SAFE SURGERY IN A SAFE OPERATING ROOM MODEL: A META-SYNTHESIS

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ABSTRACT

Safety is the cornerstone of patient care. There are numerous challenges to patient safety in the operating room. The present study conducted aim to identify risk factors related to the operating room and present a model for promoting safety in the operating room via the meta-synthesis systematic review method. The purpose of operating room safety is to perform safe operations for both patients and employees, which can be achieved through teamwork, promoting safety culture and continuous education, supervision and control of environmental risk factors.

Keywords: Operating room safety; Patient safety; Safety risk factors; Safe surgery.

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INTRODUCTION

Safety is the cornerstone of patient care (1). Safety science is a methodology that analyzes the cause of adverse events by analyzing them (2), and prevent them. Adverse events refer to risk factors that lead to injuries and complications of medical interventions (3). Hazard risk factors refer to any factor that increases the risk of adverse events (3). Hazard factors in therapeutic settings may be lead to adverse events and patient mortality. In 1999, they resulted in 100,000 deaths in the United States (4). Out of the 2 million patients hospitalized in 1984 in New York, 27,179 experienced adverse events, including therapeutic neglect and complications of medical interventions. However, more than 54% of adverse events are preventable (5). Advances in technology and therapeutic processes have enhanced surgical and therapeutic efficacy, and efforts should be made to prevent the hazard factors of medical intervention complications (5).

There are numerous challenges to patient safety in the operating room. On the other hand, occupational stress, specialized equipment, delicacy of surgery, burnout and excessive workload are factors that increase the adverse events in the operating room (6). Four percent of the world population undergoes major surgeries annually. A total of 187 to 281 million surgical procedures are performed each year, half of which result in medical intervention complications (7). Over 16% of patients undergoing open-heart surgery develop complications, which is 3% higher than surgical patients (5). According to a 2008 report by the World Health Organization (WHO), although surgery inherently saves patients' lives but planning for reduce complications and improve patient safety in the operating room due to the high incidence of surgical adverse events is

necessary (7).

Despite all efforts and guidelines, patient safety in the operating room remains a major challenge (6). So promoting safety in the operating rooms (8) and studies have focused on identifying hazard factors in the operating room is essential. In this regard, the present study was conducted aim to identify hazard factors in the operating room and provide a model to improve safety in the operating room.

METHODS

Deductive approach in the form of a meta-synthesis systematic review was used in order to obtain comprehensive knowledge on identifying contributing factors to safety in the operating room (9-11). In order to carry out the present meta-synthesis, an adapted strategy based on the guidelines of the Centre for Reviews and Dissemination, University of York, 2008 was used (12) in the following 7 steps:

1. Formulating the research question that represents the systematic review objective.
2. Searching databases.
3. Selecting studies related to the research objective and question.
4. Selecting studies based on inclusion criteria,
5. Evaluating the quality of selected studies.
6. Extracting textual data and analysis (thematic analysis), and
7. Combining textual data.
8.

According to the study objective, the main question was to identify factors affecting safety in the operating room. "Patient safety", "operating room safety", and "safe surgery" were used as keywords in PUBMED, Science Direct, Ovid, and Pro Quest databases. This review was done in the September of 2019.

This search revealed 258 articles, which were reduced to 221 after removed duplicates. In the next step, the abstracts of selected articles were reviewed for conformity to the inclusion and exclusion criteria and 142 articles were excluded from the research process. Inclusion criteria were the relevant English and Persian articles published prior to 2019 in terms of "Patient safety", "operating room safety", and "safe surgery". The articles qualities were evaluated with STROBE and CONSORT Statement. 29 articles were finally selected for research. Figure 1 illustrates the article selection process.
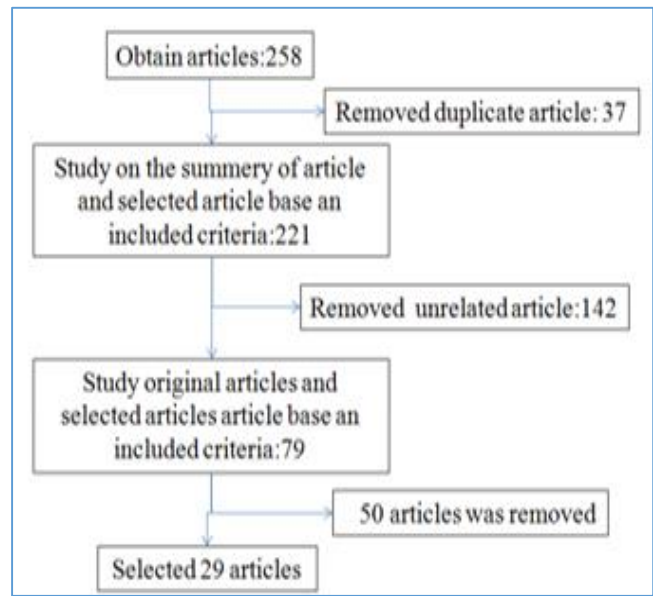

Figure 1: The article selection process

In the review phase, the articles were simultaneously and individually examined by two researchers (9, 13). Articles deemed acceptable by both researchers were included in the study and analyzed. Data were analyzed using thematic analysis. The audit research method was used to improve data accuracy. Data were analyzed simultaneously by the researchers (9, 13).

RESULTS

Complete safety is non-existent and will never be achieved in reality; hence the definition of safety as "the relative protection against hazards" (14). Table 1 showed the summary of the articles that was referred to the factors affecting safety in Operating room.

Table 1- studies related to the factors affecting safety in Operating room.

n°	References	Authors	Codes
1	(14)	Hill M and al.	Staffs and patients affect each other's safety
2	(15)	Phillips N. and al.	Hazard factors in operating room include physical, chemical, biological, and ergonomic factors
3	(3)	Bergman LM and al.	Patients factors therapeutic team, tasks, technology, environment, and management
4	(16)	Carayon P and al.	Human factors : tasks, tools, equipment, physical environment, and organization
5	(17)	Corrigana S. and al.	Human factors of staff and surgeons Safety culture
6	(18)	Catchpole K and al.	Communication, inadequate processes, and ineffective management
7	(19)	Antoniadis S and al.	Equipment failure and inappropriate physical environment
8	(20, 21)	Flin R and al.	Management, safe system, risk prediction, reporting, safe behavior, appropriate communication and feedback, teamwork, human resources, and organizational factors
9	(5)	Wahr JA and al.	Failure in technical skills, knowledge, training, teamwork, and systematic work, lack of effective communication, collaboration, and team coordination
10	(22)	Wang X and al.	Education, teamwork, management, error feedback and handling, patient safety support, error reporting, open communication, and management Safety culture. Nurses roles are undeniable for improving safety
11	(23)	Barbeito A and al.	Equipment, human factors, teamwork, and management in the operating room Surgery and surgery time.
12	(21)	Gurses AP and al.	Inadequate training, lack of professional staff, tasks such as schedule changes and unspecified task descriptions, physical environments such as improper equipment and inappropriate temperature, and management such as focus on safety, inappropriate strategies, training, and care processes such as lack of clinical standards and guidelines
13	(6)	Hurlbert SN and al.	Regular training and effective continuous education, documentation of patient safety issues, and continuous supervision, particularly peer-to-peer monitoring
14	(4)	Papaspyros SC and al.	Teamwork
15	(24)	Lingard L and al.	Improper and ineffective communication is often the root of many medical errors. Teamwork
16	(25)	Gillespie BM and al.	Incomplete and incorrect communication lead to error
17	(26)	Gillespie BM and al.	Incorrect communication leads to adverse events
18	(27)	Herlehy AM.	Poor communication among care providers is a major hazard factor
19	(2)	Hull L and al	Teamwork
20	(28)	Hu Y-Y and al.	Inter-professional and coordinated communication is essential
21	(29)	Russ S and al.	Use of an appropriate and complete checklist t for correct evaluation
22	(7)	Zingiryan A and al.	Using the checklist reduced surgery complications
23	(30)	Lepänluoma M and al.	Having a safety checklist for admission
24	(31)	Patel J and al.	Use of a safety checklist
25	(1)	Magill ST and al.	Use of a safety checklist
26	(32)	Conley DM and al.	Use of a safety checklist
27	(8)	Kaafarani HM and al.	Safety culture.
28	(33)	Xie J-f and al.	Various factors can influence safety culture management, including working in a safe environment, job satisfaction, teamwork, and stress. Nurses play a key role in reducing unintended complications.
29	(34)	Pinheiro JPA and al.	Safety culture

Safety is established when the risk of death, injury, or illness for the stakeholders (care givers and care delivers) is at the lowest extent possible. In therapeutic setting, patients are service recipients and, depending on the circumstances, staffs and patients affect each other's safety. Efforts to improve safety have been embraced by most employees (14). On the other hand, patients can influence staff safety in a variety of ways, including transmission of diseases in general and blood-borne diseases in particular (15).

Various hazard factors can affect the health of staff and patients in the operating room. hazard factors in operating room include physical (cold, heat, noise, rays, light, air pressure, radiation, electricity, magnetic fields), chemical (chemicals, dust, aerosol, gases, vapors, and solvents), mechanical (bed attachments, surgery light, and other equipment), biological (viruses, fungi, bacteria, parasites, and rickettsia), and ergonomic (patient transfer, poor physical condition, individual incongruity to work, burnout and other job stress) factors (15).

Patients factors include disease and surgery types, length of stay, degree of illness, severity of illness, positive-pressure mechanical ventilation, sedation (3). Human factors are importance (16). Human factors of staff and surgeons are responsible for more than 80% of the adverse events (17). Catchpole *et al.* maintained that incorrect communication, inadequate processes, and ineffective management are among human factors contributing to the occurrence of adverse events (18).

Successful surgery depends on the correct diagnosis and treatment plan, the surgeon's skill, appropriate equipment, and proper tasks and follow-up (18). Equipment failure and inappropriate physical environment of the operating room lead to tension and reduce patient safety in the operating room (19). Management, safe system, risk prediction, reporting, safe behavior, appropriate communication and feedback, teamwork, human resources, and organizational factors are among contributing factors to adverse events (20, 21). Preventable hazards include failure in technical skills, knowledge, training, teamwork, and systematic work, lack of effective communication, collaboration, and team coordination that can reduce adverse errors (5).

Education, teamwork, management, error feedback and handling, patient safety support, error reporting, open communication, and management can positively affect safety culture (22). Equipment, human factors, teamwork, and management in the operating room are factors influencing patient safety (23). According to Gurses *et al.*, care provider errors are caused by inadequate training, lack of professional staff, tasks such as schedule changes and unspecified task descriptions, physical environments such as improper equipment and inappropriate temperature, and management such as focus on safety, inappropriate strategies, training, and care processes such as lack of clinical standards and guidelines (21).

The main purpose of safety in the operating room, *i.e.* performing safe surgery in a safe operating room, cannot be achieved without teamwork and effective communication and control of the environmental hazard factors that threaten the safety of staff and patients. In this regard, teamwork and effective communication in the operating room are strongly emphasized. Communication, collaboration, coordination, checklist use, and proper training are factors that can reduce the incidence of unintended errors (5). Regular training and effective continuous education, documentation of patient safety issues, and continuous supervision, particularly peer-to-peer monitoring, can enhance the operating room culture (6). Figure 2 illustrates the safety model in the operating room.
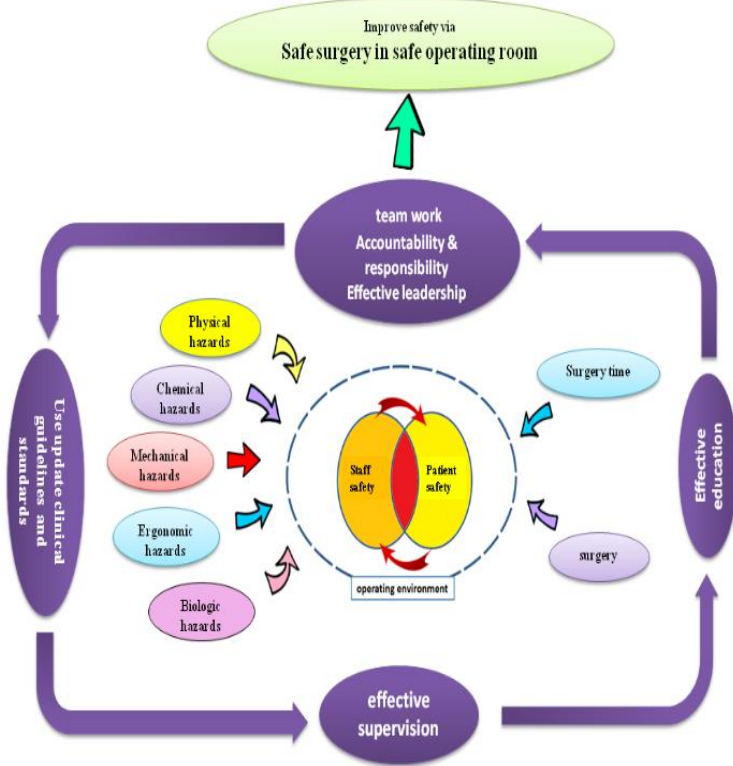

Figure 2: Model of safe surgery in a safe operating room

DISCUSSION

Gurses *et al.* categorized hazard factors into four categories of care providers, tasks, devices and technology, physical environment, management, and care process (21). According to Bergman *et al.*, factors influencing adverse events include therapeutic team, tasks, technology, environment, and management (3). Carayon *et al.* identify tasks, tools, equipment, physical environment, and organization as contributing factors to safety (16).

Improper and ineffective communication is often the root of many medical errors. Failure in communication gives rise to numerous difficulties in the operating room. Stressful environments and inadequate communication are involved in 30% of staff turnover and one-third of errors (24); 70% of errors are due to incomplete and incorrect communication (25); 30% of specialized information is lost in incorrect communication and leads to adverse events (26). Poor communication among care providers is a major hazard factor for patient safety, especially in intensive care units. Poor communication includes messy handwriting, inaccurate and illegible labels, unreported task descriptions, and irregular shift changes, for which the use of guidelines can be helpful (27).

As emphasized in the model, teamwork and proper communication are key factors in operating room safety. For example, Hull *et al.* emphasized teamwork in the operating room (2). Lingard *et al.* also underlined teamwork in the operating room (24). Gillespie *et al.* stated that 70% of errors are due to incomplete and inaccurate communication (25). According to Hu *et al.,* inter-professional and coordinated communication is essential in therapeutic processes (28).

Teamwork refers to technical skills, including management and use of surgical equipment, and non-technical skills such as communication, decision making, and situational alertness (25). Technical skills are important, yet non-inclusive, factors for successful operations, and require non-skill techniques such as leadership, communication, and teamwork (2).

Russ *et al.* emphasized proper patient identification, surgical procedures, antibiotics, patient concerns, nurse equipment, bleeding, surgical equipment, deep vein thrombosis, sterilization, monitoring, proper hair shaving, and the use of a checklist for correct evaluation of these cases that can reduce errors and prevent negligence. They also stated that the specified points should be underlined in the patient safety checklist (29).

According to a 2008 report by World Health Organization, surgery inherently saves patient life and a safe surgical checklist should be used to reduce the complications. A total of 6000 health centers around the world supported the use of a safe surgery checklist and 1,800 centers used it. The results showed that using the checklist reduced surgery complications (7).

Lepänluoma *et al.* stated that having a safety checklist for admission to the operating room and taking the patient anesthetic history are very effective in promoting safety (30). Russ *et al.* emphasized that the use of an appropriate and complete checklist can promote patient safety and safety culture (29). Patel *et al.* stated that the use of a checklist can improve patient safety (31).

Magill *et al.* argued that checklists can improve patient safety and increase efficiency and effectiveness (1). In fact, the use of an appropriate checklist is one of the factors influencing the safety of staff work conditions, management, job satisfaction, teamwork, safety culture, and stress reduction (14). As Conley *et al.* suggested, although the use of a checklist can be effective, its mode of use in hospital processes is also important. Training provision on, as well as the method and significance of completion of checklists are some of the factors that influence their efficacy in producing favorable outcomes (32).

Safety culture refers to the organizational culture or a safe space within an organization that prioritizes safety across all levels of management and employees. Safety culture embodies an ideal principle of safety in any organization (17). Patient safety culture is an important factor in reducing hospital adverse events and improving patient safety and has a very positive role in error reduction (22). Various factors can influence safety culture management, including working in a safe environment, job satisfaction, teamwork, and stress (33). Positive managerial perception of patient safety culture correlates with a low incidence of adverse events, which is yet to be established in many centers (33, 34).

Nurses form the largest members of the therapeutic staff (33), whose roles are undeniable (22). Xie *et al.* suggested that nurses play a key role in reducing unintended complications such as falls and bed sores (33). In fact, it can be argued that nurses represent a communication between team members for establishing a positive and effective relationship to achieve safety goals.

CONCLUSIONS:

The purpose of operating room safety is to perform safe operations for both patients and employees, which can be achieved through teamwork, promoting safety culture and continuous education, supervision and control of environmental risk factors.

List of abbreviations
No abbreviation was used in this manuscript.

Ethics approval and Consent to participate
Not applicable. Because manuscripts does not report on or involve the use of any animal or human data or tissue.

Consent for publication
"Not applicable" Because our manuscript does not contain any individual person's data.

Availability of data and material
"Not applicable"

Competing Interest
The authors declare that they have no competing interests.

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