

Fire Safety Awareness Among Malaysian Public Hospital

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Abstract:

This research focuses on assessing people's awareness of fire safety practice in public hospitals in Malaysia. Raising awareness of fire safety practice is important to avoid delays in the fire evacuation process. Hospital users like patients, visitors, and medical staff should be familiar with the hospital building plan and escape routes, which intend to minimize the risk of casualties in the event of fire. However, poor evacuation design and design information, lack of promotion on the importance of fire safety practice among patients and visitors and poor knowledge on fire safety practice lead to the low level of awareness on fire safety practice. Therefore, there are three purposes of this study; to determine the level of awareness on fire safety practice among hospital users, to identify the significant difference of level of awareness on fire safety procedure based on the hospital users socio-demographic and to propose improvement strategies in order to increase the level of awareness of hospital users. A total of 285 respondents, including hospital staff, patients and visitors were selected from six hospitals in peninsular Malaysia. The data were analysed using descriptive analysis and One Way Anova using SPSS software version 26. The result showed that, respondents from four hospitals show a moderate level of fire safety awareness, while only respondents from two other hospitals show a high level of fire safety awareness. A one-way Anova test did not reveal any significant difference statistically between the level of fire safety awareness and the socio-demographic background. Based on the finding, several suggestions were recommended in order to raise the awareness on the fire safety practice in public hospitals such as, advocating mini campaigns on fire safety practice at hospital level through public outreach campaigns like public talk and fire safety awareness booth, improve fire safety awareness poster designs, conduct fire drill stimulation, create video case regarding the importance of fire safety practice, educational fire safety practices through brochures, create effective fire safety advertisement, enhance safety awareness through sign board and much more.

Keywords: fire safety in hospitals, human awareness in fire safety, fire evacuation in hospitals.

1.0 INTRODUCTION

Traditionally, fire safety in building industry has been addressed by implementing globally accepted standards and codes of practice in an act or procedure established in building construction. Professional bodies such as architects, engineers, and others must follow the fire safety guidelines and codes of practice that have been established in procedures and acts under the control of authorities. The setting of specific items and criteria that must be met by the designer is to ensure the achievement of "safety levels" set and agreed upon in the procedure and act, as well as to further enhance capabilities in fire safety systems used for buildings (Bjelland et al. 2015). Most designers take the approach of reducing the level of risk and major fire hazards in the designed building by ensuring the level of fire safety used in the design is adopted in the fire safety design procedures outlined.

This demonstrates that the value of building fire safety performance can be arranged well in the early stages of design development. In the building design phase, building function is evaluated by looking at several scenarios explored to identify fire safety system requirements appropriate to space and building function (Chu and Law 2019). As a result, at each development phase of the building construction design project, they will be able to identify balanced building design and safety solutions. To do so, the designer must identify each design produced that meets the fire safety and space function criteria. The designer must follow all medical facilitation design requirements, as well as fire safety requirements, that are met during the hospital design preparation process (Rahmani and Salem 2018)

However, there are some details that have been overlooked that will impact on hospital admissions. Therefore, fire safety issues and building functions should be addressed accordingly and effectively in hospital design (Muhamad Salleh et al. 2020). The emphasis on hospital users' perceptions and interpretations must be reviewed as a space function gives benefits to users in the case of fire.

The purpose of this research was to determine the level of hospital residents' awareness of fire safety in the hospital buildings. Although most hospitals contain a variety of safety features, hospital residents are generally unaware of these features. Furthermore, residents' knowledge on the configuration of the floor plan provided in the hospital building is limited. Therefore, the main mechanism in designing a hospital to ensure that fire safety in hospitals is beneficial to hospital residents can evacuate quickly and safely during a fire is the role of hospital building design. Not all occupants of a building can understand the design configuration of a building because most of them, especially visitors, only know the route they usually use to get in and out of the building. The same will happen to the hospital's inmates, particularly visitors and the patients' relatives. In many cases, (Ong et al. 2015) believe that hospital residents' lack of fire safety awareness is caused by a lack of floor plan design information and exit signage in hospital buildings, which causes patients to delay the evacuation process.

According to (Kulkarni et al., 2016), hospital residents' knowledge and awareness of fire safety procedures in the hospital is important in ensuring that the fire safety facilities provided can assist them in making a safe evacuation during a fire. When there is a lack of awareness, occupants are vulnerable to fire hazards, which can result in injury or death (Yatim 2009). This contributes to a high risk of death for a potential group of people such as patients, visitors unfamiliar with the location, or new employees. All of these relationships are evaluated in order to determine the level of awareness of residents regarding hospital fire safety in order to ensure that the design of the hospital building can assist them in understanding the escape route to evacuate from the fire event. The interaction of these issues can aid in determining the level of effectiveness of a hospital building design for hospital residents in the event of fire. In response to the preceding statement, this study translates demographic functions such as age, gender, education level, working experience, length of hospital stays, and frequency of hospital visits to the value of their awareness of fire safety in hospital buildings.

The level of awareness of fire safety among hospital users is critical for controlling the situation in the event of fire. In this regard, the study will emphasize on the level of awareness among Malaysian public hospital users. For this study, three objectives had to be focused on: (1) identifying the level of fire safety awareness of hospital users, (2) identifying the significant difference in the level of fire safety awareness based on the hospital user's socio-demographic, and (3) proposing improvement strategies to increase the level of fire safety awareness of hospital users. The approach used in this study to reveal the value of hospital user awareness is to select several hospitals to be studied on their level of awareness on fire safety. As a result, six hospitals were chosen, all of which were major specialist hospitals with a total bed capacity of more than 700 beds. Sultan Ismail Hospital in Johor Bahru, Sultanah Aminah Hospital in Johor Bahru, Sultan Nur Zahirah Hospital in Kuala Terengganu, Raja Perempuan Zainab II Hospital in Kota Bharu, Selayang Hospital, and Serdang Selangor Hospital are among the hospitals involved. All respondents can be classified into four categories: hospital staff, former patients, former visitors, and relatives of visitors who had visited the hospital and were over the age of 12.

2.0 LITERATURE REVIEW

The impact on the degree of building fire safety awareness, according to the majority of previous research, needs to be addressed in order to prevent additional deaths and injuries. According to (Proulx et al. 1995), when a fire emergency happens, the building residents will be bewildered, confused, and unsure of what to do, and their predicament will be made much more difficult if the occupants only know the access route they use to enter the building. They will be compelled to evacuate because of this predicament. A substantial proportion of people who utilize hospital buildings have never been exposed to building fire evacuation strategies and have no knowledge of how to minimize the risk of fire. Their responses during an emergency situation during a fire demonstrate this circumstance.

Furthermore, lack of building fire safety awareness due to a lack of information and understanding about space design configuration, as well as limited exposure to training and fire safety programs among hospital users, causes delay in acting during fire situations (Rahmawati et al. 2018). Therefore, determining the level of fire safety awareness among hospital users is critical. This will provide information on hospital users who are familiar with the fire evacuation process and its implementation methods. If a fire does occur, hospital users will be able to react quickly and accurately, reducing the risk to a minimum. (Holla et al. 2016). Furthermore, socio-demographic factors such as gender, age, level of education, and work experience may influence fire safety awareness. Other factors that influence the value of this awareness include the frequency of visits and length of stay (LOS) in hospitals, which can both contribute to the level of hospital fire safety awareness because hospital users who visit more frequently and stay longer in hospitals are more sensitive to their surroundings. All of these elements have an impact on hospital residents' awareness of fire safety hazards in hospital structures (Rahmani and Salem 2018).

The effectiveness of this awareness in this context can be derived from a person's understanding and knowledge of the information offered by training, seminars, programmes, ads, readings, and visualizations on the environment established in the

hospital building(Jalali et al. 2016). When a fire emergency happens, the information provided around the hospital building regarding fire evacuation process may contradict to the users' actual reactions(Furness and Muckett 2007). This process, however, may cause the evacuation process to be delayed due to panicked and fearful residents. Their behaviour will shift, and they will react erratically, not in the direction of the chosen escape routes, which will later put them in danger of injury or death (Gerges et al. 2017). In other prescriptive, users still have a low level of fire safety awareness and a limited fire safety margin when it comes to recognising an escape route in a medical facility during a fire emergency. The effectiveness of the information offered to hospital users can help them become more conscious of hospital fire safety(Haghani and Sarvi 2018).

There are various techniques to stating the minimal value of fire safety requirements for an area whose space function does not have a higher risk of fire hazard, but some basic fire safety standards must be placed in the area to ensure building users utilize the facility in an emergency(Rahouti et al. 2020). To accomplish this, the designer must devise a method that allows the user to easily configure the design provided. As an outcome, users can easily and quickly find access routes. This method is particularly useful for building occupants who lack specific knowledge and various cognitive abilities regarding the design and configuration of space within the building(Rahouti, Datoussaid, and Lovreglio 2016). Directions and options are two critical aspects of an occupant's efficiency in finding an escape route during an emergency. The direction will determine the direction of the nearest exit route as well as the safe exit route that the user should take(Haghani and Sarvi 2019). While the option is to determine whether the user should choose the route indicated by the direction sign or take another route for which they do not know the actual exit direction. Hospital users have different perspectives and levels of comprehensions, thus their actions are based on their level of understanding and awareness of the safety hazards that exist in hospital facilities(Mkharem, Adam, and Supeni 2018).

Therefore, the level of awareness, understanding, and information received in dealing with fire problems in buildings will be greatly influenced by the users' interpretations. Their perceptions and interpretations of the design configuration and environment in their pathways impact their actions during emergencies, only those with a high level of awareness can make efficient decisions about which access route to take(Ramachandran 1990). Many studies, however, have found a correlation between this level of awareness and the behaviour of building users. Their behaviour as well as their physical perception of fire warnings, will change if they have a high level of awareness when dealing with fire events and making decisions. There is no doubt, however, that the environment has an impact on how people make decisions(Fridolf and Nilsson 2011). Many factors influence hospital residents' level of awareness, including a lack of understanding of the fire hazard warning signals, their perception and interpretation of the signboards provided, and instructions received from hospital staff, all of which can lead to them being unable to react quickly in the event of a fire. In most cases, occupants lack awareness in their behaviour and actions as a result of the initial information factor received about the possibility of fire, as well as the extent of the fire and its location, which is frequently accepted vaguely or incompletely.

As a result, they will try to obtain clear information before acting. However, if they do not have knowledge of fire safety in dealing with the issue, this move will produce complications. Why is it significant for hospital users to be aware of fire safety issues in a hospital? This is because they are all at high risk of losing life or suffering serious injuries if they are not aware of fire safety which will lead to slow evacuation process during a fire. They are also unfamiliar with the procedure used during the fire. During a fire emergency, they should go through three stages of evacuation process. Whether they are aware of it or not, they will encounter a situation in which a perception of danger is detected in their environment, after which the detection of danger signals is issued and evacuation movement instructions are issued. All of this will be completed efficiently and swiftly, but if the occupants are unaware of all of these instructions, panic and anxiety will ensue (Wang and Sun 2014). That evacuation process is known as the pre-movement procedure, and it entails both verification and decision-making.

All of these procedures need a high level of awareness on the part of hospital users since they can decide their level of safety against the possibility of a fire hazard, which might result in harm or death depending on the level of reaction and movement they take during fire evacuation. (Kobes et al. 2010). In other aspects, hospital users' perceptions are thought to be influenced by the environment of movement of other occupants rather than the directional signage placed on the ceiling or in their surroundings. The occupants' condition, which refers to how often they interact with the building, the availability of exits, the ease of access to the exit, and the configuration of space arrangement, all influence the route choice and normally occupants' perspective of the exit route is that it is long, but in actuality, the route is dictated by their interpretation of the route rather than the actual length (Kobes, Oberijé, and Duyvis 2008).

The process of fire evacuation movement of building occupants is determined by the physical (age and gender) condition and reaction (awareness and action) of the building occupants, as well as how they move down the exit route to the final exit of the building to safety. Regardless of any type or characteristics of a building, the evacuation process is closely related to the distance travelled to the nearest emergency exit to escape the wrath of the fire. As a result, the distance travelled by occupants to escape is directly proportional to the time spent in the process of fire evacuation movement. The two major factors influencing evacuation safety are human movement and restraint. Public mobility refers to the characteristics of people's movement in specific buildings and environments, such as the velocity of pedestrians in a raging fire and thick smoke conditions, the flow rate of people in certain exits, and pedestrian density or building occupants (Li, Zhuang, and Shen 2017).

In terms of human awareness, this relates to the impact of occupant behavioural features on evacuation safety, such as occupant frequency in the building, occupant sensitivity to safety, occupant pathological, physiological, and psychological responses during a fire (Twarogowska, Goatin, and Duvigneau 2014). In previous research, it was discovered that the level of awareness of hospital residents is a major issue in the process of evacuation of fire in hospital buildings. This evacuation process on the other hand is greatly influenced by elements of building design and human behaviours (Kinsey et al. 2019). Previous research also had shown that human attitudes play a critical role in ensuring a quick and safe fire evacuation. External elements such as building design

and spatial orientation, directional signs, and route specifications influence these attitudes and actions (Yang et al. 2014). Other factors, such as knowledge, experience, training, frequency of visits, and hospital user awareness, are also important. Individual factors such as age, gender, and disability, as well as patient factors, are important in the interpretation because a hospital resident is the main basis for this study. The previous study clearly examines hospital residents' level of awareness about fire safety in hospital buildings.

The ability of people who have to find their emergency access route are closely related to their knowledge and familiarity of a building. In addition, there are four groups of environmental variables which influence performance findings: (i) visual access. (ii) the degree of architectural building design layout differentiation. (iii) the use of signs and room numbers to provide identification or directional information. (iv) Configuration of the plan layout (Lovreglio, Ronchi, and Borri 2014). These four factors influence hospital users' level of awareness of fire safety; their inability to identify the four factors will cause them problems if there is a fire. As a result, hospital administration should take a proactive approach by providing facilities that are easier to understand and that allow other hospital residents to act more quickly by providing useful guidance.

3.0 METHODOLOGY

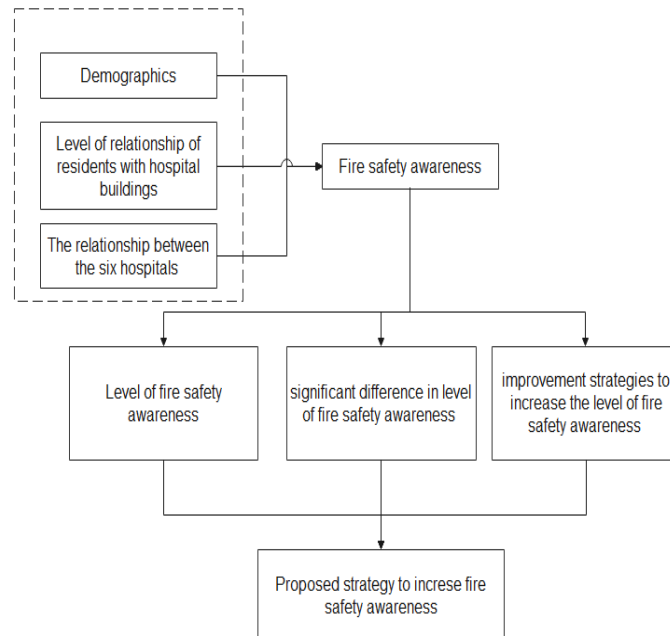
This research applied a qualitative method with the data collected via a random sampling questionnaire. The question framework for this questionnaire format is based on the adaptation of questions from (Rahim, Taib, and Mydin 2014) that use the questionnaire approach in shopping mall construction. Aside from that, this question was adapted from Kikwasi (2015) and some researchers such as Agyekum, Ayarkwa, and Joe Opoku (2016) regarding the assessment of building users' awareness of fire safety issues. The purpose of the survey was to determine the level of fire safety awareness among hospital visitors on emergency evacuation procedures and routes.

This questionnaire is divided into two sections: Section A (socio-demographic) and section B (personal information) (level of safety fire awareness). There were eight demographic questions in section A, including gender, age, working experience, education level, frequency of hospital visits, and length of hospital stays. The purpose of the questions in section B was to determine the respondents' level of fire safety awareness. This part had sixteen questions about emergency evacuation methods and access routes. In this study, all of the questions on a Likert scale were designed to assess their level of knowledge about emergency evacuation procedures and access routes. The procedure for gathering data by the respondents was chosen using a stratified random sampling method. Due to Covid-19, the survey should follow the SOP procedure by National Security Council (**Majlis Keselamatan Negara, MKN**), and data is collected from respondents via an online google form, which is distributed via email, group chat, social media, and WhatsApp group.

As a result, the framework of this study is conducted with reference to the framework model figure 1, which refers to the relationship between the level of awareness of hospital residents on fire safety with 1) Demographics backgrounds

(Gender, Age, Education, and work experience) and 2) The relationship between hospital residents and the hospital buildings, which refers to the frequency of visit to the hospital and length of stay in the hospital. 3) The relationship between the six hospitals and the level of fire safety awareness among its residents.

Figure 1: Framework model of study to achieve the objective research of level of fire safety awareness.



The research will look at the impact of gender, age, educational level, and work experience on the level of fire safety awareness in hospital buildings. In addition, the study will assess the level of awareness among hospital users and identify the relationship of residents to the value of frequency and length of stay in hospital buildings on their level of awareness of fire safety. Knowing each of these relationships will allow you to measure the level of awareness of residents about the fire safety given in the hospital building and, in return, assist them to evacuate more effectively or vice versa.

3.1 Data Analysis

Based on the data gathered the results of this study were analyzed using the Statistical Package for Social Science (version 26). The reliability test was carried out in order to assess the consistency of the questions on the level of awareness of fire safety in relation to fire evacuation procedures and access routes in the hospital building. The Cronbach alpha test will be used for the reliability test, and the value on this test is 0.942, indicating that the questions are consistent and accurate for this survey. The Sig. value of Shapiro-Wilk is 0.080, which is greater than 0.05, indicating that the data distribution in this study was normal. In order to provide answers for the objectives of this study, two types of data analysis were used in this study. First, a descriptive analysis was used to examine the socio-demographic characteristics of

respondents and provide answers for the first objective, which was to determine the level of fire safety awareness of hospital users.

The results will be presented as a frequency, percentage, and total score. A mean score of 1.00 to 2.33 indicates a low-level score, 2.34 to 3.66 shows a medium-level score, and 3.67 to 5.00 represents a high-level score, (Hamidah et al. 2015). The One Way Anova test was developed to answer the second goal, which was to examine whether there was a significant difference in fire safety awareness depending on the socio-demographics of hospital users because the data distribution was normal. A post hoc analysis was conducted in order to determine the difference between mean groups.

4.0 RESULTS

Based on the data collected, it was discovered that six hospitals contributed to a total of 285 responses. Table 1 depicts the breakdown of respondents. According to the list of hospitals, Sultanah Aminah Hospital had the highest respondent value of (n=97) with a percentage of 34.0 percent, followed by Nur Zahirah Hospital with (n=58) or a percentage of 20.4 percent, Serdang Hospital with (n=48) and percentage of 16.8, Selayang Hospital with (n=42) or percentage with 14.7, Sultan Ismail Hospital with (n=23) and percentage of 8.1 and the lowest respondent is Raja Perempuan Zainab II Hospital with (n=17) or a percentage of 6.0 percent. The total number of participants who responded to this survey was 285 which consist of hospital staff, patients, visitors, and relatives of patients.

Table 1: Distribution of respondents based on six hospitals.

Hospital	Frequency (n)	Percentage (%)
Sultanah Aminah Hospital	97	34
Raja Perempuan Zainab II Hospital	17	6.0
Serdang Hospital	48	16.8
Selayang Hospital	42	14.7
Sultan Ismail Hospital	23	8.1
Sultanah Nur Zahirah Hospital	58	20.4
Total	285	100

4.1 Socio-Demographic of The Respondents

The next analysis involves the socio-demographics of respondents in this study referring to table 2. The first demography involves the gender of respondents in this survey, with respondents representing 51.9% (n=148), while male respondents account for 48.1% (n=137), which covers those aged 12 and above. The largest level of participation is among those aged 56-60 years, with (n=102) equalling 35.8%, while the lowest level is among those aged 46-55 years, with (n=1) equalling 0.4%, and those aged 12-18 years with (n=8) equalling 2.8%.

The education background of the respondents involved in this study explained that the majority of respondents have a bachelor's Degree and above (n=148), which is 51.9% higher, followed by (n=88) or 30.9% have a Diploma level and the rest are (n=48), or 17.2% are SPM Level and below. The purpose of evaluating this education level is to assess hospital users' level of awareness of fire safety in hospital buildings. This is because, the higher level of education allows users to easily understand the building layout as well as the fire evacuation process and thus be aware of fire safety. A person with knowledge has a higher level of awareness in this matter.

The analysis found that the majority of respondents are government employees who contributed (n=119) equivalent to 41.8%, while the private sector employees contributed n=84 equivalent to 29.5%, and the self-employed group contributed (n=31) equivalent to 10.9%. While the self-employed group has a participation rate of (n=31) or 29.5%, the unemployed group has a frequency of (n=21) or 7.4%, students have a response rate of n = 18 or 6%, and retirees have a participation rate of 4.2%.

The group's participation was to ensure the continuity of their work with their knowledge and experience on the level of fire safety awareness. The highest frequency of hospital users who visit the hospital within a year is 2-5 times, which is n = 134 with a percentage value of 47.0 %, followed by more than 7 times a year, which is n = 81 or 28.4%, and the lowest frequency is between 6-7 times per year, which is (n=23) or 8.1%. The frequency of only coming once a year is (n=47), for a total percentage of 16.5%. The value of the frequency of attendance at the hospital was referred to in order to investigate the effectiveness of the level of awareness of the residents attending the hospital building on fire safety.

The proportion of respondents who had been hospitalized for less than a day was high in this study, with (n=122) and a percentage value of 42.8%. While those who stayed for 1 to 3 days had n=82 respondents (28.8%), those who stayed for 4 to 7 days had n=43 respondents (15.1%), and a total of n=38 respondents who stayed for more than 7 days, representing 13.0% of the total. All of these percentages of respondents will reflect their level of awareness of fire safety in hospital buildings, which can provide insight into the level of fire safety that needs to be emphasized in order to ensure that hospital users can save themselves in the event of a fire.

Table 2: Distribution of respondents based on socio-demographic (n=285)

Socio-demographic	Frequency (f)	Percentage (%)
Gender		
Male	137	48.1
Female	148	51.9
Age		
12 -18 years old	8	2.8
19-25 years old	17	6.0
26 - 35 years old	49	17.2
36 - 45 years old	96	33.7
46- 55 years old	1	0.4
56 - 60 years old	102	35.8
61 years old and above	12	4.2
Education level		

SPM level & below	49	17.2
Diploma level	88	30.9
Degree level & above	148	51.9
Working experience		
Student	18	6.3
Private sector	84	29.5
Government sector	119	41.8
Self employed	31	10.9
Retirement	12	4.2
Unemployed	21	7.4
Frequency visiting hospitals		
1 times	47	16.5
2 to 5 times	134	47.0
6 to 7 times	23	8.1
More than 7 times	81	28.4
Length of stay (LOS) in the hospital		
Less than 1 day	122	42.8
1 day to 3 days	82	28.8
4 days to 7 days	43	15.1
More than 7 days	38	13.3

4.2 Level of fire safety awareness by hospital users

The range of total scores for fire safety awareness is shown in Table 3 below. This table clearly shows that, as described in table 4, Sultan Ismail Hospital (Med=62) and Raja Perempuan Zainab II Hospital (Med=60) have a higher level of fire safety awareness than the other four hospitals, which are moderate levels of fire safety awareness, such as Sultanah Nur Zahirah Hospital (Med=54), Selayang Hospital (Med=52), Serdang Hospital (Med=50), and Sultanah Aminah Hospital (Med=50).

Table 3: Level of fire safety awareness score ($n=285$)

Factor	Score	Level
	16.0-37.3	Low
Level of awareness	37.4-58.7	Moderate
	58.8-80.1	High

Table 4: Level of fire safety awareness score based on hospital ($n=285$)

Hospital	Median score	Level of fire safety awareness
Sultanah Aminah Hospital	50	Moderate
Raja Perempuan Zainab II Hospital	60	High
Serdang Hospital	50	Moderate
Selayang Hospital	52	Moderate

Sultan Ismail Hospital	62	High
Sultanah Nur Zahirah Hospital	54	Moderate

According to the findings, the total range of fire safety awareness across the six hospitals ranged from 19 to 80. Based on the current findings, the data collected showed a moderate level of fire safety awareness (Med=53). The average degree of fire safety awareness was 53 (M=52.66, S=12.65). Figure 2 below showed the histogram of the total score of fire safety awareness demonstrates that the level of fire safety awareness among six hospitals is moderate.

Figure 2 illustrates the movement of the graph as a normal curve with a balanced curve, indicating that the data distribution is nominal.

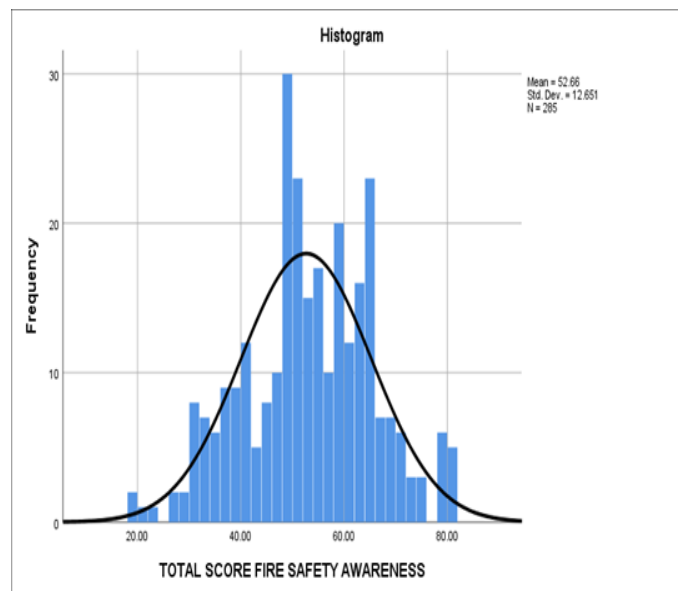


Table 5 shows the mean and standard deviation of the list of fire safety awareness indicators for six hospitals. Based on the mean score, most of the respondents' rate Statement 4; "Are you aware of the dangers of fires in hospitals?" (M=3.93, Sd= 1.02) as main fire safety awareness indicators. This indicated that the respondents understand the impact of fire breaking in the hospital.

Even though they understand the danger of fire in the hospital, they still have a lack of awareness on understanding the fire safety design as Statements 10 "do you know the design of the fire emergency exit route in this building?" (M=2.91, Sd=1.10) and Statement 6 "do you make sure the location of the emergency exit route before entering the ward or treatment room?" (M=2.95, Sd=1.20) were rate as the lowest mean score. This data support previous researches which suggests the low level of awareness on fire safety practice is due to the poor evacuation design and design information (Ong & Suleiman, 2015; Akashah et al., 2017; 2019; Perera et al., 2021).

Table 5: Mean and standard deviation for awareness level of a fire safety ($n=285$)

Item	<i>M</i>	<i>Sd</i>
(Statement 1) Do you know or understand fire safety procedures in hospitals?	3.53	0.959
(Statement 2) Do you know the way out to save yourself in the event of a fire?	3.36	1.192
(Statement 3) Do you feel safe when there is a fire emergency in a hospital?	3.06	1.019
(Statement 4) Are you aware of the dangers of fires in hospitals?	3.93	1.020
(Statement 5) Do you know how to save yourself in the event of a fire emergency?	3.50	1.016
(Statement 6) Do you know the design of the fire emergency exit route in this building?	2.91	1.097
(Statement 7) Do you know the nearest exit for you?	3.29	1.109
(Statement 8) Have you ever read or seen a hospital Emergency Action plan?	3.09	1.271
(Statement 9) Did you see the surroundings first before you entered the Ward Area?	3.18	1.172
(Statement 10) Do you make sure the location of the emergency exit route before entering the ward or treatment room?	2.95	1.195
(Statement 11) Do you take note of the signage for the exit of the building?	3.58	1.094
(Statement 12) Do you take note of the locations of firefighting equipment?	3.12	1.100

(Statement 13) Do you take note of your location in the hospital building?	3.56	1.058
(Statement 14) Do you take note of alterative exits or other exits in the event of an emergency?	3.01	1.126
(Statement 15) Do you take note of where fire - fighting equipment is located?	3.04	1.061
(Statement 16) Do you pay attention to all the information and instructions from the hospital?	3.54	0.969

*The higher the mean score, the stronger is the agreement

Table 6 shows the results of a One Way Anova of the level of fire safety awareness based on the socio-demographics of hospital users. The socio-demographic was linked to education level, frequency of hospital visits, and duration of hospital stays in order to provide answers to the second objective. All socio-demographic characteristics assessed by one-way ANOVA had no statistically significant difference between groups: education level ($F(2,282) = 1.175, p=0.310$), duration of hospital stays ($F(2,282) = 2.326, p = 0.075$), and frequent hospital visits ($F(2,282) = 1.080, p=0.358$).

A mean educational level score indicated that respondents who have completed the Diploma level ($M=3.40, Sd=0.73$) have a higher level of awareness than those who completed the Degree level and above ($M=3.27, Sd=0.81$) and SPM level and below ($M=3.20, Sd=0.82$). In terms of hospital stay duration, respondents who stayed for more than 7 days ($M=3.54, Sd=0.80$) demonstrated higher awareness than those who stayed for 1 to 3 days ($M=3.36, Sd=0.77$), less than a day ($M=3.22, Sd=0.79$), and 4 to 7 days ($M=3.15, Sd=0.74$). Respondents who have visited the hospital more than 7 times ($M=3.38, Sd=0.79$) have a greater level of fire safety knowledge than those who visit the hospital 6 to 7 times ($M=3.35, Sd=0.80$) or 2 to 5 times ($M=3.29, Sd=0.75$). Respondents who have only visited the hospital once ($M=3.13, Sd=0.86$) have a poor level of fire safety awareness. A post hoc test also reveals that for all socio-demographic characteristics, there is no significant difference between mean groups. There is no substantial difference in mean between groups, according to Homogeneous subset^a and subset^{ab}

Table6:One way Anova of the level fire safety awareness based on the hospital users' socio-demographic

Socio-demographic	<i>f</i>	<i>M±Sd</i>	<i>F value</i>	<i>p value</i>
Education level				
SPM level&bellow	49	3.20 ^a ±0.82	1.175	0.310
Diploma level	88	3.40 ^a ±0.73		

Degree&above	148	3.27 ^a ±0.81		
<u>Duration of hospital stays</u>				
Less than a day	122	3.22 ^a ±0.79		
Between 1 to 3 days	82	3.36 ^{ab} ±0.77	2.326	0.075
Between 4-7 days	43	3.15 ^{ab} ±0.74		
More than 7 days	38	3.54 ^b ±0.80		
<u>Frequency visiting hospitals</u>				
Less than 1	47	3.13 ^a ±0.86		
2 to 5 times	134	3.29 ^a ±0.75	1.080	0.358
6 to 7 times	23	3.35 ^a ±0.80		
More times 7 times	81	3.38 ^a ±0.79		

Note: ¹The higher the mean score, the stronger is the agreement

² Indicated significantly different at $p < 0.05$

³ Indicate significantly different at $p < 0.005$

⁴Subset ^a indicated there is no significant different mean between groups

⁵Subset ^{ab} indicated there is no significant different mean between groups

5.0 DISCUSSION

Based on the finding, the majority of respondents from four hospitals [Sultanah Nur Zahirah Hospital ($Med=54$), Selayang Hospital ($Med=52$), Serdang Hospital ($Med=50$) and Sultanah Aminah Hospital ($Med=50$)] show a moderate level of fire safety awareness. Only respondents from the Sultan Ismail Hospital ($Med=62$) and Raja Perempuan Zainab II Hospital ($Med=60$) show the high level of fire safety awareness. This finding provides the answer to the first objective, to identify the level of fire safety awareness of hospital user. It clearly shows that majority of hospital users still do not have a high level of fire safety awareness in the hospital area. Even though it was found that the majority of respondents are aware of the dangers of a fire in a hospital, they have a limited understanding of fire evacuation procedures, layout design configurations, and hospital signage design information.

A One Way ANOVA analysis clearly shows that socio-demographic characteristics do not influence the level of fire safety awareness among hospital users in some cases. This finding answers the second objective, which was to determine the major differences in fire safety awareness among hospital users based on socio-demographic factors. The findings of this study however contradict with previous researches that suggested socio-demographic factors influenced fire safety awareness (Huseyin&Satyen, 2006; Kulkarni et al., 2016). Only the mean score for the education level in this study indicated that respondents with higher educational levels, such as Degree level, or Diploma level tend to have a high fire safety awareness compared to respondents who have low education levels (SPM level and below). This may imply that education level is still an important factor in educating fire safety awareness among hospital users. This could be because respondents with a higher education level are more aware of the fire safety procedures than those with a lower education level.

Furthermore, respondents who spent a longer period of time in the hospital

demonstrated a high level of fire safety awareness. This could imply that respondents are taking precautions to increase their fire safety awareness in case a fire breaks out. The frequency with which respondents visit the hospital yields the same result as the duration with which respondents stay in the hospital. The result in Table 6 above clearly shows that the more often the respondents visit the hospital, the higher their level of fire safety awareness. It also clearly suggests that, respondents are increasing their awareness to prepare themselves during emergency situation such as fire.

Several ideas have been provided to increase the level of fire safety awareness among hospital users in order to address the third objective of this study which was to propose improvement strategies to increase the level of awareness of hospital users on fire.

1. Hospital management should conduct more fire safety awareness campaigns throughout the hospital, rather than focusing on a single group of people. In many organizations, an awareness campaign is limited to the organization's employees. It's great to provide employees with training and programs, but if the training and other programs also include visitors and patients, they'll be even more helpful in raising the level of awareness among hospital users. Since a hospital is a public building, it is important to intensify the awareness campaign among all hospital residents'.
2. Hospital management needs to improve the hospital's fire evacuation process information by refining the configuration of layout design, and signage design information. An understanding of hospital users' attitudes and actions must also be refined to ensure that the design is truly effective for hospital users. As previously stated, in the event of fire, a lack of fire safety awareness can cause panic and anxiety in a person. As a result, their reaction time to the evacuation process will be delayed. Individuals with limited knowledge and experience will face difficulties during the fire evacuation process. They will get confused, less confident, and less trusting when deciding whether or not to make a safe evacuation. A situation as such will further delay their evacuation and put their lives in jeopardy. In this emergency situation, they will also be hampered in their movement due to either obstruction from medical equipment or the occurrence of bottlenecks in the access route, which causes congestion and will further delay their evacuation. Therefore, it is crucial to have the configuration of layout design as well as signage design information that is clear and understandable to hospital users to assist in making evacuation process easy in the event of a fire, as well as to ensure that residents know, are aware of, and understand the design.
3. Hospital management should consider adding more information signage about fire hazard warning signs and emergency exit signs, as well as direction signage on the walls and floor of the walkway, to help occupants evacuate more effectively and efficiently. Lights indicating the direction of the exit should also be used. Furthermore, the route design should be wide and appropriate to the capacity of occupants in the space and level.
4. The hospital administration should also impose additional requirements to ensure that patient aid equipment is available at all levels and that every exit in the hospital building is always safe and free of obstacles such as flower pots and

other hospital equipment. In the event of an emergency, this will obstruct the movement of hospital users. Additional exit signage, both on the wall and on the floor of the exit, must be provided at each exit. This is done to ensure that the occupants understand the quickest and safest way out.

In general, there are several examples of awareness programs that can be considered such as advocating for a mini-campaign on fire safety practices and procedure at the hospital level through public outreach campaigns such as public talks and fire safety awareness booths, improving fire safety awareness poster designs, conducting fire drill stimulation, and creating a video case about the importance of fire safety procedures. In other parts, managing the educational fire safety procedure via brochure, effective fire safety advertisement, increased safety awareness via signboard, and much more must be considered as part of one's effort to raise the level of awareness among hospital users, particularly those who do not visit on a regular basis.

With increased awareness of fire safety in hospital buildings, hospital users can help reduce the risk of death and injury due to a fire. Furthermore, an increase in fire safety awareness among hospital users can assist management to easily handle fire emergencies, and hospital users can assist in the process of fire evacuation more efficiently, quickly, and safely, and will not experience panic and fear when faced with fire emergencies. The situation can be managed, and the evacuation can be completed quickly and orderly, as well as within the time frame expected.

Referring to these needs, a checklist of recommendations that need to be improved in the management of fire safety in hospital buildings has been proposed (see Appendix). The proposed improvement plan needs to be taken into account by the administrators and management of the hospital building in increasing the level of awareness of hospital users on the fire safety provided.

6.0 CONCLUSION

The results of hospital users' perceptions of fire safety awareness from six Malaysian hospitals are presented in this research. This finding has been taken into account for six specific healthcare facilities. In addition, the human aspects of fire safety interpretation, actions, and awareness in a hospital building were investigated. According to the findings, respondents have a moderate level of awareness of fire safety in hospitals. Even though respondents understand the consequences of a fire breaking out, they only have a moderate understanding of fire safety procedures.

The review also shows that the study's findings support the notion that people's attitudes, behaviours, and fears should be taken into account when designing a hospital because the vast majority of them are unfamiliar with the hospital layout. This suggested that people who are familiar with the building layout can help the hospital user make decisions more easily than someone who is unfamiliar with the building layout. People who visited the hospital more frequently and spent more time there had a higher level of fire safety awareness.

All hospital users are valuable resources for human evacuation strategies, but

their predictive capacities are closely related to their versatility in portraying egress components and complex behavioural processes. Hospitals should have clearly marked emergency exits for user evacuation, as well as signage instructing decision-makers on how to safely evacuate in the most convenient direction. Management should devise a plan to help people understand the layout of the building and the fire safety designation signs in order to provide information and understanding about fire safety. The hospital should provide a safety briefing, guidance, or booklet to inform them about fire safety and evacuation procedures, as well as what to do if a fire breaks out.

From this study, it is hoped that the method of fire safety awareness in Malaysia Hospitals can be broad up to other scopes such as the evacuation process, team of emergency response and the quality of fire safety facilities. With all fire safety perspectives, it will create more effective awareness to hospital employees, patients, and visitors. Aside from that, there are many topics not covered in this article that should be covered in future studies, such as fire evacuation methods in hospital buildings, fire auditing for fire certificates, ERT management and planning evacuation process, and others.

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REFERENCES

1. Akashah, F. W., Baaki, T. K., & Lee, S. P. (2017). Fire risk assessment of low cost high rise residential buildings in Kuala Lumpur: A case study. *Journal of Design and Built Environment*, 17.
2. Bjelland, Henrik, Ove Njå, Atle William Heskestad, and Geir Sverre Braut. 2015. "The Concepts of Safety Level and Safety Margin: Framework for Fire Safety Design of Novel Buildings." *Fire Technology* 51(2):409–41. doi: 10.1007/s10694-014-0400-y.
3. Agyekum, Kofi, Joshua Ayarkwa, and De-Graft Joe Opoku. 2016. "Fire Safety Awareness and Management in Multi-Storey Students' Hostels DAMPNES IN BUILDINGS View Project Project Management View Project Fire Safety Awareness and Management in Multi-Storey Students' Hostels." *Asian Journal of Applied Sciences* 04(January):23Agyekum, K., Ayarkwa, J. and Joe Opoku, D.-G. (2.
4. Chu, Mei Ling, and Kincho H. Law. 2019. "Incorporating Individual Behavior, Knowledge, and Roles in Simulating Evacuation." *Fire Technology* 55(2). doi: 10.1007/s10694-018-0747-6.
5. Fridolf, Karl, and Daniel Nilsson. 2011. "People's Subjective Estimation of Fire Growth: An Experimental Study of Young Adults." Pp. 161–72 in *Fire Safety Science*.
6. Furness, Andrew, and Martin Muckett. 2007. "Introduction to Fire Safety Management." *Introduction to Fire Safety Management*. doi: 10.1016/B978-0-7506-8068-4.50015-4.
7. Haghani, Milad, and Majid Sarvi. 2018. "Crowd Behaviour and Motion: Empirical Methods." *Transportation Research Part B: Methodological* 107.
8. Haghani, Milad, and Majid Sarvi. 2019. "Simulating Dynamics of Adaptive Exit-

- Choice Changing in Crowd Evacuations: Model Implementation and Behavioural Interpretations." *Transportation Research Part C: Emerging Technologies* 103. doi: 10.1016/j.trc.2019.04.009.
9. Holla, Ramesh, Bhagawan Darshan, Bhaskaran Unnikrishnan, Rekha Thapar, Prasanna Mithra, Nithin Kumar, Vaman Kulkarni, and Avinash Kumar. 2016. "Fire Safety Measures: Awareness and Perception of Health Care Professionals in Coastal Karnataka." *Indian Journal of Public Health Research and Development* 7(3). doi: 10.5958/0976-5506.2016.00165.0.
 10. Jalali, Habib, Elahe Baloochestani Asl, Asieh Maghami Mehr, Seyed Mehdi Pourafzali, and Malihe Ghasemi. 2016. "Prevention and Control of Operating Room Fires: Knowledge of Staff Employed by Selected Hospitals of Isfahan University of Medical Sciences." *Digital Medicine* 2(2). doi: 10.4103/2226-8561.189506.
 11. Kikwasi, Geraldine J. 2015. "A Study on the Awareness of Fire Safety Measures for Users and Staff of Shopping Malls: The Case of Mlimani City and Quality Centre in Dar Es Salaam." 9:1415–22. doi: 10.17265/1934-7359/2015.12.003.
 12. Kinsey, M. J., S. M. V. Gwynne, E. D. Kuligowski, and M. Kinatader. 2019. "Cognitive Biases Within Decision Making During Fire Evacuations." *Fire Technology* 55(2).
 13. Kobes, Margrethe, Ira Helsloot, Bauke de Vries, Jos G. Post, Nancy Oberijé, and Karin Groenewegen. 2010. "Way Finding during Fire Evacuation; an Analysis of Unannounced Fire Drills in a Hotel at Night." *Building and Environment* 45(3). doi: 10.1016/j.buildenv.2009.07.004.
 14. Kobes, Margrethe, Nancy Oberijé, and Martina Duyvis. 2008. "Case Studies on Evacuation Behaviour in a Hotel Building in BART and in Real Life." in *Pedestrian and Evacuation Dynamics 2008*, edited by C. P. P. 2008. HA Arnhem – The Netherlands: Conference Proceedings PED 2008. 4th International Conference on Pedestrian and Evacuation Dynamics. Springer. (in press) Case.
 15. Li, Shuying, Jun Zhuang, and Shifei Shen. 2017. "A Three-Stage Evacuation Decision-Making and Behavior Model for the Onset of an Attack." *Transportation Research Part C: Emerging Technologies* 79. doi: 10.1016/j.trc.2017.03.008.
 16. Lovreglio, Ruggiero, Enrico Ronchi, and Dino Borri. 2014. "The Validation of Evacuation Simulation Models through the Analysis of Behavioural Uncertainty." *Reliability Engineering and System Safety* 131. doi: 10.1016/j.res.2014.07.007.
 17. Mkharem, Mufida, Nor Mariah Adam, and Elianddy Supeni. 2018. "Awareness , Knowledge , Attitude and Practice of Safety Occupants at Residential Houses in Libya." (November). doi: 10.20944/preprints201811.0379.v1.
 18. Muhamad Salleh, Naziah, Nuzaihan Aras Agus Salim, Mastura Jaafar, Mohd Zailan Sulieman, and Andrew Ebekozen. 2020. "Fire Safety Management of Public Buildings: A Systematic Review of Hospital Buildings in Asia." *Property Management* 38(4). doi: 10.1108/PM-12-2019-0069.
 19. Ong, Woon Chin, Mohd Zailan Suleiman, Chin Ong Woon, and Mohd Zailan Sulieman. 2015. "Problems in Implementation of Fire Safety Management in Malaysia Government Hospital." *Advances in Environmental Biology* 9(4)(March 2015):47–50. doi: 10.13140/RG.2.1.4150.4887.
 20. Rahim, N. Abdul, M. Taib, and M. A. Othuman Mydin. 2014. "Investigation of Fire Safety Awareness and Management in Mall." Pp. 1–5 in *MATEC Web of Conferences Fire*. Vol. 4, edited by M. A. O. M. N. Abdul Rahim¹, M. Taib², a. Penang, Malaysia: MATEC Web of Conferences 10 , 0 004 (2014).

21. Rahmani, Abdolrasoul, and Mohammad Salem. 2018. "Fire Risk Assessment in High-Rise Hopitalls in Accordance with NFPA 101." *Revista Latinoamericana de Hipertension* 13(3):242–45.
22. Rahmawati, D., A. Pamungkas, A. M. Navastara, M. Yusuf, G. A. Rahadyan, and K. D. Larasati. 2018. "Contingency Planning for Fire Protection in Built Environment: Risk Analysis in Campus Area." in *IOP Conference Series: Earth and Environmental Science*. Vol. 202.
23. Rahouti, Anass, Selim Datoussaid, and Ruggiero Lovreglio. 2016. "A Sensitivity Analysis of a Hospital Evacuation in Case of Fire: The Impact of the Percentage of People with Reduced Mobility and the Staff to Occupant's Ratio." *Fire and Evacuation Modelling Technical Conference* (November):1–14.
24. Rahouti, Anass, Ruggiero Lovreglio, Phil Jackson, and Sélim Datoussaïd. 2020. "Evacuation Data from a Hospital Outpatient Drill The Case Study of North Shore Hospital." *Collective Dynamics* 5. doi: 10.17815/cd.2020.44.
25. Ramachandran, G. 1990. "Human Behavior in Fires-a Review of Research in the United Kingdom." *Fire Technology* 26(2):149–55. doi: 10.1007/BF01040179.
26. Twarogowska, Monika, Paola Goatin, and Regis Duvigneau. 2014. "Comparative Study of Macroscopic Pedestrian Models." *Transportation Research Procedia* 2:477–85. doi: 10.1016/j.trpro.2014.09.063.
27. Wang, Jing Hong, and Jin Hua Sun. 2014. "Principal Aspects Regarding to the Emergency Evacuation of Large-Scale Crowds: A Brief Review of Literatures until 2010." in *Procedia Engineering*.
28. Yang, Yi, Jun Deng, Chang Chun Xie, and Yun Tao Jiang. 2014. "Design and Implementation of Fire Safety Evacuation Simulation Software Based on Cellular Automata Model." in *Procedia Engineering*. Vol. 71.
29. Yatim, Yahya Mohamad. 2009. "Fire Safety Models for High-Rise Residential Buildings in Malaysia."