

Effect of Nurses' Implementation of Surgical Safety Guidelines on Their Performance and Post-Operative Complications

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Abstract:

Surgical safety has been a major challenge of the nursing profession. Much progress has been made in identifying what causes errors, and understanding the relationship between safety and patients' outcomes. **Aim:** To evaluate the effect of nurses' implementation of surgical safety guidelines on their performance and post-operative complications. **Design:** A quasi-experimental research design was used. **Setting:** The study was conducted at the operating room and general surgery department at the university hospitals in Cairo. **Sample:** A convenient sample of 72 nurse and 100 patients at the general surgery department. **Tools:** Four tools were used: **I:** self-administered questionnaire it included: demographic characteristics of the nurses and nurses' knowledge assessment questionnaire, **II:** Nurses' safety practices observational checklist. **III:** Safety attitude questionnaire, **IV:** Post-operative **Complications Questionnaire:** It included demographic characteristics of the patients and post-operative complications. **Results:** There were high statistically significant differences between nurses' mean scores of knowledge post implementation of surgical safety guidelines. All of anesthesia nurses performed surgical safety practices, there were highly statistically significant differences between nurses' attitudes regarding reporting any safety concerns and working with physicians as a team. As well; there was highly statistically significant reduction of some post-operative complications post implementation of surgical safety guidelines. **Conclusion:** Nurses' implementation of surgical safety guidelines had a positive effect on their performance and on reduction of post-operative complications. **Recommendations:** Surgical safety guidelines should be implemented as part of daily surgical routine and encourages its use to all surgical operations.

Keywords: *Performance, Post-operative complications & Surgical safety guidelines*

Introduction:

Operating room (OR) is a sophisticated hospital setting where advanced technologies are used to perform anesthetic, surgical, diagnostic and therapeutic procedures are performed. It's a high-risk medical setting with a high focus on patients' safety. Operating rooms have evolved into more complicated, interdisciplinary work environments than other types of workplaces. Long work hours, a stressful work environment and the requirement for teamwork can all have a negative impact on the health of the operating room staff, patients' safety and surgical outcomes ((Gutierrez et al., 2018; Hanfy et al. 2021; Jung et al., 2020).

Surgery is sometimes considered the only therapy to lessen disabilities and reduce the mortality rates from common conditions. Millions of people every year undergo surgical treatment and surgical interventions that account for an estimated 13% of the total management interventions. However, unsafe surgical care can cause substantial harm with a reported crude mortality rate after major surgery is 0.5-5%, complications after inpatient operations occur in up to

25% of patients, nearly half of all adverse events in hospitalized patients are related to surgical care and at least half of these events are considered preventable (World Health Organization, 2021).

World Health Organization (WHO) defines patient's safety as the absence of preventable harm to a patient during the process of health care. Patients' safety covers both absence of harm to patient and actions taken for harm prevention and also includes implementation of health care practices that eliminate recognized causes of common errors It's considered the foundation of high quality patient's care and it's a foremost issue to provide safe patient care at the operating theatre because it's possible to prevent half of surgery related errors and complications (Alhabahbeh et al., 2018; Mohamed et al., 2020).

Surgical patient safety has been a major challenge of the nursing profession for the past two decades. Much progress has been made in identifying what causes errors and understanding the relationship between safety and patients' outcomes. There are numerous reasons that contribute to human mistakes at operating rooms than at other hospital departments

such as several team compositions from day to day, complex surgery, high-alert medications, work pressure, high patients' turnover and need for rapid interventions in the case of emergency surgery (Weiser & Haynes, 2018).

Wrong surgical site, surgical specimen mishandling, drug-related events such as allergic reactions or skin rashes, improper management of blood loss, environmental hazards, retention of surgical items inside the patient's body, health care-associated infection and complications associated with anesthesia such as cardiac arrhythmias are some of the risks to surgical safety that can result from improper practices or ineffective communication among surgical team members. The World Health Organization (WHO) safe surgery checklist is used internationally to promote patients' safety during surgery by supporting effective communication and building shared safety models (Lindegger et al., 2021).

Significance of the study:

It's estimated that 134 million adverse events occur in hospitals each year which result in over 2.6 million people death in low- and middle-income nations. Egypt suffers from a severe lack of skilled staff that may not have a strong understanding of safety culture due to the nurse-to-patient ratio is half of international ratio. If they operate in a demanding and dynamic workplace with a high workload, such as an operating room, the possibility for safety concerns can increase ((Auraaen et al., 2018; El-Sherbiny et al., 2020)

Operating room nurse must exhibit the knowledge and abilities required to achieve national patients' safety goals. This includes being accountable for maintaining the sterility of the instruments and taking precautions to reduce the risk of surgical site infection and post-operative complications. It also requires the ability to handle biological specimens, recognize the needs of surgical team and develop care plans. Additional critical challenges include identifying patients' safety threats including blood loss and airway trouble or aspiration; correct counting of surgical supplies, control of environmental hazards and enhancing interpersonal communication (Mohamed et al., 2020; Von Vogelsang et al., 2020).

Aim of the study:

The aim of the study is to evaluate the effect of nurses' implementation of surgical safety guidelines on their performance and post-operative complications through:

1- Assessing nurses' performance regarding surgical safety guidelines.

- 2- Assessing incidence rate of post-operative complications pre implementation of surgical safety guidelines.
- 3- Planning for and implementing surgical safety guidelines.
- 4- Evaluating the effect of nurses' implementation of surgical safety guidelines on their performance and post-operative complications.

Hypotheses:

H1: Nurses' implementation of surgical safety guidelines has a positive effect on nurses' performance.

H2: Nurses' implementation of surgical safety guidelines has a positive effect on reduction of post-operative complications.

Operational definition:

Performance: Nurses' knowledge, practices and attitude regarding implementation of surgical safety guidelines.

Subject and Methods

Research design:

A quasi-experimental research design (pre and posttest) was used to fulfill the aim of this study.

Quasi-experimental research design is used to estimate the effect of an intervention in the lack of randomization. In the pre/post-test research plan, the research contains assessing significant outcomes both before demonstrating the sample to a stimulant and after disclosure to the stimulant. By creating an experiment in this direction, a researcher can value modification in directed outcomes to be exposed to the stimulant (Braddock, 2019).

Setting

This study was conducted at the operating room and general surgery department at the university hospitals in Cairo city, Egypt.

Sample:

A convenient sample of 72 nurses at the previous mentioned setting was participated in the study and included 30 scrub nurses, 30 circulating nurses, and 12 anesthesia nurses. A purposive sample of 100 adult patients who were undergoing gastrointestinal, vascular or orthopedic operations at the general surgery department.

Sample size calculation:

The sample size was calculated by adjusting the power of the test to 80%, and the confidence interval to 95% with a margin of error accepted adjusted to 5% using the following equation:

Type I error (α) = 0.05%

Type II error (B) = 0.20%

With power of test 0.80%

$$n = \frac{N \times p(1-p)}{\left[\frac{N-1}{d^2} \times \left(\frac{d^2}{z^2} \right) + p(1-p) \right]}$$

Nxp (1-p)	=(135*(0.5*(1-0.5))
N-1	=(135-1)*
d ² /z ²	=0.0025 / 3.8416+
p(1-p)	=0.5*(1-0.5)
N	= 100

N= Community size

z= Class standard corresponding to the level of significance equal to 0.95 and 1.96

d= The error rate is equal to 0.05

p= Ratio provides a neutral property = 0.50 (Suresh & Chandrashekara, 2012).

Based on the above equation, the sample size is 100 patients participated in this study.

Tools of data collection

Four tools were used to collect the data:

Tool I: Self-administered questionnaire:

It was developed by the researchers based on literature review (Fadlallah & Ibrahim, 2019; Mukhtar & Ahmen, 2019; Hassan et al., 2019). It composed of two parts:

Part I: Demographic characteristics of the nurses

This part included age, gender, qualification, years of experience at OR, attendance of training programs related to surgical patients safety.

Part II: Nurse's knowledge assessment questionnaire:

It developed by the researchers in Arabic language after reviewing of related literature to assess the nurse's knowledge regarding surgical patients' safety. It included (definition of surgery, phases of surgery, threats of patients' safety at operating room and nursing role to maintain patients' safety before and during operation and during anesthesia)

Scoring system of nurse's knowledge assessment questionnaire

Each correct answer was given score (one) and incorrect answer was given score (zero) and mean score was calculated for each item.

Tool II: Nurses' safety practices observational checklist:

It was adapted from WHO surgical safety checklist and was modified by the researchers to evaluate practical levels of nurses regarding surgical patients' safety and included:

1- Circulator nurses' practices regarding patient safety:

This section included 13 items to assess practices of circulator nurses regarding patients' safety.

2- Scrub nurses' practices regarding patient safety:

This section included 16 items to assess

practices of scrub nurses regarding patients' safety.

3- Anesthesia nurses' practices regarding patient safety:

This section included 5 items to assess practices of anesthesia nurses regarding patients' safety.

Scoring system of nurses' safety practices observational checklist:

Each done step had score (one) and not done step had score (zero) and mean score was calculated for each item.

Tool III: Safety attitude questionnaire (SAQ):

This questionnaire was adapted from (Sexton et al, 2006) and included six statements to assess nurses' attitude regarding surgical safety at the operating rooms. It was translated into Arabic. The researchers modified the wording of some items for use in the operating rooms to assess nurses' attitude about surgical safety at the OR

Scoring system of safety attitude questionnaire:

All responses were recorded on a five point likert scale: (1 Disagree strongly = 0%, 2 disagree = 25%, 3 neutral= 50%, 4 agree= 75% and 5 agree strongly= 100%). Two negatively worded statements were reverse scored to calculate summary statistics.

Tool IV: Post-operative complications questionnaire:

It was developed by the researchers in to Arabic language after massive literature review (Aboelseoud et al, 2015; Mohammed et al, 2017; Sonoda, et al., 2018) to assess patients' complications within 30 days after operation. It consisted of two parts:

Part I: Demographic and medical characteristics of the patients:

It included age, gender, and history of chronic disease, length of hospital stay, type of anesthesia used, and type of surgical procedure performed.

Part II: Post-operative complications:

It was used to assess patients' complications within 30 days after operation and contained main complications that the patient may experience after surgery as surgical site infections, respiratory pneumonia, deep venous thrombosis/ pulmonary embolism, ICU and ventilator use \geq 48 hours, bleeding that needed more than 4 units of blood transfusion, unplanned return to the OR, death and if the patient has more than or equal to 2 complications.

Scoring system of post-operative complications:

Each item of post-operative complications had score (one) if present and had score (zero) if not present.

Validity and reliability:

Content and face validity and reliability of the tools were checked by five experts from the medical-surgical nursing for judgment of clarity, comprehensiveness, relevance of sentences, and

appropriateness of content. Modifications were done based on their recommendations.

The internal consistency of the tools was conducted by Chronbach alpha test and the tools showed good reliability as follows: nurses' knowledge assessment questionnaire = 0.894, Nurses' safety practices observational checklist =0.870, Safety attitude questionnaire =0.792, Post-operative complications questionnaire =0.91.

Ethical considerations

Official approval and permissions from the director of the university hospitals in Cairo and the heads of the OR and surgical departments were obtained. All the participants gave informed consent after receiving full explanations about the study's aims. Participation in the study was voluntary. The confidentiality of participants' data was assured through coding of all data. In addition, the participants were informed that they could refuse or withdraw from the study at any time without giving any reason.

Pilot study

A pilot study was conducted before starting the main study data collection on 10% of study subject (8 nurses and 10 patients) to assess the recruitment feasibility and the applicability of the tools. Participants who took part in the pilot study were included in the main study sample since there was no difference in the recruitment process. The results of the pilot study confirmed that the study was feasible.

Field work was conducted in four phases:

Data collection was completed over period of six months from beginning of December 2021 to end of May 2022 in the following phases:

Assessment phase:

In this phase; the researchers interviewed the nurses and explained the study aims in order to obtain their informed consent and collect the demographic characteristics. The pretest of the knowledge, practice and attitude were collected within about two months (from beginning of December 2021 to end of January 2022).

Nurses' Knowledge assessment questionnaire was introduced by the researchers to nurses either individually or in groups in their work place. Then, explanation of content was done by the researchers so each nurse could be able to fill in it. The average time taken to fill the tool was 30-45 minutes.

Direct observation was conducted by the researchers to assess practices of each nurse regarding patient safety during (sign in, time out, sign out) phases. The researchers evaluated each practice and filled out checklist. The researchers visited operating room three times a week.

Safety attitudes questionnaire (SAQ) was filled in by the nurses and it takes about 15- 20 minutes. As well,

demographic and medical characteristics of the patients were assessed; it takes about 10-15 minutes.

Planning phase:

In this phase; the researchers designated and developed a booklet in to Arabic language after massive reading which contained knowledge about surgery, phases of surgery, threats of patients' safety at operating room and role of scrub, circulating and anesthesia nurses to maintain patients' safety before and during operation and during anesthesia and the importance of these guidelines in prevention of the complications.

Implementation phase

It takes about two months form the begging of February to end of March 2022. At this phase, the researchers interviewed the nurses to explain surgical safety guidelines and their implementation at the operating rooms to improve nurses' practices.

In this phase, the implementation of surgical safety guidelines included two parts:

- The theoretical part was given through 1 session weekly; each session lasted for about 45 minutes. These teaching sessions were done in groups (4-5 nurses/ session). The researchers used the booklet which was printed and disseminated to operating rooms nurses so that nurses could become familiar with the details. As well, lectures (power point presentation), group discussion and videos about nurses' practices regarding surgical safety at the OR were used.
- The practical part was given through 2 sessions weekly; each session lasted for about 45 minutes. These teaching sessions were done in groups (4-5 nurses/ session). The researchers demonstrated the implementation of surgical safety guidelines with scrub, circulating and anesthesia nurses at the OR, then the nurses redemonstrated these practices.

Evaluation phase:

It takes two months form beginning of April to end of May 2022. The researchers reassessed the nurse's knowledge, practices and attitude after the implementation of surgical safety guidelines.

Each patient was followed up at the general surgery department after operation until discharge or for 30 days, to record incidence rate of death and/or complications. Outcomes were identified through daily monitoring of patient's chart and communication with surgical staff.

Administrative design

The official permission was obtained from the administrator of university hospitals in Cairo to conduct the study the operating room and general surgery department. Letters of request were delivered to them from Faculty of Nursing, Helwan University, with explanation of the aim and expected outcome of the study.

Statistical design

The collected data were organized, tabulated and statistically analyzed using the statistical package for social sciences (SPSS), version 20. For numerical data, the mean and standard deviation were calculated. Qualitative data were presented as frequencies and percentages. Comparison between groups was done by t-test test. P value ≤ 0.05 was considered statistically significant.

Results:

Table (1): Frequency and percentage distribution of the studied nurses according to their demographic characteristics (N= 72)

Nurses characteristics	No	%
Age		
20 < 30	32	44.4
30 < 40	2	2.7
40 < 50	33	45.9
50-60	5	7.0
Mean= 47 ± 2.984		
Gender		
Male	39	54.1
Female	33	45.9
Qualification		
Diploma	41	57.0
Technical institute	7	9.7
University	24	33.3
Post graduate	0	0.0
Years of experience at the OR		
< 1	5	7.0
1 < 5	29	40.2
5 < 10	22	30.6
≥ 10	16	22.2
Mean= 3.6 ± 1.6		
Attendance of training program related to surgical safety		
Yes	37	51.3
No	35	48.7
Duration after attending the training program		
< 3	5	18.9
3 < 10	30	81.1
≥ 10	0	0.0

Table (2): Comparison of mean scores of nurses' knowledge regarding surgical safety pre and post implementation of surgical safety guidelines (N=72)

Nurse's knowledge	Pre	Post	T test	P
	Mean ± SD	Mean ± SD		
▪ Definition of surgery	3.14 ± 0.60	5.42 ± 0.70	20.98	0.000**
▪ Phases of surgery	3.46 ± 0.64	5.6 ± 0.38	24.39	0.000**
▪ Threats of patient safety at operating room	4.14 ± 1.01	5.22 ± 0.81	7.078	0.000**
▪ Nursing role to maintain patient's safety before operative time	3.06 ± 0.75	5.4 ± 1.02	15.68	0.000**
▪ Nursing role to maintain patient safety during anesthesia	2.11 ± 0.50	5.22 ± 0.81	27.72	0.000**
▪ Nursing role to maintain patient's safety during operative time	5.52 ± 0.42	5.6 ± 0.38	1.19	0.461

** P < 0.001 High statistically significant

Table (3): Comparison of circulating nurses' practices regarding surgical safety pre and post implementation of surgical safety guidelines (N=30).

Items	Pre- intervention		Post- intervention	
	N	%	N	%
▪ Ensuring environmental safety	21	70.0	29	96.7
▪ Ensuring availability of equipments and needed supplies	25	83.3	30	100.0
▪ Confirmation of patient's identity	25	83.3	30	100.0
▪ Confirmation of type of operation	15	50.0	30	100.0
▪ Confirmation of site marked	22	73.3	30	100.0
▪ Confirmation of written consent	11	36.7	26	86.7
▪ Preparation of patient for surgery	18	60.0	28	93.3
▪ Bleeding risk assessment	17	56.7	25	83.3
▪ Difficult airway or aspiration risk assessment	13	43.3	27	90.0
▪ Safe positioning of patient	28	93.3	28	93.3
▪ Assessing for risk for allergy	21	70.0	27	90.0
▪ Repeat counting of instrument with scrub nurse	22	73.3	28	93.3
▪ Ensure environmental hygiene and disinfection	30	100.0	30	100.0
Total (mean±SD)	8 ± 2.4		10 ± 2.1	
	T test		12.015	
	P value		<0.001**	

Table (4): Comparison of scrub nurses' practices regarding surgical safety pre and post implementation of surgical safety guidelines (N=30).

Items	Pre- implementation		Post- implementation	
	N	%	N	%
▪ Hand scrubbing	30	100.0	30	100.0
▪ Gowning	30	100.0	30	100.0
▪ Gloving	30	100.0	30	100.0
▪ Skin antiseptics	30	100.0	30	100.0
▪ Introduce themself by name and role	19	63.3	27	90.0
▪ Confirm patient identity	22	73.3	30	100.0
▪ Confirm site of surgery	30	100.0	30	100.0
▪ Confirm procedure	27	90.0	30	100.0
▪ Draping the patient	27	86.7	30	100.0
▪ Counting instrument Before	27	90.0	30	100.0
▪ Counting instrument after	20	66.7	30	100.0
▪ Handling surgical equipment to surgeon aseptically	28	93.3	30	100.0
▪ Specimen labeling	27	90.0	30	100.0
▪ Cleansing instruments	28	100.0	30	100.0
▪ Disinfecting instruments	30	100.0	30	100.0
▪ Sterilization instruments	30	100.0	30	100.0
Total (mean ± SD)	13.0 ± 2.1		14.0 ± 1.6	
	T test		11.165	
	P value		<0.001**	

Table (5): Comparison of anesthesia nurses' practices regarding surgical safety pre and post implementation of surgical safety guidelines (N=12).

Items	Pre- implementation		Post- implementation	
	N	%	N	%
▪ Patients preparations before anesthesia	12	100.0	12	100.0
▪ Frequent monitoring and evaluation of anesthetized patient condition	12	100.0	12	100.0
▪ Prophylactic antibiotics administration	9	75.0	12	100.0
▪ Immediate post-anesthesia care (during recovery)	11	91.7	12	100.0
▪ Safe transferring of patient to post anesthesia care unit	11	91.7	12	100.0
Total (mean ± SD)	3.5 ± 0.6		4.7 ± 0.01	
	T test		14.022	
	P value		<0.001**	

Table (6): Comparison of studied nurses' attitudes regarding surgical safety pre and post implementation of surgical safety guidelines (N=72)

Items	Pre	Post	T test	P value
	Mean ± SD	Mean ± SD		
▪ Feeling safe being treated here as a patient	32.21 ± 25.3	34.56 ± 24.35	0.32	0.75
▪ Briefing OR personnel before a surgical procedure is important for patient safety	80.15 ± 24.6	86.6 ± 19.5	1.3	0.16
▪ Encouragement by colleagues to report any safety concerns.	68.5 ± 24.05	76.5 ± 13.2	6.3	0.000**
▪ In the OR, it is difficult to speak up when perceiving a problem with patient care ***	63.06 ± 26.5	69.7 ± 72.27	2.5	0.20
▪ The physicians and nurses work together as a well-coordinated team	55.36 ± 28.42	68.6 ± 26.4	5.3	0.000**
▪ Personnel frequently disregard rules or guidelines that are established for the OR***	49.8 ± 27.8	60.3 ± 29.8	3.5	0.031*

* Statistically significant

*** These statements reverse-scored

** High statistically significant

Table (7): Frequency and percentage distribution of the studied patients according to their demographic and operative characteristics (N= 100)

Variable	No	%
Age		
18 < 30	30	30.0
30 < 45	15	15.0
45 -60	55	55.0
Mean= 42.3 ±6.23		
Gender		
Male	65	65.0
Female	35	35.0
Chronic diseases		
Diabetes mellitus	12	12.0
Hypertension	42	42.0
Cardiac problems	30	30.0
Length of hospital stay (day)		
1 < 5	11	11.0
5 < 10	64	64.0
≥ 10	25	25.0
Mean= 5.6 ±1.8		
Type of anesthesia		
General	41	41.0
epidural	24	24.0
Spinal	35	35.0
Type of surgical procedure		
Gastrointestinal	47	47.0
Vascular	29	29.0
Orthopedic	24	24.0

Table (8): Comparison of post-operative complications among the studied patients pre and post implementation of surgical safety guidelines (N=100)

Complications	Pre-implementation		Post-implementation		z	P
	No	%	No	%		
Surgical site infection (SSI)	37	37.0	11	11.0	4.3	0.001**
Respiratory pneumonia	18	18.0	3	3.0	3.46	0.000**
DVT/ Pulmonary embolism	2	2.0	0	0.0	1.42	0.16
ICU and ventilator use ≥ 48 hours	20	20.0	13	13.0	1.33	0.18
Bleeding that needed more than 4 blood units of blood transfusion	19	19.0	5	5.0	3.05	0.002*
Unplanned return to the OR	15	15.0	2	2.0	3.29	0.009*
Death	10	10.0	6	6.0	1.04	0.29
≥ 2 Complications	75	75.0	53	53.0	3.24	0.001**

* Significant (S) $p < 0.05$ ** Highly significant (HS) $p < 0.001$

Table (1): Shows that 45.9% of the studied nurses aged from 40 to less than 50 years with a mean age (47 ± 2.98). 54.1% of them were male and 57% of them had diploma education, while, 40.2% of the studied nurses had 1 to less than 5 years of experience at operating room. 51.3% of the studied nurses attended training program related to surgical safety and 81.1% of them attended since 3 to less than 10 years.

Table (2): Illustrates that there were high statistically significant differences between the nurses' mean scores of knowledge regarding surgical safety pre and post implementation of surgical safety guidelines except for their knowledge regarding nursing role to maintain patient's safety during operative time.

Table (3): Indicates that 100% of circulating nurses ensured availability of equipment and needed supplies, confirmed patient identity, type and site of operation and ensured environmental hygiene and disinfection post implementation of surgical safety guidelines.

Table (4): Reveals that 100% of scrub nurses performed surgical safety practices post implementation of surgical safety guidelines except for introducing themselves by name and role.

Table (5): Shows that 100% of anesthesia nurses performed surgical safety practices post implementation of surgical safety guidelines.

Table (6): Illustrates that there were high statistically significant differences between the nurses' attitudes regarding reporting any safety concerns and working with physicians as a well-coordinated team post implementation of surgical safety guidelines, as well, there was a statistically significant difference between nurses' attitudes regarding disregarding rules established for the OR.

Table (7): Presents that 55% of the studied patients aged from 45 to less than 60 years with a mean age (42.3 ± 6.23). 65% of them were male and 42% of them had history of hypertension, as well, 64% of the studied patients stayed for 5 to less than 10 days at hospital. Considering operative characteristics, 41% of the studied patients had general anesthesia and 47% of them underwent gastrointestinal surgical procedure.

Table (8): Reveals that there were high statistically significant reduction of some post-operative complications post implementation of surgical safety guidelines as surgical site infection, respiratory pneumonia and more than 2 complications.

Discussion

Concerning the age of the studied nurses, the results of the present study revealed that less than half of the studied nurses aged from 40 to less than 50 years and more than half of them were male. This

result is consistent with **Zingiryan et al., (2017)**, who conducted their study in USA about "Implementation of the surgical safety checklist at a tertiary academic center: Impact on safety culture and patient outcomes" and mentioned that less than half of the studied nurses were aged from 40 to less than 60 years and half of them were male. This might explain that nurses are aware enough to the nature of OR work.

Regarding nurses' level of education, the present study showed that more than half of the studied nurses had diploma education certificates as their highest qualification. This result is in agreement with **Mukhtar & Ahmed (2019)**, who studied the impact of a design propose program for nurses about patient safety and denoted that about two thirds of the study sample had diploma education.

As regards to years of experience, this study results mentioned that less than half of the studied nurses had 1 to less than 5 years of experience at the operating room. This result is inconsistent with **Hassan et al., (2018)**, who assessed the quality of nursing care provided to patients in the operating room, based on ministry of health standard of care and revealed that more than half of nurses had working experience in operating room of 1-5 years. It may due to the need of highly skilled personnel to work in operating room and which may minimize errors and improve quality of care.

As regards to attendance of training program related to surgical safety, the study results showed that half of the studied nurses attended training program related to surgical safety and the majority of them attended since 3 to less than 10 years. This result was incongruent with a study done by **Mukhtar & Ahmed (2019)**, who denoted that most of the studied nurses didn't receive any training course about patient safety. This may be due to availability of training chances provided by nursing authorities and reflected that the hospital policy focus on continuous feedback and training.

Considering nurses' level of knowledge regarding surgical safety, the current study revealed that there were high statistically significant differences between the nurses' mean scores of knowledge regarding surgical safety pre and post implementation of surgical safety guidelines except for their knowledge about nursing role to maintain patient's safety during operative time.

This result is in the same line with **Fadlallah & Ibrahim, (2019)**, who reported in their study about "Effect of proposed program of patient safety on nurse's knowledge and quality of care at kosti and rabak teaching hospitals-sudan", that there was an improvement in nurses' knowledge mean scores after implementing of training program with high statistically significant differences. This proves the

effectiveness of the surgical safety guidelines on improving nurses' knowledge regarding surgical safety

The present study illustrated that all circulating nurses ensured availability of equipments and needed supplies, confirmed patient's identity, type and site of operation and ensured environmental hygiene and disinfection post implementation of surgical safety guidelines. This finding is consistent with **Hassan et al., (2018)**, who found that the performance of the circulating nurses after the operation was better compared to before and during the operation, with about one third of them had total adequate performance. This could be attributed to the effectiveness of conducting surgical safety guidelines. The current findings showed that all scrub nurses performed surgical safety practices post implementation of surgical safety guidelines except for introducing themselves by name and role. This may be due to the effect of surgical safety guidelines on enhancing nurses' performance. This finding is congruent with **Mohamed et al., (2020)**, in a study in Egypt, who studied "Effect of implementing an educational program on nurses' performance regarding intraoperative surgical patient safety", revealed that there was statistically significant difference in their scores regarding aseptic technique practices post program implementation.

The current study results indicated that all anesthesia nurses performed surgical safety practices post implementation of surgical safety guidelines. This finding is consistent with **Mohamed et al., (2020)**, who mentioned that there was a great improvement in studied nurses' practices regarding patient safety along three phases of operation after program implementation.

As regards to the nurses' attitudes regarding surgical safety pre and post implementation of surgical safety guidelines, the study results showed that there were high statistically significant differences between the nurses' attitudes regarding reporting any safety concerns and working with physicians as a well-coordinated team post implementation of surgical safety guidelines, as well, there was a statistically significant difference between nurses' attitudes regarding disregarding rules established for the OR. This result is supported by **Habahbeh & Alkhalailah (2020)**, in their study entitled "Effect of an educational programme on the attitudes towards patient safety of operation room nurses", in Jordan, they stated that OR nurses' attitudes towards patient safety was significantly improved after the programme.

Concerning the age of the studied patients, the results of the present study revealed that more than half of the studied patients aged from 45 to less than

60 years, more than half of them were male and less than half of them had history of hypertension. This result is inconsistent with **Mohamed et al., (2017)**, in Egypt, who assessed the effect of intraoperative nurses' safety practices on postoperative adverse events among surgical patients undergoing general anesthesia and mentioned that more than half of studied patients' age is 35 years or more than half of them are female and don't suffer from comorbid disease.

Considering operative characteristics of the studied patients, the results of the present study mentioned that less than half of the studied patients had general anesthesia and underwent gastrointestinal surgical procedure. This finding is consistent with **Sonoda, et al., (2018)** in Japan, who evaluated operating room nurses' perception of teamwork performance and their level of mental stress and found that more than half the surgical procedures were endoscopic surgery. The current study results indicated that there were high statistically significant reduction of some post-operative complications post implementation of surgical safety guidelines as surgical site infection, respiratory pneumonia and more than 2 complications. This result was in the same line with **Aboul-Seoud et al., (2015)**, whose study aimed to improve the safety of surgical care to decrease morbidity and mortality associated with surgery at Zagazig University Hospital, and reported that surgical site infection, pneumonia, bleeding and unplanned return to OR were significantly lower among post-intervention than pre-intervention group. These improvements may be due to the effectiveness of surgical safety guidelines to prevent these complications

Conclusion:

According to the results and hypothesis of the current study; the nurses' implementation of surgical safety guidelines had a positive effect on nurses' performance and on reduction of post-operative complications.

Recommendations:

- The surgical safety guidelines should be implemented as part of the daily surgical routine and encourages its use in all surgical operations.
- Provide surgical safety guidelines posters and brochures, which include measures on patient safety, especially at the operating rooms.
- Further studies are needed to cover surgical departments in the different hospitals in Egypt. Further studies including control groups.

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