

Factors Affecting Occurrence of Nursing Errors in Operating Room: Suggestive Preventive Guidelines

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Abstract

Background: Operation rooms are one of the most hazardous environments in terms of possible human-related health hazards, identifying the contributing factors is a necessity to reduce the errors and improve the quality of health care. **Aim:** this study aims to explore the nursing errors in operating room as perceived by nurses under study, investigate the factors affecting them and suggest Preventive guidelines regarding their prevention. **Study design:** cross-sectional descriptive research design was utilized in this study to fulfill the aim of the study and answer the research question. **Subject:** convenient sample include all available (96) nurses who works at operating rooms in the three previously mentioned hospitals and agree to participate voluntarily in the study. **Setting:** The study was conducted at operating theatre at the three hospitals from 3 geographical governorates including; Mansoura university hospitals, Port Said Health insurance hospitals and Ain shams university hospital. **Data collection tools:** Semi-structured nurses' interview questionnaire to investigate the nursing errors in operating room and explore factors affecting its occurrence as perceived by nurses under study. It consists of three parts including; assessment of demographic and general characteristics of the nurses under study, assessment of nursing errors in operating room as perceived by nurses under study and assessment of the factors affecting occurrence of nursing errors in operating room as perceived by nurses under study. **Results:** it was found that 72.9%, 67.7 % and 62.5% of the studied nurses agree that lack of appropriate equipment, poor aseptic technique in skin preparation/handling/ draping and inadequate documentation process respectively were common nursing errors in OR setting. The results showed that the most common reported human factors which were arranged in descending order as communication system-related factors (77.3%) and training/ supervision related factors (58.46%). Regarding environmental domain, it was found that the most common reported factors as perceived by studied nurses were material and equipment resources / maintenance (79.33%). **Recommendations:** All operating room nurses should participate in training programs to increase their knowledge and practice, as well as to reinforce positive attitudes towards patient safety and error minimization.

Keywords: Nursing Errors, Operating Room, Suggestive Preventive Guidelines

Introduction

The environment in which operating room (OR) nurses work is becoming more stressful and demanding. Demands result from the rapid changes and tightened economic situation of health care. The focus on increased public service needs also has an impact on nursing, and often the psychosocial needs of staff are overlooked. In these stressful conditions, a higher incidence of errors might be possible. Worldwide, health care organizations continuously urge multidisciplinary perioperative teams to deliver and maintain a high quality of surgical care (Garrett, 2016).

Despite best efforts, some factors lead to operating room errors. Patient safety may be put at risk by issues like inadequate communication, information overload, stress and exhaustion, emergency surgery that deviates from accepted procedures; interruptions, distractions, severe workloads, hierarchical structures, insufficient skill, and poor equipment design (Teunissen et al., 2020).

The operating room (OR) is the main area for high-risk patient-related risks and is considered the proper location to apply advanced technologies. Patient safety and health outcomes in the operating room are directly correlated with

increased care provider professionalism **Fesco et al. (2017)** reported that effective technical performance has a favorable effect on patient outcomes such as intraoperative complications, morbidity, and death. The nursing personnel in the operating room is specifically responsible for ensuring patient safety during and following surgical operations (**Jung et al., 2020**).

The operating room is a highly technical and stressful work environment where patients undergo invasive procedures. Interpersonal conflicts are common in the operating room as different specialists overlap their duties. Life-threatening situations and events frequently occur in this environment that requires immediate decisions. Because of these characteristics, operating room nurses always are exposed to ethical challenges (**Aghamohammadi et al., 2021**).

Blomberg et al. (2018) found that the operating room nurse is responsible for two aspects. The first is the duty of possessing the specialized knowledge and abilities to prepare patients and the required tools for various surgeries. The second is the moral responsibility of operating room nurses in having a professional and respectful relationship with patients and colleagues.

Effective surgical patient care depends on the work of perioperative nurses. With attitudes of safety, risk management, professionalism, accountability, and consumerism affecting nurses working in the perioperative area, the perioperative environment is always evolving. It is essential to be able to use an ever-expanding range of technologies while providing and supervising surgical patient care in order to lower risk and promote patient safety. For perioperative carers to practice at their highest levels, they must be able to maintain a safe environment. This includes upholding morality, legal requirements, educational standards, autonomy, accountability, decision-making, and ethical standards (**European Operating Room Nurse Association, 2022**).

The operating room, due to the high level of technology and the specialized tasks required, the operating room is a source of confusion, stress, emotional stress, and interpersonal conflicts. It's critical to have methods in place to prevent mistakes because the strain and stress enhance the

likelihood of making errors. These moments of tension and increased stress, potentiate the occurrence of errors, and it is fundamental to define strategies to avoid them (**Vinagre & Marques, 2019**).

It's critical to develop techniques to prevent errors since the strain and stress in the operating room increase the likelihood of errors. Guidelines are a crucial component of safe, effective, and error-free nursing care. The use of checklists, written policies, and procedures were emphasized by nurses, who also emphasized the necessity to sign policies to show that they had been read. Adherence to this guideline is intended to prevent items of equipment being left inside the patient after the operation. This and other examples highlighted the potential for guideline compliance to become an end in itself, with some members of staff losing sight of the overall aim of the guidelines or at least displaying an unquestioning acceptance of their contents (**Delacroix, 2017**).

Significance of the study

Various studies have shown that 53 to 70 percent of surgical errors occur in the operating room. Therefore, errors detection has been considered as the basis for maintaining and improving the safety of the patient. Nurses understand that human factors contribute to nursing errors, but it is unclear if nurses agree on which factors are most likely to cause errors, which errors are most important, what can be done to intervene to reduce or eliminate errors, and even how commonly errors occur. Understanding the degree of agreement or discordance will help identify what kinds of education, remediation, or oversight might be needed to decrease errors (**Zabihirad et al., 2018**).

The perceptions of nurses can contribute to solutions and acceptance of new strategies to control and mitigate human errors in hospitals. Getting the nursing perspective will help hospital managers, quality control professionals, patient safety officers, and nurses themselves to understand how to control for these human cognitive processing constraints in order to improve the safe delivery of nursing care. Human fallibility and system fallibility has been the subject of an abundance of research and development, yet nursing errors continue to occur. Exploring those factors and designing nursing guidelines around

controls for human processing failures may assist in providing a higher level of patient safety (Mi Ra & Soon, 2019).

Due to the sensitivity and complexity of working conditions in the operating room and a limited number of studies conducted in factors affecting nursing errors in the operating room in Egypt, the present study was conducted to explore the factors affecting the nursing errors in the operating room. Operating room nurses are considered to have different practical concern needs according to their clinical careers because they need to develop highly complex nursing performance competencies, different from those of other nurses in general wards (Fearon, 2018).

Operating theaters are recognized as high-risk environments; however, mechanisms to reduce error have not been adopted universally, leaving patients at risk of perioperative harm, to overcome these errors. When looking into the causes of nursing errors, nurses experiences regarding errors were under-valued and recommended that more research is done in this area (Woo & Avery, 2021). Nursing errors should be analyzed thoroughly to identify their underlying causes to serve as a benchmark for the development of effective error preventive strategies. Hence suggestive guideline should be developed to overcome these factors and reduce nursing errors.

Aims of the study

This study aims to

- Explore the nursing errors in operating room as perceived by nurses under study.
- Investigate the factors affecting occurrence of nursing errors in operating room as perceived by nurses under study.
- Suggest preventive guidelines regarding prevention of nursing errors in operating room based on study findings.

Study questions

- What are the nursing errors in operating room as perceived by nurses under study?
- What are the factors affecting occurrence of nursing errors in operating room as perceived by nurses under study?

- What are the suggestive preventive guidelines regarding occurrence of nursing errors in operating room based on study findings?

Operational definition

Nursing errors referred to as the commission of wrong care or the omission of care, both of which lead to an unfavorable outcome during delivering nursing care at operating room theatre.

Nurses 'perception in this study means nurses' point of view based on their beliefs, values and experience.

Subjects and Methods

The subjects and methods of the present study will be described as technical, operational, administrative, and statistical designs.

Study design

Cross-sectional descriptive research design was utilized in this study to fulfill the aim of the study and answer the research question. This type of research design used to inspect the prevalence of a phenomenon or condition in a defined population at a specific point and variables are recorded for each participant (Fain, 2017).

Subjects and Method

Setting

The study was conducted at an operating theatre at the three hospitals from 3 geographical governorates including; Mansoura University Hospitals, Port Said Health Insurance Hospitals, and Ain shams university surgical hospital. All study settings include operating room theatre with main different specialties including; general surgery, cardiothoracic, orthopedic, urology, neurology, ENT and ophthalmology. The nurses in all study settings work as a scrub nurse, circulator and anesthesia nurses.

Study sample

A convenient sample includes all available (96) nurses who work in operating rooms in the three previously mentioned hospitals (32 nurses from Mansoura university hospitals, 33 nurses from Port Said Health insurance hospital, and 31 nurses from Ain shams university hospital) regardless of educational level, gender, years of experience, operating room specialty, agree to

participate voluntarily in the study and available at the time of data collection. Selecting study participants from three different settings to increase study sample and give more power and generalization of study findings.

Tools of data collection

One tool was utilized to obtain the necessary data to achieve the aim of the study.

Tool: Semi-Structured nurses' interview Questionnaire

It was developed by the researchers in an Arabic language to investigate the nursing errors in operating room and explore factors affecting its occurrence as perceived by nurses under study. It consists of three parts:

Part one was concerned with assessment of demographic and general characteristics of the nurses under study such as age, educational level, years of experience, operating room specialty and attendance of training courses.

Part two was concerned with assessment of nursing errors in operating room as perceived by nurses under study. It was developed by the researchers after reviewing relevant and updated literatures regarding that topic (**Jun & Lee, 2014; Ugur et al., 2016; Mojdeh et al., 2019; Vinagre & Marques, 2019**). It was consisted of 19 items and the nurses were asked to respond on 3-point likert scale (agree, somewhat agree and disagree). It was translated and retranslated into Arabic language to maintain its content validity.

Part three was concerned with assessment of the factors affecting occurrence of nursing errors in operating room as perceived by nurses under study. This tool was developed by the researchers after reviewing most relevant literatures (**Hashemi et al., 2012; Van Beuzekom et al., 2012; Cramer, 2013**). It included 9 domains with a total of 45 indicator factors classified into two main categories human and environmental factors domains. Human factors category included 5 domains (communication system (4 items), teamwork (5 items), training/ supervision (6 items), patient, nursing staff (3 items) and nursing staff related factors (11 items). Environmental category included 4 domains

(operating room structure/ environment related factors (5 items), material and equipment resources management/ maintenance (5 items), recording and reporting system related factors (2 items) and policies /rules/ procedures related factors (4 items).

Scoring system:

Each response from part two and three was graded on 3-point likert scale. One grade was given for disagree response, two grades were given for somewhat agree response; while three grades were given for agree response. Total score for each domain and sub domain was summed and mean scores were calculated.

Suggestive preventive guidelines for relieving factors affecting occurrence of nursing errors in operating room:

The Suggestive preventive guidelines were developed and highlighted based on the current study findings to fulfill the aim of the study and answer its question. It was guided by recent and related literatures (**Silén-Lipponen, 2005; Zabihirad et al., 2018; El-Sayed et al. 2021; Alshyyab et al., 2022**). It is translated into Arabic in a booklet developed by the researchers after reviewing recent relevant literatures.

Ethical considerations

The study protocol was approved by the local Research Ethics Board NUR from port-Said ethical approval board of faculty of nursing, Port Said University with ethical code NUR(5/2/2023) (22) at 5/2/2023. Oral consent to participate in the study was obtained from all participant nurses after explaining the aim of the study and they were assured that all collected data would be confidential and only will be used for the study's aim. The nurses were informed that refusal to participate in the study would not affect them and they have the right to withdraw at any time.

Pilot study:

It was conducted before performing the main study on 10% of the total sample (9 nurses). They were randomly selected to determine the applicability of the tool, the feasibility of the test, the clarity of the language, estimate the time required to fill out the questionnaire, and identify potential barriers and problems that may be

encountered in the data collection process. The nurses who involved in pilot study were excluded from the total sample due to required modifications.

Validity and reliability

The content validity of the questionnaire was obtained by using the views of 12 experts from faculty members of the medical-surgical nursing department of Mansoura, Ain Shams, and Port-Said Universities in addition to 3 operating room senior nurses of study settings. They were asked for their opinions on the study tools concerning its overall structure, design and internal consistency, accuracy, and applicability to the current study and making the necessary corrections and approving them. Researchers assessed the statistical reliability of the study tool (Semi-Structured nurses' Interview Questionnaire) using Cronbach's alpha test which was used to determine the degree to which the tool's items all assessed the same idea and correlate with one another. Cronbach's alpha test for the study tool was 0.864, this value indicate reasonable level of reliability of study tool.

Field Work

The actual fieldwork and the process of data collection consumed 2 months; starting from mid of February to mid of April, the researchers sent official letters of permission to collect the data from the last-mentioned settings. The operating room director either surgical or nursing of each hospital contacted and informed to obtain permission to conduct the study. Translation and retranslation of the study questionnaire under language expert supervision were done. The researchers introduced themselves to study participants in the first meeting to initiate communication, explain the nature and aim of the study for nurses, and their agreements were obtained.

Data were collected using semi-structured, face-to-face, in-depth interviews. The researchers were interviewing the participants using semi-structured questionnaire to provide an opportunity for studied nurses to express their thoughts and explain each investigated topic from their point of view which facilitate the discussion of study findings. The interviews took place in a quiet room at a hospital and lasted an average from 30–45 minutes. Each participant was interviewed once because the acquired information was complete, clear, and sufficiently detailed. Before

the start of the interview, the goals of the study were stated, and the participants were given a written questionnaire to record their answers.

The researcher entered the operating room after receiving approval from the hospital authorities. The participants were assured that the questionnaires would be anonymous and the received information would be confidential. The data were collected in morning and afternoon shifts three days per week.

The researchers distribute the questionnaire individually to ensure that the participants' data were collected individually to avoid ideas sharing and ideas bias. Each participant was asked to fill out the questionnaire and asked to resolve the ambiguity in their statements. Participants were encouraged to describe the incidents in as much detail as they could; sometimes the researchers repeat the question or ask for an explanation if the answer was vague.

Statistical analysis

All statistical tests were conducted using SPSS for windows version 25.0 (SPSS, Chicago, IL). Due to the explorative nature of the study, p-values have not been adjusted for multiple comparisons, and should only be interpreted as descriptive measures of the strength of association. Continuous data were normally distributed and were expressed in mean \pm standard deviation (SD). Categorical data were expressed in frequency and percentage. To identify the independent predictors multiple linear regression test was used. Statistical significance was set at $p < 0.05$.

Results

Table (1) shows that 67.7% of the nurses under study their age ranged between 26 -40 years with mean age about twenty nine and 64.6% of them were females, 59.4% of them were married. It was found that 37.5 % of studied nurses were holding bachelor degree and 33.3% of them were graduated from nursing school or had bachelor degree of nursing. Regarding years of experience in OR setting, 39.6% of the studied nurses have less than 5 years of experience with mean years almost eight years. Also, 58.3% of the nurses under study reported that they didn't receive previous training. 41.7% of the nurses worked in general surgery theater.

Table (2) shows distribution of the most frequent errors in the operating room from nursing point of view, the findings demonstrates that 92.7%, 87.5 and 84.4 % of the studied nurses respectively disagree that incorrect identification of

surgical site, Leaving supplies/ equipment in the operation site and poor patient identification are common errors among nurses in OR setting. Meanwhile, 72.9%, 67.7 % and 62.5% of the studied nurses agree that lack of appropriate equipment, poor aseptic technique in skin preparation/handling/ draping and inadequate documentation process respectively were common nursing errors in OR setting . Moreover, 41.7%, 40.6. %, 37.5% of the studied nurses respectively were to somewhat agree that blood transfusion errors, incorrect/ inaccurate counting of instruments and diathermy accidents /burns were common nursing errors in OR setting. .

Table (3) illustrates human factors affecting nursing errors in operating room as reported by studied nurses. Regarding communication system related factors, the findings shows that 67.7 % and 61.5% of the studied nurses agree respectively that information about changes in OR program / planned procedure in the right time and adequate communication about patients with other disciplines/ units / departments are major communication related factors, meanwhile 63.5%, 62.5% and 59.4% reported their agreement that team coordination, team's ability to deal with unexpected events and sufficient team instruction during operation / shift are common factors contributing nursing errors respectively.

Furthermore, 69.8% , 64.6 % and 58.3% of studied nurses agree that the most common training/ supervision related factors that contribute nursing errors in OR setting are respectively inadequate supervision system for detection of poor performance, training nurses about dealing with new equipment technology and assessment of training needs of OR theatre personnel periodically. Also, inadequate patient assessment, emergency of the surgical procedure and inappropriate patient identification system are common patient related factors causing nursing errors as reported by 61.5%, 56.3% and 55.2% of studied nurses respectively.

Concerning nursing staff related factors, 63.5%, 62.5%, 61.5% and 60.4% of nurses under study agreed that physical and mental condition of nursing personnel, lack of adequate nursing experience/poor qualification and role conflict between nurses in OR theatre and other health care team were the most reported factors from nurses' point of view.

Table (4) clarifies environmental factors affecting nursing errors in operating room as perceived by studied nurses. Results shows that 65.6%, 62.5% and 60.4% of the nurses under study agree that increased noise level, poor temperature adjustment / air conditioning and inadequate lightening respectively are common operating room structure/ environment related factors, meanwhile 53.1% of them their point of view that unawareness of the health staff with the importance of reporting system activation are common contributing factor.

Regarding material and equipment resources / maintenance related factors, it was found that 59.4% of the studied nurses were agreeing about unavailability of materials and equipment, 55.2 % of them reported inadequate equipment/facilities while, 50% of them reported equipments malfunctioning. As regard to policies / rules/ procedures related factors, 58.4% and 46.9% of studied nurses agreed that poor compliance with OR safety checklist to maintain patient safety in addition to inadequate following of standards of care, policies and processes were common factors affecting nursing errors.

Table (5) clarified the total mean scores of factors affecting the occurrence of nursing errors in operating room as perceived by studied nurses. The results showed that the most common reported human factors which were arranged in descending order as communication system-related factors (77.3%), training/ supervision related factors (58.46%), patient related factors (56.12%), nursing staff related factors (52.45%) and finally teamwork related factors (42.95%). Regarding environmental domain, it was found that the most common reported factors in descending order as perceived by studied nurses were material and equipment resources / maintenance (79.33%), OR theatre structure/ environment related factors (74.53 %), recording and reporting system related factors (44.66%) and finally policies / rules/ procedures related factors (42.43%).

Table (6) demonstrates that there is a significant effect of both of age, educational level and experience and their perception regarding factors affecting occurrence of nursing errors in operating room (p- value < 0.05). While there is non-significant effect of nurses' gender, marital status, receiving training and operation type on occurrence of nursing errors in operating room (p-value >0.05).

Table (1): Demographic and general characteristics of nurses under study (N=96)

Items	No	%
Age (Years)		
▪ 18- 25	26	27.1
▪ 26 -40	65	67.7
▪ > 40	5	5.2
Mean age ± SD	29.260 ± 0.645	
Min. Max.	18-48	
Gender		
▪ Male	34	35.4
▪ Female	62	64.6
Marital status		
▪ Single	57	40.6
▪ Married	39	59.4
Educational level		
▪ Nursing school	32	33.3
▪ Technical Institute	18	18.8
▪ Bachelor nursing	36	37.5
▪ Postgraduate	10	10.4
Experience (Years)		
▪ < 5	38	39.6
▪ 6-10	32	33.3
▪ >10	26	27.1
Mean experience ± SD	7.895 ± 0.538	
Min. - Max.	1 - 22	
Receiving previous training regarding OR procedures/ safety		
▪ Yes	40	41.7
▪ No	56	58.3
Operative specialty		
▪ E.N.T	13	13.5
▪ Neuro	15	15.6
▪ Cardiothoracic	7	7.3
▪ General surgery	40	41.7
▪ Ophthalmology	6	6.2
▪ Urology	9	9.5
▪ Others	6	6.2

Table (2): Frequency and percentage distribution of most frequent errors/adverse events in the operating room from the perspective of studied nurses (n= 96)

Factor domains	Agree		Somewhat		Disagree	
	No	%	No	%	No	%
▪ Poor Patient identification	5	5.2	10	10.4	81	84.4
▪ Incorrect Identification of surgical site (part/side/level)	2	2.1	5	5.2	89	92.7
▪ Anesthesia administration errors	12	12.5	30	31.2	54	56.2
▪ Blood transfusion errors	30	31.2	40	41.7	26	27.1
▪ Drug administration errors	40	41.7	20	20.8	36	37.5
▪ Errors related to safety of high risk medication	20	20.8	25	26	51	53.1
▪ Incomplete filling of surgical checklist	40	41.7	24	25	32	33.3
▪ Incorrect/ inaccurate counting of instruments	32	33.3	39	40.6	25	26
▪ Incorrect/ inaccurate counting of dressing/pads	38	39.6	34	35.4	24	25
▪ Poor aseptic technique in skin preparation/handling/ draping.	65	67.7	25	26	6	6.3
▪ Patient fall accidents	10	10.4	17	17.7	69	71.9
▪ Diathermy accidents /burns	36	37.5	36	37.5	24	25
▪ Misuse of equipment/devices/ new technology	45	46.9	25	26	26	27.1
▪ Poor patient positioning	37	38.5	26	27.1	33	34.4
▪ Improper management (identification/securing/ labeling) of surgical specimen	34	35.4	22	22.9	40	41.7
▪ Inadequate documentation process	65	62.5	30	31.3	6	6.2
▪ Leaving supplies/ equipment in the operation site	5	5.2	7	7.3	84	87.5
▪ Errors related to equipment / supply safety	30	31.2	32	33.3	34	35.5
▪ Lack of appropriate equipment	70	72.9	20	20.9	6	6.2

Table (3):Frequency and percentage distribution of human factors affecting nursing errors in operating room as perceived by studied nurses (N=96).

Factor domains	Agree		Somewhat Agree		Disagree	
	No	%	No	%	No	%
Communication system-related factors						
▪ Information about changes in OR program / planned procedure timely provided	65	67.7	13	13.5	18	18.8
▪ Information about changes in OR program / planned procedure are communicated through the right channels	53	55.2	17	17.7	26	27.1
▪ Adequate communication about patients with other disciplines/ units / departments	59	61.5	12	12.5	25	26
▪ Adequate communication about patients between teams within OR theatre.	41	42.7	15	15.6	40	41.7
Teamwork related factors						
▪ Familiarity with other team member.	51	53.1	17	17.7	28	29.2
▪ Team's ability to deal with unexpected events	60	62.5	16	16.7	20	20.8
▪ Members of my team work together as a well coordinated team (team coordination)	61	63.5	12	12.5	23	24
▪ Team members sufficiently instructed during operation / shift	57	59.4	20	20.8	19	19.8
▪ Feeling confidence in other team members	25	26	12	12.5	59	61.5
Training/ supervision related factors						
▪ Adequate orientation and training of new personnel and nurses.	48	50	13	13.5	35	36.5
▪ Training nurses about dealing with new equipment technology.	62	64.6	29	30.2	5	5.2
▪ Co-workers in operating theatre have the necessary qualifications	46	47.9	18	18.8	32	33.3
▪ Lack of knowledge about common types of error	34	35.4	17	17.7	45	46.9
▪ Assessment of training needs of OR theatre personnel was done periodically (advance planning).	56	58.3	18	18.8	22	22.9
▪ Inadequate supervision system for detection of poor performance	67	69.8	10	10.4	19	19.8
Patient related factors						
▪ Inappropriate patient identification system	53	55.2	17	17.7	26	27.1
▪ Inadequate patient assessment	59	61.5	12	12.5	25	26
▪ Emergency of the surgical procedure	54	56.3	17	17.7	25	26
Nursing staff related factors						
▪ Lack of adequate nursing staff	60	62.5	8	8.3	28	29.2
▪ Enough support/ co work staff	45	46.9	10	10.4	41	42.7
▪ Bringing in /replacement staff during absence leave	55	57.3	11	11.5	30	31.2
▪ physical and mental condition of nursing personnel	61	63.5	13	13.5	22	22.9
▪ Poor/overwhelming assignment	52	54.1	11	11.5	33	34.4
▪ Long OR procedures	50	52.1	16	16.7	30	31.2
▪ Lack of nursing experience/poor qualification	59	61.5	28	29.1	9	9.4
▪ Role conflict among nurses in OR theatre (circulating –scrub nurse)	55	57.3	11	11.5	30	31.2
▪ Role conflict between nurses in OR theatre and other health care team (surgeon, anesthesiologist)	58	60.4	10	10.4	28	29.2
▪ Documentation problems	34	35.4	17	17.7	45	46.9
▪ Nursing satisfaction	46	47.9	18	18.8	32	33.3

Table (4): Frequency and percentage distribution of environmental factors affecting nursing errors in operating room as perceived by studied nurses (N=96).

Factor domains	Agree		Somewhat agree		Disagree	
	No	%	No	%	No	%
Operating room structure/ environment related factors						
▪ The suitability of physical space and access to the equipment in the operating room environment	43	44.8	33	34.4	20	20.8
▪ Inadequate lightening	58	60.4	15	15.6	23	24
▪ Increased noise level	63	65.6	17	17.7	16	16.7
▪ Poor temperature adjustment / air conditioning	60	62.5	11	11.5	25	26
▪ Poor cleanliness and waste disposal system	15	15.6	25	26	56	58.3
Material and equipment resources management/ maintenance						
▪ Unavailability of materials & equipment at the time it is needed	57	59.4	9	9.4	30	31.2
▪ Inadequate equipment/facilities	53	55.2	8	8.3	35	36.5
▪ Poor quality of materials and equipment	42	43.8	15	15.6	39	40.6
▪ Equipment malfunctioning	48	50	11	11.5	37	38.5
▪ Maintenance is not carried out on a regular basis	36	37.5	16	16.7	44	45.8
Recording and reporting system related factors						
▪ Availability of reporting system for errors/ accidents in OR	35	36.5	11	11.5	50	52.1
▪ The health staff are unaware of the importance of reporting system activation	51	53.1	9	9.4	36	37.5
Policies / rules/ procedures related factors						
▪ Accessibility and applicability of procedures / regulations / rules regarding OR measures	15	15.6	25	26	56	58.3
▪ Procedures / regulations / rules applied correctly	34	35.4	16	16.7	46	47.9
▪ Poor compliance with OR safety checklist to maintain patient safety.	56	58.4	25	26	15	15.6
▪ Inadequate following of standards of care, policies, processes (Some examples include poor documentation and labeling of specimens)	45	46.9	17	17.7	34	35.4

Table (5): Total mean scores of factors domains affecting nursing errors in operating room as perceived by studied nurses (N=96).

Domain	Min.	Max.	Mean (SD)	Total score	Mean %
Human domain					
▪ Communication system-related factors	4	12	9.281(0.349)	12	77.3%
▪ Teamwork related factors	5	13	6.435(0.353)	15	42.95%
▪ Training/ supervision related factors	6	16	15.372(0.422)	18	58.46%
▪ Patient related factors	3	8	5.049(0.397)	9	56.12%
▪ Nursing staff related factors	11	21	17.292(0.522)	33	52.45%
Environmental domain					
▪ OR theatre structure/ environment related factors	5	15	11.187(0.500)	15	74.53 %
▪ Material and equipment resources / Maintenance	5	14	11.895(0.199)	15	79.33%
▪ Recording and reporting system related factors	2	5	2.676(0.277)	6	44.66%
▪ Policies / rules/ procedures related factors	4	10	5.088(0.266)	12	42.43%

Table (6): Predictors of association between demographic and general characteristics among studied nurses and their perception regarding factors affecting nursing errors in operating room.

Model	Unstandardized Coefficients		Standardized Coefficients	t-test	Sig.
	B	Std. Error	Beta		
Age group	9.317	5.114	0.219	1.822	0.032*
Gender	4.056	5.185	0.085	0.782	0.436
Marital status	6.317	5.124	0.136	1.233	0.221
Educational level	2.461	2.424	0.111	1.015	0.013*
Experience	3.885	3.470	0.137	1.120	0.026*
Training	0.276	5.056	0.006	0.055	0.957
Operation type	0.380	1.322	0.030	0.287	0.774

Not significant at $P > .05$

*Significant at $P < .05$

Discussion

Operation rooms are one of the most hazardous environments in terms of possible human-related health hazards and reduction of errors in these environments is a necessity to improve the quality of health care. The purpose of this study was to determine the common nursing errors and factors affecting the errors in the operating room from nursing point of view. Therefore, the first step is controlling the job errors, and identifying the effective factors and removing them. The researchers' objective in conducting the present study was to investigate the care errors in operational procedures and explore factors affecting its occurrence from the perspectives of nurses in the operating room in order to develop effective preventive guideline to remove them.

As regards studied nurses' demographic and general characteristics, the current study shows that more than two thirds of the nurses under study their age ranged between 26 -40 years with mean age about twenty nine. This could be explained in the light of nature of operating theatre as area of specialty necessitates young qualified nurses for better quality of nursing care provided and ability to tolerate the working load. Also, three fifths of studied nurses were females and married, that was because the age group of studied nurses was considered the age of marriage. Regarding qualifications of studied nurses, it was found that nearly two fifths of them had bachelor nursing degree while the other three fifths were graduates of nursing school and technical nursing institute, these poor qualifications may be one of the factors affecting nursing errors in study settings. Nearly two fifths of the studied nurses have less than 5 years of experience and other

three fifths had more than five years of experience with mean years of experience exceed seven years. Also, nearly three fifths of the nurses under study reported that they didn't receive previous training regarding OR procedures and patient safety, this may be due to lack of in service educational program conducted by administrating staff inside the hospitals which was considered one of the factors affecting occurrence of nursing errors among studied subjects.

In this regard, **Nemati et al. (2018)** in their study titled "Factors affecting errors in the operating rooms: study of employees' viewpoint" and reported that most of their study participants were females in the age range of 22 to 60 years, more than two fifths of them had bachelor graduation with an average of 10 years of work experience in the operating room.

One of the most important aims of current study was to investigate the common nursing errors in operating room setting as perceived by the studied nurses. The findings shows agreement of most of studied nurses about lack of appropriate equipment, poor aseptic technique in skin preparation/handling/ draping and inadequate documentation process as arranged in descending order were the most common nursing errors occurred in OR setting, meanwhile nearly one third of them were to somewhat agree that blood transfusion errors, incorrect/ inaccurate counting of instruments and diathermy accidents /burns were common nursing errors in OR setting. From researcher point of view, lack of appropriate equipment is common error due to lack of fund and resources which is common factor in developing countries. Poor aseptic technique in skin preparation/handling/ draping may be due to poor compliance with aseptic techniques because

of negligence, ineffective supervision system or overcrowding of surgical schedule. Regarding inadequate documentation process as a common error as reported by studied nurses, it may be due to lack of standards of nursing documentation and nurses' distraction with other professional tasks.

Results of current study was to somewhat in agreement with the results of **Song et al. (2022)** who found in their study entitled "Prevalence and associated factors of self-reported medical errors and adverse events among operating room nurses in China" that surgical instruments disinfection, equipment and specimen poor management were the most frequent errors that occurred among operating room nurses in their study as their report. On the other hand and in the light of current study findings, surgical instruments disinfection was reported by more than two thirds of our studied nurses, meanwhile equipment and specimen poor management was reported only by about one third of current studied nurses. This agreement may be because issues as instruments disinfection and specimen poor management are common universal errors among operating room nurses in all worldwide.

However, the findings of present study demonstrates that most of the studied nurses disagree that incorrect identification of surgical site, leaving supplies/ equipment in the operation site and poor patient identification are common errors among nurses in OR setting. This might be due to fear of nurses in current study to report these errors due to its severity and its catastrophic consequences and absence of reporting system for errors in all Egyptian governmental and university hospitals.

These findings is in contradiction with the results by **Nemati et al. (2018)** who declared in their study that operating the patient wrongly, operating on an organ wrongly, leaving an instrument in the patient's body are common nursing errors reported by more than three fifths of their studied subjects. This contradiction may be due to the different healthcare systems and quality of care in both countries in addition to activation of reporting system of errors among nurses there which gave them the courage to report that types of life-threatening errors.

The second aim of this study is to explore the factors affecting occurrence of nursing errors in operating room from the perspective of studied nurses. These factors are categorized under human and environmental factor domains. Discussion for each domain will answer the study questions concerning factors affecting nursing errors from the prospective of nurses under study.

As regard to domain of human factors affecting nursing errors in operating room as reported by studied nurses, there are many factors under that domain. concerning communication system related factors, the findings shows that more than three fifths of the studied nurses agree that information about changes in OR program / planned procedure in the right time and adequate communication about patients with other disciplines/ units / departments are major communication related factors, meanwhile the most common teamwork related factors as reported by studied nurses are team coordination, team's ability to deal with unexpected events and sufficient team instruction during operation / shift. From researcher point of view, communication failure among disciplines / units / departments is one of the factors that lead to lack of knowledge about patients during their transfer among hospital departments and operating room that lead to occurrence of errors. On the other hand, team coordination and sufficient team instruction was one of the most important factors that enhance team ability to deal with unexpected events and reduce errors among OR team members.

This findings are in agreement with findings of **Vinagre, and Marques (2019)** in their study titled "Safety culture in the context of operating room: Nurses' perception regarding notification of errors/adverse events" which declared that communication failure and lack of effective teamwork performance are common factors affecting negatively on occurrence of errors in operating room. **Ugur et al. (2016)** in their study added that all problems that can result in catastrophic consequences including wrong-site or wrong-surgical procedure and retained sponges, can easily be avoided with effective communication

Furthermore, more than half of studied nurses in the current study agree that the most common training/ supervision related factors that contribute nursing errors in OR setting are inadequate supervision system for detection of poor performance, training nurses about dealing with new equipment technology and assessment of training needs of OR theatre personnel periodically. Hence, continuous in-service education and training programs was a suggestive preventive measure.

Also, inadequate patient assessment, emergency of the surgical procedure and inappropriate patient identification system are common patient related factors causing nursing errors as reported by more than half of studied nurses. This result was in agreement with **Beuzekom, et al. (2007)** in a study titled "Assessing system failures in operating rooms and intensive, care units," which concluded that problems with communication played a role in 65% of the incidents/ errors, while training deficiencies were reported by 56% of cases.

Concerning nursing staff related factors, the findings of the current study illustrated that more than three fifths of nurses under study agreed that physical and mental condition of nursing personnel, lack of adequate nursing experience/poor qualification and role conflict were the most reported factors from nurses' point of view. This finding was very representative to nursing scene in Egypt that poor nursing qualifications and role conflict are one of the causes that lead to poor quality of care and increase probability of errors. Also, according to studied nurses, frequent exposure to stress and painful conditions in OR setting in addition to standing in long surgical procedures were the causes of mental, psychological and anxiety states in a person, which can cause adverse consequences such as a decrease in the quality of performance and an increase in the incidence of errors in the operating room. In this context, studied nurses in a study by **Vinagre, and Marques (2019)** reported that the work pressure and professional inexperience quickly increases the occurrence of errors in the operating room with significant percentages. Also, **Nemati, et al. (2018)** clarified that the mental-psychological-physical condition of the employees is an

individual factor that has a great impact on the occurrence of errors from the perspective of the employees.

Regarding the domain of environmental factors, results shows that more than three fifths of the nurses under study agree that increased noise level, poor temperature adjustment / air conditioning and inadequate lightening are common operating room structure/ environment related factors, meanwhile more than half of them their point of view that unawareness of the health staff with the importance of reporting system activation are common contributing factor. In agreement with these findings, **El Bardissi and Sundt (2012); Zabihirad et al. (2018)** reported in their studies about factors affecting errors in the operating room that the operating room environment and its design, such as physical suitability, light, temperature, bustle, and noise, are factors that affect the occurrence of an error.

Another influential factor contributing to occurrence of nursing errors in OR setting was material and equipment resources / maintenance related factors, more than half of studied nurses was agreeing about unavailability of materials and equipment, inadequate equipment/facilities in addition to equipments malfunctioning. This is in the same line with results of **Nemati, et al. (2018)** who reported in their study that lack of familiarity with how to use the equipment was the most important factor in the occurrence the error. Also, in this respect, **Alshyyab et al. (2022)** in their study about factors influencing patient safety in operating room highlighted the importance of maintenance of medical equipment in the OR and adequate training for the new equipment as preventive strategy for decreasing mortality and harms during patients' surgery.

As regard to policies / rules/ procedures related factors, about half of studied nurses agreed that poor compliance with OR safety checklist to maintain patient safety in addition to inadequate following of standards of care, policies and processes were common factors affecting nursing errors. From pint of view of researchers, there is a gap in the awareness of when and how to use the checklist, which

suggests that medical and nursing managers for operating room nurses to improve their awareness and compliance of OR checklist as an important tool for patient's safety. **Rodziewicz et al. (2022)** declared in their article titled "Medical Error Reduction and Prevention". That errors are avoided by standardizing procedures and orienting staff to follow verification procedures.

According to abstracting total mean percent scores of factors affecting the occurrence of nursing errors in operating room as perceived by studied nurses. The results showed that the most common reported human factors as arranged in descending order are communication system-related factors, training/ supervision related factors, patient related factors, nursing staff related factors, and finally teamwork related factors which inferred that communication system-related factors and training/ supervision related factors are the top factors causing errors from the perspective of studied nurses. Communication system-related factors are the highest contributing factor according to studied nurses because lack/ missed/ fragmented/ misinformation and inadequate information regarding surgical patient increased risk for complications and errors. Furthermore, training/ supervision related factors were highlighted among study subjects due to report of three fifths of them for lack of in-service training regarding operating room procedures and safety measures.

The previously mentioned finding was not in agreement with findings of **Eslamian et al. (2011)** in a relevant study titled "Assessing the nursing error rate and related factors from the view of nursing staff" who mentioned that the most significant factors affecting errors are those related to managerial factors and patient-related factors. This discrepancy between the two studies may be due different health system and view of nurses in both studies.

Regarding environmental domain, it was found that the most common reported factors which were arranged dissimilarly as perceived by studied nurses were material and equipment resources management/ maintenance related factors, OR theatre structure/ environment related factors, policies/ rules/ procedures related factors, and finally policies/ rules/

procedures related factors. This finding means that material and equipment resources management/ maintenance related factors and OR theatre structure/ environment related factors are the highest reported factors among studied nurses in this domain. According to studied nurses, equipment and resources are the most influencing factors they confront in the setting of operating room because they are the most team member was in charge for any problems related to unavailability/ missing/ troubleshooting of devices/ equipment in front of other operating room team member.

The previous result was consistent with **Zabihirad et al. (2019)** which reported in their study that the most important factor in the occurrence of care errors in the operating room were environmental and structural factors with a mean score of 80.25%. They added in their study that the suitability of physical space and access to the equipment in the operating room environment were important factors in this domain.

One of the most striking finding in the current study that there is a significant effect of age, educational level and experience of studied nurses on their perception regarding factors affecting occurrence of nursing errors in operating room. While there is non-significant effect of nurses' gender, marital status, receiving training and operation type on their perception regarding factors affecting occurrence of nursing errors in operating room. In this respect, there are many studies support the previous finding, which found that nurse's age, level of education and length of experience in clinical settings were the factors most strongly associated with the incidence of errors in acute care settings (**Hussein et al., 2017; Soori et al., 2019**).

Based on the current study findings and nurses' perception regarding factors affecting occurrence of nursing errors in operating room, many suggestive preventive guidelines were recommended regarding allocation or alleviating of factors affecting occurrence of nursing errors in operating room. Generally speaking, the suggestive preventive guidelines should allocate all factors with heightening the most important ones according to study findings. Concerning domain of human factors

affecting nursing errors in operating room, effective communication system between operating team members and between operating room and other health care departments of the hospital. Also, sufficient operating team training regarding role performance and how to deal with unexpected event during surgery in addition to all measures that promote team coordination.

Concerning nursing staff related factors, it is suggested to conduct periodical in-service educational program for nurses regarding all operating room procedures and patient safety and management of crisis situations. Moreover, staff coverage and reallocation policies regarding job description for all operating team member and increasing supervision level in addition to recruitment of highly qualified and experienced nursing staff for operating room setting is highly recommended measures. In addition, physical, mental and psychological conditions of nursing staff should be considered when the duty roaster is made.

The previous finding is supported by Audet et al. (2018) who stated that “there is a growing body of evidence indicating that inadequate nurse staffing in acute care hospitals is associated with adverse events and errors and in-hospital mortality and are consistent with those of prior studies, which suggest that teamwork and collaboration are essential to providing safer surgeries in the OR (Tørring et al., 2019). Also, Schneider and Weigl (2018) highlighted the significance of providing social support and rewards, whether financial or non-tangible rewards, for OR professions to mitigate the occupational stress and psychological demands.

The suggestive preventive guidelines as regard to the domain of environmental factors should focus upon modifying environmental factors in operating theatre as air conditioning, adequate light source in addition to avoidance of any distraction and noise during operative procedure. This suggestive guideline was recommended by Alshyyab et al. (2022) who reported that the OR environment should be arranged according to international guidelines, for example, the temperature should be around 22–26 degrees Celsius regardless of what

temperature suits the surgeon, and the humidity should be around 55%.

One of the most important preventive guideline for reducing nursing errors in operating room is activation of error reporting system in operating theatre among health care team. Ghobadian et al., (2021) identified error reporting system as a key aspect of establishing safety culture in OR. They argued that the higher the error reporting within a OR, the safer the OR.

Great emphasis should be directed to equipment resources and maintenance in operating theatre, all equipment and devices needed should be available and checked for their functioning in addition to adequate training for all the staff members regarding any new equipment and device use/management to maintain safety and reduce errors. Furthermore, special concern should be directed toward enhancing nurses' compliance with operating room checklist as an important tool to maintain patient safety and reduce errors in operating theatre.

This study has taken a step towards identifying the nursing errors in operating theatre as perceived by nurses who actually are at the sharp end of errors and investigate factors that cause them from the point of view of nurses of the operating room in university hospitals from different geographical areas in Egypt, it is hoped that future research will determine the frequency of errors in the operating room and the effective factors by evaluating the risk factors related to other health care team member.

Conclusion

Based on study findings, the study concluded that lack of appropriate equipment, poor aseptic technique in skin preparation/handling/ draping and inadequate documentation process were the most common nursing errors in occurred in OR setting.

The results showed the most common reported factors affecting occurrence of nursing errors in operating room as perceived by nurses under study. As regard to domain of human factors and concerning communication system related factors, the findings shows that

information about changes in OR program / planned procedure in the right time and adequate communication about patients with other disciplines/ units / departments are major communication related factors, meanwhile the most common teamwork related factors are team coordination, team's ability to deal with unexpected events and sufficient team instruction during operation / shift.

On the other hand, team coordination and sufficient team instruction, one of the most important factors. Also, the most common training/ supervision related factors that contribute nursing errors in OR setting are inadequate supervision system for detection of poor performance, training nurses about dealing with new equipment technology and assessment of training needs of OR theatre personnel periodically. Furthermore, inadequate patient assessment, emergency of the surgical procedure and inappropriate patient identification system are common patient related factors. In addition, inadequate patient assessment, emergency of the surgical procedure and inappropriate patient identification system are common patient related factors causing nursing errors.

Regarding the domain of environmental factors, results shows that increased noise level, poor temperature adjustment / air conditioning and inadequate lightening are common operating room structure/ environment related factors, meanwhile, unawareness of the health staff with the importance of reporting system activation are common contributing factor. Another influential factor was material and equipment resources / maintenance related factors. Furthermore, unavailability of materials and equipment, inadequate equipment/facilities in addition to equipments malfunctioning are common factors. As regard to policies / rules/ procedures related factors, that poor compliance with OR safety checklist to maintain patient safety in addition to inadequate following of standards of care, policies and processes were common factors affecting nursing errors.

One of the most suggestive preventive guideline in this study was directed to equipment resources and maintenance in operating theatre, all equipment and devices should be available and checked for their functioning in addition to adequate training for all the staff members

regarding any new equipment and device use/management to maintain safety and reduce errors.

Recommendation

- All operating room nurses should participate in training programs to increase their knowledge and practice, as well as to reinforce positive attitudes towards patient safety and error minimization.
- Continuing education should be systematic, involve all operating team nurses and focus on updates on care procedures and new equipment and/or technologies available for patient safety.
- Standardized nursing procedure booklet and guidelines regarding patient safety for the nurses should be available at the operating rooms to guide nurses in maintaining patient safety and reduce errors.
- Strict observation and supervision of operating room nurses during work and continuous evaluation of their performance and correction of mal practice is essential.
- Developing or activation of policies and procedures regarding improving the interpersonal communication of the surgical team, aiming at the uniformity and continuity of care behaviors
- Nursing errors should be analyzed thoroughly to identify their underlying causes to serve as a benchmark for the development of effective error-halting strategies.
- Recommendations regarding the compliance of all operating room team with use of the Operating Room Checklist were emphasized.
- Developing and activation of reporting system for clinical errors in operating theatre for recording and following up clinical errors and addressing their consequences are proposed.
- The equipment and materials needed for the surgical procedure must be available in sufficient quantity and properly tested and/or checked before surgery. A periodic maintenance plan is essential for the proper functioning of equipment and materials.
- Further research was required to assess errors in operating room from the perspectives of other operating team

member including surgeons and anesthesiologists.

- Distribution of study suggestive guidelines on all operating room settings hospital hoping this as a step to reduce errors among nurses in these critical settings.

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