Factors Affecting on the Implementation of Surgical Safety Checklist in Operating Room

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Abstract

Background: The operating room is critical care setting in the hospital and more complications occurs inside it that threaten patient's life. So in 2008 the World Health Organization (WHO) developed the Surgical Safety Checklist (SSC) to improve surgical patient safety. The WHO SSC is a perioperative communication and safety tool to improve perceptions of surgical safety by the surgical care teams. **Aim of the study:** To identify factors affecting on the implementation of surgical safety checklist in operating room. **Design:** A descriptive exploratory design was utilized in this study. **Subjects:** A convenient sample of 30 nurses, 30 surgeons and 30 anesthesiologists, and 167 patients. **Setting:** This study was conducted in the operating room at Eldemerdash Hospital which affiliated to Ain Shams University, Cairo Governorate**. Tools:** Three tools were used in the current study **I)** Operating staff - related factors assessment tools **II)** patients -related factors assessment tool **III)** Environmental related factors assessment tool**. Results:** 61.1 % of total operating team had satisfactory level of knowledge regarding surgical safety checklist. 75.6% of staff related factors opinionnaire agreed that these factors affected on implementation of surgical safety checklist. 70.0 % of total level of practice of operating team was competent regarding implementation of surgical safety checklist. 100.0% of high volume, of emergency situation and 69.4% of chronic diseases and affected on implementation of surgical safety checklist respectively. 77.8 % of environmental related factors affected on implementation of surgical safety checklist**. Conclusion**: The study findings concluded that, less than two thirds of the operating team had satisfactory level of knowledge about surgical safety checklists. Also, more than three quarters of staff related factors opinionnaire agreed that these factors affected on implementation of surgical safety checklist. Also, less than three quarters of the operating team had a competent level of practice. And also, more than three quarters of environmental related factors affected on implementation of surgical safety checklist. **Recommendation:** Regular scientific meetings for surgeons, anesthesiologists and nurses who provide direct care for surgical patients must be conducted to discuss patients' problems and to detect barriers of adherence to the surgical safety checklist.

Keywords: Factors, Surgical Safety Checklist (SSC), Patients' safety, Operating room.

Introduction:

The operating room (OR) is critical care setting in the unit of the hospital environment where anesthetic-surgical, diagnostic, and therapeutic procedures elective and emergency are performed .This presents a peculiar dynamics of health care due to the attendance to a variety of situations and the accomplishment of invasive interventions requires the professional tasks awareness .Also, work in the operating room is complex and interdisciplinary practices, with a dependence on individual performance. The operating room is a complex work in the healthcare system due to the high level of technology, therapeutic principles, and patient related issues, which must have its own unique rules and regulations **(Hannani et al., 2020).**

Patient safety is the most important dimension of quality health care. Patient safety is

"To err is human: building a safer health care system" report by the Institute of Medicine (IOM) in 2000. Risks to patients are associated with various factors such as individual fallibility, communication and teamwork issues, organizational culture, and glitches with technological devices. The operation room (OR) is one of the hospital settings where medical errors happen repeatedly. Indeed, the highest percentage of hospitalized patients who experienced medical errors was managed in the OR. Therefore, patient safety in the OR is a key concern as it is characterized as a high-pressure, time-constrained and technologically complex environment. The factors that endanger patient safety should be recognized and mitigated **(Alshyyab, Albsoul & Fitzgerald, 2022).**

Patient safety incidents include all types of errors, mistakes and accidents that can occur in a hospital regardless of the patient's actual injury. In particular, patient safety accidents in the operating room can cause catastrophic loss to patients, their families, hospital staff and hospitals. Patient safety incidents that can occur in the operating room include, for example, count discrepancy, surgical site errors, surgical site infections, falls and burns. Such an accident can be prevented by performing a surgical time-out to ensure that all instruments, equipment and gauze used in the surgery have been removed from the body before completing the surgery **(Kwon et al., 2020).**

As part of a global effort to reduce the number of adverse events and postoperative deaths, the world health organization (WHO) developed and implemented the surgical safety checklist (SSC). The WHO SSC is composed of 19 items divided into 3 sections, 1 for use at 3 critical perioperative moments before induction of anesthesia, before skin incision, and before the patient leaves the room. The items within the checklist are a mix of process checks, intended to reinforce accepted safety practices **(Sotto et al., 2021).**

The WHO SSC is administrated in three sections: "Sign-in," "Time-out," and "Sign-out." "Sign-in" includes verification of the patient's identity, the surgical procedure and site, and consent before induction of anesthesia. Besides, the known allergy and risk of blood loss are reviewed. "Time-out" includes further confirmation of correct operation on the correct patient and site before the skin incision. There is a review of anticipated critical events, antibiotic prophylaxis, equipment availability, and essential imaging results. "Sign-out" includes the record of the procedure, the completion of the instrument count, and the labeling of specimens before the patient leaves the operating room (OR) **(Gong et al., 2021).**

The WHO SSC is a perioperative communication and safety tool to improve adherence with basic standards, including the use of preoperative antibiotics and instrument counts. Implementation of the WHO SSC also improved perceptions of surgical safety by the surgical care teams **(Ngonzi et al., 2021).**

Significance of the study

Study done in OR indicated that 74% of surgical adverse events are preventable by applying SSC. When the WHO SSC was introduced in eight hospitals, a significant reduction of 36% in mortality and postoperative complications was achieved. The reduction rate of complications and mortality provides evidence that the WHO SSC plays a major role in patient safety in the OR. A retrospective study stated that the use of the WHO SSC could prevent 85.3% of all wrong-side errors ***(Alsadun et al., 2021).***

The World Health Organization SSC was designed to reduce preventable surgical complications, reduce mortality, improved (OR) personnel communication, decrease infection-related complications such as administration of antibiotic remains doubtful, decrease in surgical site infections and blood loss. So this study was carried out in an attempt to identity the factors affecting on the implementation of surgical safety checklist in operating room.

Aim Of The Study

This study aimed to:

Identify factors affecting on the implementation of surgical safety checklist in operating room through the following:

- Assess factors affecting on the implementation of surgical safety checklist in operating room.

• Assess the implementation of surgical safety checklist.

Study questions:

This study is based on answering the following research question:

- What are the factors affecting on the implementation of surgical safety checklist in operating room?

Subjects and Methods:

1-Technical Design:

The technical design will include research design, setting, subject and tools for data collection.

Research Design: A descriptive exploratory design was utilized to achieve the aim of this study and to answer the research question. Descriptive design: was under taken to describe answer to question of who, what, where, when and how. Exploratory design was conducted when the investigator didn't know much about the problem and need additional information or desires new or more recent information. It was adapted from **(Stephen,2022)**

Setting: This study was conducted in the collected operating rooms in the second floor which consist of 21 rooms and big recovery room which contains 10 beds at Eldemerdash Hospital which affiliated to Ain Shams University, Cairo Governorate, Egypt.

Subjects: A convenient sample of 30 nurses, 30surgeons and 30 anesthesiologists in the previously mentioned setting and accept to participate in the study and 167 patients.

Study tools:

Human related factors assessment tools:

Tool (I): Operating staff - related factors assessment tools:

This tool was collected through the following parts:

Part(1):self–administered operating staff knowledge assessment questionnaire:

It was developed by the investigator based on related literatures review **(Haugen, et al., 2019),(jones, et al., 2018)** , it was used to assess operating staff-related factors that will affect on the implementation of surgical safety checklist (SSC) in operating room, validity and reliability were tested. It included three sections as the following:

Section (A): operating staff demographic characteristics : It was used to assess the demographic characteristics of operating staff (nurses, surgeons and anesthesiologists) under study such as age, gender, marital status, level of education, and years of experience and training courses.

Section (B): operating staff level of knowledge regarding surgical safety checklist (SSC): It was used to assess the knowledge of operating staff (nurses, surgeons and anesthesiologists), knowledge related to definition, indications, time in implementation, phases of SSC and role of operating staff. This section consists of 20 mcq questions. **Scoring system**

The scoring system for this part was as follows:

• One grade was given for the correct answer and zero for the incorrect answer, with total grade = 20 grade, for total 20 questions.

The total level of staff knowledge score was categorized as follows:

• ≥ 90 % was considered satisfactory(≥18 grade)

• < 90 % was considered unsatisfactory(<18 grade)

Part (2): operating staff observational checklist :

This tool was adapted from **(Safety &WHO ,2009)** . It was used to assess staff practice regarding implementation of SSC items. It included (sign in that will be done by nurses),(time out will be done by nurses,

surgeons and anesthesiologists) and (sign out will be done by nurses, surgeons and anesthesiologists), validity and reliability were tested ,it composed of 33 steps.

Scoring system

The scoring system for the operating staff observational checklist was as follows:

One grade for each step that done correctly and zero for step that not done, with total grade = 33 grade, for total 33 steps.

- The total level of staff practice score was categorized as follows:

- **For nurse:**

- ≥ 90 % was considered competent (≥ 15 grade)
- < 90 % was considered not competent (< 15 grade)

- **For anesthesiologist:**

- ≥ 90 % was considered competent (≥ 17 grade)
- < 90 % was considered not competent (< 17 grade)

- **For surgeon:**

- ≥ 90 % was considered competent (≥ 11 grade)
- < 90 % was considered not competent (< 11 grade)

Tool (II): patients -related factors assessment tool:

It was developed by the investigator based on related literatures review ***(Haugen et al., 2019; Marshall & Touzell, 2020; Schreier & Hayn, 2018)***. It was used to assess patients-related factors that affected on the implementation of surgical safety checklist (SSC) in operating room, validity and reliability were tested, it composed of 14 questions.

Scoring system

The scoring system for patients`-related factors was as follows:

- One grade was given for yes; it means that SSC was used and zero for no; it means that SSC wasn't used or not completed, for total 14 questions.

Non-Human related factors assessment tools:

Tool (III): Environmental related factors assessment tool:

It was developed by the investigator based on related literatures review **(Alidina, et al., 2017; Alqattan et al., 2019; Kisacik & Cigerci, 2019)**. It was used to assess the environmental related factors that affected on the implementation of surgical safety checklist (SSC) in operating room, validity and reliability were tested, and it composed of 18 questions.

The scoring system for environmental related factors was as follows:

- One grade was given for yes; it means that this factor presented and zero for no; it means that this factor didn't present, for total 18 questions.

2. Operational design: -

Included preparatory phase, content validity, reliability, pilot study and fieldwork.

A- Preparatory Phase:

It included reviewing of related literatures and theoretical knowledge of various aspects of the study using books, articles, internet search, periodicals and magazines concerning factors affecting on the implementation of surgical safety checklist in operating room to develop tools for data collection.

B- Validity of the study tool:

Content validity: Validity of the developed tools was tested using face and content validity .The tools was revised by a

panel of 5 experts, 4 experts from medical surgical nursing department, Ain shams university (1 professors, 2 assistant professors and one lecturer) and one professor in surgery, faculty of medicine, Ain shams university. The experts reviewed the content of the tools for comprehensive, clarity and relevance.

Reliability: reliability of the tools was tested statistically using alpha Chrombach test.

C-Pilot Study:

A pilot study was carried out on a group of 9 operating staff and 16 patients (10%) to test the applicability of the study and to test clarity of the designed questionnaires, as well as to estimate the time needed to conduct the study. The modifications were done for the used tools then the final form was developed. Operating staff of the pilot study were not included in the study sample.

D-Field work:

- Approval was obtained from the director of Demerdash Hospital and the Director of Nursing.
- The purpose of the study was explained simply to the operating room team (nurses - surgeons - anesthesiologists) who agree to participate in the study before any data collection.
- The investigator was available 2 days (Saturday and Monday) in a week at the previous mentioned setting in the morning and evening shifts to collect data. Data collection was started and completed within 6 months; from October 2022 to March 2023.
- The data was filled by the investigator.
- The self-questionnaire sheet was filled out by the operating room team (nurses - surgeons - anesthesiologists), took about 5 minutes to fill it.
- The operating room team (nurses- surgeons - anesthesiologists) was monitored by the investigator during the implementation of the surgical safety checklist and during the operating time, took time according to the type of operation to monitor (sign in) before induction of anesthesia, (time out) after induction and before surgical incision and (sign out) during or immediately after wound closure. The observational checklist was prior to administration of the knowledge assessment questionnaire to insure the maximal realistic observations of the operating room team performance and minimize the possibility of bias.
- Knowledge of the operating room team (nurses - surgeons - anesthesiologists) towards the implementation of the surgical safety checklist was filled out as definition, role of operating staff, phases of SSC and indications of SSC, it was translated into Arabic for diploma nursing, took about 5-10 minutes to fill it.
- Staff-related factors opinionnaire that affect the implementation of the surgical safety checklist filled by operating room team according to their opinions as communication between staff, increasing workload on staff, staff turnover, staff number, lack in training for updating staff and level of education or culture of staff, took about2- 5 minutes to fill it.
- Patients`-related factors that affect the implementation of the surgical safety checklist was observed by the investigator as type of anesthesia, type of operation, emergency situations, high volume, age of patient and chronic diseases, took time according to the type of operation.
- Environmental related factors that affect the implementation of the surgical safety checklist was assessed within six month of data collection as system design, policies, procedures, noise level and basic equipment and supplies.
- Observational checklist and patients`-related factors took time according to the type of operation.
- The investigator within 6 months took 2-4 patients in every visit.

E- Ethical considerations:

- The investigator approval was obtained from the ethical committee of faculty of nursing before initiating the study work.
- The investigator clarified the objectives and aim of the study to operating staff included in the study.
- Operating staff written consents to participate in the study were obtained.
- The investigator assured maintaining anonymity and confidentiality of subjects` data.

- Operating staff were informed that they are allowed to withdraw from the study at any time without any pressure.

3- Administrative design

Approval was obtained through an issued letter from the dean of faculty of nursing Ain Shams University to directors of the previously mentioned settings.

4- Statistical design

The data were collected, coded and entered into a suitable excel sheet. Data were transferred into SPSS. Quantitative data were presented as mean, standard deviation; comparison was done using X^2 test. Qualitative data were presented as percentages. The observed differences and association were considered as follows:

- Non significant at $P > 0.05$
- Significant at $P \leq 0.05$
- Highly significant at $P < 0.001$

Results

Tool (I): Nursing

Part I: Demographic data of nursing:

This table shows that mean age of the nurses under study was 34.13±5.80and 73.3% of them were female. Concerning educational level, the result revealed that 46.6% of the nurses under study were bachelor degree of nursing. In relation to marital status, it was found that 93.3% of the nurses under study were married, regarding years' of experiences 46.7% of the nurses had adequate experience , as well as training courses 93.3% of the nurses had training courses.

This figure shows that 61.1 % of total operating team had knowledge regarding surgical safety checklist, while 38.9% of total operating team hadn't have knowledge regarding surgical safety checklist.

This figure shows that 70.0 % of total level of practice of operating team was competent regarding implementation of surgical safety checklist, while 30.0 % of total level of practice of operating team was not competent regarding implementation of surgical safety checklist.

Table 2 shows that 100.0% of high volume and 69.4% of chronic diseases affected on implementation of surgical safety checklist respectively, while 63.6 % of type of anesthesia didn't affect on implementation of surgical safety checklist.

Table 3 shows that 77.8% of environmental related factors affected on implementation of surgical safety checklist.

Table 4 show that there were statistically significant correlation between total knowledge and total staff-related factors, total practice and total patient related factors. This table show that there were highly statistically significant relation between staff-related factors and patient related factors, while statistically significant correlation between staff-related factors and total knowledge and total practice. This table shows that there were statistically significant correlation between total practice and total knowledge, staff-related factors and patient related factors. As well as, there were statistically significant correlation between patient related factors and total knowledge and total practice, while highly statistically significant correlation between patients related factors and total staff-related factors.

Table (1): Number and percentage distribution of the studied nurses according to their demographic data (n=30).

Demographic data	No.	%
Age (years)		
<30 years	6	20.0
30-35years	10	33.3
>35years	14	46.7
Mean±SD	34.13±5.80	
Gender		
Male	8	26.7
Female	22	73.3
Marital status		
Non-married	2	6.7
Married	28	93.3
Level of education		
Nursing diploma	8	26.7
Technical institute of nursing	8	26.7
Bachelor degree of nursing	14	46.6
Post degree	0	0.0
Years' of experiences		
<5 years	4	13.3
5-10 years	12	40.0
>10years	14	46.7
#Training courses		
Yes	28	93.3
No	2	6.7

#Training courses Have been attended on how to implement the surgical safety checklist (SSC)

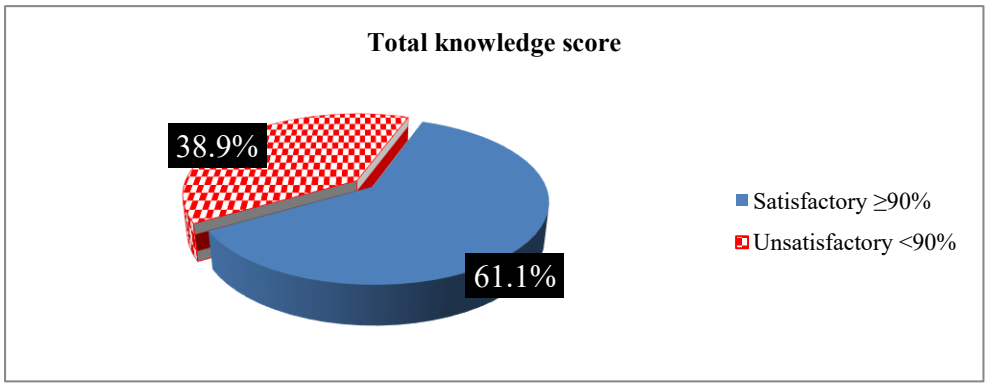

Fig. (1): Percentage distribution of the studied teams work according to their knowledge about regarding implementation of surgical safety checklist.

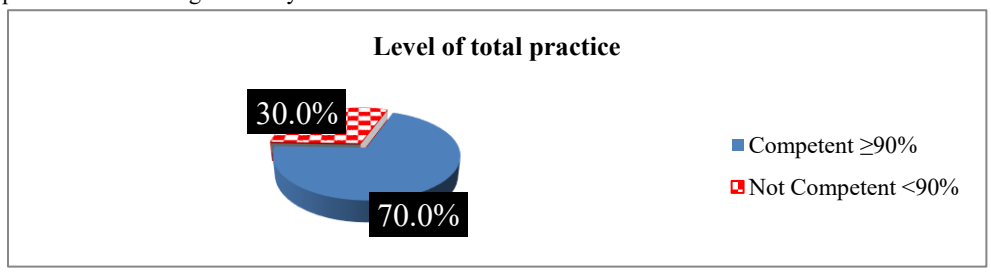

Fig. (1): Percentage distribution of the studied teams work practice according to their operating staff observational checklist.

Table (2): Number and percentage distribution of patients related factors regarding implementation of surgical safety checklist (SSC) (n=167).

Patients` related factors	Yes		No		Mean (Max. Score 1)	±SD
	No.	%	No.	%		
I-Type of anesthesia 1- The regional anesthesia affects implementation SSC (n=55)	20	36.4	35	63.6	0.36	0.20
2- The awake patient is prone to anxiety and thus affecting the implementation SSC(n=55)	20	36.4	35	63.6	0.36	0.20
3- Weaning from the general anesthesia affects implementation SSC (n=112)	50	44.6	62	55.4	0.45	0.25
II-Type of operation						
4- Major operation affects implementation SSC:- (n=22)	10	45.5	12	54.5	0.45	0.25
5- Minor operation affects implementation SSC:- (n=145)	70	48.3	75	51.7	0.48	0.27
III-Emergency situation:- (n=3)						
6- Patient with bleeding affects implementation SSC	2	66.67	0	0.0	0.67	0.37
7- Patient with breathing difficulties affects implementation SSC	1	33.33	0	0.0	0.33	0.19
8- Patient with unconscious affects implementation SSC	0	0	N/A	-	--	--
9- Patient with severe pain affects implementation SSC	0	0	N/A	-	--	--
10- Patient with stroke affects implementation SSC	0	0	N/A	-	--	--
IV-High volume:-(n=36) 11- Rapid turnover cases affects implementation SSC	36	100.0	-	-	1.00	0.00
V-Age of patient:-(n=167) 12- The patient's age affects implementation SSC						
18 -<30 (n=50)	25	50.0	25	50.0	0.50	0.28
30-<40 (n=45)	20	44.4	25	55.6	0.44	0.25
40-<60 (n=50)	30	60	20	40	0.60	0.34
> 60 (n=22)	10	45.5	12	54.5	0.45	0.25
VI-Chronic diseases:- (n=72) 13- Chronic diseases need to wide range of intervention that affect implementation SSC	50	69.4	22	30.6	0.69	0.39
14- Frequent monitoring of symptoms for chronic diseases patients affects implementation SSC	50	69.4	22	30.6	0.69	0.39
Total mean score					**8.16**	**4.02**

Table (3): Number and percentage distribution of the environmental related factors regarding implementation of surgical safety checklist.

Environmental Related Factors	Yes		No	
	No.	%	No.	%
I-System design:- 1- Patient admission testing	1	5.6	0	0.0
2- List of number of operations of the day	1	5.6	0	0.0
3- Enough numbers of nurses, surgeons and anesthesiologists	1	5.6	0	0.0
4- Confirmation of the anesthesia is safe for the patient	1	5.6	0	0.0
5- Physical assessment for each patient	1	5.6	0	0.0
II-Policies:- 6- Identify patient correctly	1	5.6	0	0.0
7- Being of infection control measures	1	5.6	0	0.0
8- Legal rights of patient	1	5.6	0	0.0
9- The restricted accountability in the operating room	1	5.6	0	0.0
III-Procedures:- 10- Preparing the site of operation	1	5.6	0	0.0
11- Preparing the equipment for operation	1	5.6	0	0.0
12- Vital procedures that taken in emergency situations such as blood transfusion, specific fluid access and lifesaving	1	5.6	0	0.0
IV-Noise level:- 13- High voices from nurses, surgeons and anesthesiologists	0	0.0	1	5.6
14- The noise from the entry and out during the operating time	0	0.0	1	5.6
15- The noise from operating room (OR) devises (monitors, ventilator, diathermy, etc…)	0	0.0	1	5.6
V- Basic equipment and supplies:- 16- Present of basic equipment and supplies	1	5.6	0	0.0
17- The problems in basic equipment and supplies	0	0.0	1	5.6
18- Checking the equipment for(sterilization, number, efficiency) before each operation	1	5.6	0	0.0
Total	14	77.8	4	22.2

Table (4): Correlation between total score of knowledge and practice, staff related factors opinionnaire and patients related factors regarding surgical safety checklist

		Total knowledge	Total staff-related factors	Total practice	Total patient related factors
Total knowledge	r		0.762	0.618	0.617
	p-value		0.004*	0.013*	0.018*
Total staff-related factors	r	0.762		0.507	0.753
	p-value	0.004*		0.038*	<0.001**
Total practice	r	0.618	0.507		0.516
	p-value	**0.013***	0.038*		0.037*
Total patient related factors	r	0.617	0.753	0.516	
	p-value	0.018*	<0.001**	0.037*	

r-Pearson Correlation Coefficient;
**p-value <0.05 significant correlation; **p-value <0.001 highly significant*

Discussion:

As regards to age of the studied nurses, the current study results showed that, less than half of the studied nurses were more than 35 years old with mean ±SD =34.13±5.80. From the investigator point of view this indicated that this life stage of studied nurses were inside the operating room as circulatory and scrub nurse. This result in the same line with ***Gong et al. (2021)*** in study entitled "The surgical safety checklist: a quantitative study on attitudes and barriers among gynecological surgery teams" who found that, the median age of nurses was 33 years old.

According to the gender of the studied nurses, the current study results showed that, less than three quarters of them were female. From the investigator point of view this finding may be due to more significant fraction of the nurses' task force in Egypt was females and may also relate to the study of nursing in Egyptian universities exclusive for females until a few years ago, additionally male nurses prefer to travel abroad or working in private hospitals for high salary outcome. These results were paralleled with ***AM et al. (2019)*** in study entitled "World Health Organization Surgical Safety Checklist with Addition of Infection Control Items: Intervention Study in Egypt" who showed that, the majority of nurses were female.

As regards to level of education of the studied nurses, the current study results revealed that, less than half of them had a bachelor's degree in nursing. From the investigator point of view this finding may be due to the operating room is critical area that needs skillful, high educated, high graduated and high specialty nurses. These results were paralleled with ***Gong et al. (2021)*** who illustrated that, the majority of studied nurses had bachelor's degree in nursing education among 96 nurses.

In accordance with marital status of the studied nurses, the current study results showed that, the most of the studied nurses were married, which may be due to this is the age of marriage in Egypt. This finding was contrasted with ***Abdel Mowla Ahmed & Awad (2020)*** in study entitled **"**The impact of development and implementation of surgical safety checklist educational program on the surgical team compliance during major operations" who found that, less than two third were married.

Regarding years of experience of studied nurses, the present study results revealed that, less than half of them had more than 10 years of experience. From the investigator's point of view this finding may be due to about half of them were more than 35 years old. This finding was consistent with ***Rogers et al. (2020)*** in study entitled "Perioperative nurses' engagement with the surgical safety checklist: A focused ethnography" who found that, two thirds of nurses have enough experience. This finding was inconsistent with ***Shin & Kim (2021)*** in study entitled "Operating room nurses want differentiated education for perioperative competencies based on the clinical ladder" who found that, more than one third had less than 3 years of experience.

As regards training courses of the studied nurses, the present study results indicated that, the most of the studied nurses had training courses related to surgical safety checklists. From the investigator's point of view this finding may be due to the study setting had put policies through providing training courses for operating staff to improve patient safety in the operating room and decrease the risks. This result was consistent with ***Rogers et al. (2020)*** who showed that, training and education are important factors in promoting the effective implementation of checklists.

Regarding total operating team knowledge, the current study results showed that, less than two thirds of the operating team had knowledge about surgical safety checklists. From the investigator point of view these results may be due to anesthesiologists and nurses had training course, surgeons were fresh educated and search a lot of knowledge which belonged to OR to avoid mistakes during surgery to achieve patient safety.This result was consistent with ***Noaman et al. (2020)*** in study entitled "Evaluating compliance to world health organization surgical safety checklist in operating room." who showed that, knowledge an important factor in promoting the effective implementation of surgical safety checklists and showed that, half of the study sample had adequate knowledge regarding surgical safety checklists.

This result was disagreed with ***Abdel Mowla Ahmed & H Awad (2020)*** who observed that, the majority of studied operating room teamwork had incorrect knowledge about SSC. This result was agreed with ***Turley et al.,(2023)*** in study entitled "International Perspectives on Modifications to the Surgical Safety Checklist" who observed that, operating room team had firsthand and intimate knowledge of the SSC's use.

Regarding the total level of practice of studied nurse, the current study results showed that more than three quarters of nurses demonstrated a competent level of practice regarding the implementation of the surgical safety checklist. The findings related to nurses aligned with ***Kisacik and Cigerci (2019)*** in study entitled **"**Use of the surgical safety checklist in the operating room: operating room nurses' perspectives." who found that, the majority of the nurses were aware of the SSC and used the checklist. While, this result wasn't in line with ***Hosny & Almasry (2021)*** in study entitled "Effect of A designing nursing infection control protocol on operating room nurses performance, A comparative study" who clarified that, nurses' practice weren't good.

Regarding the total level of practice of studied surgeons, the current study results showed that, less than three quarters of surgeons demonstrated a competent level of practice regarding the implementation of the surgical safety checklist. This result was supported with ***Harris et al. (2020)*** in study entitled "Patients' and healthcare workers' recommendations for a surgical patient safety checklist–a qualitative study" who found that, half of surgeons had adequate practice. They added that operating staff engagement in the checklist has been linked to better practice with safety measures, reduced surgical errors, and improved patient outcomes.

Regarding the total level of practice of studied anesthesiologists, the current study results showed that, less than two thirds of the anesthesiologists showed a competent level of practice in implementing the checklist. This finding was matched with ***Mutsumi & Midigo (2019)*** in study entitled "Enhancing patient's safety: understanding theatre team's attitude as a barrier towards use of surgical safety checklist in Kenya" who showed that, less than two thirds of the anesthesiologists fully used the SSC.

Regarding the total level of practice of all team, the current study results revealed that, less than three quarters of the operating team had a competent level of practice. This finding was matched with ***Mutsumi & Midigo (2019)*** who showed that, almost tow third of the operating team had a competent level of practice

From the investigator's point of view, **for the studied nurses,** these findings may be due to this practice that's considered from the daily routine duties of them, they work in critical places that not need any mistakes, the most of them had training courses and less than half of them had more than 10 years of experience. **For the studied anesthesiologists,** most of complications come from anesthesiologists so they should examine the patients perfectly and they did many operations daily and more than three quarters of them had training courses and **for the studied surgeons,** they checked the patient's name and procedure & checked antibiotic prophylaxis to prevent complications during and after operation and they did many operations daily.

Regarding the type of anesthesia, the current study results showed that less than two thirds of types of anesthesia did not affect on the implementation of surgical safety checklist (SSC). From the investigator's point of view this may be due to most patients interact with staff before anesthesia and could interact with the staff. This result was supported with ***Abd Elhy & El Sol (2020)*** in study entitled "Effect of World Health Organizational Surgical Checklist Application on Patients' Safety and Postoperative Complications" who showed that, the type of anesthesia did not affect on the implementation of surgical safety checklist (SSC).

Also, this result was contrasted with ***Ziman et al. (2018)*** in study entitled "Looking beyond the checklist: An ethnography of interprofessional operating room safety cultures "who added that type of anesthesia can influence patients' cognitive function and ability to actively participate in the checklist.

In relation to the type of operation, the current study results showed that, more than half of the type of operation did not affect on the implementation of surgical safety checklist (SSC). From the investigator point of view this may be due to the majority of operations were minor operations. This result was supported with ***Abd Elhy & El Sol (2020)*** who showed

that, the type of operation did not affect on the implementation of surgical safety checklist (SSC). Also, this result was supported with ***Delisle et al. (2020)*** in study entitled "Variation in global uptake of the surgical safety checklist" who showed that, the type of operation did not affect on the implementation of surgical safety checklist (SSC) and it was used less often in minor and moderate *versus* major operations (OR 0·84, 0·78 to 0·91).

As regard to emergency situations, the current study results showed that, almost all emergency situations affected on the implementation of surgical safety checklist (SSC). From the investigator point of view this may be due to emergency surgeries often involve time-sensitive decisions and may have different safety requirements to save patient's life and there may be pressure to bypass certain safety checks. This result was supported with ***Close et al. (2017)*** in study entitled "Overcoming challenges in implementing the WHO Surgical Safety Checklist: lessons learnt from using a checklist training course to facilitate rapid scale up in Madagascar" who showed that, checklist takes too long, and the time taken puts the patient at risk in emergency situations.

As regard to high volume of cases, the current study results showed that, almost all of cases affected on the implementation of surgical safety checklist (SSC). From the investigator point of view this may be due to decreased number of nursing staff in the afternoon shift and increased the workload didn't match with the number of nursing staff. This result was supported by ***Aouicha et al. (2021)*** in study entitled "Evaluation of the Impact of Intraoperative Distractions on Teamwork, Stress, and Workload" who revealed that, intraoperative distractions in ORs was workload and the mean workload score was M = 58.60 (SD = 24.27).

As regard to age of patient, the current study results showed that, more than half of age of patient affected on the implementation of surgical safety checklist (SSC). From the investigator point of view this may be due to patient anxiety and old patient with chronic diseases that may have different healthcare needs and potential comorbidities that required additional attention during surgery. This result was supported with ***Chhabra et al. (2019)*** in study entitled "Role of perioperative surgical safety checklist in reducing morbidity and mortality among patients: an observational study" who showed that, the age are important factors which can affect the SSC and surgical outcome.

Concerning chronic diseases, the current study results showed that, more than two thirds of chronic diseases patients affected on the implementation of the SSC. From the investigator point of view these results may be due to they need a wide range of intervention and frequent monitoring of symptoms. This result was contrasted with ***Abbott et al. (2018)*** in study titled "The surgical safety checklist and patient outcomes after surgery: a prospective observational cohort study" who showed that, the majority of chronic diseases patients did not affected on the implementation of the SSC.

Concerning environmental related factors regarding implementation of surgical safety checklist as system design, policies, procedures, noise level, and basic equipment and supplies, the current study results showed that, more than three quarters of environmental related factors affected on implementation of surgical safety checklist. From the investigator's point of view, this may be due to that the availability of necessary resources is crucial for the successful implementation of the SSC and patient safety. This result was aligned with ***Schwendimann et al. (2019)*** in study entitled "Adherence to the WHO surgical safety checklist: an observational study in a Swiss academic center. Patient safety in surgery" who showed that, the SSC's may be affected by individual, procedural and contextual factors, which supported or limited the application of the surgical checklist. They added that lack of basic equipment affected supplies, as well as problems with these items, affected SSC implementation.

This finding was consistent with ***Munthali et al. (2022)*** in study entitled "Barriers and enablers to utilization of the WHO surgical safety checklist at the university teaching hospital in Lusaka, Zambia: a qualitative study" who indicated that, non-availability of essential surgical equipment and supplies had an indirect, negative impact on the

use of the SSC. Inadequate essential surgical equipment and supplies at the time of an operation affect the implementation of the SSC.

Concerning **noise level** inside the operating room, the current study results showed that, noise level didn't affect on the implementation of SSC. From the investigator's point of view, this may be due to high technology, automatic doors and organized practice inside the operating room. This finding was contrasted with ***Mcleod et al. (2021)*** in study entitled "The impact of noise in the operating theatre: a review of the evidence" who showed that, the effect of noise on theatre staff performance in the operating room, distraction reported was equipment difficulties and verbal interruptions that affected on the surgical performance.

Concerning correlation between total score of knowledge and practice, operating staff related factors opinionnaire and patients related factors regarding surgical safety checklist, the current study results showed that, there was statistically significant correlation between total knowledge and total staff-related factors, total practice and total patient-related factors. This may be because less than two thirds of the operating team had knowledge about the SSC are more likely to also provide better practices. This indicated the importance of knowledge, staff-related factors, and practices in ensuring the effective implementation of the surgical safety checklist and ultimately improving patient safety and outcomes. These findings highlight the need for ongoing training and teamwork within healthcare settings to enhance patient safety during surgery**.**

In harmony with ***Aziz et al. (2020)*** who showed that, there was a positive correlation and significant between total knowledge and total practice. Also, this finding was agreed with ***Hassan & Ahmed (2015)*** in study entitled "Patient safety: Assessing Nurses Compliance" who revealed that, there was a statistically significant correlation between educational levels & attending programs and total scores of nurse's compliances to safety practices regarding administration of high alert medication. This finding reflected that nurse's performance was based on their knowledge. Also, this finding agreed with ***Shaheen et al. (2016)*** in study entitled "Health care Providers practice toward Patient Safety in El-Ebor family health centers" who revealed that, statistically significant positive correlation between knowledge and practice of universal precaution.

Conclusion

In the light of the current study findings, it can be concluded that:

Less than two thirds of the operating team had knowledge about surgical safety checklists. Also, more than three quarters of staff related factors opinionnaire agreed that these factors affected on implementation of surgical safety checklist. Also, less than three quarters of the operating team had a competent level of practice. And also, more than three quarters of environmental related factors affected on implementation of surgical safety checklist. Additionally, there was statistically significant correlation between total knowledge and total staff-related factors, total practice and total patient-related factors

Recommendation

- Hospitals should consider implementing operating room checklist as a strategy to improve operating room efficiency and clinical outcomes in surgical patients.

- Nurses, anesthesiologists and surgeons must be committed to the common goals of patient safety to ensure safe surgery.

- Key components to the successful implementation of the checklist include senior administrative support, surgical buyin, ensuring underlying processes of care are in place and the use of local champions.

- Illustrated manual for the surgical team as a guideline for recent and updates in the surgical safety checklist should be available in the operating rooms.

- Regular scientific meetings for surgeons, anesthesiologists and nurses who provide direct care for surgical patients must be conducted to discuss patients' problems and to detect barriers of adherence to the surgical safety checklist.

- The study should apply in other governmental hospitals and non-governmental hospitals to generalize results on large numbers of hospitals to improve patient safety.

- Regular training and education program for the operating team to improve using surgical safety checklist.

- Strict observation of surgical team during the work and continuous evaluation of their performance regarding the implementation of surgical safety checklist in operating room.

- Number of nurses in operating unit based on international nurse patient ratio to improve quality of care should be considered.

- Continuous availability all supplies and resources that help nurses for the implementation of surgical safety checklist in operating room.

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