Hospital Fire Outbreaks Before and During the COVID -19 Pandemic in Low- and Middle-Income Settings

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Funding: None received.

Abstract

Objective

To identify and synthesise existing published and grey literature reporting on hospital fire outbreaks before and during the pandemic.

Methods

A two-phased narrative review approach was employed. The search covered peer-reviewed, grey literature sources, and news outlets. The pre-COVID hospital fire outbreak search period was from January 2000-December 2019 while that for during COVID was from December 2019- July 2021 (repeated in December 2021).

Results

Thirteen and 24 media reports were identified for the pre-COVID and during COVID periods respectively. Although varied fire risks existed before the emergence of the COVID-19, this paper demonstrates that the incidence of hospital fires has increased more than two-folds in recent times in COVID-19 wards and intensive care units causing death, injuries, and extensive damage to property. The main risk in the pre-COVID era was identified as electrical faults. During the pandemic, other issues such as oxygen explosions, inefficient cooling systems, and lack of fire control measures in makeshift COVID centres were identified as additional risks/ causes of the hospital fire outbreaks.

Conclusions

Additional risks have emerged during the COVID-19 era which increased the occurrence of hospital fire outbreaks. Guidelines, protocols, and policies regarding the prevention of hospital fire outbreaks and strategies for attenuating its effects need to be highlighted across settings and adhered to. Existing policies need to evolve to help resolve these risks. Beyond the preventive strategies, context-specific psychosocial support is also required for healthcare staff, families, and patients who survive episodes of hospital fire outbreaks.

Keywords: COVID-19; Hospital; Fire outbreaks; LMICs

1.0 Introduction

The coronavirus disease 2019 (COVID-19) was declared a global pandemic on 11th March 2020 by the World Health Organization (WHO), following the first identification of the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in the Chinese city of Wuhan in December 2019 [1]. Across the globe, COVID-19 has led to the hospitalization of several millions with many others succumbing to death. Further to the varying incidence of COVID-19 is another emerging worrying trend of hospital fire outbreaks, particularly in COVID-19 wards and intensive care units (ICUs) which has caused deaths and injuries to several people as well as an urgent need to evacuate seriously ill patients. More worrying is the fact that, the most devastating outbreaks have so far occurred in low-and-middle-income settings (LMICs) which may have significant ramifications for their health systems.

Fire outbreaks remain a significant issue globally which can impact adversely on economies, societies, and geographies with enormous costs to businesses, people, and the environment. Hospital buildings make up a part of the built infrastructure which are constructed to last for several years to offer residence and functional operations to people requiring healthcare [2]. Hospitals are considered safe places where injuries are treated rather than generated. Healthcare facilities therefore need to adhere to existing safety measures as several biological, chemical, physical, and fire hazards may exist [3].

The Hospital Fire Prevention and Evacuation Guide developed by the Pan American Health Organization (PAHO) and the World Health Organization (WHO) emphasise the prevention and suppression techniques as key strategies to avoiding fires and minimizing their effects respectively, with evacuation training and preparedness to evacuate if need be, to avoid or minimize loss of life [4]. Preventive actions reported in one study from India include monitoring and preventing oxygen leakages, maintaining oxygen control rooms outside the hospital buildings, installing fire alarms and sprinklers, a uniform approach to color coding of pipelines, scheduled maintenance of electrical gadgets, and ensuring proper layout of electrical wirings [5]. In addition to these recommendations, country-specific policies also exist to provide strategies to prevent hospital fires or minimise their

effects. For instance, in India, the minimum requirements for a reasonable degree of safety from fire emergencies in hospitals focus on the design and construction of hospitals with items that minimize the possibility of fires, provision of detection, alarm, fire extinguishment, fire prevention, planning and training programs for isolation of fire; and transfer of occupants to a place of comparative safety [6].

Although policies and guidelines may exist, implementation and compliance remain significant challenges in LMICs [7]. In Nigeria for instance, enforcing fire safety measures in healthcare facilities has been reported to be inadequate with poor compliance to precautions as electrical faults, faulty installations, and other combustible materials top the list of the causes of hospital fire outbreaks [2]. Additionally, fire emergency safety preparedness in Nigerian healthcare facilities have been reported to be low and fire prevention strategies in these hospitals are not usually considered a priority [8]. Most public healthcare facilities are old and often in poor states with poor maintenance culture [9, 10]. The existence of outdated fire safety technology and blocking fire safety systems have also been reported as key issues faced by Malaysian public hospitals which increase the risks of fires [11-13]. In a previous study, significant knowledge regarding fire safety was been reported among Indian healthcare workers, yet, the authors argue for a need for continuous training at regular intervals [14]. Across the African continent, a general lack of fire safety engineering and weak institutional support has been reported as key issues mitigating the fight against fire outbreaks [7].

The situation can be dire as these fire outbreaks cause damage to properties requiring urgent evacuation to other facilities, increasing pressure on limited resources, pressure on healthcare staff, and psychosocial distress for patients and family members. People who survive the injury will also require ongoing clinical care and may have to live with the complex aftermath of surviving burns, including varied biopsychosocial issues [15]. This may be challenging considering the hypermetabolic and hyperdynamic processes associated with burns which can add on to the ongoing physiological alterations associated with COVID-19. Taken together, the phenomenon may represent moving from a difficult circumstance of managing severe COVID-19 to perhaps, a worse situation

creating significant public health issues (burn injuries, mental health issues, evacuation amidst the pandemic etc.). Beyond the hospitals, fire outbreaks remain a major issue in LMICs. However, a general lack of robust and consistent reporting makes it difficult to estimate their incidence and impact [7, 16, 17]. As reported, more than 90% of burn injuries from fires occur in LMICs which is suggestive of a high burden of fires [18]. In addition to the hospital fires, these fires can occur in the homes, informal settlements, and markets.

Electrical problems resulting from faulty wirings, power fluctuations, and misuse of electrical gadgets remain the major causes of fire outbreaks [19]. Other causes include kerosene stoves, leakage from gas cylinders, candles, lanterns, mosquito coils, cigarettes, defective generators, bush fires, and illegal tapping from the national grids [19]. A recent wildfire in Algeria which killed 90 people has been attributed to arson with 22 suspected people arrested [20]. Fire outbreaks and their risks, therefore, remain significant issues across LMICs which may have been accentuated in recent times as the countries continue to navigate through the COVID-19 pandemic. Despite this critical public health concern, there is no review examining the occurrence of hospital fire outbreaks across LMICs. Information in this regard can be helpful in identifying key issues to inform the development of preventive strategies and comprehensive approaches to managing future outbreaks. Thus, this review aimed to ascertain the occurrence of hospital fire outbreaks prior to and during the COVID-19 outbreak in LMICs and formulate recommendations to managing and preventing future occurrences.

2.0 Methods

Considering the nature of the phenomenon under investigation (that is, examining hospital fire outbreaks pre and during COVID periods), a narrative literature review approach was employed. Narrative reviews focus on providing a broad perspective on a phenomenon, often with no predetermined research question [21]. This broad perspective is congruent with the goal of this review.

2.1 Literature sources and strategies

A two-phased search approach was utilized in this study. To provide an overview of hospital fire outbreaks prior to and during COVID-19 in LMICs, an evidence search was systematically undertaken in peer-reviewed databases (CINAHL, PubMed, EMBASE, Medline, and Web of Science), grey literature sources (MedNar, Trove, Grey Literature Report, and OpenGrey), and news outlets (Cable News Network, British Broadcasting Corporation, allAfrica, Reuters, and Aljazeera). All data sources in the first phase of the review were searched from January 2000 to December 2019 to obtain a pre-COVID picture of hospital fire outbreaks. The systematic evidence strategy employed earlier was repeated to ascertain hospital fire outbreaks following the advent of COVID-19 as phase two of the review. The same search terms and data sources were utilised. However, the search period extended from December 2019 to July 2021 and repeated in December 2021.

2.2 Search strategy

The comprehensive search for the first phase was conducted using the following search terms: 'fire' OR 'fires' OR 'flame' OR 'flames' OR 'ablaze' OR 'combustion' AND 'hospitals' OR 'health care facilities' OR 'healthcare facilities' OR 'health services' OR 'health service' AND 'outbreak' AND 'developing countries' OR 'developing nations' OR 'third world' OR 'low income countries' OR 'middle income countries' OR 'LMIC' OR 'LMICs' OR 'resource limited settings'. In the second phase, the same search terms were applied in addition to 'covid-19' OR 'coronavirus' OR '2019-ncov' OR 'SARS cov-2' OR 'cov-19'.

2.3 Study selection

All identified references were exported to EndNote X9.2 to remove duplicates. Only studies or reports in English were considered for inclusion. The 2021 Organization for Economic Co-operation and Development (OECD) list of LMICs guided the selection of applicable studies or reports [22].

3.0 Results

3.1 Pre-COVID hospital fire outbreaks

The extensive search regarding the pre-COVID hospital fire outbreak yielded one policy document [4], one peer-reviewed study [23], and five media reports [24-28]. Overall, the results affirm the existence of hospital fire outbreaks in the pre-COVID period with causes including electrical faults and explosions representing poor adherence to safety regulations. Varying number of persons were injured with others succumbing to death. Potentially, there may be more instances of fire outbreaks, however, issues such as under-reporting may have led to few reports in public domain.

Table 1: Pre-COVID hospital fire outbreaks

3.2 Hospital fire outbreaks during COVID-19 era

Table 2 below provides a summary of the trend of hospital fire outbreaks which emerged from one peer-reviewed study [23] and fifteen media reports [29-31]. From June 2020 to December 2021, the results of the systematic search highlighted that fire outbreak in COVID-19 wards and ICUs have occurred in various LMICs. Comparatively, the results highlight that the incidence of fire outbreaks in the COVID-19 era have increased approximately a two-fold compared to the last ten years [23]. In Baghdad's Ibn al-Khatib Hospital alone, 82 people died from the fire with burn injuries to 110 people [32]. India has so far recorded several episodes of hospital fire outbreaks as the country further grapples with global records of the COVID-19 pandemic [33, 34]. Electrical faults, oxygen explosions, inefficient cooling systems, and lack of fire control measures in makeshift COVID centres emerged as key issues related to the occurrence of hospital fires.

Table 2: Hospital fire outbreaks during COVID-19 era

4.0 Discussion

This study sought to examine the incidence of hospital fire outbreaks before and during the pandemic. Overall, the findings suggest an increased rate of hospital fire

outbreaks following the pandemic which warrants the enforcement of existing policies and safety measures.

4.1 Reported causes and mechanisms

As shown in *Table 2*, oxygen tank explosion and electrical fault remain the significant (or probable) causes or risks of the hospital fires which suggests that an additional risk factor during the COVID-19 era considering that electrical fault was the main risk in the pre-COVID era. Clearly, the physiological alterations associated with COVID-19 such as respiratory compromise has created a high dependence on supplemental oxygen as a key part of the clinical management strategies which can extend to the post-discharge period [35]. Even in low-resource settings where there were huge "oxygen gaps", great efforts and supports were offered to improve in-hospital oxygen systems during the COVID-19 pandemic. However, whilst supplemental oxygen therapy may be a 'good servant' to support the respiratory efforts of affected people, it may be a 'bad servant' by creating a rich atmosphere that facilitates combustion.

Exhaled air contains approximately 16% oxygen. However, the utilisation of 100% oxygen for people with compromised respiratory status as in the case of people with moderate to severe COVID-19 may increase the oxygen concentration in exhaled air. In fact, a concentration >23.5% in the atmosphere poses increased risk of flammability [36]. Thus, with an increasing number of people on oxygen therapy, an usual negligible risk becomes a substantial one increasing the odds for fire outbreaks [23, 36]. The Hospital Safety Index Guide formulated by the WHO recommends that oxygen supply banks should be located outside the hospital building and each oxygen outlet should have a valve which are constantly evaluated [37]. Additionally, valves in cylinder banks, outage valves and intake points should have flexible couplings with appropriate color-coding and labeling of pipes and supported at a distance from electrical panels or wirings [37]. The requirement of proper check and maintenance may be lacking in various LMICs leading to leakages and increasing the oxygen concentration in the unit [23]. In fact, compliance to and enforcing these standards may be low as reported by two Nigerian studies [8, 9]. Fire safety preparedness may also be lacking. For instance, it was reported that the Iraqi hospital

where 92 people died lacked fire alarms or sprinkler systems [38]. Although the outbreaks so far have been reported in the clinical setting, existing literature suggest that some people recovering from COVID-19 may require long-term supplemental oxygen usage after discharge [39, 40], indicating a potential fire risk in the home and this warrants further attention such as ensuring that they understand the correct usage of the oxygen gadgets and adhere to fire prevention measures at home.

Further to the above, other instances of fire outbreaks have been associated with electrical malfunctioning and yet in others, the causes are still being investigated. Electrical faults have remained a significant cause of hospital fires even before the advent of COVID-19. These faults can emerge from gadgets such as ventilators [5], short circuits and air conditioning systems [5, 23], or factors such as poor insulation of wires and spark generating sockets [36]. Although healthcare staff may have knowledge regarding fire safety and operating medical equipment, they may not be sufficiently aware of faults or maintenance as they race to save lives. The need for urgent care in COVID-19 wards and ICUs may lead to overlooking electrical risks even when present. Besides, healthcare systems are already stretched with the increasing number of people with COVID-19, and this has contributed to the construction of makeshift structures to cater for the patients which may be associated with various risks [41, 42]. Irrespective of the cause, the hospital fire outbreak situation highlights a need for more attention towards accident prevention, early detection, emergency preparedness, and ensuring the availability of psychosocial support for staff, patients, and family members particularly as the pandemic is persisting.

4.2 Prevention and Control Strategies

The strategies for preventing the occurrence of fire outbreaks in clinical or home settings are important starting points and hospitals need to ensure that national regulations are adhered to. Wood and colleagues recommend the following as key strategies to prevention and minimizing the effects of outbreaks: creating awareness, active risk monitoring and management, assessment of electrical loading, inspection and maintenance, oxygen leakage detection, improving room ventilation, maintaining oxygen pipeline supply systems, proper handling of oxygen cylinders and storage, change

management as hospitals continue to navigate through the pandemic, open communication, and emergency preparedness [23].

In fact, it is essential to recognize the COVID-19 wards and ICUs as high-risk places and undertake ongoing risk assessments [23]. Although there is no data regarding arson in LMIC hospitals, it has been implicated in a previous fire in Burnaby which killed five people in December 2020 [43]. Thus, the possibility of arson should also be considered in risk assessment. Aside oxygen, a fire needs heat and fuel without which it will not start or spread. Thus, these three components need to be monitored closely in the COVID-19 wards and ICUs [23, 36]. The air conditioning systems and other electrical gadgets used in the wards and ICUs require ongoing maintenance and repairs by competent staff [23, 36]. Overloading of electrical sockets should be avoided and availability of effective cooling mechanisms of frequently used gadgets such as ventilators should be ensured [23]. Hospitals need to maintain proper pest control to avoid rodent damage to the wiring systems and equipment. Healthcare staff should be trained to be knowledgeable and adhere to precautions or regulations regarding the safe use of electrical equipment even in emergency situations [23]. Room oxygen monitors should be used where applicable, particularly in places where gas leakage remains an issue [36]. Fire alarms and smoke detectors should be installed in these areas to facilitate early detection of fire [23].

Further to the above, healthcare settings should have a clear evacuation/ emergency preparedness plan congruent with national regulations and known to all staff through drills and in-service training [4]. Emergency evacuation plans should also include strategies to adhere to COVID-19 precautions during transfer and movement of injured people to the relevant areas. A liaison plan with the necessary emergency services should also be adopted for implementation as soon as possible [4]. The lessons learned from previous episodes of outbreaks should be used as the basis for improvement and avoiding further occurrences [23]. Concerns regarding safety should be handled with utmost priority and staff should be encouraged to speak up about safety concerns. Reporting mechanisms and structures should be in place to facilitate easy relay of information regarding safety risks in healthcare facilities.

Beyond the preventive and early detection strategies, healthcare settings need to develop and implement psychosocial support programmes for staff, people who survive the injuries and family members. Fire outbreaks are sudden, and the resulting injuries and deaths are unexpected. The pandemic has predisposed people to psychological issues. Adding this to an episode of fire outbreak which is often chaotic, and traumatizing can worsen mental health issues among staff, patients, and families. Therefore, mental health first aid strategies should be inculcated into post-evacuation plans as further professional health support is sought for. Bereavement and post-bereavement support should be available to family members as they are particularly at risk of complicated grief considering the sudden loss in a place where injuries are expected to be treated. The WHO mental health guidelines for acute stress, post-traumatic stress disorder (PTSD) and bereavement may be useful in this regard. However, as highlighted in a recent study, implementing these guidelines can be challenging particularly in LMICs due to competing priorities and limited resources allocated to mental health [44]. Considering the impact of the pandemic, national policies need to place emphasis on mental health support. Particularly In LMICs, there is a critical need for ongoing collaboration between government and non-governmental organizations to ensure the availability of support when needed.

5.0 Conclusion

The pandemic seems to be a 'new normal' as it remains unclear when it will be over. However, in our attempt to weather the COVID-19 storm, new issues are emerging that warrant attention. Clearly, without measures in place, we will be reliving the 15th century fable of "jumping out from the frying pan into the fire", but this can be avoided. The consequences can be dire for LMICs where health systems are already stretched to their limits and the destruction of existing facilities by fires may create significant challenges. Collaborative efforts are required to prevent or detect fire outbreaks early and have clear emergency plans. In implementing these, ongoing practical and psychological supports are required for healthcare staff, patients, and their families where applicable. Despite the uniqueness of this review, it is worth mentioning that the

availability of mostly media reports may affect the strength of conclusions reached. Though a limitation, it provides a starting point for future studies aimed at examining the phenomenon of hospital fire outbreaks.

List of abbreviations: Not applicable

Declaration

Ethical approval and consent to participate: Not applicable

Consent for publication: Not applicable

Availability of data and material: All data used to in this study are included within the article.

Competing interests: The authors declare no competing interests

Funding: No funding received

Authors' contributions: JB conceptualized the study; JB and PAD performed the literature search and review; JB undertook data synthesis; JB and PAD undertook the manuscript write-up, critically reviewed it, and approved for submission.

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