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FIRE SAFETY IN HEALTHCARE FACILITIES: RISK ASSESSMENT AND MITIGATION

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Executive **Summary**

Fire safety in healthcare facilities is a critical component of patient and staff safety, given the complex infrastructure, continuous operations, and vulnerable patient populations typical of these environments. An interactive session, led by Dr. Özlem Yildirim, focused on identifying high-risk areas, analyzing potential hazards, and exploring comprehensive mitigation strategies through group discussions and scenario-based learning.

Participants examined critical zones such as electrical and mechanical rooms, kitchens, patient wards, and areas containing medical gases, each posing distinct fire hazards. Discussions highlighted the interplay between engineering controls, human factors, and organizational preparedness in determining overall fire safety resilience.

The session underscored that preventing fire incidents requires a multidisciplinary and proactive approach, integrating structural design improvements, procedural safeguards, and staff competence. By fostering a culture of safety and ensuring that risk mitigation measures are embedded in everyday operations, healthcare organizations can significantly reduce the likelihood and impact of fire-related emergencies.



1. INTRODUCTION

Fire safety is a fundamental but often underestimated component of hospital safety systems.

Unlike most public buildings, healthcare facilities present unique vulnerabilities: immobile or critically ill patients, reliance on life-support equipment, the use of flammable medical gases, and the need for continuous 24/7 operations. These factors make rapid evacuation challenging and increase the potential consequences of even small fire incidents (World Health Organization [WHO], 2015).

Globally, hospital fires have resulted in devastating loss of life and property. For example, the AMRI Hospital fire in Kolkata, India (2011) claimed 90 lives, largely due to inadequate evacuation planning and blocked exits (National Disaster Management Authority [NDMA], 2016).

Similar incidents in other countries have revealed common systemic gaps, ranging from design flaws and poor maintenance of fire protection systems to insufficient staff training (NFPA, 2021).

In response, international standards bodies such as the Joint Commission International (JCI) and the National Fire Protection Association (NFPA) emphasize the integration of fire safety into hospital governance and daily operations. Regular hazard identification, fire risk assessments, preventive maintenance, and comprehensive staff education are core expectations (JCI, 2022; NFPA 101, 2021).



2. PROBLEM STATEMENT

Healthcare environments are inherently vulnerable to fire incidents due to their complex infrastructure and the presence of high-risk zones such as kitchens, basements, electrical rooms, and areas with medical gases.

The problem is compounded by design flaws, aging equipment, inadequate maintenance, and the storage of combustible materials in inappropriate spaces.

Equally significant are human factors. Staff may lack adequate fire safety training or familiarity with evacuation protocols. Mock drills, when conducted, are often infrequent or of insufficient quality to build true readiness. This creates dangerous gaps between theoretical procedures and actual response capability during emergencies.

These vulnerabilities are not isolated; they are systemic and interrelated. A lapse in preventive maintenance can trigger an electrical fire, which may then be exacerbated by delayed human response or poorly planned evacuation routes. Without a comprehensive and proactive risk assessment approach—integrating engineering, administrative, and human factors—healthcare facilities remain exposed to catastrophic events that could otherwise be prevented.



3. ANALYSIS OF SYSTEMIC FAILURES AND OPPORTUNITIES

Effective fire safety in healthcare settings requires a nuanced understanding of both environmental vulnerabilities and human behavior.

3.1 High-Risk Zones

Hospitals contain multiple areas with inherently higher fire risk. These include basements and service areas, which often house electrical panels, HVAC systems, and fuel storage; kitchens, where open flames and grease accumulation are common; electrical and mechanical rooms, where short circuits or equipment failures can ignite fires; and wards or operating areas that rely on medical gases, which can accelerate fire spread if leaks occur (NFPA, 2021). The interconnectivity of hospital spaces through ducts and corridors means that fires in these zones can spread rapidly, compromising patient evacuation routes.

3.2 Technical and Design Vulnerabilities

Design flaws and inadequate infrastructure significantly heighten fire risk. Obstructed exits, insufficient compartmentalization, lack of automatic sprinkler systems, and outdated electrical systems are frequent issues, particularly in older facilities (NDMA, 2016). In many hospitals, combustible materials are stored inappropriately near ignition sources, and fire detection systems may be poorly maintained. Such lapses create a latent hazard environment where a minor incident can escalate quickly.

3.3 Human Factors and Organizational Preparedness

Human factors remain among the most critical contributors to hospital fire incidents. Inadequate staff training, low awareness of evacuation procedures, and insufficient quality or frequency of mock drills undermine response effectiveness (WHO, 2015). Staff turnover further compounds this, leaving many employees unfamiliar with safety systems. In several documented incidents, fires that could have been contained early resulted in mass casualties because staff did not know how to activate fire suppression systems or execute timely evacuations (JCI, 2022).



4. PROPOSED SOLUTIONS & BEST PRACTICES

Addressing fire safety in healthcare facilities requires a multi-pronged strategy that integrates engineering controls, administrative safeguards, and human factors.

4.1 Engineering Controls

- Install and maintain automatic fire suppression systems, such as sprinklers and gas-based extinguishers, especially in high-risk zones.
- Ensure clear, well-designed evacuation routes, compartmentalization, and fire-rated doors to prevent smoke and flame spread.
- Upgrade electrical infrastructure, including proper circuit protection and surge control, to minimize the risk of short circuits.
- Integrate early warning systems linked to centralized alarm panels for rapid response.

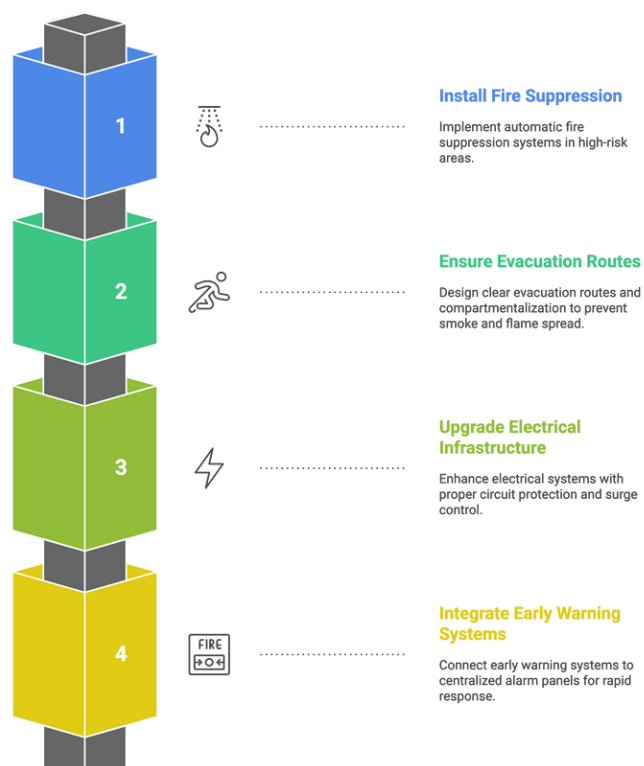
4.2 Administrative and Procedural Safeguards

- Conduct periodic multidisciplinary fire risk assessments.
- Establish protocols for safe storage of combustible and hazardous materials.
- Implement preventive maintenance programs for all fire protection equipment.
- Develop evacuation plans tailored to different patient populations.
- Incorporate tabletop exercises and scenario-based drills regularly.

4.3 Human Factors and Culture of Safety

- Provide comprehensive, role-specific fire safety training for all staff.
- Conduct regular, high-quality mock drills that reflect realistic scenarios.
- Promote a safety culture where staff are empowered to act during incidents.
- Include fire safety in orientation programs for all new employees and contractors.

Enhancing Fire Safety Measures



5. CONCLUSION

Fire safety in healthcare facilities is not simply a compliance requirement; it is a critical patient safety priority. Hospitals house some of the most vulnerable populations and operate in complex environments where the margin for error is minimal. As this session underscored, effective fire prevention and response demand a layered approach that integrates engineering controls, procedural safeguards, and human factors.

Technical measures such as compartmentalization, alarm systems, and suppression infrastructure form the essential first line of defense. However, without robust administrative protocols and well-trained, empowered staff, these systems cannot perform optimally. Human error, inadequate training, and poor preparedness have been recurring themes in many fire disasters across the globe.

Sustained safety requires continuous risk assessment, regular maintenance, scenario-based drills, and a deeply ingrained culture of safety at all organizational levels. By proactively addressing vulnerabilities and embedding fire safety into daily operations, healthcare institutions can significantly reduce the risk and impact of fire events, safeguarding both lives and infrastructure.



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