



# Effectiveness of Safety Training on Knowledge and Practice of Operating Room Personnel Regarding Fire Prevention

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## Abstract

**Background and Objectives:** Fire is an inherent and permanent risk in the health settings and the prevention of it in the operating room require the knowledge of risks and effective communication among the staffs. Thus the purpose of this study was to explore the knowledge and the practice of the operating room staff about fire prevention and the relevant effectiveness of safety training.

**Methods:** This quasi-experimental intervention was carried out by involving 64 staff in the operating room from 5 hospitals in Khuzestan province (southwest of Iran). Sampling was done randomly for the case and the control groups. After matching the samples based on age, work experience, and previous training, the case group was trained on fire management, and compared with the control group. The collected data were analyzed by paired and independent t tests.

**Findings:** The mean of the awareness and performance in the case group before the intervention were found to be 2.6 and 3.93, respectively and after the intervention, 3.1 and 3.9, respectively. This difference was statistically significant for awareness ( $P < 0.05$ ) but insignificant for the practice ( $P > 0.05$ ). While there was no significant difference in the knowledge of the case and control groups before the intervention ( $P > 0.05$ ), after the intervention, a significant difference appeared ( $P < 0.05$ ). The performance of the study groups showed no significant difference before and after the intervention ( $P > 0.05$ ).

**Conclusions:** Our results show that safety training has potentially positive impact on knowledge and practice of operating room personnel, regarding fire management.

**Keywords:** Safety training, Awareness, practice, Fire prevention, Operating room personnel

## Background and Objectives

Death and damage to property by fire is always stressful. Hospital fire is associated with worrying repeat, and potentially with catastrophic consequences around the world. Hospital fires usually are derived from 3 sources: (1) flammable liquids such as liquids containing alcohol (Prep solution) and volatile chemicals such as ether and acetone used in the operating room. In the presence of oxygen and nitrogen dioxide the materials are a good source of fire; (2) small spark or heat from equipment that work in the area of use of oxygen to patients; and (3) combinations of oxygen gas pipelines, storage tanks

of liquid oxygen and cylinders containing pure oxygen.<sup>1</sup>

According to the ECRI report, from 550 to 650 fires occur annually, of which 100 to 200 fires are related to the surgery fires.<sup>2</sup> Thus, many small fires happen in the operating room and it is estimated that about 20 to 30 fires that occur in the operating room of America hospitals, or disabling event and one to two events have resulted in death.<sup>3</sup>

ECRI also states that the majority of the places of fire is in the head and face and most fire sources are electrosurgical and laser equipment respectively 68% and 13%.<sup>4</sup> However, nowadays fire safety in the operating room is not a topic of high priority, and its cause is the lack of sufficient information in this regard. Some of the most common misconceptions in this field include (1) fire in the operating room in the hospital does not happen today; (2)

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if fire happen, it can be preventable; (3) fire occurs only in inferior equipment; and (4) all operating room staffs know how to do when the fire happens.<sup>5</sup> However, studies show that fire in the operating room is inherent<sup>6</sup> and permanent risk and unfortunately operating room staff's sensitive to this risk has dropped over the past 25 years.<sup>7</sup> But the important point in relation to the fire is that the fire is completely preventable.<sup>8</sup>

Fire prevention in the operating room necessitates the staff's awareness of the risks, and effective communication between staffs of the surgery, anesthesia, and nursing in the operating room. To understand fire prevention, at first we must know how it happens. Fire may happen at any time when the three sides of the fire (combustible, oxidized and heat materials) will put together.<sup>9</sup> Since surgery processes and the existing instruments have these three are side, staffs must be trained in the field of and compounds related to fire triangle in the operating room and be involved also in the maneuvers related to fire prevention in the operating room.<sup>2</sup> According to the Sentinel Event Alert statement on June 2003, all the staffs related to the care of the patient must be trained in the field of fire safety and fire prevention. Therefore, the present study was conducted to determine the effect of safety training on awareness and performance of fire prevention.

## Methods

This quasi-experimental intervention study was conducted on 64 staffs working in operating rooms in 5 teaching hospitals in the Khuzestan province. The subjects were selected by simple random sampling and divided into 2 groups: case and control. After the samples were matched for gender, age, work experience and previous training level, the staffs in the case group were trained indirectly in the fire field. Then, in order to evaluate the effectiveness of training, they were compared with the control group.

### Teaching Methods

After determining the level of awareness of fire prevention, intervention training was conducted through posters to raise awareness and performance. Since the hospital staff workload is high, so there is not opportunity for cooperation in face to face education and lecture in a hospital environment. For this same reason, education was done for operating room staffs indirectly using a poster. For this purpose, an appropriate poster of fire prevention was designed and attached in the place of traffic and rest of operating room staff due to the accumulation of these employees. After attaching the posters, within 20 days the employee's awareness and performance of the fire prevention was measured and compared with pre-

intervention levels. The tools used in this study included demographic questionnaires and questionnaires of fire prevention and educational posters.

**Fire Prevention Questionnaire:** The questionnaire included 11 questions with four choices that measured the level of knowledge (the first factor consists of 5 questions) and performance (the latter includes 6 questions) of operating room staffs about ways to prevent fires in the operating room. The questionnaire was designed based on the Likert scale (1 = full knowledge, 2 = moderate awareness, 3 = poor awareness and 4 = without awareness) and the points of 1, 2, and 4 and zero were considered for the four options. The second factor was the performance that was 4 choices, and scoring methods were the opposite. So that the scores of zero, 1, 2 and 4 were considered for the four options and on this basis, they were divided into four options: high-performance, moderate performance, weak performance and non-performance. The second questionnaire included demographic characteristics of participants (age, gender, work experience, qualifications, previous training in the field of fire prevention and the need for training).

The tool used in the study was of acceptable validity and reliability. Validity and reliability of fire prevention questionnaire were examined and approved in Davudian Talab and colleagues' study at hospitals affiliated to Shiraz University of Medical Sciences.<sup>10</sup>

**Fire education poster:** this poster consists of essential factors and important information in relation to the prevention and control measures in the field of fire. The poster was designed in A3 size based on the faculty's comment of the operating room department and Occupational Health of Medicine Sciences School and was attached to the resting and traffic places according to the analysis of the working environment for the operating room staffs. The number of posters for each hospital was considered according to the size and space of operating room and a survey of employees in these wards. In this study, at first, the research objectives and how to respond to questions about the necessary explanations were given to the participants, and then the questionnaire was available to them. Due to the workload and the time limit of the participants, completed questionnaires were collected the next day and the posters were attached. Twenty days after attaching the posters, the questionnaires were completed by participants again. The data analysis was performed using SPSS version 16.

## Results

The study was conducted on 65 staffs working in the operating room in 5 hospitals out of hospitals in Khuzestan

province. Of these, 34 people were selected as cases and 31 people as controls. The average age of the control group was  $32 \pm 5.3$  years and the average age of case group was  $32 \pm 7.4$  years, which there was not a statistically significant difference between age of people in the case and control groups ( $P = 0.9$ ). In addition, the experience of the participants in this study for the case and control groups, was respectively  $1.1 \pm 7.6$  years and  $8.5 \pm 5.8$  years, which there were statistically not significantly different between cases and controls ( $P = 0.3$ ). However, there were significant differences between the groups in education degree ( $P = 0.04$ ). Table 1 shows demographic data, including mean age, work experience, gender and education degree. Also, this table shows the differences between the case and control groups in the demographic variables. Table 2 shows the amount of knowledge and performance before and after intervention that both variables of knowledge and performance after intervention show more values. The results of the study also showed that there is no significant difference in the average score of awareness between the case and control groups before the intervention ( $P = 0.7$ ); but after the intervention, this difference was ( $P = 0.003$ ).

Furthermore, there was not a statistically significant difference in mean performance score before the intervention between the case and control groups ( $P = 0.9$ ). After the intervention, the difference was not significant, as well ( $P$

$= 0.6$ ); Table 3 shows its values. Table 4 shows the effect of safety training in case group performed with the paired  $t$  test.

## Discussion

Since the fire in the hospital is a special status because different from other modes of fire, when fire the patients cannot save themselves,<sup>11</sup> and surgical services is one of the most basic health care services in hospital and %70 of these fires is related to the electro surgical equipment.<sup>12</sup> So, first, this study investigated the level of knowledge and performance of the staffs in relation to fire prevention, which its results showed that the awareness of fire prevention is in moderate and low, but the performance level is high. The results of knowledge level, compared with another study of the operating room staffs, conducted by Davudian Talab et al in 2012 at Shiraz University of Medical Sciences and 2014 in Behbahan showed higher levels.<sup>10,13</sup> And consistent with other studies in Iran, they have expressed that awareness of the fire in the operating room is at the moderate level.<sup>14,15</sup> Among other related studies, we can point out to Habibi and colleagues' study at the hospitals of Isfahan University of Medical Sciences. In this study, none of the hospitals surveyed did not have a decent safety status.<sup>16</sup> In terms of average the results

**Table 1.** Demographic Characteristics of the Sample and Determining Differences Between Groups

Variable	Group		Frequency	Percent	Mean	SD	P Value
Age	Case		-	-	32	7.4	0.9
	Control		-	-	32	5.3	
Experience	Case		-	-	10.1	7.6	0.9
	Control		-	-	8.5	5.8	
Sex	Case	Men	10	29.4	-	-	0.3
		Women	24	70.4	-	-	
	Control	Men	9	29	-	-	
		Women	22	71	-	-	
Education	Case	Associate	17	50	-	-	0.04
		Bachelor	17	50	-	-	
	Control	Associate	22	71	-	-	
		Bachelor	9	28	-	-	

**Table 2.** Level of Awareness and Practice of Fire Prevention, Pre- and Post-intervention

Variable	Time	Level			
		High	Moderate	Low	Very Low
Awareness	Pre-test	21.6	21.6	51.4	5.4
	Post-test	43.8	37.5	15.6	3.1
Practice	Pre-test	94.1	5.9	-	-
	Post-test	97.2	2.8	-	-

**Table 3.** Comparison Awareness and Practice to Fire Prevention Between Case and Control Group

Variable	Group	Mean	SD	P Value
Awareness	Case	2.95	0.89	0.7
	Control	2.66	0.77	
	Case	3.21	0.83	0.003
	Control	2.61	0.81	
Practice	Case	3.94	0.23	0.9
	Control	3.94	0.22	
	Case	3.97	0.16	0.6
	Control	3.94	0.32	

**Table 4.** Effect of Safety Training on Awareness and Practice to Fire Prevention

Variable	Mean	SD	P Value
Practice	Pre-test	3.94	0.24
	Post-test	3.97	0.17
Awareness	Pre-test	2.59	0.96
	Post-test	3.21	0.83

of this study showed that 45% of the hospitals are at the moderate level of safety and 55% of the hospitals are at the poor level of safety. By studying the hospitals affiliated to Gilan University of Medical Sciences, Safavi et al highlighted that there is the greatest amount of deviation from the standards of safety at the stage of preparation of the operating room. Due to the impact on the physical structure and expendable and non-expendable equipment, this stage plays a significant role in the safety of the operating room.<sup>17</sup>

According to the results obtained in this study and previous studies, we can conclude that the awareness level of fire prevention is low and safety in the operating room is not satisfying. According to Podnos and Williams study, as a result of the increasing awareness of the factors creating combustion, safety factor in staffs and patients as well as the usefulness and effectiveness of the operation room staffs increased.<sup>18</sup> According to Bruley and colleagues' study, prevention of combustion in an operating room necessitated the awareness of the risks and established effective communication between employees including Department of Surgery, Department of Anesthesiology and Nursing.<sup>7</sup> Daane and Toth also suggested that increased awareness of operating room staffs increased the safety factor of staffs and patients.<sup>19</sup>

Andersen stated that a tutorial on combustion sources was the main thing to recognize potential hazards in the operating room.<sup>20</sup> Shahbazi et al suggested that in addition to standardizing the operating room, training the operating room staffs regarding the 3 main combustion

factors, understanding the causes of combustion and its control was effective in fire prevention.<sup>15</sup>

Therefore, in this study the necessary training in the field of fire training in the form of posters was provided to staffs. The results showed that training in fire prevention was effective and awareness level has shown training higher values than before. This result is consistent with the study conducted by Salehi et al.<sup>21</sup> But in relation to the performance of operating room staffs on fire prevention, education did not have a great impact on increase of performance. Therefore, it would be caused by the high level of performance of employees before offering the training. Approximately 94% of the staffs, prior to be trained, had a high performance; however, after training, this performance increased to 97%, but this difference was not statistically significant.

## Conclusions

Consistent with previous studies, our results confirmed that training is effective in improving awareness and practice of the operating room staffs. Therefore, constant education using up-to-date training methods may reduce the fire incident in operating room and promote patient and staff safety.

## Competing Interests

The authors declare no competing interest.

## Authors' Contributions

The authors made the same contributions to this study.

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## References

1. Chowdhury K. Fires in Indian hospitals: root cause analysis and recommendations for their prevention. *J Clin Anesth.*

- 2014;26(5):414-424. doi:10.1016/j.jclinane.2013.12.014.
2. Flowers J. Fire Safety in Procedural Areas. *J Radiol Nurs*.31(1):13-19. doi:10.1016/j.jradnu.2011.10.007.
  3. Yardley IE, Donaldson LJ. Surgical fires, a clear and present danger. *Surgeon*. 2010;8(2):87-92. doi:10.1016/j.surge.2010.01.005.
  4. Beyea SC. Preventing fires in the OR. *AORN J*. 2003;78(4):664.
  5. Hart SR, Yajnik A, Ashford J, Springer R, Harvey S. Operating room fire safety. *Ochsner J*. 2011;11(1):37-42.
  6. Watson DS. New recommendations for prevention of surgical fires. *AORN J*. 2010;91(4):463-469. doi:10.1016/j.aorn.2009.12.023
  7. Bruley ME. Surgical fires: perioperative communication is essential to prevent this rare but devastating complication. *Qual Saf Health Care*. 2004;13(6):467-471. doi:10.1136/qhc.13.6.467.
  8. Goldberg JL, Feldman DL. Implementing AORN recommended practices for prevention of retained surgical items. *AORN J*. 2012;95(2):205-216. doi:10.1016/j.aorn.2011.11.010.
  9. Smith LP, Roy S. Operating room fires in otolaryngology: risk factors and prevention. *Am J Otolaryngol*. 2011;32(2):109-114. doi:10.1016/j.amjoto.2009.11.004.
  10. Davoudian Talab AH, Akbari F, Bazdar SH, Kiani H, Yaghoubi SH, Yousefi F. Assessment of awareness and practice of operating room personnel to fire prevention and effective factors. *Iran Occup Health J*. 2016;13(4):77-84.
  11. Lalla RK, Koteswara CM. Fire in the operating room due to equipment failure. *J Anaesthesiol Clin Pharmacol*. 2013;29(1):141. doi:10.4103/0970-9185.105836.
  12. Melekie TB, Getahun GM. Compliance with Surgical Safety Checklist completion in the operating room of University of Gondar Hospital, Northwest Ethiopia. *BMC Res Notes*. 2015;8:361. doi:10.1186/s13104-015-1338-y.
  13. Davoudian Talab A, Zadeh F, Moshkani M, Ahmad S, Afshin A, Mofidi A. Evaluation of awareness concerning fire prevention and control methods among personnel of operating room in a hospital. *Journal Health Safety at Work*. 2012;2(2):69-78.
  14. Bagheri H, Ebrahimi H, Amozade H, Najafi N, Darisavi A, Abedi S, et al. Survey of awareness of operating room staff about fire sources and its prevention methods in operating room in Shahroud. *Journal of Knowledge Health*. 2007;2(2):11-16.
  15. Shahbazi S, Heidari M, Aliakbari F, Goddosi M. Knowledge of Operating Room Staff on Fire Resources and Fire prevention Measurements. *Preventive Care in Nursing Midwifery Journal*. 2012;2(1):31-35.
  16. Habibi E, Soleymani B, Nateghei R, Lotfirosbehani M, Yarmohammadian M. Risk management in radiology units of Isfahan University of Medical Sciences' Hospitals. *Health Information Management*. 2008;4(1):133-141.
  17. safavi M, Mahjobipor H, Mohammadzadeh M, Honarmand A. Education and Treatment Guideline for Evaluation of Applying Basic Standards of Anesthesia Care in Surgery. *Iran J Med Educ*. 2011;10(4):357-363.
  18. Podnos YD, Williams RA. Fires in the operating room. *Bull Am Coll Surg*. 1997;82(8):14-17.
  19. Daane SP, Toth BA. Fire in the operating room: principles and prevention. *Plast Reconstr Surg*. 2005;115(5):73e-75e.
  20. Andersen K. Safe use of lasers in the operating room-what perioperative nurses should know. *AORN J*. 2004;79(1):171-188.
  21. Salehi Zahed L, Asadi M, kordmir K. The effect of risk management education on the knowledge and performance of Operating room personnel at hospitals affiliated with Islamic Azad University Tehran Medical Sciences Branch in 1392. *Iran J Nurs Res*. 2016;11(1):42-50.

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