Original Research Article

A study on reported fire incidents in major hospitals of India

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ABSTRACT

Background: An uncontrolled fire is dangerous especially in the healthcare establishments as they frequently cater to the sick who often require assistance. We studied the various aspects of fire incidents that occurred in major Indian hospitals through media reports in the past decade (January 2010 to December 2019). It is our intention that this study would act as a reference to prioritize and stimulate research in hospital fire safety.

Methods: An extensive internet search was done for news reports/articles on fire incidents in major hospitals by mainstream media outlets. Major hospitals were those with more than 100 in-patient beds.

Results: 33 major fire incidents were reported during the defined period. The most common cause of fire was due to electrical short circuit 78% with air conditioners being the most common source. Functional firefighting systems were reported in 19 incidents. Fires originated at or near intensive care units (ICU’s) in 10 instances. 72.72% accidents occurred at night (8:01 p.m. to 7:59 a.m.). Casualties were reported in 39% of the fire accidents.

Conclusions: The most common cause of fire accidents is electrical short circuit. Hospitals need to prioritize periodic testing of firefighting systems and regular training of staff on their use. Judicious placement of electrical equipment combined with oxygen monitoring devices in intensive care areas is recommended. Storage of flammable materials and placement of central gas supply points should be away from the vicinity of patient care areas and always in conjunction with robust fire detection and control methods. Hospitals should adhere to their planned capacity.

Keywords: Fire, Hospital fire, Fire accidents, Fire safety, Indian hospitals

INTRODUCTION

An accidental fire is a mishap that could be either man-made or natural. Accidental fire occurs frequently and can be controlled often; but may at times result in loss of life and property. India, just like any other country, has a history of fire accidents. The incident of fire and explosion at Bombay Dock on 14 April 1944 has become an inalienable part of its history. Annually, this day is observed as National Fire Service Day in the memory of 66 firemen who lost their lives while battling this devastating fire. Eight Indian cities with a high population density are vulnerable to man-made disasters as per an executive summary published by the integrated research and action for development. The Pan American Health Organization (PAHO) and the World Health Organization (WHO) have defined a ‘safe hospital’ as one that “will not collapse in disasters, killing patients and staff; can continue to function and provide its services as a critical community facility when it is most needed; and organized, with contingency plans in place and health workforce trained to keep the network operational”. To be safe, hospitals need to be designed for every eventuality. At the heart of it lies poor hospital design and lack of policy implementation. There is lack of awareness of safety at the national and the state level when such policies are planned.

“Fire is a good servant but a bad master”, which implies that controlled fire is a necessity of life but uncontrolled fire is dangerous for both life and property.
incident at AMRI Hospital in 2011 has highlighted the necessity of an articulate preparedness plan, which can minimize the loss of life and property. In order to prevent fire from occurring and to extinguish it successfully, an understanding of the chemical and physical characteristics of fire is important. Inputs and outputs of a fire (combustion reaction) is represented in Figure 1.

Figure 1: Inputs and outputs of fire.

The AERB monograph states that the combustion phenomena are of five types. They are- explosion: the rapid release of high-pressure gas into the environment, the main difference between a fire and an explosion is the rate at which energy is released; deflagration: burning of a gas or aerosol that is characterized by a combustion wave; detonation: the burning of a gas or aerosol characterized by a shock wave, the shock wave travels at a speed greater than the speed of sound, and the wave is characterized by very high pressure, which serves to create a heat source for igniting other combustibles; flashover: a fire in an enclosed area that fosters the buildup of heat, when the temperature reaches the ignition temperature of the majority of combustibles in the area, there is spontaneous combustion of the combustibles in the area and; backdraft: sometimes referred to as a smoke explosion because it is a fire in an enclosed area that consumes the oxygen supply and generated carbon monoxide and heat.

Presently there is no compiled reference of such fire accidents that have been reported in the Indian health care sector. It is our intention that this study would act as a reference to prioritize and stimulate research in hospital fire safety and help learn from past mistakes.

The aim of the research was to study the fire incidents that occurred in major Indian hospitals reported via various media outlets in the past decade (January 2010 – December 2019).

The objective was to enumerate the fire incidents that occurred in major hospitals in the past decade and to analyze the various aspects such as hospital attributes, details of the incident and extent of damage.

METHODS

The study design was a descriptive study which included an extensive internet search using the keywords “fire accidents”, “fire tragedy” and “fire in Indian hospitals”. News reports/articles by mainstream media outlets in English language which mentioned fire accidents in major hospitals across India and which were reported widely and extensively were included. A major hospital was defined as one with more than 100 in-patient beds for the purpose of this study. The study period was defined to include all fire incidents reported between January 2010 and December 2019. Information was entered into a spreadsheet and analyzed on hospital attributes, nature of the accident and extent of damage.

Statistical methods and tools

Mathematical summations, means and averages.

Study setting

Geographical location of India.

Inclusion criteria

All fire incidents reported by mainstream media/new media through websites/web pages. Multiple news reports of the same incident were also included.

Exclusion criteria

News reported on social media e.g. Facebook, Twitter and in clinics, nursing homes or hospitals with less than 100 inpatient-beds.

Data sources

Media/press article available on internet.

RESULTS

The details of fire incidents were compiled and tabulated as in Table 1.

A total of 33 fire incidents were reported online by mainstream media sources. A total of 131 fatalities were occurred in 8 of these incidents. 25 incidents were reported to have occurred in government owned establishments, 7 in private hospitals and 1 in a trust hospital. In 19 incidents occurred in hospitals which reported having functional firefighting measures. 7 fire incidents each were reported from states of West Bengal, Orissa and National Capital Region (NCR). West Bengal reported the highest number of hospital fire related deaths in the past decade (n=117); most of these were due to the AMRI hospital incident. The most common cause of fire was reported as due to electrical short circuit 78%. Air conditioners were the most common source of origin for short circuit.
Table 1: Major fire incidents reported in the past decade (2010-2019).

| No. | Date            | Hospital name                        | Govt./pvt./trust | Location of hospital      | Time of incident | Reported cause of fire | Location | No. of people injured/dead | Functional status of existing firefighting systems, Additional fire tenders used | No. of patients shifted to nearby hospitals | Time taken till control achieved (hour) | Damage as reported |
|-----|-----------------|--------------------------------------|------------------|---------------------------|------------------|------------------------|----------|---------------------------|-----------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------|------------------------------------------|
| 1.  | 2019 November 8 | KEM hospital                         | Govt.            | Mumbai, Maharashtra       | Night            | Pediatric ward         | Short circuit       | 1 injured                |                                                                                  |                                             | 5                                       |                                                                         |
| 2.  | 2019 October 22 | Shine Children’s Hospital             | Pvt.             | Hyderabad, Telangana      | Night            | NICU 4\textsuperscript{th} floor | Short circuit from refrigerator | 1 dead 4 injured |                                                                                  |                                             | 6                                       |                                                                         |
| 3.  | 2019 September 27 | North Bengal Medical College and Hospital | Govt. | Siliguri, West Bengal | Morning | Critical Care Unit | 1 dead | 9 |                                                                                  |                                             |                                         |                                                                         |
| 4.  | 2019 August 17 | AIIMS                                | Govt.            | New Delhi                 | Afternoon        | Dispensary at ground floor | – | Nil | Functional, 34 fire tenders | – | 6 | – |                                                                                             |
| 5.  | 2019, May 10   | SMS Hospital                         | Govt.            | Jaipur, Rajasthan         | Night            | Medical shop in ground floor | Short circuit | Nil | 12 fire tenders | 125 | 4 | – |                                                                                             |
| 6.  | 2019 April 10  | Lok Nayak Jai Prakash Narayan Hospital | Govt. | Central, Delhi | Night | First floor plastic surgery ward | – | – | 4 fire tenders | – |                                             | Lab equipment’s, crores worth of material were burnt, Complete department was destroyed |
| 7.  | 2019, March 8  | SCB Medical college and Hospital      | Govt.            | Cuttack, Orissa           | Night            | Pathology Department   | Short circuit [AC were left on during the night] | Nil | Functional | – |                                             |                                                                         |
| 8.  | 2019 March 24  | AIIMS Trauma Centre                  | Govt.            | New Delhi                 | Afternoon        | Ground floor (operation theatre) | Short circuit (leakage of oxygen supply pipe behind the manifold) | Nil | Functional, 24 fire tenders | 50 | – | – |                                                                                             |

Continued.
| No. | Date          | Hospital name                        | Govt./pvt./trust | Location of hospital | Time of incident | Location | Reported cause of fire | No. of people injured/dead | Functional status of existing firefighting systems, Additional fire tenders used | No. of patients shifted to nearby hospitals | Time taken till control achieved (hour) | Damage as reported |
|-----|---------------|--------------------------------------|------------------|----------------------|------------------|----------|------------------------|-----------------------------|---------------------------------------------------------------------------------|------------------------------------------|------------------------------------------|-------------------|
| 9.  | 2019 February 27 | SCB Medical college And Hospital, Govt. | Cuttack, Orissa | Night | Main Operation Theatre of Surgery | Short circuit | Nil | Functional | Nil | 26 | 1 |  |
| 10. | 2019, February 7 | Metro Hospital and Heart Institute Pvt. | Noida, Uttar Pradesh (NCR) | Morning | 2nd floor of the hospital [ICU] | Short circuit | No | Non functional, 10 fire tenders | 100 | >40 |  |
| 11. | 2019, February 2 | Apollo Hospital Pvt. | Bhubaneswar, Orissa | Morning | 5th floor battery room [ICU is present beside] | Short circuit | Nil | Non functional | 26 | 1 |  |
| 12. | 2019, January 23 | Chhattisgarh Institute of Medical Sciences Govt. | Bilaspur, Chattisgarh | Morning | Paediatric ward | Short circuit | 3 people fainted (fire fighting employees) | Functional | 40 children | 40 mins |  |
| 13. | 2019, January 9 | ESIC hospital Govt. | Noida, Uttar Pradesh | Morning | Basement of 7 storey building | Nil | 5 fire tenders | 100 | 2 |  |
| 14. | 2019, January 1 | Geetanand Hospital Govt. | Alwar, Rajasthan | Night | NICU | Oxygen pipeline linked to a radiant warmer | 1 dead |  |
| 15. | 2018 December 20 | ESIC Kamgar Hospital Govt. | Suburban Andheri, Mumbai, Maharashtra | Afternoon | Third/Fourth floor | Short circuit [AC] | 8 dead | 145 injured incl. a firefighter | Non functional, 810 fire tenders | 147 | 3 |  |

Continued.
| No. | Date            | Hospital name                  | Govt./pvt./trust | Location of hospital | Time of incident | Location | Reported cause of fire | No. of people injured/dead | Functional status of existing firefighting systems, Additional fire tenders used | No. of patients shifted to nearby hospitals | Time taken till control achieved (hour) | Damage as reported |
|-----|-----------------|--------------------------------|------------------|----------------------|------------------|----------|------------------------|-----------------------------|--------------------------------------------------------------------------------------|---------------------------------------------|------------------------------------------|-------------------|
| 16. | 2018 December 31 | Calcutta Medical College and Hospital | Govt.           | Kolkata, West Bengal | Night            | Second floor | Short circuit in a refrigerator in haematology dept.  | Nil                         | Functional, 3 fire tenders                                                      | -                                           | -                                         | -                 |
| 17. | 2018 November 20 | Chittaranjan National Cancer Institute | Govt.           | South Kolkata, West Bengal | Afternoon       | Genetic research wing | Short circuit in [AC]                      | Nil                         | Functional, 3 fire tenders                                                      | -                                           | 1.5                        | -                 |
| 18. | 2018 November 12 | Calcutta School of Tropical Medicine | Govt.           | Calcutta, West Bengal | Morning          | Ground floor | Short circuit in [AC]                   | Nil                         | Non functional, 3 fire tenders                                                   | 7                                           | 1.5                        | -                 |
| 19. | 2018, October 3  | Calcutta Medical College & Hospital | Govt.           | Calcutta, West Bengal | Morning          | Pharmacy [ground floor] | Short circuit | Nil                         | Functional, 10 fire tenders                                                      | 250                                         | 1.5                        | Rs.5 crore worth medicines were damaged |
| 20. | 2018, September 14 | Apollo Hospital, Jubilee Hills, Hyderabad, Telangana | Pvt.            | Hyderabad, Telangana | Morning          | Cellar       | Short circuit | Nil                         | Functional, 2 fire tenders                                                      | -                                           | -                                         | -                 |
| 21. | 2018 September 13 | Safdarjung Hospital               | Govt.           | New Delhi           | Morning          | 4th floor [eye Operation Theatre] in new OPD | Overheating of chemical [spirit]      | 3 injured                    | Functional, 7 fire tenders                                                      | -                                           | 0.5                        | No damage          |
| 22. | 2017 July 16    | Trauma Center, King George Medical University | Govt.           | Lucknow, Uttar Pradesh | Afternoon        | Second floor [Disaster managemen t ward] | Short circuit | Nil                         | Functional                                                      | 250                                         | 3                          | -                 |
| No. | Date       | Hospital name                         | Govt./pvt./trust | Location of hospital | Time of incident | Location           | Reported cause of fire                  | No. of people injured/dead | Functional status of existing firefighting systems, Additional fire tenders used | No. of patients shifted to nearby hospitals | Time taken till control achieved (hour) | Damage as reported |
|-----|------------|---------------------------------------|------------------|----------------------|------------------|-------------------|------------------------------------------|---------------------------|-----------------------------------------------------------------------------------|------------------------------------------|------------------------------------------|-------------------------------|
| 23  | 2016 October 18 | SUM Hospital, Shiksha ‘O’ Anusandhan Univ. | Govt.            | Bhubaneswar, Orissa  | Afternoon        | First floor [dialysis] Spread to near by ICU | Short circuit               | 22 dead, 120 injured                           | Functional, 7 fire tenders                   | –                                    | –                              |
| 24  | 2016 September 21 | Safdarjung Hospital                   | Govt.            | New Delhi            | Afternoon        | Ground floor, near Casuality                  | Short circuit from meter box | Nil                                  | Functional, 4 fire tenders                         | Nil                                | few minutes                       | –                              |
| 25  | 2016 May 31 | SCB Medical College                   | Govt.            | Cuttack, Orissa      | Afternoon        | 2nd floor [cardiac wing] 5 stored building   | Short circuit [AC]              | Nil                                  | Functional, 3 fire tenders                         | 104                                | 0.5                                    | –                              |
| 26  | 2016 August 27 | Murshidabad Medical College Hospital  | Govt.            | Baharampur, West Bengal | Morning         | Second floor [ward]                         | Short circuit [AC]              | 3 dead, 50 injured                        | Nonfunctional                                    | –                                    | –                              |
| 27  | 2015 November 29 | Sardar Vallabhai Patel Postgraduate Institute of Pediatrics (Sishu bhawan) | Govt.            | Cuttack, Orissa      | –                | Neonatal Intensive Care Unit (NICU)          | Short circuit [Electrical warmer] | nil                                  | Functional, 22 newborns                                 | –                                    | Medical equipment other infrastructure in NICU |
| 28  | 2015 October 16 | Acharya Harihar Regional Cancer Centre | Govt.            | Cuttack, Orissa      | Afternoon        | 3rd floor [Store Room, operation theatre]  | Short circuit [AC]              | 1 dead                                 | Non functional, 4 fire tenders                        | 80                                  | –                                    | –                              |

Continued.
| No. | Date          | Hospital name                  | Govt./ Pvt./ trust | Location of hospital | Time of incident | Location | Reported cause of fire | No. of people injured /dead | Functional status of existing firefighting systems, Additional fire tenders used | No. of patients shifted to nearby hospitals | Time taken till control achieved (hour) | Damage as reported |
|-----|---------------|--------------------------------|--------------------|----------------------|------------------|----------|------------------------|----------------------------|----------------------------------------------------------------------------------|--------------------------------------------|-----------------------------------------|----------------|
| 29. | 2015 September 19 | Surana Sethia Hospital Trust | Chembur, Mumbai | Afternoon | [ICU] 5th floor | Short circuit | [AC] | Nil | Functional, 4 fire engine 3 tankers 2 special fire appliances | 48 | 2 | _ |
| 30. | 2013 January 13 | PBM Govt. | Bikaner, Rajasthan | Morning | ICU | Short circuit | [AC] | 3 injured | Functional, 2 fire tenders | 107 children | few minutes | _ |
| 31. | 2012 May 26 | Medi Point Hospital Pvt. | Aundh, Pune, Maharashtra | Morning | 3rd floor [store room located on the terrace] | Short circuit | Nil | Functional, 3 fire tenders, 2 water tankers | 36 | 45 min | Rs.1.5 lakh worth documents |
| 32. | 2011 December 9 | AMRI Hospital Pvt. | Kolkata, West Bengal | Night | Basement | Flammable materials | 90 dead | Functional, 28 fire tenders and 3 sky lifts | 70 | 5 | _ |
| 33. | 2010 February 2 | Park Super Specialty Hospital Pvt. | Hyderabad, Telangana | Morning | Ground floor | Short circuit | 43 injured | Non functional | 42 | 2 | _ |
Other causes of the fire incident such as overheating of chemicals (spirit), storage of flammable materials in the basement and materials used in renovation of the building constituted 9%. In the remaining 13% incidents, no specific cause was reported. 39.39% of the accidents occurred during morning hours (8:00 a.m. to 2:00 p.m.); 33.33% during afternoon (2:01 p.m. to 8:00 p.m.) and 72.72% at night (8:01 p.m. to 7:59 a.m.). Casualties were reported in 39% incidents. Based on the nature of reported casualties these were further classified as: only injuries (15%), only deaths (12%) and; both deaths and injuries (12%). Non-functional firefighting systems were reported in 4 government and 3 private hospitals. In 10 incidents fires originated from within or nearby intensive care areas (ICU’s). More than a hundred patients had to be evacuated to nearby hospitals in more than 7 incidents. In more than 9 instances control over the fire was achieved beyond 2 hours.

**DISCUSSION**

The major fire accident which occurred in AMRI Hospital in the year 2010 was a watershed moment in fire safety among hospitals. It has since become infamous for having the single largest number of casualties (n=94) reported from any hospital fire in India. Multiple lapses were reported in the management of this disaster. Combustible items like empty and full liquefied petroleum gas (LPG) cylinders, rejected mattresses, wooden boxes and diesel for the generators were being stored in the basement which acted as fuel. However, the fire did not spread to the other levels and was confined to the basement only. The fire detection and alarm systems were reportedly switched off as a routine practice rendering them ineffective. As the hospital was centrally air-conditioned, the smoke started billowing out of the basement and spread fast to all the floors through the air-conditioning duct.

Power cut in response to the fire turned the floors above into smoke chambers. This effect was magnified due to the glass facade of the centrally air conditioned hospital with unopenable windows causing poor ventilation of smoke. This was attributed to the main reason behind increased number of casualties.

Multiple fire incidents had occurred in SCB Medical College and Hospital, Cuttack. The first one being in 2016 and others during a period of three consecutive months in 2019. Other hospitals similar to SCB Medical College such as Calcutta Medical College, Kolkata and Sardar Vallabhai Patel Postgraduate Institute of Pediatrics (Sishubhavan), Cuttack suffered huge losses due to fire incidents that destroyed equipment, infrastructure and medicines worth millions of rupees. All these institutions were reported as having functional firefighting systems. It could be inferred that staff were unaware of the fire policy and were poorly trained. In a study conducted in Maharashtra, 83.3% respondents reported a lack of awareness of fire service preparedness policy of their hospital and it was concluded that the availability of firefighting equipment did not correspond to staff knowledge of its use. Fires frequently started as an electrical short circuit which was accentuated by the presence of flammable materials stored in areas such as labs, operation theatres and intensive care areas (n=15). Electric short circuit as the most common source of fire is graphically represented as a cause and effect diagram (Ishikawa diagram) in Figure 2. The presence of oxygen rich environment especially in ICU’s and operating rooms reduces the amount of ignition energy required to initiate fires. Split air conditioners in ICU’s should not be placed above the patients bed where the oxygen concentration is

**Figure 2: Fishbone diagram showing short circuit as a cause for fire.**

| Circuit | Fuses & Circuit Breakers | Conductors Cables | Connection |
|---------|--------------------------|-------------------|------------|
| Trialg Load | Overloading | Absence of earth leakage circuit breaker | Damaged |
| Not Earthed | Insufficient size | Joint/s Inaccessible |
| | | |
| Worn or Damaged | Appliances | Insulation | Switches |
| | | | |
| Unearthed | | | |
| | | | |
| Inadequate | | | |
| | | | |
| Ungrounded | | | |
| | | | |
| Broken | | | |
| | | | |
| Defective | | | |
| | | | |
| Isolation & control not provided |

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expected to be high (above 23.5%).\textsuperscript{40} In a significant number of the incidents (n=19) fire could not be controlled by existing firefighting systems which were reported to be functional. Further, in 21 incidents additional firefighting equipment was pressed into service. This indicates that these hospitals did not conduct fire safety audits. Though there were fire incidents where no casualties were reported, expensive equipment and a number of important documents were destroyed.

It took more than 2 hours to achieve fire control in 9 incidents and that all of them occurred in big cities is further evidence that our cities ate truly ‘at risk’ of fire related disasters.\textsuperscript{5} Instead, internal fire control measures should be strengthened. In more than 100 patients were evacuated to nearby hospitals in 5 fire incidents underscoring the need to maintain buffer capacity in surrounding hospitals. This should be made mandatory during the grant of hospital license. Dr. R. K. Dave former senior specialist on policy and plans, National Disaster Management Authority in an interview had remarked: “at any given time, hospital gadgets consume 5-10 times of the permissible electricity usage and it is estimated that the load goes up nearly 25% annually. No hospital or authority ever estimates correctly, at the time of licensing, the number of patients it will get, how many machines it will have to install, and the required safety checks. This situation is worse in government and private hospitals where the sheer number of people overwhelm the resources every minute, every single day”.\textsuperscript{4}

\textbf{Limitation}

Fire incidents which may have occurred but were not reported by mainstream media and by news agencies which do not have internet presence may have been overlooked. Reports published in printed newspapers and news reports in vernacular language were not included due to logistical reasons and language barrier respectively.

\textbf{CONCLUSION}

Hospitals, especially in the government sector, should strictly adhere to their planned capacity both in terms of physical space as well as energy needs. It is the responsibility of every healthcare establishment to ensure that fire safety standards and regulations are followed to prevent fire accidents and the consequent human suffering.

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