International Journal of Community Medicine and Public Health
Laturkar S et al. Int J Community Med Public Health. 2026 Mar;13(3):1410-1416
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20260701

Original Research Article

Determinants of fire safety awareness and emergency evacuation preparedness in intensive care units and operating theatres: a cross-sectional study

Shirin Laturkar[1]*, Rakshitha G. R.[1], Vidya K. R.[2], Andrea Neha Dias[1], Ayyali Ambresh[3]

[1]Shri Atal Bihari Vajpayee Medical College and Research Institute, Bangalore, India
[2]Department of Community Medicine, Shri Atal Bihari Vajpayee Medical College and Research Institute, Bangalore, India
[3]Department of General Medicine, Shri Atal Bihari Vajpayee Medical College and Research Institute, Bangalore, India

Received: 01 January 2026
Revised: 08 February 2026
Accepted: 09 February 2026

***Correspondence:**
Shirin Laturkar,
E-mail: shirinlaturkar@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Evacuation in intensive care units (ICUs) and operation theaters (OTs) is a complex task that requires well-trained staff. The aim of the study was to assess the level of fire safety awareness and emergency evacuation preparedness among healthcare personnel working in ICUs/OTs, and to identify the determinants influencing them.
Methods: A cross-sectional study was conducted among healthcare workers in ICUs/OTs of two tertiary care hospitals in Bengaluru. A total of 150 participants were selected using population proportionate sampling followed by random number tables. Data were collected using a pre-tested, semi-structured questionnaire assessing socio-demographic characteristics, awareness of fire safety measures, and recommended practices during ICU/OT fire emergencies. The responses were compiled and analysed using descriptive and inferential statistics.
Results: Of the 150 participants, 144 (96%) acknowledged the need for fire safety training; however, 125 (83.3%) did not consider themselves adequately trained to manage fires or related emergencies in the ICU/OT. Higher questionnaire scores were significantly associated with age, designation, and years of experience. Greater confidence in handling fire emergencies was observed among participants with prior training, longer work experience, or previous exposure to a fire incident. Overall, 125 (83.3%) participants demonstrated poor or very poor knowledge scores.
Conclusions: The study revealed significant gaps in fire safety awareness and emergency evacuation preparedness among healthcare workers in ICUs and OTs. Factors such as age, designation, experience, and prior training were positively associated with better awareness and preparedness. These findings highlight the need for regular fire safety training to strengthen emergency preparedness in critical care areas.

Keywords: Fire safety, ICU, OT, Medical education

INTRODUCTION

An evacuation process in a hospital is a particularly difficult and complex task that requires a strategy, well-trained staff, and careful execution. While hospitals are often well equipped to accommodate the input of patients resulting from some type of a disaster situation, there are few studies that are concerned with the issues that a hospital faces when their occupants must be evacuated.[1] Internal incidents like hospital fires are arguably more disruptive than external incidents, because patients are dependent on supportive measures and are neither in position to respond to such crisis situation, nor do they know how to respond, often requiring outside assistance for evacuation.[2,3]

Hospital fires are prevalent in India, with the frequency with which hospital fire accidents have been occurring in India increasing sharply in recent years, especially in intraoperative and intensive care unit settings.[3-5] The incidence of hospital fires are almost evenly distributed across both private and government hospitals.[3] Hospitals zones like the intensive care units are not only more prone to accidents than other zones but can also cause greater loss of lives due to the presence of critically ill patients, or persons who are extremely vulnerable.[3] The patients are often immobile and oxygen dependent, greatly hindering their evacuation.

The rising frequency in hospital fires is likely due to the lack of adequate infrastructure, faulty wiring and inadequate observation of fire prevention protocols in hospitals.[6] A large number of hospitals operate in resource poor settings, often leading to compromises in standardized protocols. Hospitals lack the updates in infrastructure required to have adequate fire safety and evacuation routes intact. Most healthcare facilities in India have not yet adopted fire safety practices on a day-to-day basis, completely ignoring the existence of this problem.[3,7] This is unfortunate as hospital preparedness as one of the most important factors can reduce the hospital evacuation time.[8]

Healthcare workers' knowledge of basic protocols and recommendations, both to prevent fires and to respond in the event of a fire, is essential.[9] Evacuation during a fire accident is most effective when all hospital officials are equipped with adequate knowledge about the protocol as each member of the hospital staff becomes an integral member of the rescue team.[10] Knowledge of codes and standards, good maintenance practices, and frequent drills in fire prevention and suppression are among the practices recommended for keeping a hospital fire from becoming a disaster.[11] Clinical staff of all grades should receive multidisciplinary training in their place of work as part of annual mandatory training, covering the management of a fire and evacuation of their work area. This should include the location and operation of manual fire call points, oxygen shut off valves (area valve service units), fire extinguishers, evacuation aids, evacuation routes and procedures as well as the importance of keeping evacuation routes clear.[9]

Fire training is often relegated to the responsibility of the individual hospital administrations. Unfortunately, the involved skills and procedures do not feature prominently in the curricula taught to medical students in India, with medical students often graduating without the confidence required to handle hospital fires.[11] This gap in students' education results in untrained doctors, likely contributing to increased frequency of hospital fires in India. While certain aspects of fire training must be individualized to the specific hospitals doctors work in, such as evacuation routes and assembly points, awareness of basic protocols to be followed in such events is a necessity in clinical staff of all levels. Studies have shown that training is effective in improving awareness and practice of the operating room and ICU staff. Therefore, constant education using up-to-date training methods may reduce the fire incidence in operating rooms and ICUs and promote patient and staff safety.[12]

Basic protocol states that in the event of a fire it is the responsibility of the most senior healthcare worker on the floor at the time to manage the evacuation.[9] Knowledge of the factors affecting knowledge and confidence in fire evacuation protocols such as age, years of training, field of specialization, etc can help focus fire training and limited resources on the necessary areas.

Understanding the weak points in healthcare workers knowledge and confidence in operating in emergency settings is critical to improving fire preparedness. The aim of the study was to assess the level of fire safety awareness and emergency evacuation preparedness among healthcare personnel working in intensive care units (ICUs) and operating theaters (OTs), and to identify the determinants influencing them.

METHODS

The present study was conducted after obtaining approval from the Institutional Ethics Committee, and all procedures adhered to the ethical standards of the Committee and the principles of the Helsinki Declaration.

This was a cross-sectional, descriptive study conducted among healthcare personnel including medical students, interns, postgraduate students, doctors, and nurses working or studying in the Departments of Anaesthesiology, General/Internal Medicine, Paediatrics, Obstetrics and Gynaecology, Surgery, Orthopaedics, Otorhinolaryngology, and Ophthalmology of two tertiary care hospitals in Bengaluru. Nurses not working in the operating room or intensive care unit were excluded from the study.

Population proportionate sampling was employed to determine the study population. Participants were distributed across levels of training (e.g., medical students, nurses, doctors) based on the average number of personnel typically assigned to an operating theater at a given time in the respective hospitals. From each category, the required number of participants was selected using random number tables. The sample size was calculated assuming favorable perceived knowledge at 54.9%, with a 95% confidence interval and an absolute allowable error of 10%. The calculated sample size of 147 was rounded off to 150 participants.

A pretested, semi-structured questionnaire developed by the investigators was used for data collection. It comprised 30 questions divided into sections assessing personal and demographic details, knowledge of standard evacuation protocols in ICUs and OTs, location and use of oxygen shut-off valve service units and fire extinguishers, triage

and evacuation procedures, and awareness of fire alarm signals. The questionnaire underwent face and content validation by faculty from the Departments of Anaesthesiology and Community Medicine of the parent institution. After obtaining informed consent, the questionnaire was administered in person by the investigators. In cases of non-response or refusal, replacement participants were selected using random number tables from the same population. The study period extended from January 2024 to June 2024.

Collected data were entered in Microsoft Excel and analyzed using R statistical software. Associations between demographic variables and knowledge scores were assessed using appropriate statistical tests. The study adhered to the STROBE guidelines for reporting cross-sectional studies. Following completion of data collection, fire safety and evacuation training sessions were conducted for healthcare workers in both hospitals to enhance awareness and preparedness.

RESULTS

Sociodemographic characteristics

Of the 150 participants, 72 (48%) were male and 78 (52%) were female. The participants' ages ranged from 20 to 60 years, with the majority belonging to the 20-25 years (71, 47.3%), 26-30 years (50, 33.3%), and 31-35 years (13, 8.7%) age groups. Most participants had less than 5 years of professional experience (127, 83.7%), while 12 (8%) had 5-10 years, 5 (3.3%) had 11-15 years, and 6 (4%) had more than 15 years of experience. Participants represented various designations and levels of training: faculty (37, 24.7%), postgraduate students (49, 32.7%), interns (8, 5.3%), nurses (8, 5.3%), and undergraduate students (48, 32%). They were distributed across multiple specialties, including medicine (12, 8%), surgery (18, 12%), paediatrics (20, 13.3%), obstetrics and gynaecology (8, 5.3%), anaesthesiology (8, 5.3%), orthopaedics (7, 4.7%), ENT (13, 8.7%), and ophthalmology (10, 6.7%), while 54 (36%) were not attached to a specific department.

Evacuation training and experience

Only 6 (4%) participants reported having experienced an emergency evacuation or fire in an operating theater or Intensive Care Unit. A large majority (144, 96%) believed that training in emergency evacuation and fire management is essential. However, only 25 (16.7%) felt adequately trained and confident to handle such emergencies, while the remaining 125 (83.3%) did not feel sufficiently prepared.

Confidence in fire training received

When asked about prior fire safety training, 119 (79.3%) participants reported never having received any formal training, while 31 (20.6%) had undergone some form of training (Graph 2). The primary sources of information on evacuation guidelines included formal training (49, 32.7%), the internet (49, 32.7%), and social media (36, 24%) (Figure 1, Table 1).

Knowledge of evacuation protocols

Knowledge was assessed on a 20-point scale, with one mark awarded for each correct response. The distribution of scores is depicted in Figure 3. Overall, the majority of participants (125, 83.3%) scored poorly or very poorly, indicating limited awareness of fire safety and evacuation protocols. Knowledge regarding the Alarm-Safety-Ventilate-Use (ASVU) protocol and the management of airway fires was particularly inadequate.

Factors affecting knowledge of evacuation protocols

No significant association was observed between gender and knowledge scores (Fisher's exact test, p=0.5). However, higher knowledge scores were significantly associated with increasing age, higher level of training, and greater years of experience (Table 2).

Factors affecting confidence in knowledge of evacuation protocols

No significant association was found between confidence in evacuation knowledge and gender (p=0.66), age (p=0.20), or area of specialization (p=0.19). However, participants with higher levels of training, longer work experience, and prior experience of an emergency reported significantly greater confidence in managing fire or evacuation situations (Table 3).

Table 1: Knowledge of individual aspects of evacuation protocols.

S. no.	Aspects of evacuation protocols	Number of relevant questions	N (%) of participants that answered all questions correctly	N (%) of participants that answered some questions correctly	N (%) of participants that answered all questions incorrectly	Total n (%) participants
1	Fire alarm interpretation	2	17 (11.3)	60 (40)	73 (48.6)	150 (100)
2	ASVU	3	0 (0)	81 (54)	69 (46)	150 (100)
3	Triage and Evacuation Strategy	5	17 (11.3)	129 (86)	4 (2.6)	150 (100)

Continued.

S. no.	Aspects of evacuation protocols	Number of relevant questions	N (%) of participants that answered all questions correctly	N (%) of participants that answered some questions correctly	N (%) of participants that answered all questions incorrectly	Total n (%) participants
4	Fire extinguisher location and usage	2	64 (42.6)	52 (34.6)	34 (22.6)	150 (100)
5	Management of airway fires	2	19 (12.6)	64 (42.6)	67 (44.6)	150 (100)

Table 2: Age, level of training, years of experience and specialization vs knowledge of evacuation protocols.

Parameters	N (%)				
	0-5	**6-10**	**11-15**	**16-20**	**Total**
Age/score (years)					
20-25	20 (28.2)	45 (63.4)	6 (8.5)	0 (0)	71 (100)
26-30	7 (14)	31 (62)	11 (22)	1 (2)	50 (100)
31-35	4 (30.8)	6 (46.2)	2 (15.4)	1 (7.7)	13 (100)
36-40	3 (33.3)	4 (44.4)	2 (22.2)	0 (0)	9 (100)
41-45	0 (0)	2 (66.7)	1 (33.3)	0 (0)	3 (100)
46-50	2 (100)	0 (0)	0 (0)	0 (0)	2 (100)
51-60	0 (0)	1 (50)	1 (50)	0 (0)	2 (100)
Total	36 (24)	89 (59.3)	23 (15.3)	2 (1.3)	150 (100)
Fisher exact test 27.2 with p value 0.04					
Experience /score (years)	0-5	6-10	11-15	16-20	Total
0	15 (29.4)	32 (62.7)	4 (7.8)	0 (0)	51 (100)
1	5 (14.3)	24 (68.6)	6 (17.1)	0 (0)	35 (100)
2	4 (22.2)	12 (66.7)	2 (11.1)	0 (0)	18 (100)
3	4 (40)	4 (40)	2 (20)	0 (0)	10 (100)
4-5	3 (30)	5 (50)	1 (10)	1 (10)	10 (100)
6-10	3 (25)	4 (33.3)	4 (33.3)	1 (8.3)	12 (100)
11-20	0 (0)	5 (71.4)	2 (28.5)	0 (0)	7 (100)
>20	2 (28.5)	3 (42.8)	2 (28.5)	0 (0)	7 (100)
Total	36 (24.5)	87 (59.2)	22 (15)	2 (1.4)	150 (100)
Fisher exact test 45.3 with p value 0.012					
Training/score	0-5	6-10	11-15	16-20	Total
Student	14 (29.2)	29 (60.4)	5 (10.4)	0	48 (100)
Intern	2 (25)	6 (75)	0 (0)	0 (0)	8 (100)
Postgraduate	8 (16.3)	31 (63.3)	10 (20.4)	0 (0)	49 (100)
Faculty	12 (32.4)	20 (54.1)	5 (13.5)	0 (0)	37 (100)
Nurse	0 (0)	3 (37.5)	3 (37.5)	2 (25)	8 (100)
Fisher exact test 46.2 with p value<0.0001					
Specialization/score	0-5	6-10	11-15	16-20	Total
Medicine	4 (33.3)	6 (50)	2 (16.6)	0 (0)	12 (100)
Surgery	6 (33.3)	8 (44.4)	4 (22.2)	0 (0)	18 (100)
Pediatrics	1 (5)	14 (70)	3 (15)	2 (10)	20 (100)
Obstetrics and gnaecology	0 (0)	7 (87.5)	1 (12.5)	0 (0)	8 (100)
Anaesthesiology	0 (0)	3 (37.5)	5 (62.5)	0 (0)	8 (100)
Orthopedics	2 (28.6)	4 (57.1)	1 (14.3)	0 (0)	7 (100)
ENT	2 (15.4)	9 (69.2)	2 (15.4)	0 (0)	13 (100)
Ophthalmology	7 (70)	3 (30)	0 (0)	0 (0)	10 (100)
Not attached to specific department	14 (25.9)	35 (64.8)	5 (9.3)	0 (0)	54 (100)
Note: Fisher exact test 50.24 with p value=-0.001.					

Table 3: Level of training, years of experience and previous experience of emergency verses confidence in knowledge of evacuation protocols.

Parameters	Confident	Not confident	Total
Training/confidence			
Student	5 (10.4)	43 (89.6)	48 (100)
Intern	0 (0)	8 (100)	8 (100)
Postgraduate	12 (24.5)	37 (75.5)	49 (100)
Faculty	4 (10.8)	33 (89.2)	37 (100)
Nurse	4 (50)	4 (50)	8 (100)
Fisher exact test 12.3 with p value 0.014			
Experience/confidence	Confident	Not confident	Total
0	4 (7.8)	47 (92.2)	51 (100)
1	5 (14.3)	30 (85.7)	35 (100)
2	4 (22.2)	14 (77.8)	18 (100)
3	3 (30)	7 (70)	10 (100)
4-5	2 (20)	8 (80)	10 (100)
6-10	2 (16.7)	10 (83.3)	12 (100)
11-20	4 (57.14)	3 (42.86)	7 (100)
>20	0 (0)	4 (100)	4 (100)
Fisher exact tet 18.35 with p value 0.031			
Previou experience of emergency/confidence	Confident	Not Confident	Total
Experienced	4 (66.7)	2 (33.3)	6 (100)
Not experienced	21 (14.6)	123 (85.4)	144 (100)
Fiher exact test 11.25 with p value 0.001			

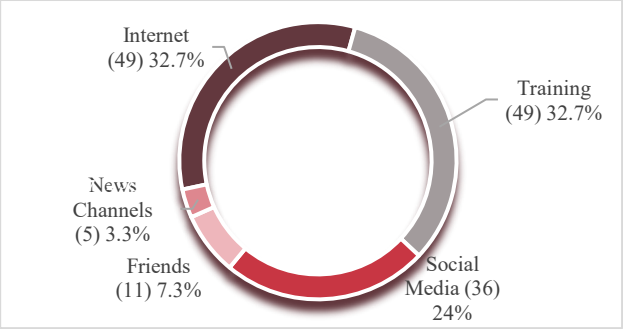

Figure 1: Source of information regarding evacuation guideline.

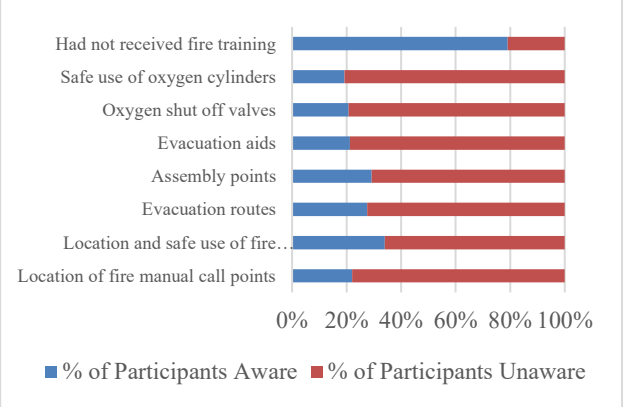

Figure 2: Confidence in fire training received.

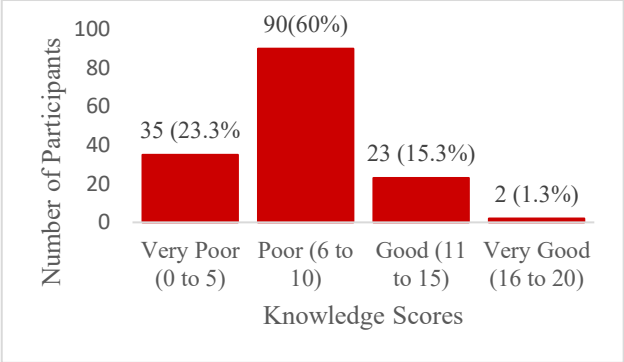

Figure 3: Knowledge of evacuation protocol-core out of 20.

DISCUSSION

The study was found to be evenly distributed across genders, with a majority of the participants under 35 years of age (134, 89.3%) and with less than 5 years of experience (127,83.7%). This is likely due to the large proportion of medical students (48, 32%) and postgraduates (49, 32.7%) surveyed in the study. Faculty (37, 24.7%), interns (8, 5.3%) and nurses (8, 5.3%) were also included in the study.

Respondents' areas of specialization were distributed across various departments that work in Operation Theaters and Intensive Care Units. However, a large

proportion of respondents - medical students, interns and nurses - were not attached to a specific department (54, 36%).

Six (4%) respondents had previously experienced a fire in an operating theater or ICU. This is consistent with previous research, where Juyal et al estimated that only 8 hospital fires would occur in India in the previous year.[3] It is possible that numerous fires go undocumented or unreported in India, and that this has contributed to these low figures.

Despite this, 144 (96%) of respondents felt that training for emergency evacuation in the case of a fire emergency is required. This implies that, despite fires being a relatively uncommon experience in the OT/ICU setting, most of the healthcare workers in these settings believe that training is relevant and necessary. That most respondents (125, 83.3%) did not feel confident in their ability to handle a fire emergency likely contributes to this. Meundi EM, in a similar study in Kenya medical training campuses, found that a majority (75.2%) of the respondents felt a high need for training on fire safety preparedness.[13]

Only 49 (32.7%) respondents listed training as their primary source of information regarding fire safety and management, with the rest listing the internet, social media, friends and news channels (Figure 1). This is unfortunate - prevention of and response to surgical fires can greatly be improved by training, as evidenced by Lee et al in their 2018 paper on the effectiveness of an on-line training program for improving knowledge of fire prevention and evacuation of healthcare workers.[14] Cowels et al in the 2019 paper on prevention of and response to surgical fires recommends that organizations take a proactive role in surgical fire prevention and allow time for education for operating-theater-specific fire prevention education as well as encourage the participation in fire drills for the operating theater.[15] Neglecting the inclusion of fire training in standardized curricula could thus be considered a significant misstep - the lack of training may have encouraged respondents to rely on information from less reliable sources like social media.

With respect to the individual aspects of fire training, respondents lacked in all areas but showed the most severe deficiencies in fire alarm interpretation, ASVUs and airway fire management (Table 1). Kulkarni et al found that the majority (83.3%) of the respondents were aware of the location of the closest fire extinguisher from their workrooms.[10] However 44.9% of the respondents did not know how to use a fire extinguisher in case of a fire outbreak. This is consistent with the findings of this study, where only 40 (26.6%) participants were aware of how to use a fire extinguisher. Forty-seven (31.3%) were unsure or believed there was no fire extinguisher in the ICU/OT where they worked. Since most of the participants in the present institution were employed through outsourced agencies, many of them were being replaced regularly and therefore lacked fire evacuation protocol training.

Participants rated their own knowledge of all aspects of fire safety very poorly, with a majority of individuals unaware of the same. This is likely due to the fact that 119 (79.3%) participants stated they have never received fire evacuation training in the past (Figure 2).

Participants were awarded scores out of 20 and these scores were then compared to various factors such as gender, age and years of experience. However, it is notable that almost all participants scored poorly - 125(83.3%) scored less than 10/20, indicating a severe generalized lack of training in fire safety (Figure 3). There was a statistically significant association between age, designation and years of experience with higher scores in the questionnaire (Table 2). Region of specialization was also significant, with Anesthesiologists scoring the highest (62.5% scored in the 11-15 range). Similarly, there was a statistically significant association between designation and years of experience with confidence in participants' fire safety knowledge (Table 3). Interestingly, a past experience with a fire in an OT or ICU was strongly associated with increased participant confidence in their ability to handle a fire emergency in the future.

Limitations

The study was limited by its restriction to healthcare workers within limited hospitals, and further study could serve to understand if similar deficiencies exist in other hospitals and cities in India and across the world. Further, the study was conducted in a government funded hospital, and the standards and training in private hospitals may not be consistent with the results of this study. The study was funded by the investigators and received no external funding.

CONCLUSION

The study highlights significant gaps in fire safety awareness and knowledge of evacuation protocols among healthcare workers in Intensive Care Units and Operating Theaters. Although most participants recognized the importance of fire safety training, the majority demonstrated inadequate knowledge and low confidence in handling fire or evacuation emergencies. Higher levels of training and greater professional experience were positively associated with better knowledge and preparedness. Ensuring safety in critical care areas such as ICUs and OTs cannot depend on optimism or the assumption that emergencies are unlikely to occur. Instead, systematic preparedness through continuous education and practice is essential.

Recommendations

Regular fire safety training

Conduct mandatory and periodic fire safety and evacuation training programs for all categories of healthcare workers, including refresher sessions at regular intervals.

Mock drills

Implement routine hospital-wide mock evacuation drills in ICUs and OTs to reinforce practical response skills and coordination among staff.

ACKNOWLEDGEMENTS

Authors wish to express sincere gratitude to everyone who contributed to the successful completion of this research project. Authors appreciate the thoughtful discussions and insightful comments from our colleagues in the Department of Anesthesiology and Department of Community Medicine, Shri Atal Bihari Medical College and Research Institute. Authors are especially grateful to the healthcare workers who generously participated in this study, making this work possible.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Golmohammadi D, Shimshak D. Estimation of the evacuation time in an emergency situation in hospitals. Comput Ind Eng. 2011;61:1256-1267.
2. Sharma R, Kumar A, Koushal V. Response to a fire incident in the operation room: a cautionary tale. Disaster Med Public Health Prep. 2019;14:284-28.
3. Juyal S, Tabassum-Abbasi, Abbasi T, et al. An analysis of failures leading to fire accidents in hospitals; with specific reference to India. J Fail Anal Prev. 2023;23:1344-55.
4. Chowdhury K. Fires in Indian hospitals: root cause analysis and recommendations for their prevention. J Clin Anesth. 2014;26:414-24.
5. Patharla SS, Pyreddy SR, Panthagani SN. A study on reported fire incidents in major hospitals of India. Int J Community Med Public Health. 2020;7:3896.
6. Bayuo J, Duodu PA. Hospital fire outbreaks before and during the COVID-19 pandemic in low- and middle-income settings. J Patient Saf. 2023;19:223-8.
7. Paul VK, Basu C, Rastogi A. Status of fire safety in healthcare facilities in India. Int J Archit Infrastruct Plan. 2022;8:871.
8. Saheb S, Jahangiri K, Alibabaei A. Factors influencing hospital emergency evacuation during fire: a systematic literature review. Int J Prev Med. 2021;12:156.
9. Kelly FE, Bailey CR, Aldridge P. Fire safety and emergency evacuation guidelines for intensive care units and operating theaters. Anaesthesia. 2021;76:1377-91.
10. Kulkarni RS, Giri PA, Gangwal PR. Knowledge and practices regarding fire safety amongst health care workers in tertiary care teaching hospital in Marathwada region of Maharashtra, India. Int J Community Med Public Health. 2016;3:1900-4.
11. American Society of Anesthesiologists. Practice advisory for the prevention and management of operating room fires. Anesthesiology. 2008;108:786-801.
12. National Medical Commission. Guidelines under graduate medical education regulation. New Delhi: National Medical Commission; 2023.
13. Davoudian Talab AH, Azari G, et al. Effectiveness of safety training on knowledge and practice of operating room personnel regarding fire prevention. Int J Hosp Res. 2017;6:14-8.

Cite this article as: Laturkar S, Rakshitha GR, Vidya KR, Dias AN, Ambresh A. Determinants of fire safety awareness and emergency evacuation preparedness in intensive care units and operating theatres: a cross-sectional study. Int J Community Med Public Health 2026;13:1410-6.