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The Paradigm of Malaysia's Old and New Public Hospital Buildings on Passive Fire Protection System with UBBL 1984 Compliance

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Abstract

Public hospitals in Malaysia require stringent fire safety measures for high occupancy due to government policy against convoluted building design and layouts. Ensuring compliance with fire safety regulations, particularly passive fire protection systems, is critical for safeguarding lives and facilitating safe evacuation during emergencies. However, older hospital buildings often face challenges meeting fire safety standards due to outdated designs and spatial limitations before the Uniform Building By-Laws, 1984 (UBBL 1984) was mandated in 1984. The paper summarises and explores the peer-reviewed literature on passive fire protection systems versus the appraisal of UBBL 1984 between existing, new, and old public hospital buildings. The key disparities are design criteria such as escape routes, fire compartments, emergency exits, and fire protection systems. The findings indicate that newly constructed hospitals are more likely to fully integrate passive fire safety features from the outset, ensuring better compliance with UBBL 1984. In contrast, older hospital buildings often lack essential fire safety components due to constraints in retrofitting, potentially compromising containment, disobeying by-laws and evacuation efficiency. This paper provides valuable insights for hospital administrators, fire safety professionals, and policymakers to enhance fire safety requirements in existing hospital facilities.

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1. Introduction

Fire safety plays an essential role in hospital building design, construction, and management, given that these facilities accommodate individuals with different degrees of vulnerability. Individuals with restricted movement, health issues, or reliance on relatives require a higher level of safety in the case of a fire. Hospitals serve as multifaceted environments characterised by a high density of occupants and

various functions, in addition to their primary role in healing. Fire safety measures are essential to guarantee the safety and well-being of all individuals within these facilities.

A fire protection system in a building is a combination of active and passive systems that detect, contain, and extinguish fires [1]. A passive fire protection system in a building refers to structural components designed to slow or prevent the spread of fire and smoke without any active mechanism, typically including fire-resistant walls, floors, ceilings, doors, and fire-stopping materials, essentially creating compartments within a building to contain a fire and allow for safe evacuation [1,2]. The factors influencing fire in Asian hospital buildings were categorised into technical, management and legislation factors, which were also conducted by Salleh et al. [3]. Risk assessment among old and new hospital buildings has been debated in three areas: fire control, exits, and general safety, which was also conducted by Salleh et al. [4]. These explain that the old hospital building built before 1984 requires solutions to overcome this egress or fire exit requirement, and parameters were also conducted by Salleh et al. [4].

The Uniform Building By-Laws (UBBL) 1984 functions as the essential regulatory framework for fire safety in Malaysia. The regulations outline the criteria for passive and active fire safety systems to reduce fire hazards, ensure safe evacuation, and limit damage. Recently built hospitals typically incorporate these specifications throughout the design and construction phases, thereby achieving enhanced adherence to fire safety regulations. Conversely, older hospitals, built under earlier regulations or with constrained resources, often face difficulties complying with contemporary fire safety standards. The gap highlights significant concerns regarding the sufficiency of fire safety protocols in current hospital structures and the potential hazards they may present to patients, staff, and visitors.

This study examines peer-reviewed literature on UBBL1984 compliance in both new and existing public hospital buildings, focusing on passive fire protection systems such as fire-resistant materials, compartmentation, and well-designed escape routes. With Malaysia's growing emphasis on healthcare infrastructure, assessing fire safety systems' compliance levels and effectiveness in new and older hospital buildings is essential.

2. Literature Review

2.1. Overview of the Malaysian Public Hospital

Malaysia's Ministry of Health (MOH) is the primary government agency responsible for providing healthcare services. Both the public and private sectors play significant roles in Malaysia's healthcare system, which is centred around hospitals. Additionally, government hospitals in Malaysia are grouped into various categories, as outlined in Table 1.

Government hospital activities encompass curative, preventive, rehabilitative, promotive, and regulatory concerns [5]. The MOH provides a wide range of hospital services through a sophisticated and integrated network of programmes. The MOH delivers medical care through public hospitals. Meanwhile, public health hospitals follow other rules besides providing healthcare services. Public hospitals are involved in patient care, training, health research, and education. Malaysian public hospitals are classified based on their needs and organisational requirements. According to Hameed and Bibi [6], hospitals are district hospitals with specialist services, general hospitals, and National Referral Centres/ Institutions. Table 1 shows the example classification of the hospitals involved in peer research, which was also conducted by Salleh et al. [4]. Meanwhile, buildings less than 8 years old are considered new, and buildings 8 years old and above are considered old [7].

Table 1: Classification of the hospitals involved in the peer-research [4].

Hospital	Classification
Penang General Hospital	State hospital, specialist services
Seberang Jaya Hospital	Cluster, district hospital with specialist services
Bukit Mertajam Hospital	Cluster, district hospital with specialist services
Sungai Bakap Hospital	Cluster, district hospital
Balik Pulau Hospital	District hospital

2.1.1. District Hospitals

These are small hospitals located in the districts of a state with 24 to 150 beds. They provide outpatient care, inpatient and emergency care, and emergency services. In general, these hospitals have medical officers of two to four years' seniority to provide basic care. The cases encountered primarily involve straightforward conditions in medicine, general surgery, paediatrics, obstetrics, and gynaecology.

2.1.2. District Hospital with Specialist Services

These hospitals are in the state's bigger district with a bed complement of 150 to 500 beds. In each state, there are between two and six hospitals, depending on the size of the population, which was also conducted by Jabatan Perancangan Bandar dan Desa [8]. The specialist services available in these hospitals are general medicine, general surgery, paediatrics, obstetrics and gynaecology, anaesthesia, pathology, and radiology. Other services based on needs are provided by visiting specialists from the general hospitals.

2.1.3. General Hospitals

Each state capital has a general hospital. This hospital forms the final referral for all the hospitals in the state. This hospital has a bed complement of 400 to 1000 beds. Besides providing all secondary-level services, some provide tertiary-level services like neurosurgery, neurology, urology, neonatology, cardiology, cardiothoracic surgery, etc.

2.1.4. National Referral Centres/ Institutions

There are several National Referral centres and institutions. The main National Referral Centre is named Hospital Kuala Lumpur (HKL). Historically, HKL was designated as a general hospital, but due to its central location and being in the country's capital, it became the focus of the development of hospital services. With the growth of these services, several national institutions were designated. For example, Paediatric Institute, Maternity Hospital, Institute of Urology and Nephrology, Institute of Neurological Sciences, Institute of Orthopaedics, etc. The National Heart Institute was originally part of the HKL complex but was later corporatised as a government-owned entity.

2.1.5. Non-MOH Hospitals

Non-MOH hospitals are hospitals provided by other Ministries such as the Ministry of Higher Education (University teaching hospitals), the Ministry of Defence (military hospitals), and the Ministry of National Unity and Social Development (Orang Asli hospitals). There are six non-MOH hospitals in Malaysia, with nearly 3,000 beds.

2.2. Factors Influencing Fire Incidents in Hospital Buildings

Lessons learned from the fire accident cases provide valuable lessons and experiences to prevent a similar mistake from happening. Fire incidents in Malaysia, such as at the ICU on the second floor of the Sultanah Aminah Hospital in Johor Bahru, dated 25 October 2016 [9], shocked the public regarding fire safety prevention in government hospital buildings. The incident took six lives, 11 people were injured, and triggered the evacuation of hundreds of others. Another example of a fire accident is the one that happened in Public Sinying Hospital, Taiwan, on 23 October 2012. Thirteen people were killed and 60 people injured. As a result, the Taiwan government ordered hundreds of hospitals and nursing homes across the island to conduct fire safety checks and enhance fire drills after the incident. Fire drills and evacuation routes constitute key elements of passive fire protection [1].

At the same time, Jaipur Chief Fire Officer Ishwar mentioned that Jaipur Government Hospitals are not properly equipped with fire safety equipment. These examples raise the question that the quality of fire safety in government hospital buildings may be insufficient to protect the user from fire harm. Table 2 describes the list of fire accidents in Malaysia's hospitals. Multiple fire accidents reported in hospitals have generated the study of these fire accident cases to identify the mistakes and problems which occurred at the fire scenes, which can prevent the repeat of similar errors and problems. Out of 16 incidents (refer to Table 2), 13 of the accidents were triggered by the electrical wiring and the installation of the medical equipment system, which did not comply with current standards. Most of the latter hospital buildings are older than 50 years old.

They cannot evacuate the building by themselves without the help of others. Exemplar as emergency evacuation of patients on mechanical life support, such as oxygen supply systems, the dialysis machine is challenging, as medical equipment is typically not portable and bulky, which was also conducted by NYCTP [16].

Potential fire hazard sources and flammable materials can be easily found in hospital buildings, including faulty electrical circuits, poor electrical wiring and insulation, fabrics, medical equipment, and volatile combustible chemicals. Bedridden patients are the most vulnerable.

Table 3 highlights the factors affecting fire incidents in hospital buildings within various Asian countries. In total, 16 articles were reviewed that specifically examine fire safety in hospital environments. Fire safety plan implementation in hospital buildings is generally low in Asia's systematically reviewed literature. Findings from the most reviewed literature perceived that safety rules and violation of building codes are among the key factors contributing to fire incidents in Asian hospital buildings. Followed by the application of combustible and flammable materials, electricity, a lack of fire safety installation and negligence of the staff. Thus, these major dual factors indicate that most healthcare building contravene by-laws and safety rules enumerated in passive fire protection. It has been agreed that the evacuation and emergency route was also conducted by [14], where most problems were found in the old hospital building versus the new one built after the UBBL 1984 mandate.

In Malaysia, the Fire and Rescue Department of Malaysia (FRDM), as cited by [20], reported that between 2010 and 2016, approximately 209 fire cases occurred in hospitals and clinics in Malaysia. The fire outbreak on 25th October 2016 at the Intensive Care Unit (ICU) Ward in Sultanah Aminah Hospital, Johor Bharu, Malaysia was one of the recent and disastrous cases. Although the report is yet to be officially released, an unconfirmed finding is that a lack of natural smoke ventilation design may have caused the high casualties.

Table 2: List of fire accidents at hospitals in Malaysia.

Type of Fire Accident	Death	Date	Cause of incident	Reference
1. Fire on first floor of Neurology Institute, Kuala Lumpur Hospital	50 patients and visitors evacuated	May 2, 2007	Power supply tripping in an elevator[1]	**Error! Reference source not found.**
2. A fire in storeroom at the South ICU ward, Sultanah Aminah Hospital, Johor Bahru	-	July 30, 2008	Short Circuit[2]	**Error! Reference source not found.**
3. A small fire at the South ICU ward, Sultanah Aminah Hospital, Johor Bahru	-	January, 2010	Electrical wiring[1]	**Error! Reference source not found.**
4. Fire occurred in Mental Patient's Isolation room at Kuala Lumpur Hospital's emergency department	1 death (patient)	July 30, 2011	Caused by a mentally-ill patient who ignited a lighter[1]	**Error! Reference source not found.**
5. A block of a new building at Sarawak General Hospital caught fire	1 death (construction worker) and 151 patients evacuated	Feb 15, 2014	Due to welding sparks from construction work in the hospital's compound[1]	**Error! Reference source not found.**
6. A fire in the ward was empty at Tuanku Jaafar Hospital, Seremban	-	May 16, 2015	Explosion at main switchbox[1]	**Error! Reference source not found.**
7. A small fire in the ward at Level 7, Tengku Ampuan Rahimah Hospital, Klang.	-	May 27, 2015	Fire at Switch oxygen pipeline and socket outlet[1]	**Error! Reference source not found.**
8. A small fire near bed No. 26 in the South ICU ward, Sultanah Aminah Hospital, Johor Bahru.	-	May 5, 2016	Small fire at air conditioning system[1]	**Error! Reference source not found.**
9. Near bed No. 31 in the South ICU ward, Sultanah Aminah Hospital, Johor Bahru.	-	October 14, 2016	A small fire at the switch socket outlet[3]	**Error! Reference source not found.**
10. A fire broke out in the storage room of the South ICU ward, Sultanah Aminah Hospital, Johor Bahru.	6 patients died, 11 were injured, and 100 patients were evacuated	October 25, 2016	Faulty ceiling light capacitor[4]	**Error! Reference source not found.**
11. Small fire in Ward 5B, Raja Permaisuri Bainun Hospital, Ipoh.	43 patients evacuated	November 9, 2016	Faulty wiring (in a cubicle or dividing wall between the beds)[5]	**Error! Reference source not found.**
12. A small fire at the NICU ward, Shah Alam Hospital	36 patients (babies) evacuated	February 15, 2017		**Error! Reference source not found.**
13. A fire broke out in the linen room of the 3rd & 4th wards of Segamat Hospital.	67 patients evacuated	March 25, 2017	Electrical short circuit[6]	**Error! Reference source not found.**

14. Small fire in Ward 23, Sibu Hospital.	1000 evacuated	November 17, 2017	Short circuit[1]	**Error! Reference source not found.**
15. A fire broke out at the disposable items storage room in the Institute Perubatan Forensik Negara (IPFN), Kuala Lumpur Hospital.	-	March 17, 2018	Short circuit[7]	**Error! Reference source not found.**
16. A fire broke out at the female ward at the Sultanah Aminah Hospital		June 28, 2020	Short Circuit[2]	**Error! Reference source not found.**

Table 3: Factors that influence fire incidents in Asian hospital building.

	Authors/countries	Ref	Main design/ Methodology	Factors that influence fire in Asian hospital building						
				SR	SC	E	NS	S	TS	BC
1.	Salleh et al. (2023)-Malaysia	**Error! Reference source not found.**	MM	√			√			√
2.	Salleh et al. (2020)-Malaysia	**Error! Reference source not found.**	QL	√			√	√		√
3.	Ong & Suleiman (2015a) - Malaysia	**Error! Reference source not found.**	QL	√	√					√
4.	Samsuddin et al. (2018) - Malaysia	**Error! Reference source not found.**	QN	√						
5.	Olanrewaju et al. (2018) - Malaysia	**Error! Reference source not found.**	QL	√				√		
6.	Ghani & Aripin (2018) - Malaysia	**Error! Reference source not found.**	QL	√	√					√
7.	Martiana & Wahyudiono (2018) - Indonesia	**Error! Reference source**	QN	√		√				

		not found.								
8.	Jiang et al. (2014) – China	**Error! Reference source not found.**	QN	√						
9.	Chowdhury (2014) – India	**Error! Reference source not found.**	QN		√					
10.	Pal & Ghosh (2014) – India	**Error! Reference source not found.**	CS	√	√	√	√			√
11.	Mulyasari et al. (2013) - Japan	**Error! Reference source not found.**	QN	√						
12.	Shohet & Lavy (2017) - Israel	**Error! Reference source not found.**	QN	√						
13.	Rafi et al. (2012) - Pakistan	**Error! Reference source not found.**	QL	√						√
14.	Nankongnab et al. (2018) - Thailand	**Error! Reference source not found.**	QN	√						
15.	Sarsangi et al. (2014) – Iran	**Error! Reference source not found.**	CS	√						√
16.	Alzaben et al. (2016) – Saudi Arabia	**Error! Reference source not found.**	QN	√					√	
	Total			**15**	**4**	**2**	**3**	**2**	**3**	**7**

QN = Quantitative | **QL** = Qualitative | **MM** = Mixed methods | **CS** = Case study

SR = Disregard for safety rules | **SC** = Use of combustible and flammable materials | **E** = Electricity
NS = Lack of fire safety installation | **S** = Negligence of staffers | **TS** = Low standard of the contractor's work
BC = Violation of building codes

The absence of vents in the hospital buildings for hazardous smoke to move out in case of a fire outbreak is always a challenge because most windows are fixed glass walls for natural lighting. It is suggested that a fire engineering approach be used to arrive at an adequate natural smoke venting design for hospital buildings. Also, Ong and Suleiman [17] identified mistakes associated with global fire accidents in hospital buildings constructed between 1918 and 2013. They are inadequate automatic fire protection installations, inadequate law enforcement, weak planning, inadequate maintenance and management in fire safety, combustible material, among others. In the Malaysian context, four public hospitals have been investigated and found that documentation issues, use of combustible and flammable materials, lack of fire safety installations, locked doors and windows due to security reasons and lack of training of hospital staff are the factors contributing to fire in Malaysian hospital buildings. Some of these findings agree with this paper findings that cut across Asia's hospital buildings, for example, Rafi et al. [27] found that carelessness of the stakeholders using the facility, violation of building codes by the relevant authorities and users, unawareness of safety measures, and inadequate training of staff were the major causes of fire incidents in Pakistan's hospital buildings. Sunindijo et al. [31] evaluated hospital readiness and resiliency in a disaster like a fire outbreak in Indonesia. Ten hospitals in West Java and five in Yogyakarta were engaged in the study.

Public hospital facilities are critical infrastructure that must remain safe and operational during crises. The hospital safety index (HIS), consisting of 151 items, was adopted as a measurement tool in line with the World Health Organisation (2015). The authors found that the HIS levels of the studied hospitals suggest they could not function effectively during and after a fire outbreak, highlighting a potential risk for these healthcare facilities.

2.3. Fire Prevention Systems in a Public Hospital Building

FRDM defined fire prevention and control systems as a protection in the aspects of fire prevention, control and extinguishment for a certain area based on the availability of risks in that area. A fire prevention system in the building is essential to ensure that fire can be prevented from the early stage and control the fire from spreading to other parts of the building. It could also describe a temporary defence system against fire while waiting for the fire brigade to arrive. The system differs from one building to another, depending on the building's type, size, and function. Installation of the fire prevention systems device must comply with the requirements of the fire brigade and, most importantly, with the UBBL 1984 [1].

According to Chow and Lui [32], fire prevention systems must be designed according to the specifications of the UBBL 1984 and its needs. Fire prevention systems can be divided into active and passive fire control. Engineers need to implement both active and passive fire prevention systems when designing an effective fire protection system in a building, as also conducted by Spitzenberger et al. [33]. Active fire prevention systems are required to manage and mitigate process fires, while passive fire prevention prevents escalation.

2.3.1. Passive fire prevention systems

Passive fire prevention systems are a method to control the fire threat by not using mechanical devices. It is a system that combines with the building design, such as exit routes, exits, emergency doors, fire-rated doors, and staircases. In the event of a fire, passive fire prevention systems can prevent the fire from spreading to other parts of the building and protect the occupants so they can leave the building

safely. Spitzenberger et al. [33] concluded that the main function of a passive fire prevention system is to contain fires or slow their spread to limit damage to the facility and give occupants more time to escape and evacuate to a safer area.

The system is an effective barrier to prevent escalation, which does not require energised initiation or any motion to activate it. However, these systems' limitations do not prevent the fire from spreading, provide cooling, require more space, or need more maintenance. The passive fire prevention systems include materials designed to limit temperatures and prevent excessive heat absorption within process plant equipment, structures, and vessels, such as fire-rated walls, doors, insulation, drainage sumps, and compartmentalisation [1]. However, the challenges for the systems are determining how much additional fire resistance is required beyond the active fire prevention system, even though the need for personnel in a fire area can be minimised with a passive fire prevention system.

2.4. Fire Safety Rules and Regulations for Hospital Buildings in UBBL 1984

Regulatory framework and fire requirements provision in Malaysia's Uniform Building By-Law 1984. Definition of terms and references used in the Uniform Building By-Laws 1984 can be found in Table 4. Local authorities are a government agency. One of its functions is to check all applications for a new building to be built in its territory. Any application for a new building will be approved if it has fulfilled all requirements by the bylaw. The consideration to approve any building plans submitted to the local authority will only be given after the local authority has received a written recommendation from internal and external technical departments.

The application for a new building needs to be made by the developer or by the developer's representative, normally a registered architect. The number of internal technical departments depends on the size of the local authority. For example, the Kuala Lumpur Municipal Council has 12 internal technical departments, i.e., the Economic Planning and Development Department, the Town Planning Department, the Building Department, the Mechanical Engineering Department, the Architect Department, etc. Meanwhile, the Penang Municipal Council only has five internal technical departments, i.e., the Building Department, Engineering Department, Town Planning and Development Department, Licensing Department, and Urban Services Department. Among the internal technical departments, the Building Department is responsible for controlling, implementing, and enforcing the control and enforcement of all buildings in their area to ensure that all buildings are safe for occupancy.

Besides, there are several external technical departments that the local authority will have to refer to for technical comments before any building plans can be approved, including the Fire Services and Rescue Department (FRDM). FRDM is responsible for commenting on the design and specifications of escape routes, emergency exits, party walls, and/or fire doors, fire barriers, compartment floors, etc. The reference for regulatory requirements regarding the fire safety aspects in the building is The Uniform Building By-Law 1984 [1], which both departments, i.e., the Building Department and the Fire Services and Rescue Department, use for statutory satisfaction.

Apart from Uniform Building By-Laws and other regulations which apply to all buildings, another act governs private healthcare facilities to ensure the safety of patients. The Private Healthcare Facilities and Services Act 1998 Act 586 enforced in 2006, mandated the healthcare facility. Alternatively, a few international codes and guides published by a non-profit organisation such as the National Fire Protection Association (NFPA), Historic Scotland, and the Fire Protection Association are useful for reference [33].

2.5. Malaysia Old and New Public Hospital Buildings on Passive Fire Protection System with UBBL 1984 compliance

Research by Salleh et al. [3] shows the old building had the most violations of evacuation, fire containment, and safety standards. Fire extinguishment recorded the highest numbers of zones that complied with the bylaws. Fire exit/egress revealed the greatest score among average value differences between the required and obtained fire safety scores in the three exit areas. Elements that are computed in these items that contribute to the score include exit access, exit route, emergency response program, manual fire alarm and corridor partitions/walls.

A fundamental knowledge of fire containment and extinguishment is necessary to make reasonable judgements about action priorities and viable egress routes [30]. The newest construction among all the case studies had better fire safety than older buildings. Meanwhile, the total average difference between the desired and obtained results in the three areas of general safety, fire control, and exit routes in all surveyed buildings fulfilled by the newest hospital was also determined by [32].

3. Results

The results of this study indicate that newly constructed hospitals exhibit a higher level of compliance with the Uniform Building By-Laws (UBBL) 1984, as their designs inherently incorporate passive fire protection measures. Modern fire safety standards benefit these hospitals, including well-planned escape routes, fire-resistant materials, compartmentation, and adequate emergency exits. By integrating these features from the outset, new hospital buildings ensure a safer environment for patients, staff, and visitors, reducing fire hazards and improving evacuation efficiency.

Table 4: UBBL 1984 criteria or passive fire preventive system.

No.	Tittle	Reference	Criteria
1	Storey Exits	UBBL 84'-167 (1)	At least a two-storey exit located no closer than 5 meters and not exceeding the travel distance
		UBBL 84'-172 (1)	Any decorations, furnishings or other equipment shall not obscure storey exit and access to such exits
2	KELUAR Signage	UBBL 84'-172(3)	All exit sign letters are > 150 millimetres high and 18 millimetres wide. The lettering shall be in red against a black background.
		UBBL 84'-172(1)	Readily visible sign and shall not be obscured by decorations, furnishings, etc
		UBBL 84'-172(4)	Illuminated continuously during periods of occupancy
		UBBL 84'-172(2)	A sign reading "KELUAR" with an arrow indicating direction shall be placed in every location where the direction of travel to reach the nearest exit is not immediately apparent.
3	Exit Door	UBBL 84'-173(1)	Shall be openable from the inside without the use of a key or any special knowledge
		UBBL 84'-173(2)	Shall close automatically when released
		UBBL 84'-186(1)	Shall open only in the direction of exit
4.	Travel Distance	UBBL 84'-165, UBBL 84'-166(2)	Travel distance to all exits must not be more than 45m.
		UBBL 84'-188(1)	The travel distance from any point to the place of assembly to reach an exit does not exceed 45m.
		UBBL 84'-165	Compliance of the travel distance with the maximum distance calculated in accordance with the provision in the Seventh Schedule

5	Fire-fighting staircase	UBBL 84'-168 (1), UBBL 84'-229(1)	Availability of means of egress via at least 2 separate staircases.
		UBBL 84'-168(2)	Compliance of the staircase width with the width calculated per provision in the Seventh Schedule.
		UBBL 84'-197(1)	A protected lobby to serve the staircase is available.
		UBBL 84'-198(1)	Determining whether the enclosed staircase comes with ventilation at each floor or landing level by either permanent openings or openable windows to the open air with a free area of not less than $1m^2$/floor.
		UBBL 84'-201(1)	Determination of whether the enclosed staircase below ground level is equipped with suitable means to prevent the ingress of smoke.
		UBBL 84'-229(4)	Determination of whether the staircase provided has direct access to the fire-fighting lobby.
		UBBL 84'-177(1)	Computation of the number of stairs and the staircase width.
6	Place of assembly	UBBL 84'-178	Determination of whether the exit for the place of assembly is located, separated or protected to avoid any danger to the occupants of the place of assembly from fire originating in the other occupancy or smoke therefrom. Identification and classification of places of assembly. UBBL179, UBBL183
		UBBL 84'-179, UBBL 84'-183	Identification and classification of places of assembly.

Conversely, older hospitals face significant challenges in adhering to fire safety regulations due to outdated infrastructure, space constraints, and structural limitations. Many of these hospitals were built before the introduction of UBBL 1984, making it difficult to retrofit fire protection systems without major renovations. Key issues identified include narrow corridors, insufficient fire compartmentation, and a lack of designated emergency exits, all of which increase the risk of a fire. Retrofitting efforts are further hindered by financial constraints and the complexity of modifying existing structures, leading to partial or ineffective implementations of fire safety measures.

The findings suggest that while compliance is significantly better in newer hospitals, older hospitals require urgent intervention to enhance fire safety. Without strategic upgrades, these buildings remain vulnerable to fire hazards, putting occupants at risk. The study highlights the need for phased retrofitting plans, regular fire audits, and continuous safety training to improve compliance and mitigate risks in older healthcare facilities. These measures would ensure that all hospitals maintain a high fire safety standard regardless of age, ultimately safeguarding lives and reducing potential fire-related damages.

4. Conclusions

In conclusion, the review demonstrates that new hospitals are better equipped to meet fire safety regulations by integrating passive fire protection features such as fire-resistant materials, fire compartmentation, and designated escape routes into their original designs. These hospitals benefit from modern construction practices, ensuring higher compliance with fire safety standards and reducing the risks associated with fire incidents.

On the other hand, older hospital buildings face considerable challenges in meeting UBBL 1984 requirements due to outdated designs, space constraints, and structural limitations. Many buildings were constructed before fire safety regulations were fully established, making retrofitting complex and costly. Key issues include insufficient escape routes, inadequate fire compartmentation, and a lack of fire-resistant materials, all compromising fire containment and evacuation efficiency. The inability to fully comply with modern fire safety regulations poses risks to patients, staff, and visitors, particularly in emergencies.

To address these challenges, proactive measures must be taken to improve fire safety compliance in older hospitals. The study suggests that phased retrofitting, regular fire safety audits, and enhanced fire safety training are essential strategies to bridge the gap between older and newer hospitals. By implementing these improvements, hospital administrators, fire safety professionals, and policymakers can work together to enhance fire safety standards, ensuring that all hospital buildings—regardless of their age—provide a safe and secure environment for their occupants.

Declaration of Conflict of Interest

The authors declared no conflict of interest with any other party on the publication of the current work.

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