Challenges that Hospital Facilities Managers Face in Ensuring Patients' Safety

Ir. Al-Khairi Mohd Daud

There have been many occurrences of fires in hospitals. Many were minor incidences which were spotted and controlled easily. However, a few major fires have hit the national headlines.

In a major incident, 6 patients died when fire broke out in the Intensive Care Unit in Hospital Sultanah Aminah (HSA) on 25 October, 2016. One staff nurse was injured when she jumped out the window to escape the engulfing smoke.

Listed here are some fire incidents in local hospitals:

DATE	INCIDENT
30 July, 2011	At 12.30 a.m., a patient started a fire with a cigarette lighter in the Mental Patients Isolation Room at the Hospital KL Emergency Department. The fire spread rapidly, generating thick smoke. Only one casualty reported.
8 September, 2012	74 patients at Port Dickson Hospital were evacuated after a small explosion at the main electrical switch board led to electrical outages. Surgery was brought to a standstill.
15 February, 2014	A new building block at Sarawak General Hospital caught fire because of a welding spark from a nearby construction site. No damage was reported. However, an Indonesian construction worker was found dead on the scene with burnt marks and 151 patients from 6 wards were evacuated.
15 August, 2016	A small fire occurred in a storeroom of Sri Kota Hospital in Klang. There were no casualties and none of the patients had to be evacuated.

As for the fire at Hospital Sultanah Aminah, although the government had promised to conduct a thorough investigation, some questions remained unanswered.

- Are our hospital facilities safe?
- Have healthcare industries taken serious actions to prevent fire fatalities?
- What are the lessons learnt from the incidents?
- How can Hospital Facilities Managers avoid incidents such as fires from happening?

Fire broke out at the ICU room of Hospital Sultanah Aminah on 25 October 2016

INFRASTRUCTURE SAFETY AND INTEGRITY

Unlike other buildings, hospitals require a higher level of safety standards because of the poor health conditions of patients and their limited mobility in cases of evacuation.

Apart from Uniform Building By-Laws etc., which apply to all buildings, there is an additional act that governs private healthcare facilities and which ensures the safety of patients. The Private Healthcare Facilities and Services Act 1998 Act 586, which was enforced in 2006, mandated that healthcare facilities be designed and operated to ensure patient safety. In addition, the Medical Device Act was enacted in 2012 to govern medical device design, supply, installation, operation and maintenance activities.

The Ministry of Health is responsible for ensuring that private healthcare institutions built after 2006, comply with the Private Healthcare Facilities and Services (Private Medical Clinic or Private Dental Clinic) Regulations 2006. In the regulation, there is a clear reference that private health care facilities are required to have regular building inspections by the Fire Department and to show the Fire Certificate when renewing their operating licences.

Many government hospitals built after 2006 were also designed and constructed to meet the standard

requirements. The problem lies in older government hospitals which were not constructed according to the regulation and standard. Many cannot comply, especially on architectural and structural designs.

According to records from the Ministry of Health, 46 hospital buildings are more than 50 years old. For instance, the main building of Hospital Sultanah Aminah, where the fire occurred, was commissioned in 1941 and was based on Nanking Central Hospital, a pre-World War II design hospital. To make things worse, many of these hospitals have seen significant changes in the clinical layout, due to changes in functionality. They are now operating with facilities which are not the intent of the original designs.

After the HSA incident, the Ministry conducted a fire safety audit in these hospitals and identified several fire risks, such as ageing fire prevention systems, dilapidated electrical wiring and installation systems and the installation of medical gas systems which were not according to required standards. There was also the need to upgrade engineering systems.

But with the present budget constrain, how quickly can the authorities fix these issues in these government hospitals? Meanwhile, under these conditions, how do Facilities Managers make hospitals safe and ensure they meet the latest safety standard requirements?

STANDARD FOR HOSPITAL ENVIRONMENTAL AND SAFETY SERVICES

The Malaysian Society for Quality in Health (MSQH) 5th Edition: 2017 clearly defines the requirements for Environmental & Safety Services as the Standard 2 (Figure below).

MSQH Standard 2 requirements

Facilities Managers of hospitals need to ensure the risk for patients is minimised. He/she needs to ensure proper management of fire safety, disaster management and hazardous material management. He/she is responsible to ensure hospital facilities are safe from hazards and that the fire-fighting system is functional at all time.

Hospital facilities vary from highly complex infrastructures for general hospitals to simpler designs for district hospitals and psychiatric hospitals. It is important that the Facilities Manager identifies the risks and hazards of fires according to the design of the hospital and the systems installed. He/she has to ensure that the hospital employees are well trained in fire safety and the evacuation process as well as organise an annual fire fighting inspection programme. There must also be a trained emergency response support team as part of the disaster management.

1. Fire Chemistry

Fires can only start when the fire triangle components (fuel, oxygen and heat) are available in the right composition. To manage fire incidents, a Facilities Manager must ensure the fire triangle is never complete or, if a fire breaks out, that this is arrested at the earliest possible time.

a) Fuel: There are many flammable items in wards such as alcohol rubs, drapes, linen, boxes and documents. A high volume of combustible and flammable materials are also stored in areas such as laboratories and the pharmacy. Storage such as bulk LPG cylinders for use in the kitchen should not be located near the oxygen VIE tank or the car park area.

It is worthy to note that to minimise the fire risk, many hospitals have implemented proper storage and good housekeeping, using the 5S concept.

b) Oxygen: Hospitals use oxygen and medical air, either piped in from gas plant rooms or from cylinders placed next to the patients' beds. Leaking oxygen terminal heads and regulator valves are seldom detected. This is very dangerous, especially in an enclosed room such as the isolation unit.

Few hospitals have a medical gas leak detection survey programme. In most cases, the Facilities Department is notified when the ward staff nurse complains after the local alarm panel is sounded, which occurs only if there is a major leak.

The Facilities Manager is responsible for ensuring that the Medical Gas Piping System (MGPS) Authorised Person regularly trains nurses on how to close the valve during a potential fire emergency. The area valves service unit (AVSU) should be located in an easily accessible area, preferably close to the nurse station or at the entrance to the department/room. The AVSU should not be blocked by emergency trolleys or other items at all times.

c) Heat: A heat source can be man-made or from equipment. Examples of man-created heat source are:

- Patients/visitors smoking and using lighters.
- A contractor installing piping in the ward.

- Cooking done at a proper designated place.
- Charging hand-phones at the clinic power socket.

These activities need to be controlled either by permit to work system and continuous surveillance by the Safety & Health Officer. Under Act 281, Food Act 1983, hospitals are gazetted as non-smoking areas.

A more common heat source is the electrical system such as:

- Short circuit due to old or damaged wiring.
- Overuse of extension cords. These should not be used in critical areas such as operation theatres and critical care units.
- Electrical installation that do not comply with electrical safety standards.
    - Domestic appliances to be checked for certification.
    - Overloading relay protection being tampered with.
    - Inadequate power supply to facilities, causing an overload in the main switchboard breakers.
    - Electrical single line drawings not endorsed by Professional Electrical Engineer or when the actual installation differs from the drawings.
- Poor maintenance and replacement programmes.
    - Air conditioning systems are not serviced regularly.
    - Use of uninspected biomedical equipment.
- Poor equipment design and installation. For example, wiring and medical gas piping has to be physically separated by metal compartments for pendants and bed heads.
- Electrical rooms are not locked and flammable/ combustible materials are stored inside the room.
- Rodent infestations.

The Facilities Manager needs to establish proper inspections by competent personnel as well as have a good maintenance programme and a policy for equipment purchased and obsolescence.

2. *Fire-fighting System*

In the event of fire, a fire-fighting system acts as a protection system. The Facilities Manager must ensure that all active and passive systems are well designed, installed and maintained in good working condition. Older hospitals have a serious issue where the fire-fighting system has not been upgraded to current requirements or the equipment installed, such as panels, is obsolete.

Hospitals may comprise different blocks of buildings and the various fire-fighting systems are sometimes not connected to a main central alarm. Or the panels are faulty and the maintenance costly. When budget is limited, the fire-fighting systems are not monitored from a main central control room.

Because of their architectural layout, old hospitals may not be able to comply with current passive fire protection standards such as emergency staircases, fire and smoke compartments, fire barriers and protected areas. Even when a fire-fighting system is provided, we often find fire doors kept open with chokes or faulty magnetic holders, penetration by cables conduits and air-conditioner ducting on fire walls without fire barriers or fire dampers. This is evident when a hospital has gone through many retrofitting over the years and, most of the time, the fire-fighting system requirement is overlooked.

The author also wishes to highlight the challenges between clinical and fire safety requirements. For example, according to the Private Healthcare Facilities & Services Act, patients' toilet doors should open outwards. The Fire Services Act requires that doors should not open to the corridor. So it is a challenge when the patients' toilet is located next to the main corridor.

Another case to highlight is that the door to a patient's room should not be a fire-rated door as the patient will not be able to open it in case of fire. Our regulations do not mandate dedicated escape windows especially in high rise hospitals to allow the Fire Department to assist in evacuating patients and the congested building design of some hospitals means fire trucks cannot get close to the building for the sky lift to reach the upper level windows.

3. *Ventilation System*

In the HSA fire incident, all the patients died from smoke inhalation and not because of the fire itself. Older hospitals generally use natural ventilation in the wards. Today, most wards, except for class 3 wards in government hospitals, are equipped with an air-conditioning system. For high rise hospitals, the windows are kept locked or can only open minimally to prevent patients committing suicide. So, when fire breaks out, the smoke will quickly engulf the room and spread rapidly to the floor via the return ducting.

Hospital Air Handling Units (AHUs) should be equipped with fresh air supply to maintain the air change requirements. The air should be returned in a duct system. AHUs should be cut off when the fire alarm is triggered. Often, the interlocking logic is not installed and even when it is, it is not tested to avoid interrupting the patients' comfort.

For newer design hospitals, there are pressurised corridors to minimise smoke ingress. However, the pressurised fan can be a hazard especially if the air extraction is from polluted areas such as the road and brought into rooms for critically-ill patients. The author noted this when investigating the deaths of five critically-ill infants in a neo-natal ICU which were directly contributed by dirty air due the smoke spill fan running under faulty conditions.

It is thus important that a Facilities Manager understands the hospital ACMV system and its functionality during emergencies.

ORGANISATION MANAGEMENT

The Facilities Manager must be fully conversant with the fire risks in a hospital. It is not enough that the fire-fighting system undergoes a normal maintenance inspection. There must be an annual plan which includes testing of the system to ensure everything is fully functional.

The Facilities Manager has to establish and test procedures for evacuating critically-ill patients, the disabled, children and elderly patients. All staff members must be

trained to use the fire-fighting and rescue equipment. It is important that the staff orientation programme includes basic fire-fighting skills and evacuation methods.

There is a need for regular disaster drills which involve departmental and total evacuation, including table top exercises that cover various incidents so that the staff members will know how to respond in an incident.

The Facilities Manager should be the field driver of disaster management as he/she is the person who knows the design and operation of hospital systems. He/she needs to coordinate the cutting off of the medical system, air conditioning system and electrical supply to the affected area. He/she is also responsible for activating the back-up system and for getting the supply back to non-affected areas.

One area that is greatly lacking is the sharing of lessons learnt from incidents. Investigation findings are not publicised among Facilities Managers to prevent similar errors from being repeated. There are limited circulars on improving the system and making them the standard. In some cases, the root causes of the incidents are not even revealed due to confidentiality and to avoid potential legal proceedings.

MANAGEMENT OF CHANGE

Most changes in hospital facilities are due to clinical requirements. The clinician will look at short-term requirements and request the Facilities Manager to make the modifications. Where changes to the layout and functionality are concerned, attention is usually given to architectural layout instead of mechanical and electrical system requirements. When consultants are engaged, they confine their scope to the retrofit area without looking at the overall hospital design. A few fires have occurred due to the electrical system when the main supply system could not cope with the added load requirements.

Often, hospital design documents are not made available for reference or are not accurate as minor changes have not been incorporated. Many major retrofitting of government hospitals are planned and executed by the Ministry of Health's Engineering Department at its headquarters. There had been cases where the Hospital Engineers and Facilities Managers were not consulted until the project was handed over. Because of this, costly mistakes at the construction stage could not be avoided.

COMPETENCY

Facilities Managers of hospitals require additional competencies to handle the complexities involved. They and healthcare engineers should not be restricted to their own disciplines but should be trained in the hospital operations too.

It is commendable that the Ministry of Health has taken steps to ensure that Facilities Managers are trained and qualified to manage government hospital facilities. The Medical Device Authority has also taken similar steps to start registering competent persons to operate and maintain medical devices, including piping systems for medical gases.

Facility and Biomedical Equipment Management

Facility Management	Building Management	Mechanical System	Electrical System	Performance Management
• Biomedical Management • Facility Management	• Building Requirement • External Management	• Air Condition and Mechanical Ventilation System • Vertical Transportation System • Medical Gases System	• General Requirement • Critical Areas	• Energy Management • Indoor Air Quality

Most Facilities Managers are also engineers. When a Facilities Manager is from another discipline, he must ensure he is supported by competent engineers who understand the electrical, ACMV, vertical transport and fire-fighting systems so that they can act in an emergency. Below are the areas that a Facilities Manager needs to understand for effective management.

It is equally important that Facilities Managers in private organisations also undergo similar training.

CONCLUSION

Facilities Managers not only keep the hospital equipment and system functioning but more importantly, they also keep patients safe and comfortable. With hazards posed by equipment, ageing systems, patients and staff members, a Facilities Manager must be equipped with the knowledge and skills to manage a hospital effectively. He/she should not be regarded as just a maintenance person but rather as the person who ensures the building is fit for occupancy and for patient healing. ■

Author's Biodata

Ir. Al-Khairi Mohd Daud *is a Chief Consultant in Faqeh Management. He currently serves as a committee member in Building Services Technical Division and Oil, Gas and Mining Technical Division.*