
- Sprinkler systems do not automatically discharge water upon activation of the fire alarm but, rather, act independently.

2.2.4 Mist Sprinkler Systems

- Mist sprinkler systems function similarly to traditional water sprinkler systems.
- Their water droplet diameter is less than 1 mm, and their cumulative surface area coverage for 1 liter of water is approximately 60 square meters.
- Once the system is activated, a pump drives water through a special nozzle to form a dense water mist or fog.
- This mist suppresses and extinguishes the fire through the removal of heat and displacement of oxygen from the fire zone.
- These systems require only a low volume of water, making them safer than some other systems for use around medical and electrical equipment, especially in the ICU.

Some of the key advantages of well-maintained sprinkler systems are:

- They allow for a more open-plan layout in a facility—in other words, longer distances between fire compartments—while still meeting fire safety requirements.
- They allow greater flexibility in the design and future adaptability of the space in the facility.
- Structures with sprinklers can reduce fire rating requirements for structural elements by as much as 30 minutes, depending on building code specifications and a country's regulations with respect to health care facilities.

A key disadvantage of sprinkler systems is that they may be quite expensive to incorporate into existing health care facilities. A fire safety specialist should investigate the building's structural and architectural layouts to determine the

8. Source: http://nahfo.com/files/Knowledge/SprinklerGuide1.pdf.

feasibility of installing a sprinkler system. If it is not feasible to install a system for the entire facility, installation should be considered at least for critical areas of the hospital with higher vulnerability to fires.

IMPORTANT: Sprinkler systems should be a suppression feature in ALL new health care facilities.

2.2.5 Water Hose Reels

- Water hose reels should be located on every floor of the hospital, to provide a realistically accessible and controlled supply of water to fight a fire.
- Fire hoses are connected to the main water supply or an independent water storage system.
- Fire hoses are typically 18 m to 36 m (59 to 118 feet) in length and have an internal diameter of 13 to 19 mm (0.5 to 0.7 inches). The size of the hose reel used is dependent on the size of the medical facility, as there needs to be sufficient length to overlap adjacent hoses.
- Fire hose reels are all similar in their operation. The general procedure for their use is as follows:
  - Ensure that the nozzle/jet is in the closed position.
  - Turn on the main valve.
  - Pull the hose off the drum, toward the fire.
  - Open the nozzle/valve and direct the stream of water toward the fire.
- Use fire hose reels only to fight Class A fires.
- Canvas fire hose reels are typically located close to fire hydrant points and are intended for use only by the fire service's emergency response team. It is important to ensure that the hose's nozzle/valve fittings correspond to those used by the local fire service.

2.2.6 Smoke Extractors

The rapid spread and accumulation of smoke usually poses one of the highest risks to human life in the event of a fire. One of the means of minimizing this danger is by incorporating special smoke extraction systems, usually in the initial design of heat, ventilation, and air-conditioning (HVAC) systems.

- Smoke extraction systems are mechanical systems that can be manually or automatically activated once the alarm is triggered.
- These systems are designed to remove hazardous smoke from the area of the fire and prevent the spread of smoke to other areas of the building through the closing of specific vents and the high-pressure pumping of air to designated areas to to prevent the ingress of smoke.
- Smoke extractor systems tend to be quite costly to incorporate in existing facilities.

Figure 3: Sample Illustration of a Proprietary Ventilation/Smoke Extraction System by Belimo[9]

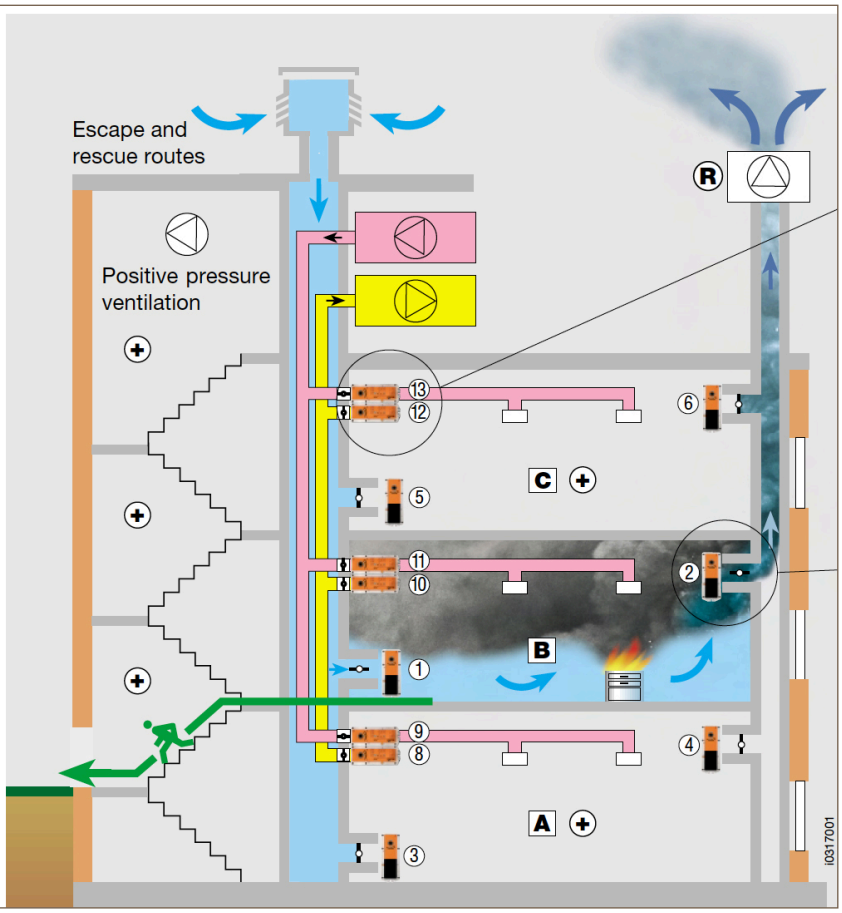
A typical installation:

A ventilation system with fire dampers and a separate smoke extraction system for efficient removal of smoke.

The procedure in an emergency involving the presence of smoke on Floor B (e.g. tripping by fire detector):

a) Smoke extraction system
- Smoke damper 2 is opened and the poisonous fumes are extracted by fan R. So that it can be replaced by fresh air from outside, smoke damper 1 is opened at the same time.
- Smoke dampers 3, 4, 5 and 6 remain closed.
- The trapped occupants can escape safely via the staircase.

b) Ventilation system
- Fire dampers 10 and 11 are closed in order to seal off the fire and smoke on Floor B from the remainder of the ventilation system.
- Fire dampers 9 and 13 are open. The supply air fan produces a positive pressure on Floors A and C to prevent the penetration of smoke (+).
- Fire dampers 8 and 12 are closed.



2.3 Planned Preventative Maintenance

One of the most critical aspects of an effective suppression system for combating fires is planned preventative maintenance. Regular checks should be performed and documented as part of a health care facility's management system. When an equipment item has been checked, it should be tagged and signed off for safe use with an indication of any action taken and the next scheduled check date. Refer to Annex 1 for a sample hospital fire safety inspection form.

- The National Fire Protection Association[10] (USA) recommends that smoke detectors be replaced every 10 years. However, if they operate on batteries, smoke detectors should be checked as part of standard hospital maintenance, usually every month.
- Water sprinkler systems require planned preventative maintenance as well as robust reactive maintenance procedures. Generally, individual sprinkler heads are virtually maintenance free; therefore, costs are related to maintaining the system through weekly tests and upkeep of water supplies and pump equipment.
- Hose reels should be checked and signed off monthly.
- The hospital administration should ensure that canvas hose reels are certified for use by the fire service each year.
- Ad hoc inspections of equipment should be carried out after its use in an incident such as a fire.

9. Source: http://www.hevacomphelp.com/mech/1pdf/BEL/0009.PDF.
10. Source: http://www.nfpa.org/.

REMEMBER: Planned preventative maintenance is a critical aspect of an effective fire suppression system. All equipment should be periodically checked, signed off for safe usage, and documented.

2.4 Important Considerations

It is important to note that all mechanical suppression systems, including sprinkler systems, smoke extractor systems, and water storage tanks, need to be designed to withstand earthquakes. Damage to mechanical systems is common during earthquakes because these systems tend to have rigid connections and fittings that fail in the event of seismic movements and forces. Water tanks in particular can worsen the effects of earthquakes on health care facilities if they are not properly designed.

REMEMBER: All mechanical systems, including sprinkler systems, smoke extractor systems, and water storage tanks, need to be designed to resist earthquakes.

Section 3: EVACUATION

This is a crucial component of the aim to save lives in emergency situations in hospitals. A comprehensive evacuation plan needs to be in place that all staff members are aware of and are experienced in carrying out.[11] This section presents the basic steps involved in the evacuation of a medical facility. It is important to note that there is no fixed methodology for evacuations; the procedure will vary for each individual health care facility.

Recall that evacuation procedures are undertaken only as a final resort action for the hospital. In the case of a fire, evacuation is performed once the preventative and suppression measures described earlier have failed to contain the fire and lives are under immediate threat.

The following assumptions were made in the development of this document:

1. The hospital's Incident Command System (ICS) will be used throughout the duration of the evacuation response.
2. This guide does not replace or alter the hospital's fundamental ICS structure but is intended to contribute to additional operations that may be activated during an evacuation.

Evacuation of a health care facility may be required in a range of disasters, not only in the event of fires. The following table lists some of these disasters.

Table 4: Types of Disasters[12]

Natural Hazards	Manmade Hazards/Terrorism	Technological Hazards
Earthquakes	Explosions	Hazardous Materials Incidents (e.g., oil spills, gas leaks)
Hurricanes	Biological Threats	Nuclear Power Plant Incidents
Floods	Chemical Threats	
Fires	Radiological Dispersion Devices	
Volcanoes		
Landslides and Mudslides		
Extreme Heat		
Tornadoes		
Tsunamis		

3.1 At the Sound of the Fire Alarm

11. See the Harvard School of Public Health Hospital Evacuation Planning Guide (http://www.mass.gov/).
12. Source: http://www.ready.gov/natural-disasters.

- Once the fire alarm is triggered, there need to be designated personnel to investigate the reason for the alarm (and the possibility of a false alarm) and to identify the level of the threat. They must also determine whether the fire is a small one that can be suppressed or whether evacuation is necessary.
- These designated personnel must communicate with the hospital telephone operator, who will inform the rest of the staff what sequence of evacuation (if necessary) needs to be followed.

3.1.1 Notification of External Agencies

If there is a fire threat and the decision to evacuate is made, there should be a designated person responsible for notifying the entire facility of the evacuation order, using appropriate systems such as overhead pages, emails, text messages, and internal hospital communication systems with loudspeakers.

The procedures of the hospital emergency operations center (EOC) should include immediate notification of appropriate agencies such as the Ministry of Health; fire, police, and/or army services; and national disaster offices. For instance, in the event of a fire, consider posting conspicuous notices, at various locations in the hospital, of agencies to be notified. An example is shown below.

IN CASE OF FIRE
CALL THE FIRE SERVICE AT

{INSERT LOCAL EMERGENCY NUMBER}

ASK THE OPERATOR
"IS THIS THE FIRE SERVICE?"

When the fire service answers, clearly say:
"FIRE"
"AT {INSERT ADDRESS OF FACILITY}"

3.2 Types of Evacuation

Time frames for evacuation may differ depending on the nature of the threat and the amount of time that can be taken to prepare for moving patients. Specific types of evacuations are as follows:

Immediate	"Emergency move"—evacuate immediately or patients and staff may die; no time to prepare.
Rapid	Evacuate as quickly and safely as possible; limited time to prepare (1 to 2 hours); follow procedures.
Gradual	No immediate danger; sufficient time for systematic evacuation procedures (many hours to several days).
Prepare Only	Do not move patients, but begin to prepare for evacuation.

Fire and bomb threats, for example, may necessitate immediate or rapid evacuation depending on the level of danger. Natural disasters with adequate warning periods, such as hurricanes and floods, may require only a gradual evacuation of the health care facility.

The following actions may be needed when the "prepare only" instruction is issued:

- If you hear the fire alarm or see flashing lights, close all fire doors in your area.
- Ensure that egress corridors are clear to allow movement of patients and equipment.
- Locate and secure patients' medical records and medical supplies.
- Ready evacuation transport equipment such as wheelchairs, blankets, and gurneys.
- Set in motion a system to move people to designated assembly points.[13]
- Await further instructions; do not evacuate unless given the authorization to do so.

3.2.1 Movement

The hospital's incident commander determines, based on reports from the persons who detected and/or reported the fire situation, what type of evacuation is required:

- Horizontal: The primary mode of evacuation, this involves moving patients in immediate danger away from the threat but keeping them on their current floor.
- Vertical: This usually involves the complete evacuation of a specific floor in the hospital. Patients and staff will be evacuated out of the hospital only if necessary.
- Shelter in Place: The staff may be instructed to "shelter in place," that is, remain in their units and await further instructions.

The type of movement is dependent on the type of hazard; for instance, the fire may be on the floor below or the threat may be a tsunami, in which case the evacuation sequence will be to move upward.

3.2.2 Evacuation Routes

Evacuation routes should be clearly established, as detailed earlier in Section 1.2.4. All hospital staff should have working knowledge of the evacuation routes and which one to take, based on the type of evacuation and as instructed by the hospital's incident commander.

Specifically assigned staff members, sometimes referred to as "wardens" or "health and safety officers," should then direct patients and visitors to orderly and calmly evacuate.

Evacuation planning must take into consideration all spaces around the hospital compound. This will help in the development of emergency transit routes, assembly areas, holding areas, and so forth.

3.3 Level of Evacuation

The level of evacuation can be one of the following:

- complete evacuation
- partial evacuation

In most emergencies, a full evacuation will not be required. Due to the complex needs and unstable condition of many hospital patients, evacuation is generally considered as a last resort. Evacuation should be ordered only when absolutely necessary and when there is an imminent or potential unmitigated threat to patient/staff safety.

The following situations may warrant evacuation:

- Fire, smoke, and/or toxic fumes
- Structural damage to the facility

13. Refer to Section 3.13.1 for information on assembly points.

- Potential exposure to hazardous materials
- Terrorism or violent, armed visitors
- Credible bomb threat

When more time is needed and is available to assess the danger posed by the situation, hospitals should consider issuing a prepare only order.

3.4 Estimating Needed Personnel Resources

Effective evacuation of a health care facility depends on the number of staff and trained personnel available, at any given point in time, to perform the necessary evacuation duties. Understanding the scope of the evacuation and knowing the minimum number of people required to undertake these procedures in the event of an emergency is paramount in saving lives.

3.4.1 Number of Staff

Standard acceptable ratios of number of medical staff to number of patients have been established. These ratios are dependent on the level of care required for each patient. Examples of nurse to patient ratios are shown in the table below.

Table 5: Legislated Ratios of Nurses to Patients in Hospitals in California, USA[14]

Nurse:patient ratio	Description of patient care
≤ 1:8	Routine care (generally, this ratio should not be exceeded)
≤ 1:2	ICU, neonatal, post-anesthesiology recovery, labor and delivery, emergency unit and recovery unit
≥ 1:1	Operating theatre (typically more than 1 nurse to 1 patient)
1:4	Antepartum, postpartum, pediatrics, emergency room, specialty care
1:5*	General surgical units

* General surgical units in the Caribbean typically have medical staff to patient ratios of up to 1:8.

- Staff ratios are based on the hospital's protocol and the country's statutory regulations.
- Generally, all other departments (e.g., biomedical) may have one person on duty after regular working hours or all personnel in the department would be on-call.
- Every shift should have health and safety officers or wardens on-site who are trained and knowledgeable regarding fire response and evacuation procedures. The minimum number of wardens on duty is determined according to the health care facility's emergency protocol.
- In some instances, volunteers can assist with the gradual or rapid evacuation of a hospital. For example, hundreds of volunteers helped in the evacuation of Memorial Hermann Hospital in Texas after flooding caused by Tropical Storm Allison.

3.5 Patient Prioritization Evacuation Models

The three types of patient prioritization models outlined in the table below are frequently used in emergency evacuation procedures. The model employed is dependent on patient acuity, the time available for evacuation, and the type of event prompting the evacuation.

14. Source: http://nurses.3cdn.net/f0da47b347e41bb03a_z1m6vl1sd.pdf.

Table 6: Patient Prioritization Evacuation Models

Geographic Model	Usually applied in cases of gradual evacuation. This systematic model focuses on evacuation of areas at greatest risk within the hospital or designates individual care units to evacuate sequentially, depending on their location in the facility.
Pro(s)	Allows for a partial evacuation that will not disrupt the entire hospital; allows units to stay together throughout the evacuation process, enhancing consistency of medical care.
Con(s)	Requires considerable evacuation time.
Resource Model	This model focuses on utilizing resources in the most efficient manner possible. Therefore, patient prioritization is directly linked to resource availability. For example, ICU patients would be evacuated in a way that makes the best use of ambulances equipped to handle these patients.
Pro(s)	Uses available resources effectively; effectively streamlines the evacuation process in a top-down or bottom-up manner.
Con(s)	Requires significant real-time planning and logistical management to best allocate limited resources during a crisis.
Acuity Model	This evacuation model attempts to account for patients' mental and physical condition or acuity during the evacuation operation. In this model, evacuation is conducted in the same top-down or bottom-up manner described for the resource model. However, the most medically fragile patients may be evacuated last to ensure that they are not removed from ventilators and other life support equipment until absolutely necessary.
Pro(s)	Evacuates the most mobile patients first to ensure the greatest good for the greatest number of patients. Partial evacuation can be accomplished in a shorter amount of time than with the other two models.
Con(s)	Does not account for allocation of scarce resources, which could lead to a situation in which ICU patients would have to wait long periods for appropriate transport vehicles.

3.6 Patient Special Needs

It is important to identify the special needs of patients, some of whom may require additional attention:

- **Needs of Patients with Disabilities**
  - Patients who cannot hear or see or are under anesthetics (unconscious) at the time of the evacuation may require special accommodations.
- **Medical Care and Equipment Needs**
  - Patients may require specific life support equipment (e.g., ventilators) that should accompany them when they evacuate. Equipment that is battery operated should be regularly checked as past of the hospital's programmed maintenance.
  - Specific medications that patients need for treatment should also accompany them when they evacuate.
- **Emotional Support Needs**[15]
  - Patients may require psychological support as a result of the stress of the disaster situation.

Typically, medical supplies are stored within the main hospital building; ideally, however, they should be stored in an independent facility that is designed to withstand hazards. This will allow easy access to critical medical supplies and equipment to treat patients during an evacuation.

3.7 Patient Prioritization in Different Evacuation Scenarios

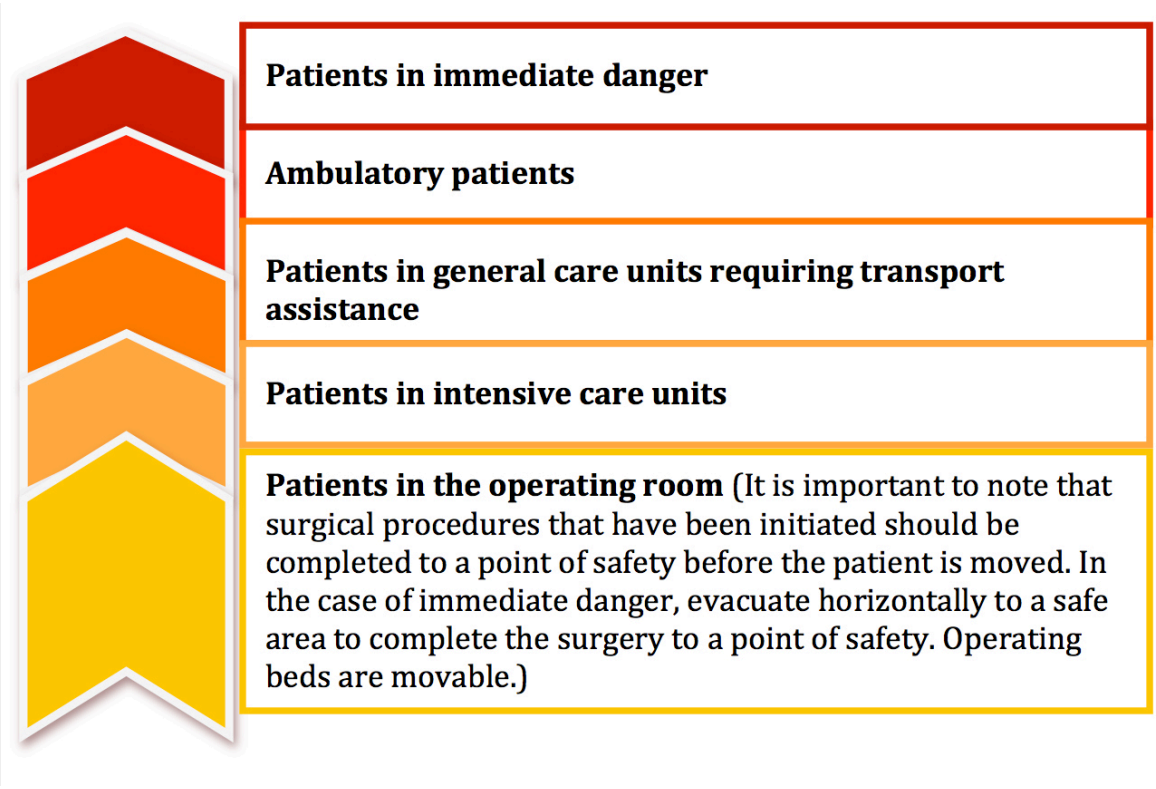
Prioritizing patients with respect to the limited physical resources available for evacuation (e.g., personnel, elevators, stairwells, transport sleds) is among the most logistically and ethically challenging tasks involved in the evacuation of a hospital.

15. For information on mental health and psychosocial support in disaster situations, see http://www.paho.org/disasters/index.php?option=com_content&task=view&id=1649&Itemid=807.

There is no single priority model that will function equally well in all hospitals and all circumstances. Listed below are some general potential evacuation priorities in selected scenarios. Hospital leaders, including the chief executive officer, administrators, and the hospital board, should use these scenarios to discuss patient prioritization as part of their planning efforts.

In an **immediate evacuation** that is severely time sensitive and involves immediate and broad threats to life safety, the priority must be to get as many patients out as possible. Therefore, the acuity model[16] (wherein the patients needing the most assistance are the last to be moved) may be adopted in these situations. Default priorities in such situations are indicated in Table 7.

Table 7: Priority Ratings for Immediate Evacuation of Patients



If time is critical and the acuity model is employed, ICU patients may be moved after all of the general care units have been evacuated. In addition, to maximize the number of patients evacuated in the least amount of time, this model ensures that critical care patients have access to medical gases, suction, and monitoring for as long as possible.

If a resource model evacuation is possible, ICU patients should be evacuated as transport resources become available. Although ICU patients may be the last to leave the hospital, they should be the first to leave the assembly point, as they are the highest priority for transfer to other hospitals.

In a **rapid evacuation**, the default transport plan should be based on an orderly, rapid process in which entire patient care units are moved sequentially. Simultaneous evacuation may also take place; that is, a general medical/surgical unit and an ICU may be evacuated in parallel when possible to avoid uneven demand on EMS resources.

There is controversy regarding the order of floor evacuations, but one recommended plan is to evacuate from the top of the building to the bottom if elevators are available or from the bottom of the building to the top if only stairs are available. It is important to note that, in situations such as fires and earthquakes, elevators should not be used.

16. See Table 6 for more information on the acuity model.

In a **gradual evacuation**, hospitals may not require the use of assembly points; rather, they may choose to send patients directly from their units to waiting EMS assets in the staging area. In such a circumstance, communication between the staging area and the hospital floors is critical to ensure that the flow of patients out of the units anticipates available EMS units and prevents congestion of ambulances waiting to transport arriving patients.

REMEMBER: Patient prioritization may vary depending on the time, staff, and equipment resources available for evacuation.

3.8 Special Hazards or Concerns

Several types of hazards may contribute to risks to the lives of staff and patients, as well as to property risks, in a hospital fire. A health care facility's evacuation procedure will be incomplete without due care and consideration given to these impediments.

Table 8: Special Hazards and Concerns Associated with Hospital Fires

Special Hazards/ Concerns	Description
Oxygen	Procedures must be in place for turning off oxygen and other medical gases and equipment, which may contribute as fuel to the fire. Each operating room has a manifold to turn off medical gases. Staff should be aware of the location of this manifold and should turn it off once an evacuation is ordered.
Smoke/ Fumes	Fumes and smoke pose a high risk to life safety, and the evacuation procedure should incorporate a strategy to move people away from areas where these hazards are present. (See the prevention and suppression sections above for descriptions of measures to hinder the development and spread of fumes and smoke.)
Electrical Equipment	Unplug electrical equipment. An alternative (although quite costly) is to install an automatic system that switches off all electricity other than that for use with essential medical equipment.
Lighting	Ensure that there is adequate emergency lighting to perform the evacuation, as the electricity is normally switched off in a fire. Emergency lighting systems with capacitors that are activated when the power is switched off are commonly used.
Water	Medical equipment should be protected from water, which may damage essential machines (recall the use of mist sprinklers). Also, exposed patients will become wet and cold and possibly quite sick; consider having plastic sheeting (e.g., "visqueen")[17] available to cover patients during an evacuation.

There may be other special hazards specific to a given health care facility. These would need to be considered and incorporated into the fire safety and evacuation strategy.

3.9 Evacuation Transport Equipment

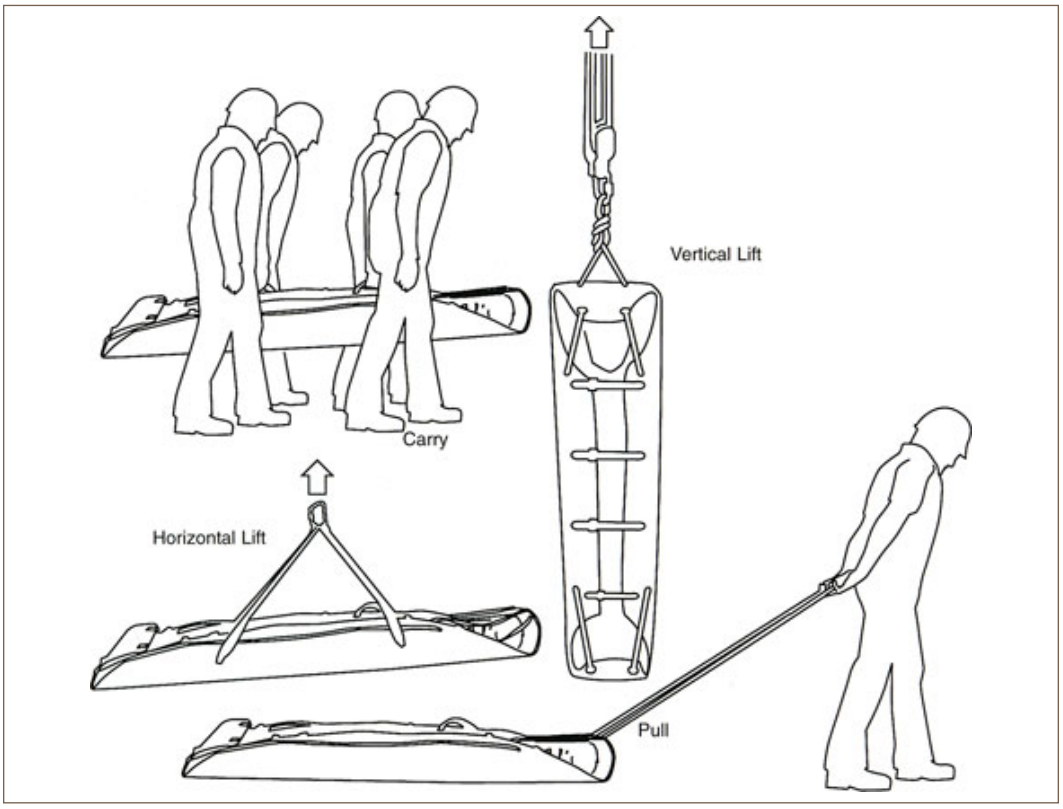
In the event of an evacuation, it is essential to have transportation equipment available for patients. This equipment may include the following:

- Blankets
- Wheelchairs
- Beds
- Canvas Stretchers/Litters/Gurneys

17. Visqueen (produced by British Polythene Industries Limited) is a common trademark name for polyethylene plastic sheeting. The sheets are typically 0.1 mm to 0.25 mm thick.

- Backboards
- Sked Stretchers18

Figure 4: Diagrammatic Use of a Sked Stretcher



Some of the equipment, such as backboards and sked stretchers, is usually not stored in the hospital. These materials may be supplied by the national disaster office, the fire service, or the defense force/army.

There are important practical notes to remember when using transportation equipment in a hospital evacuation, as follows:

- A sufficient amount of equipment should be available to evacuate each floor of the facility.
- Equipment should be stored in areas that are easily accessible at all times; it should not be stored in locked closets.
- All transportation equipment should be part of the facility's regular planned preventative maintenance program.

3.10 Command and Control

3.10.1 Authority to Order an Evacuation

After activation of a hospital's EOC or the national EOC, the authority to order a partial or full evacuation of the facility generally rests with the hospital's CEO, the administrator on call, and/or the designated incident commander.

Often, the decision of whether or not to evacuate is not immediately obvious and may require input from a variety of individuals. When time permits (i.e., not in the case of an immediate evacuation), hospitals may wish to consider

18. For more information on sked stretchers, see http://www.westernsafety.com/msafallpro2006/msafallpg4.html.

creating an evacuation decision team with representation from nursing, physicians, safety, facilities maintenance, security, and others who can quickly weigh the risks of evacuation against the risks of sheltering in place.

3.10.2 Key Decisions for the Incident Commander

Once the decision to evacuate has been made, there are several additional key decisions that must be made quickly and communicated.

1. Level of evacuation: partial, complete
2. Type of evacuation: immediate, rapid, gradual, prepare only
3. Patient prioritization
4. Activation of preplanned evacuation components/personnel:
    a. Assembly point and discharge site Locations
    b. Evacuation/operations coordinator
    c. Staff assignments
    d. Patient destination team(s)

It is imperative that the incident commander continuously assess the situation, as plans and activities may need to adapt to changes in the circumstances surrounding the evacuation.

3.10.3 Command Center

In the evacuation process, the hospital's incident commander will be required to activate a command center or the hospital's EOC, where decisions can be made and issued throughout the evacuation. The command center or EOC should be part of the hospital's existing ICS and is separate from the staging area for firefighters. However, the fire chief or fire incident commander should work together with the hospital's incident commander to make decisions throughout the evacuation process.

Assignments

- A designated person (assigned by the hospital) needs to be in charge of the coordination and organization of the evacuation process. This individual is usually referred to as the evacuation coordinator.
- The hospital incident commander determines the locations to which patients will be evacuated (i.e., safe locations prearranged by the hospital).
- All of the personnel involved need to know their roles and responsibilities. They can be assigned their roles either prior to or during the event (e.g., through action cards).

Communications

- A specific communication system must be in place so that the evacuation coordinator can maintain contact with the personnel under his or her control and personnel can communicate with each other.
- In some countries, the national disaster office or defense force assists in this role and will supply communication devices.
- A traditional form of communication is the use of "runners," individuals who move from point A to point B to relay information.

Accountability

- One of the main criteria for the ICS is accountability, which falls to the evacuation coordinator for all of the personnel under his or her command.

Refer to Annex 2 for a sample description of evacuation responsibilities in different hospital departments. Not all health facilities will have the range of departments listed, so some departments or staff members may be required to share a range of responsibilities.

3.10.4 Evacuation Coordinator

The evacuation coordinator is the primary link between the hospital incident commander and the patient wards during an evacuation. His or her main responsibilities are to communicate with each ward and monitor progress to ensure that all wards are safely evacuated.

In the event of an evacuation, the evacuation coordinator should be able to answer the questions listed below.

1. Time for units to prepare: How much time is available to prepare patients before transport begins?
2. Assembly point location: Should units move to their default assembly point, or are modifications needed as a result of the evacuation scenario?
3. Discharge site location: Should units send ambulatory patients (i.e., those who do not require urgent medical attention) to the discharge site, or are modifications needed as a result of the evacuation scenario?
4. Priority evacuation sequence: In what order will units be evacuated?
5. Elevator use: How will any available elevators be used in the evacuation?
6. Stairwell use: How will any available stairwells be used in the evacuation?
7. Non-unit staff: Should hospital staff currently in a care unit, but not based in that unit (e.g., physical therapy or respiratory therapy), return to their home department or remain where they are and help evacuate patients?
8. Staff recycling back into the building: Transporters and security staff may reenter the building when needed, but what about other unit staff? Should nurses escort patients to the assembly point and then return for another group of patients?
9. Labor pool staging area: Where should extra staff report for assignment?
10. Family support center location: Where should families be directed for support? (It is important to note that some family members may be willing and able to assist in the evacuation of patients. This possibility should be incorporated into the evacuation scenario.)

REMEMBER: The evacuation coordinator communicates with patient wards and monitors their progress to ensure that everyone is evacuated safely.

3.10.5 Roles/Staff Assignments

Evacuation is an extremely labor-intensive process. Teams of staff members assigned duties to support the evacuation should be activated immediately. Some staff may need to be called in from home, but this is more likely a requirement if an evacuation occurs during the evening shift, the night shift, or weekend hours.

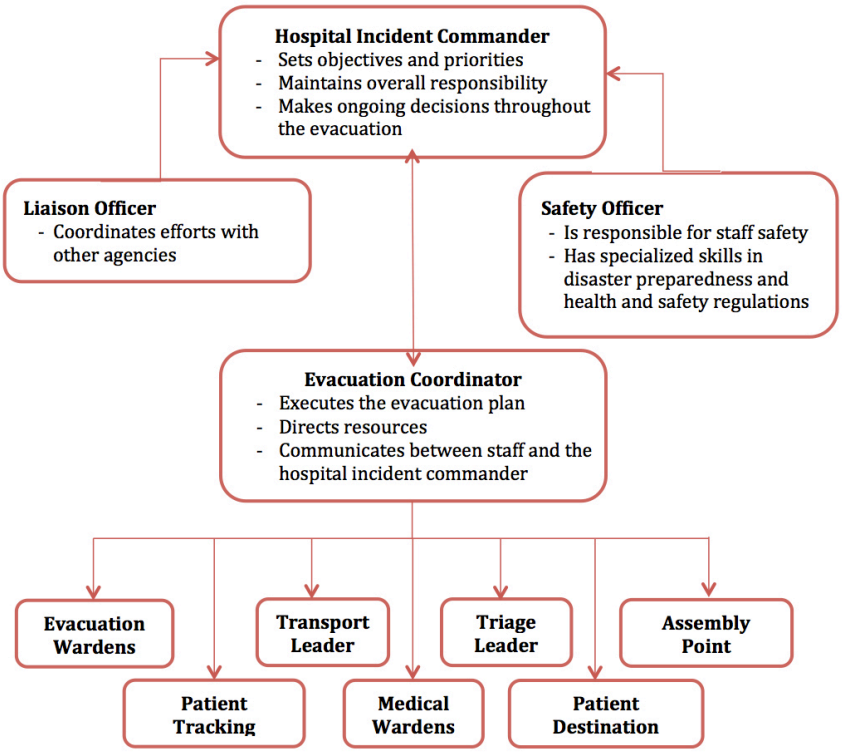
Estimated needs with respect to staff resources depend on a facility's patient demographics. Staff may be assigned multiple roles; for example, some of the personnel transporting patients out of the building can be reassigned as runners at the assembly point once the majority of patients have been evacuated.

Table 9: Example Staff Assignment Chart

Function	Supervisor	Estimated Staff
Prepare patients for evacuation	Evacuation Warden	Fill in staff requirements(dependent on hospital requirements)
Transport patients to assembly point	Transport Leader	
Track patients at assembly point	Patient Tracking Supervisor	
Assess patients at assembly point (assign one clinician for each patient care unit until additional clinicians have arrived at the assembly point)	Assembly Point Leader	
Care for patients/support nurses at assembly point (identify number of staff members needed for each unit)	Medical Warden	
Relay information/supplies/medications between assembly point and hospital (identify number of runners needed for each assembly point)	Assembly Point Leader	
Triage patients for transportation or discharge	Triage Leader	
Arrange vehicle transport for patients and ensure patient readiness to travel	Transport Leader	
Care for/assist patients at discharge site	Discharge Site Leader	
Determine emergency contacts/assist with family notification	Administrator	
Triage patients for transportation or discharge	Triage Leader	
Arrange vehicle transport for patients and ensure patient readiness to travel	Transport Leader	
Care for/assist patients at discharge site	Discharge Site Leader	
Determine emergency contacts/assist with family notification	Administrator	

3.11 Hospital Incident Command System Structure

The flow chart below is an example of the structure of a hospital ICS.



3.12 Tracking

3.12.1 Patient Tracking

There should be designated "patient tracking" staff who are responsible for tracking and reporting on the location of patients throughout the evacuation process to provide continuous accountability. These staff members (and their roles) include the following:

- An individual designated to perform head counts at the assembly points.
- Staff assigned to check rooms and floors to ensure that they have been vacated.
- Senior personnel in each department responsible for addressing special hazards or concerns (e.g., turning off medical gases, performing head counts in their areas of responsibility).

3.12.2 Medical Records

- Medical records are usually located on the wards with the patients. Ensure that medical records accompany patients when they evacuate the facility.
- Medications and critical equipment for patients should be taken as well.
- A specific protocol for ensuring that records leave with patients should be established as part of the evacuation procedures.
- Consideration should be given to storing all of a health facility's medical/essential records in fireproof filing cabinets (although such equipment can be extremely expensive).

3.12.3 Patient Status/Location

Patients' current locations and their destinations must be determined by the hospital's incident commander.

3.12.4 Emergency Contacts/Family Notification

There should be an emergency contact for all patients. Information on this contact person is usually kept with the patient's medical records. In an evacuation, designated personnel should:

- Attempt to notify family members and other responsible parties about the patient's transfer destination.
- Answer calls and respond to questions from family members about the patient's welfare and location.

3.13 Relocation/Staging Areas

3.13.1 Assembly Points and Discharge Site Locations

The hospital should identify several locations surrounding the building that could be used as assembly points, holding areas, and/or discharge sites.

Assembly Point/ Holding Area	A place or set of places where patient care units gather (outside the main clinical buildings of the hospital) to receive basic care and await transfer or reentry back into the hospital. Assembly points are not intended to be comprehensive field hospitals; rather, they should be designed as holding areas where only essential care resources are available.
Discharge Site	The place where patients who are being discharged home wait for family or friends to pick them up. Discharge sites should be located some distance away from assembly points to minimize traffic congestion and competition for roadways.

Important considerations include:

- The proximity and size of assembly points and discharge sites: While an assembly point in close proximity to the hospital can aid in the effort to relocate fragile patients during an evacuation, it also can be of concern in any event involving an explosive device, chemical hazard, or some other type of potentially expansive threat. It

is also important to consider wind direction, particularly with respect to the smoke dispersion related to a fire. Ideally, both the assembly point and the discharge site would permit sheltering indoors.

- Economies of scale: The selection of assembly points and discharge sites should take into account that it is difficult for clinical support services (e.g., the pharmacy service) to support patient care in many separated locations.
- Site identification: Several nearby sites should be identified, and their willingness to help in the event of an emergency should be confirmed. If an emergency occurs, these sites should be contacted immediately.

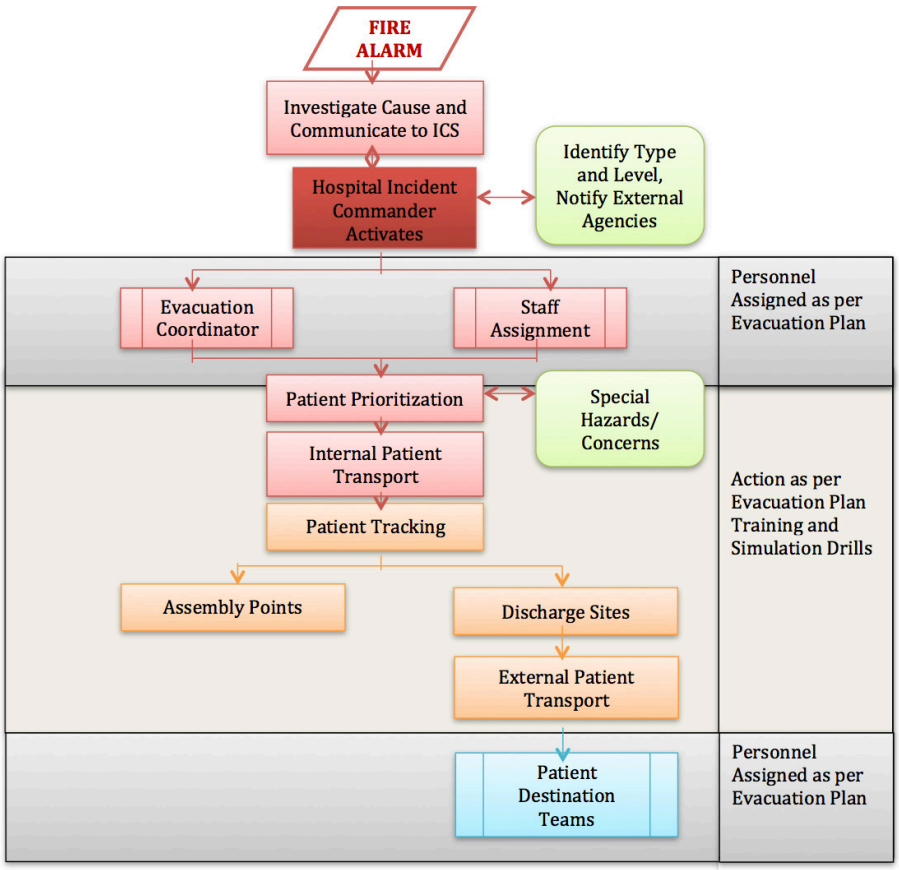
3.13.2 Patient Destination Team

If patients are to be relocated to alternative health facilities, a patient destination team should be activated. This team should include a representative from the incident command group as well as senior nurses, admitting office representatives, and case managers. The team works closely with EMS officials to identify available beds and ambulances for patient transfers.

All physicians and nurse practitioners must be notified that the patient destination team has been activated and is arranging appropriate destinations for all patients. It is vitally important to the success of the evacuation that individual physicians not compete with the team and attempt to arrange transfers on their own. This may create significant confusion and introduce potential errors into the process.

3.14 Process Overview

The process of evacuation of a health facility can be divided into several key components. All personnel should be aware of their roles and responsibilities; also, through regular training drills and simulations, they should know the details of the evacuation plan. Below is an example schematic of the core stages of a hospital evacuation:



Section 4: EVACUATION TRAINING DRILLS

4.1 Activation

Upon the sound of the fire alarm, it is expected that hospital staff will activate a practiced system or sequence of activities in response. Each health facility should have a unique system that has been tailored to meet its needs.

An evacuation/response plan should be discussed and developed by the hospital administration and the engineering and medical teams. The plan should include regularly scheduled training for all staff.

4.2 Training of Staff

General training of all staff should include, but not be limited to, the following:

- Training on how to lift and move patients.
- Training on how to use fire extinguishers.
- Training on what to do if they see a fire. For example, the RACE acronym specifies actions to be taken in a fire (although not in a specific order; the hospital's incident commander determines the appropriate actions to be taken in a given situation):
  - R – remove anyone endangered by the fire to a safe area
  - A – activate the alarm
  - C – close all windows and doors; contain the fire
  - E – evacuate
- Training on what to do if they hear the alarm and see the flashing lights.

Specific training defines the roles and responsibilities of each staff member. For example, in the case of a fire alarm, who notifies the fire service and the rest of the hospital?

4.2.1 Action Cards

Action cards are brief summaries that define each role in an emergency situation and detail the tasks assigned to this role. All staff members should have a general knowledge and understanding of a variety of roles, as a single staff member may be tasked with more than one or may be required to undertake different roles given the situation.

4.3 Fire Drills

Fire drills are designed to ensure that, through regular training and simulations, staff members will:

- Have knowledge and understanding of the fire safety plan so that they can act swiftly, safely, and in an orderly manner.
- Be knowledgeable regarding fire protection. Frightened individuals cannot act sensibly and intelligently, and they may do things to harm themselves or those around them.
- Have increased self-confidence and power to fulfill their responsibilities in the event of a fire.

It is important to note that all training simulations and fire drills need to be scheduled and performed regularly, and performance evaluations need to be completed and used to improve subsequent training drills.

REMEMBER: Regular training and simulations are necessary to improve the response and safety of the staff and patients.

ANNEX 1

HOSPITAL INSPECTION REPORT: FIRE SAFETY[19]	
Hospital Name and Address:	
1. MEANS OF ESCAPE	**YES/NO**
Are all exits clear of obstructions?	
Are exit signs adequate?	
Are exit routes clear?	
If fitted with locks, are the locks operable?	
Do fire/smoke-stop doors operate satisfactorily?	
Is there an adequate number of fire doors?	
COMMENTS:	
2. (MANUAL) FIRE ALARM SYSTEM	**YES/NO**
Is the system regularly serviced?	
Are operation points safely located?	
Are smoke/heat detectors appropriately located?	
Is any smoke/heat detector head obstructed?	
Is the alarm clearly audible in all areas?	
Is there an adequate number of fire doors?	
COMMENTS:	
3. FIRE EQUIPMENT	**YES/NO**
Is the portable equipment adequate?	
Is it properly located?	
Do hose reels operate satisfactorily? Date of last service:	
Are fire hoses properly maintained? Date of last service:	
Do hydrants operate satisfactorily?	
Are water supplies adequate?	
COMMENTS:	

19. Source: http://www.ghmc.gov.in/tender%20pdfs/Hospital%20Fire%20Drill.pdf.

HOSPITAL INSPECTION REPORT: FIRE SAFETY[19]	
4. TRAINING	**YES/NO**
Is there a staff training program?	
Are fire orders displayed?	
Is there an emergency procedure plan?	
Date of last fire drill:	
COMMENTS:	
5. FIRE PREVENTION STANDARDS	**YES/NO**
Inspecting officer:	
Inspection date:	
Copy of inspection report to hospital secretary:	
Date of next inspection:	

ANNEX 2

General Evacuation Responsibilities of Different Departments

The following table provides a sample summary of key evacuation responsibilities for various departments in a hospital. Depending on the hospital's administrative structure, these responsibilities may fall under the department listed or may be better assumed by another department. For smaller hospitals, many of these responsibilities may need to be combined under one department or ICS function. All of the responsibilities listed are in addition to the general responsibilities otherwise included in the hospital's emergency operations plan.

Department	Responsibilities
Admitting	**Patient Tracking** I. Assist in assembly point (AP) check-in and discharge II. Assist in discharge site check-in and discharge **Other** I. Assist patient destination team
Biomedical Engineering	I. Identify all available equipment for internal and external patient transport II. Transport appropriate medical equipment to AP III. Troubleshoot malfunctioning equipment during evacuation IV. Track any equipment that leaves the facility
Blood Bank	I. Inventory available blood products II. Identify coolers and other resources available to support blood transport III. Transport blood products to AP
Facilities Maintenance	I. Activate emergency systems to commandeer elevator banks II. Monitor system utilities III. Assist with AP site setup IV. Assist with patient transport as needed
Case Management	I. Assist patient destination team II. Identify non–acute care patients who can be discharged to skilled nursing facilities III. Staff discharge site as needed IV. Support family assistance center as needed
Emergency Department	I. Provide staffing assistance in the AP emergency resuscitation and stabilization area II. Respond to injuries/illness during evacuation as requested III. Provide staff to support loading teams
Environmental Services	I. Set up AP and discharge site II. Provide staff for patient transport
Food/Nutrition Services	I. Transport emergency supplies to AP and discharge site and distribute supplies as needed
Health Information Systems	I. Retrieve or track medical records before transfer of patients to other facilities II. Assist receiving institutions with obtaining medical record data
Human Resources	I. Provide staff resources II. Assign AP representative III. Track staff who travel to other facilities IV. Monitor emergency challenges to labor agreements
Interpreter Services	I. Provide interpreter staff at the AP and discharge site II. Assist with translation in the family assistance center

Department	Responsibilities
Materials Management	I. Manage the patient transport process II. Transport medical supplies, linens, and other needed items to the AP and discharge site
Pharmacy	I. Transport medications and IV fluids to the AP and dispense as needed II. Support discharge site with needed medications and dispensing if possible
Security	I. Communicate with outside agencies II. Lock down facility and secure roads III. Unlock all stairwell doors IV. Manage access to/from secure units V. Clear evacuation route VI. Manage routes/checkpoints VII. Check units after closing (if possible) VIII. Support care units and family waiting areas at the AP IX. Assist with transport of psychiatric patients X. Provide staff to manage ambulance flow
Respiratory Therapy	I. Deploy staff to critical care units for internal and external transport II. Transport respiratory equipment to the AP III. Provide emergency care as needed in the AP resuscitation and stabilization area
Telecommunications	I. Use overhead paging system to communicate information as appropriate II. Set up phone bank at AP, discharge site, and family support center

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REGIONAL OFFICE FOR THE **Americas**

Emergency Preparedness and Disaster Relief Coordination
525 Twenty-third Street, N.W.
Washington, D.C. 20037, USA
www.paho.org/disasters
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