Analysis of Fire Protection System Standard in Hospital: Case Study in Jakarta, Indonesia

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A hospital is a place that has a high risk of fire because there are many occupants. The risks would be even greater if fire protection systems and means of evacuation are not available in the hospital. The objectives of this study were to analyze the implementation of active and passive fire protection systems and means of evacuation in the hospital and also analyze the fire protection standard comparing with NFPA Standards for the hospital, which assumed and focused only on fire process without considered the unique characteristic of hospital and patients. The study is an analytical descriptive using observational approach. The objects of this study are active fire protection, passive fire protection, and means of evacuation. The data was collected by observation, interviews, and document review. The results showed that from 112 variables of fire protection systems and means of evacuation, 30 variables does not comply with the NFPA standards. Other findings showed that the fire safety standards in the hospital have not based upon the unique activities and conditions in the hospital. Besides that, the priority and commitment of management toward fire safety in the hospital are very low.

Keywords: *Evacuation Facilities; Fire Protection System; Hospital; NFPA*

INTRODUCTION

Fire is one of the disasters that become a major problem and also be a threat. Fire is the flame uncontrolled which spread and cause damage and loss of life (Ramli 2010). Fire can attack all kinds of work every time. In this case, the fire became one of the greatest threats to an organization both in material losses, casualties, and damage to property (Ferguson 2005).

Fire contributed 15% of total disaster in Indonesia. In 2011, there were 16,500 fires in 498 cities and districts in Indonesia (Sundari 2012). Based on data from the Department of Fire and Disaster Management Jakarta in 2014, there have been 1,260 fires in Jakarta. The leading causes of fires in Jakarta are due to an electrical problem (675 events), fires caused by stoves (75 events), fires caused by cigarettes (45 events), and the remainder due to other causes (Jakarta, Dinas Penanggulangan Kebakaran dan Penyelamatan Provinsi DKI 2015)

The cases of fires that have occurred in the hospital in Indonesia. The fires occurred in the electrical panel Harapan Kita Hospital in West Jakarta[5] and the Radiology Room Center of Infection Sulianti Saroso Hospital, North Jakarta in 2014 (Anas 2014), also a fire on the 7th floor Siloam Hospital in 2015 (Malawi 2015). The lastest cases are fire tube chamber at Mintohardjo Navy Hospital, Bendungan Hilir, Jakarta (Wisnu 2016) , and in the panel on the ground floor of a new building Koja Hospital, Jakarta in 2016 (Romadoni 2016).

The hospital is one of the places that have a high risk of fires. Many sources of potential fire hazards that exist in hospitals ranging from the use of electrical equipment which can trigger short-circuit connection, the use of compressed gas cylinders, and the use of chemicals that are flammable. Besides, hospitals are categorized as high risk of fire because the general hospital is a multi-storey building and the people who are in hospital are mostly have limitations in saving themselves when there is a fire (Hesna 2009)

The risk would be even greater if appropriate fire safety is not available in the hospital. Fire safety is an essential component to minimize the spread of fire, consisting of fire protection system, both active and passive protection system and also means of evacuation. Fire protection systems and means of evacuation have an important role in preventing casualties and material losses and property damage due to fire.

Hospital X is a hospital that is in the East Jakarta. This hospital is quite large and becomes a place of reference for the citizens of Jakarta. Thus, the number of patient visits to the hospital is quite high. It is necessary to provide safety building systems that appropriate with applicable standards to ensure the safety of visitors and patients.

Based on the explanation above, the objectives of this study were to analyze the implementation of active and passive fire protection systems and means of evacuation in the hospital and also analyze the fire protection standard for the hospital, which assumed and focused only on fire process without considered the unique characteristic of hospital and patients.

METHOD

The study was conducted from February to March 2016 using descriptive analytic with the observational approach, consist of direct observation and interviews with three Safety Personnel in the hospital. The data was collected through primary data, such as field observations using a checklist and interviews, as well as secondary data, such as documents concerning fire protection systems, floor plan or layout of the building, and geographical sketch of the building. The analysis of data was carried out using comparative analysis, which compares the data from the study to the applicable standards, such as NFPA 10 (NFPA 10 2013) , NFPA 13 (NFPA

13 2013) , NFPA 14 (NFPA 14 2013), NFPA 72 (NFPA 72 2013), NFPA 99 (NFPA 99 2015), NFPA 101 (NFPA 101 2012), and Regulation of Minister of Public Works No. 26/PRT/M/2008 on Technical Requirements for Fire Protection System in Buildings and Environment (Ministry Of Public Works Republic Indonesia 2008). The objects of this study are active fire protection systems (fire detectors, fire alarm, fire extinguisher, sprinkler and hydrant); passive fire protection systems (building construction and compartmentalization); and a means of evacuation (means of egress, emergency door, emergency stairs, ramp, signage, fire elevators, emergency lighting, emergency communication, and the provision of assembly point).

RESULTS

The analysis was conducted based on survey data of comparison between NFPA standards with the actual condition in the hospital. The analysis showed that from 112 variables consisting of 16 elements in the active and passive fire protection systems and means of evacuation, 30 variables are not following NFPA standards. The Emergency Stair and Fire Elevator are the elements with the most data that do not comply with NFPA Standards. The incompatibility between NFPA Standards and hospital condition shown in Table 1.

Table 1. The Incompatibility between NFPA Standards and Hospital Condition

Variable of NFPA Standard	Descriptions	Hospital Condition	Remark
Active Fire Protection System			
Fire Detector (NFPA 72)			
	There are fire detectors on each floor of the building that can function properly.	There are no fire detectors in the front hall on the ground floor and first floor.	Inappropriate
Fire Alarm (NFPA 72)			
	The manual call sign is placed on crossing the exit lane with 1.4 m height from the floor.	The manual call sign is placed with a height of 1.5 m from the floor.	Inappropriate
Fire Extinguisher (NFPA 10)			
	The fire extinguisher is certified.	The fire extinguishers have not a certificate.	Inappropriate
	There are signs or symbols on fire extinguisher placement.	Some signs or symbols are not appropriate (too high from fire extinguisher position).	Inappropriate
Sprinkler (NFPA 13)			

Variable of NFPA Standard	Descriptions	Hospital Condition	Remark
	Each floor of the building is protected by the sprinkler.	Some parts of the corridor are not equipped with the sprinkler.	Inappropriate
	The distance between the sprinklers is not more than 4.6 m and less than 1.8 m.	The distance between the sprinkler over than 4.6 m.	Inappropriate
Hydrant (NFPA 14)			
	Available hydrants inside and outside the building are in good condition and ready for use.	Several hydrants on the basement floor are empty.	Inappropriate
	The hydrant boxes located not less than 0.9 m (3 ft) or more than 1.5 m (5 ft) above the floor surface.	The hydrant boxes located 0.2 m above the floor.	Inappropriate
	There is a user guide on the visible place.	There are no instructions for using hydrants.	Inappropriate
Passive Fire Protection System			
Compartmentalization (NFPA 101)			
	The compartment equipped with fireproof doors.	The door is made of wood.	Inappropriate
Means of Evacuation			
Means of Egress (NFPA 101)			
	The furnishings, decorations or other objects should not be placed on the track lane exit.	There are chairs along the corridor for patients or visitors to wait.	Inappropriate
	Means of egress is maintained continuously, free from any obstacles.	There are obstacles, such as the chair in the means of egress.	Inappropriate
Emergency Doors (NFPA 101)			
	Each door on each means of egress must be of a kind or a swinging door hinge side and must reach the fully open position.	The emergency doors are not made of hinge type or a swinging door. However, the door can be fully opened.	Inappropriate
	The doors resistant to fire	Emergency doors made of	Inappropriate

Variable of NFPA Standard	Descriptions	Hospital Condition	Remark
	for at least 2 hours.	glass, so it does not have the fire resistance.	
Emergency Stairs (NFPA 101)			
	If there is an emergency stair that serves the five floors or more must there marking that indicates the level of the floor and show the top and bottom end of each floor.	There are no clues that indicate the level of the floor on each floor.	Inappropriate
	The marking must be painted or written on a wall or in a separate marking which is secured to the wall.	There is no floor-level tagging.	Inappropriate
	The stairs are equipped with fireproof doors that can close automatically.	The stairs are not equipped with fireproof doors because it is made of glass while the doors can close automatically.	Inappropriate
	The surface of stairs is rough and there are no obstructions.	The surface of stairs made of the ceramic surface that slippery.	Inappropriate
	There is a ventilation hood in the form of emergency stairs.	There are windows for ventilation, but there is no hood on the fire escape.	Inappropriate
Ramp (NFPA 101)			
	The ramp made of non-flammable material.	The hospital has not a ramp.	Inappropriate
	The ramp floor surface made of materials that are not slippery.	The hospital has not a ramp.	Inappropriate
	The ramp surfaces are given coating levels or anti-slip material.	The hospital has not a ramp.	Inappropriate
Fire Elevator (NFPA 101)			
	At least there is a fire or emergency elevator.	The hospital has not a fire elevator.	Inappropriate
	The fire elevator can be	The hospital has not a fire	Inappropriate

Variable of NFPA Standard	Descriptions	Hospital Condition	Remark
	used as a passenger elevator if there is a fire.	elevator.	
	The fire elevator must be fireproof for at least 1 hour.	The hospital has not a fire elevator.	Inappropriate
	The fire elevator should be able to stop at every floor.	The hospital has not a fire elevator.	Inappropriate
	The fire elevator should be adjacent to the fire exit stairs and easy to reach.	The hospital has not had a fire elevator.	Inappropriate
Emergency Lighting (NFPA 101)			
	Emergency lighting is mounted on a means of egress.	The hospital has emergency lighting but not all of the means of egress equipped with emergency lighting.	Inappropriate
Emergency Communication (NFPA 101)			
	There is a particular phone number to call for emergencies complaint.	There is no particular phone number.	Inappropriate
Assembly Point (NFPA 101)			
	The area conditions are safe, easy to reach, and wide enough to accommodate all occupants.	The condition of assembly point is safe and easy to reach, but not large enough to accommodate all occupants.	Inappropriate

DISCUSSION

This study has the limitation, which is the lack of secondary data obtained regarding fire protection systems and means of evacuation in the X Hospital, so most research based on observations and interviews on the hospital safety personnel.

Active Fire Protection System

Based on comparative analysis between the variables of active fire protection systems in NFPA standards to the conditions at the hospital, the results show that there is still a lack of hospital management awareness and lack of attention to facilities and infrastructure of active fire

protection systems in the hospital. It is evidenced by the absence of periodic inspection and maintenance of the fire detectors, manual call points are damaged and cannot be used, as well as hydrant boxes are empty in the basement and not well maintained. Not doing a routine check, causing the system broke down due to the management still considers that conduct the inspections and repairs the equipment require a high cost. The management makes the cost savings without considering the impact that caused.

Besides that, in an interview, the management is still a lack of fire safety knowledge in the hospital buildings. The management did not know about the standards of fire detectors, fire alarms, sprinkler placement, and hydrants.

The provision of active fire protection systems in hospitals have to pay attention to the occupants, such as fire alarm should meet the requirements for hospitals. The sound level for the fire alarm in the hospital must be at frequencies between 65 dBA up to 105 dBA. The alarm sound level that is in the patient room can be adapted to minimize trauma consistent with the type and condition of the patient. If necessary, the provision of particular alarm should be considered for patients who have hearing problems (Department of Human Services 2008).

Passive Fire Protection System

Passive fire protection system consists of building construction and compartmentalization. This hospital construction is included into the construction type I, based on NFPA 220 related to the type of construction of the building. This would correspond to the standards of the International Building Code where the hospital buildings belonging to the type 1-B, the construction of fireproof building, which has a fire resistance level each of 2 hours for walls, structures, roof separator, and ceiling (International Code Council 2012).

The construction requirements for existing hospital building are the same as new building, except wall and ceiling linings need not be non-combustible unless refurbishment or replacement of existing wall or ceiling linings, or installation of new wall or ceiling linings, occurs. Besides, when carpets are being replaced, thought should be given to selecting a carpet with low flammability and low flame spread characteristics (Department of Human Services 2008).

The comparison between NFPA 101 regarding compartmentalization with conditions on the ground indicates that the compartment is not equipped with fireproof doors because the doors are made of wood which is a flammable material, so that if a fire occurs, the door cannot withstand fire and spread into the other room.

Fire doors and frames should be installed between each fireproof compartment 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 (Pan American Health Organization 2014).

Means of Evacuation

Based on the NFPA 101, there is incompatibility about the means of evacuation on the hospital conditions. There are obstacles on the means of egress, such as the chairs for patients or visitors to wait in the corridor. The chairs can obstruct the evacuation when the fire occurred. Based on Hospital Fire Prevention and Evacuation Guide (Pan American Health Organization 2014), The width of the corridor leading to the emergency exits (unobstructed) should be at least 2.4 m (7.9 feet). The exit routes should be located as far away from each other as possible so that if one exit route is blocked by smoke or fire, the alternate route can be used.

The emergency doors made of glass, so it does not have the fire resistance for 2 hours. The emergency door is not made of the type of hinges or door swing but kind of push/pull. The doors do not fit the standard although it can be opened fully. Besides that, the emergency doors should be shutdown automatically, so that it can prevent the entry of smoke into the room (Kurniawan 2014).

The lack of awareness and knowledge of the emergency stairs functions are indicated by two of four emergency stairs provided at the hospital are not working. The management uses those two emergency stairs as the operational room of hospital. The management does not consider the risk that occurs when unwanted incidents occurred while the two stairs changed its function into operational rooms. In addition, the arrangement of space that is not appropriate contribute to the onset of fire[22]. The management also did not provide ramp and fire elevator as access to evacuate patients, visitors, and medical staff at the time the fire occurred.

The emergency lighting is already available in the hospital, but some parts of the hospital buildings are not equipped with the emergency lighting. Meanwhile, when the unwanted event occurs, the occupants will be directed toward the assembly point while being located in the parking area of the hospital and into the exit of two emergency exits. The assembly point equipped with a guideline which can be seen clearly, but not large enough to accommodate the whole of occupants due to partly used for parking lot.

Overall, the provision of fire-fighting facilities and infrastructures are very necessary, especially in the hospital. The lack of fire-fighting facilities and infrastructures contribute to the emergence of the fire (Nugroho 2010)

CONCLUSION

The results showed that there are 30 data from 16 variables of fire protection systems and means of evacuation is not by NFPA standards. The incompatibility caused by the hospital management has not committed and prioritized fire safety in the hospital building. The management still lacks awareness and knowledge of the standards to meet the fire protection system and a means of evacuation in hospitals. The management only focused on extinguishing the fire, such as the inspection of the fire extinguisher and a fire hydrant, but there are no inspection and maintenance on the system's elements, such as fire detectors, fire alarms, and other support elements. The management still considers that the complementary facilities and infrastructure on the fire protection system requires a high cost, while the management to make cost savings without considering the impact that caused.

Meanwhile, the fire safety standards in the hospital have not based upon the unique activities and conditions in the hospital. The standards only focus on the fire. It has not yet considered the unique activities and conditions of the hospital such as the design of evacuation for patients who are the most occupants in the hospital who need assistance and special tools such as the rolling bed and chair.

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