The Impact of Development and Implementation of Surgical Safety Checklist Educational Program on the Surgical Team Compliance during Major Operations

Heba Abdel Mowla Ahmed[(1)], Wafaa H. Awad[(2)]
(1) Assistant Professor of Medical-Surgical Nursing Faculty of Nursing, Alexandria University, Egypt.
(2) Lecturer of Medical-Surgical Nursing, Faculty of Nursing, Alexandria University, Egypt.
E-mail: heba.abdelmowla@alexu.edu.eg

Abstract

Safe surgery saves lives. Surgical complications and deaths have remained largely unchanged over the past two decades. A surgical safety checklist may be used as a tool to prevent such complications. Wrong-site surgery is all too common. The World Health Organization's (WHO) surgical safety checklist aimed to improve safety in both anesthesia and surgery and to reduce complications and mortality by better teamwork, communication, and consistency of care. The surgical safety checklist outlines the essential standards of surgical care and has been shown to reduce complications and deaths associated with surgery. It was designed to prevent wrong-site surgery and improve patient safety in the operating room. The aim of this study the study was aimed to assess the impact of development and implementation of surgical safety checklist educational program on the surgical team compliance during major operations. Design: A quasi-experimental design was used to conduct this study. Setting: The study was conducted in operating rooms in Alexandria Main University Hospital. Subjects: The subjects of the present study included a convenience sample of 50 nurses and surgeons. They were enrolled into one group pre and post-intervention. Tools: The data were collected by the following study tools: Tool I: operating room teamwork knowledge about surgical safety checklist interview questionnaire. It was divided into three parts there were the operating team's socio-demographic data, operating room teamwork knowledge for surgical safety checklist, and nurses 'attitudes, and beliefs about the surgical safety checklist. Tool II: operating room teamwork implementation of surgical safety checklist performance checklist. Method: Pre-intervention and post-intervention study. The effect of implementing a surgical safety checklist during major surgical procedures on patients' safety. After conducting an education program, checklist implementation and patient safety outcome indicators were studied. Results: the main results of the present study about one-third of the studied operating room teamwork were in the age group (30<40) and the majority were female. It was observed that the majority of studied operating room teamwork had incorrect knowledge pre implementing the program. Also, the majority had correct answers following the educational program. More and more, 100.0% of the studied group had barriers to implement the surgical safety checklist. Conclusions: The study showed that the implementation of such an education program had improved patient safety. In general, these efforts are viewed favorably by operating room personnel. However, the role of these checklists and other tools in reducing wrong-sided surgeries has not been proven. The goal of the health care professional should be to continue to improve on the advances that have been made in implementing surgical checklists and preventing wrong-site surgery. Implementation of the checklist was associated with a greater than the one-third reduction in complications among adult patients undergoing surgery in a diverse group of hospitals. The use of the world health organization's surgical safety checklist in major operations is feasible and should be considered.

Keywords: Safe Surgery, Surgical Safety Checklist, Major Operations, Compliance , Adherence , Operating room staff .

Introduction

Surgery is an integral part of global health care, with an estimated 234 million operations performed yearly. It is sometimes considered the only option for saving a patient's life, reducing pain, or managing a disability. It has a role in treating a broad spectrum of diseases in the alleviation of human suffering **[Dare, Grimes, Gillies, Greenberg, *et al.*, 2014]**. American Hospital Association (AHA) revealed that at least 44,000 people, and perhaps as many as 98,000, die in hospitals each year as a result of medical errors that could have been prevented **[MacDonald, 2016]**. Furthermore, **[Thomas, Studdert, Burstin, Orav, *et al.*, 2015]** notes that "operative adverse events comprised 44.9% of all adverse events", of with 16.9% was caused by negligence, and 16.6% resulted in permanent disability outside the operating room medication errors were the leading cause of adverse events. More and more, the national incidence rate of wrong-patient, wrong-procedure, or wrong-site surgery is estimated to be as high as 50 per week. Patients undergoing major surgical intervention are at increased risk for complications and death. Even routine surgery requires the complex coordination of surgeons, anesthesia providers, nurses, and support staff to provide timely and effective care; heightened patient acuity and time pressure increase the potential for critical errors and omissions in established standards of care **[Treadwell, Lucas & Tsou, 2017]**.

Operation is any invasive operative procedure in which a more extensive resection is performed, e.g. a body cavity is entered, organs are removed, or normal anatomy is altered. Also, it is referring to any surgery involving a risk to the life of the patient specifically**:** an operation upon an organ within the cranium, chest, abdomen, or pelvic cavity **[Webster, 2020]**.

Implementation of the World Health Organization's 19-item surgical safety checklist (SSC) improved the process of care and was associated with a one-third decrease in complications across all types of non-cardiac adult surgery **[Lyons, 2015]**. In situations requiring urgent intervention, however, there has been worry that the use of a checklist will interrupt workflow and delay therapeutic care in ways that increase the risk to patients. Delays are recognized to increase the risk in the treatment of appendicitis and open fractures, these delays are measured in hours rather than minutes and a brief perioperative checklist may avert errors that are common in urgent surgery. We hypothesized that implementation of this checklist in urgent surgical cases would improve compliance with basic standards of care and reduce rates of death and complications following surgery **[Weiser, Haynes, Dziekan, Berry, *et al.*, 2018]**.

World Health Organization's surgical checklist is an effective intervention to decrease morbidity and mortality in surgical procedures **[Urbach, Govindarajan, Saskin, Wilton, *et al.*, 2019]**. The purpose of this checklist aims to help operating room teams remember important details that may be missed during an operation. Besides, it served as a tool to encourage teamwork and communication. The items included in the surgical safety checklist are aimed at preventing uncommon but serious errors by reminding the team to confirm patient identity, surgical site, and other important characteristics such as comorbid conditions or anticipated complications **[Pugel, Simianu, Flum, & Dellinger, 2016; Safety & World Health Organization, 2009]**.

Furthermore, the Joint Commission's 2016 national patient safety goals include improving communication and implementing the use of a protocol to prevent wrong-site, wrong-procedure, and wrong-person surgery. Also, it specifically mandates the completion of a time out to prevent mistakes in surgery. The time out process can be enhanced by using the WHO SSC, which involves three checkpoints, including items that must be addressed by team members before the induction of anesthesia, before the incision is made, and before the patient leaves the OR **[Sewell, Adebibe, Jayakumar, *et al.*, 2016]**. So, implementing a program for process improvement that improves communication could also improve patient safety. Also, WHO has estimated that 234 Million operations are performed annually around the globe. A systematic review including over 74000 patient records found a median incidence of in-hospital adverse events

of 9.2% with approximately half of those events being operation or drug-related, and 43% deemed preventable **[Haynes, Weiser, Berry, Lipsitz, *et al*., 2019]**. In Egypt, the national statistical reports indicated alarming and provide clear motivation to make surgery safer.

Sign-in, time-out, and sign-out are routinely conducted as part of the surgical safety checklist. The team member who greets the patient is generally the person responsible for coordinating sign-in with the nurse or anesthetic technician. Coordinators consider that the main function of sign-in is to ensure that the correct procedure is being performed on the right patient. Coordinators modify the sign-in checks according to how relevant they perceive the checks are to the procedure, their level of comfort performing the checks, the anxiety of the patient, and the order of the patient on the surgery list. Checking surgeon availability, anesthetic safety, and equipment are reported to be more relevant at the start of the list, especially when there is continuity for the rest of the list. Some of the sign-in checks are rigorously undertaken while others are glossed over or just ticked without the checks being confirmed **[Abbott, 2014]**.

Time-out was a known concept before the introduction of the checklist and was conducted in some form by surgeons or teams at more than one study site. It is considered by most theatre personnel to be an important final safety check and ensuring everyone is on the same page before knifing to skin. It is reported to be the most effectively implemented phase of the checklist. Time out is mainly coordinated by a circulating nurse. The participation of surgeons and anesthetists during Time out is varied. While a few are reported to take an active role in time out, by asking for it to be called and fully participating in the checks, others are reported to be less engaged in the process, consider it a burden, and prefer it is done concurrently with other activities e.g., scrubbing **[Aveling, McCulloch, & Dixon-Woods, 2013].**

Sign-out is the least well-implemented phase of the checklist. The end of the procedure is a busy time for theatre personnel and is a particularly critical time for the anesthetic team because they are waking up the patient. There is also, the pressure to progress through the lists on time and with short turnaround times between patients. Theatre personnel comment that having everyone physically present after wound closure to conduct sign out is also, challenging. Often, the surgeon has left the operating room, to dictate his/her notes or to take a break before the next patient, and has left his/her registrar to close the wound. When sign-out is conducted, it is generally a discussion between the surgeon and the nursing team to confirm the counts are correct and specimens have been correctly labeled. Rarely does the coordinator verbally confirm key concerns for patient handover or whether there are equipment issues that need to be addressed **[Woodman & Walker, 2016]**.

Implementing the checklist

The WHO issued an implementation manual in support of the checklist. This gives detail on how each step should be conducted. The manual highlights the importance of leadership and institutional buy-in and emphasizes that a department should practice using the checklist before introduction and should modify it so that it can be established within the normal operative workflow. A single person should be responsible for checking the boxes on the list and this can be any healthcare professional in the operating team, often the circulating nurse. That nominated coordinator should prevent the team from moving forward before each step has been addressed. Initially, this could lead to tensions and resistance within the team, but only through consistently following the safety steps will the most common and avoidable risks be minimized **[Woodman & Walker, 2016]**.

Briefing and debriefing

The patient safety first campaign was established to support implementation. It was reported that some elements of the checklist could be more effective if incorporated into a briefing before the list starts. This is an opportunity to make a plan for the list, amongst all the team members, to anticipate and plan for any problems that can be foreseen. Any team member can lead the briefing, ensuring that everyone has introduced himself or herself and clarified their role and responsibilities for the

list. An overview is taken of the list, highlighting any changes, equipment considerations, special requirements, or safety concerns. All theatre team members should be present for the briefing and debriefing. The debriefing naturally occurs at the end of the list, before any team members have left the theatre or department. The purpose of this debrief is to reflect on the list and share perspectives on tasks that went well and tasks that did not go well. This may include discussion of teamwork, the theatre atmosphere, errors or near misses, and a retrospective looks at the briefing and use of the surgical safety checklist throughout the day. It is important to register successes, learning points, areas that require change or escalation and for this to be conducted in a non-threatening, open environment. patient safety first developed and promoted the 'Five Steps to Safer Surgery'9 (Figure 1) **[Woodman & Walker 2016]**.

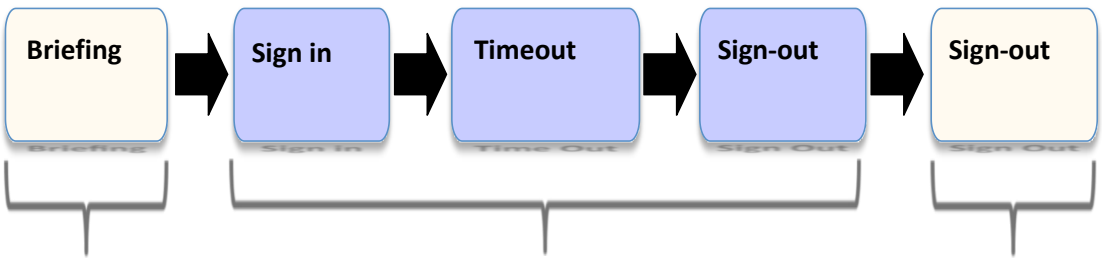

Figure 1: Five Steps to Safer Surgery

Timing of briefing and surgical checks

The 'Five steps to safer surgery' help to highlight issues at the start of the day and enable an early resolution to minimize the negative impact on theatre safety and throughput. If your facility is going to adopt this approach, it is helpful to define a fixed time for the pre-list briefing to occur. This will avoid team members arriving casually at different times, and thus inefficiency and resentment whilst waiting for other team members. Staff needs to free themselves up from distracting tasks when the checks are being completed, ideally asking for 'a surgical pause' or a moment of silence' to gather everyone's attention. In addition to being attentive, all members need to be present. It is helpful for the sign out to be completed whilst the surgeon is closing the wound as this integrates the checklist into the surgical process and ensures the surgeon is still present in the theatre **[Woodman & Walker 2016]**.

Appropriate utilization and compliance of surgical safety checklist reduces occurrence of periopera-tive surgical complications and improve patient outcomes. However, data on compliance of surgical checklists are scarce in the study area. Therefore, the aim of this study was to **to assess the impact of the development and implementation of surgical safety checklist educational program on surgical team compliance during major operations.**

Aim of the Study:

The study was aimed to assess the impact of the development and implementation of surgical safety checklist educational program on surgical team compliance during major operations.

Research Hypotheses:

To fulfill the aim of the study, the following research hypotheses was tested:
Implementing of surgical safety checklist educational program for operating team members **will:**
H_1: Improve their knowledge.
H_2: Improve compliance with basic standards of care
H_3: Exhibit positive attitude regarding implementing of surgical safety checklist.

Materials and Method

Design: A quasi-experimental design was utilized to conduct this study (one group pre-test post-test).

Setting: The study was conducted in operating rooms in Alexandria Main University Hospital.

Subjects: The subjects of the present study included a convenience sample of 50 nurses and surgeons according to the Epi-info program. They were enrolled into one group pre and post-intervention.

Tools:

The data were collected by the following study tools:

Tool I: Operating Room Teamwork's Knowledge about Surgical Safety Checklist Interview Questionnaire.

It was divided into three parts.

Part 1: Operating Team Socio-demographic Data: It was developed by the researchers, it included age in years, gender, marital status, level of education, years of experience in the operating room, received any formal training on surgical safety checklist and role in the operating room.

Part 2: Operating Room Teamwork Knowledge for Surgical Safety Checklist: this tool was adapted from **[Schwendimann, Blatter, Lüthy, Mohr, *et al*., 2019; Dangyangs, & Afonne, 2016]** to assess operating team knowledge about surgical safety checklist it includes 16 questions and the response measure through correct, incorrect and I do not know **[Mascherek, *et al*., 2017; Dangyangs *et al*., 2016]**. The scoring system was computed and the items were classified and evaluated as follow:

- Good knowledge was given to anyone who correctly answered questions between (20- 38).
- Poor knowledge was given to anyone who incorrectly answered questions between (1-19).

Part 3: Operating Room Teamwork's Attitudes and Beliefs about the WHO Surgical Safety Checklist: This tool was adapted from **[O'Connor, Reddin, O'Sullivan, O'Duffy, *et al*., 2016; Verwey, & Gopalan, 2018]** questionnaire consisted of 41 questions covering five dimensions (attitudes towards hospital norms on the use of the checklist (six items); the impact of the checklist on safety and teamwork (five items); support of the checklist from specific groups (six items); intent to initiate the checklist (two items) and barriers to the use of the checklist (twenty-two items). All responses to the attitude section were based on a five-point scale from 1 (strongly disagree) to 5 (strongly agree). **Scoring System** was computed and the items were classified and evaluated as follow:

- Positive attitude range from (31-41)
- Neutral attitude range from (16-30)
- Negative attitude range from (1- 15)

Tool II: Operating Room Teamwork Implementation of Surgical Safety Checklist Performance Checklist:

This tool was adapted from WHO, 2009 it consisted of three parts before induction of anesthesia, before induction of anesthesia, and before wound closure/patient leave OR. Each part contains a sub-item to assess operating team performance in surgery. The researchers used a standardized verification compliance checklist to record the nurses' and surgeons' compliance with the WHO checklist. The verification checklist was developed by itemizing the elements of the WHO surgical safety checklist. The checklist divides the operation into three phases namely sign-in, time-out, and sign-out. Each phase corresponds to a specific period in the normal flow of a procedure. It included19 Safety items correlates to those of the WHO safe surgery checklist.

The first Phase (7 items):

It corresponds to 'Sign-in' protocol (before induction of anesthesia) and includes the following items:

Item 1: Confirmation of patient's identity, procedure planned, site of surgery, consent for surgery given.

Item 2: Confirmation that the surgeon marked the site of surgery.

Item 3: Completion of an anesthesia safety check.
Item 4: Confirmation that a functioning pulse oximeter is placed on the patient.
Item 5: Verbal confirmation of whether the patient has a known allergy.
Item 6: Anesthesia team has assessed whether the patient has a difficult airway.
Item 7: Confirmation patient's risks of losing >500 ml blood during surgery.

The second phase (7 items):

It corresponds to 'Time out' protocol (before skin incision) and includes the following items:

Item 8: All team members introduced themselves by name and role.

Item 9: Confirmation of patient's name, surgery performed, site of surgery and, positioning of the patient.

Item10: Prophylactic antibiotics were given during the previous 60 minutes.

Item 11: Asking each team member about any anticipated critical events.

Item12: Discussion with nurses and surgeons: to identify critical or non-routine steps? And a discussion with anesthetist:aboutany patient-specific concerns?

Item 13: Confirmation:that sterilization is successfully performed (indicator).

Item 14: Confirmation that essential imaging is in the room and prominently displayed.

The third phase (5 items):

It corresponds to 'Sign-out' protocol (before the patient leaves the operating room) and includes the following items:
Item 15: Confirmation of the teamthatthe exact procedure is done.
Item 16: Confirmthecompleteness of final sponge and needle counts.
Item 17: Confirm the correct labeling of any pathological specimen.
Item 18: Equipment problems arising are identified by the team.
Item 19: Review the post-operative recovery and management plan. All observations and data collection started at the time the patient entered the operating room before the start of the case and ended at the time the attending surgeon left the operating room at the end of the case.

The researchers calculated team compliance scores for each surgical case observed. All safety practices and steps were weighted equally such that a team was given 1 point for compliance with a practice or process and 0 points for non compliance. Scores could range from 0% to 100%. Mean score percent was calculated by dividing actual score on maximum score and multiplied by one hundred.

Operation of the study:

The preparatory phase:

- Review of the related literature covering different aspects of patient safety in operation, This was done using books, articles, magazines, and internet research available to find relevant and current literature and studies to develop relevant tools for data collection. The guiding booklet was prepared by the researcher. It was specially designed in a simple Arabic language to meet the operating team's practical needs or knowledge deficits.
- Data collection tools were presented to five experts in the medical surgical nursing sector at the faculty of nursing to evaluate the validity of the content. The necessary modifications were made according to the experts' judgment on the clarity of the sentences, the adequacy of the content, and the sequence of the elements. Experts agree with the content, but recommend minor changes in the language that would make the information clearer and more accurate. Suggested changes have been made.
- Internal consistency reliability of all items of the tools was assessed using coefficient alpha. It was 0.77 for the structured questionnaires sheet and 0.92 for the nurses' practices observation sheet

Administrative phase

- Permission to get approval for conducting the study to access the operating room and conduct the study was obtained from the head of Alexandria main university hospital after showing the title and the purpose of the study.

Ethical consideration

- Approval was obtained from the research ethics committee of Alexandria Faculty of Nursing to conduct the study.
- The researcher obtained approval consent from each operating team member for participation in this study after explaining the aim of the study and securing the confidentiality of the collected data.
- The operating team members were assured that they can withdraw at any stage from the study without any responsibilities.
- The operating team members' privacy, anonymity, and confidentiality of the collected data for each patient will be assured.

Pilot Study:

- A pilot study was conducted on 10% of the total sample size (3 nurses and 2 surgeons) to demonstrate the viability and applicability of tools, and to assess the time required to fulfill the tools.

Implementation Phase and Fieldwork:

- The data were collected from June 2019 to January 2020. The purpose of the study was explained by the researcher to each nurse. The researcher was available at different times on morning and afternoon shifts for data collection.
- Each operating team was assessed for their knowledge, attitude about SSC through a predesigned questionnaire sheet, and a practical observation sheet was used to assess the actual operating room team performance of the surgical safety checklist.
- Based on the findings of the assessment and review of literature, the educational program was developed and implemented for the operating room team. The program consisted of theoretical and practical sessions. The time for each session was varied from 45 to 60 minutes. The program included the following items.
- Operating room team was divided into small groups; five to eight in each group. Various teaching methods were used in the form of lectures, group discussions, group activities questions, brainstorming, demonstration, and re-demonstration. Numerous teaching media were used, such as powerPoint, figures, flipcharts, pens, papers, and illustrated videos. The program was carried out in the unit and the conference room of the unit.

The Evaluation Phase:

- Operating room team knowledge and practices were reassessed after three months of the program (follow up).
- Pre-intervention and post-intervention study design was utilized to investigate the effect of implementing the WHO surgical safety checklist and its impact on patient safety outcomes and documentation. After an education program, the checklist implementation and patient safety outcome indicators were studied.

Results

Table 1: Illustrate the frequency distribution of the studied operating room teamwork according to their socio-demographic characteristics. Regarding **age in years**, it was noticed that about one-third (40.0%) of studied operating room teamwork were in the age group (30 < 40). Regarding the **gender**, it was observed that the majority (72.0%) of studied operating room teamwork were female. As regards **marital status**, it was found that nearly two-thirds (64.0%) of studied operating room teamwork were married. Concerning **years of experience in the operating room**, it was observed that 46.0% of studied operating room teamwork were between (5<10 years of experience). Concerning **professional background (role in the operating room)**, it was noticed that 28.0% of studied operating room teamwork were scrub nurses, while 20.0% of studied operating room teamwork were circulating nurses and 12.0% were nurse anesthetists and 16.0% were surgeons. Also, 8.0% to 16.0% of the study group were anesthesiologists and assistant surgeons respectively.

Table (1): Frequency Distribution of the Studied Operating Room according to their Socio-demographic Characteristics

Socio-demographic Data	No. (n = 50)	%
Age in years:		
▪ 21 < 30	11	22
▪ 30 < 40	20	40
▪ 40 < 50	11	22
▪ 50 ≤ 60	8	16
Gender:		
▪ Male	14	28
▪ Female	36	72
Marital status:		
▪ Single	12	24
▪ Married	32	64
▪ Divorced	4	8
▪ Widow	2	4
Years of experience in the operating room:		
▪ 5 years	9	18
▪ 5< 10 years	23	46
▪ 10<20 years	13	26
▪ ≤ 20 years	5	10
Professional background (role in operating room):		
▪ Surgeon	8	16
▪ Assistant Surgeon	8	16
▪ Anesthesiologists	4	8
▪ Nurse anesthetists	6	12
▪ Scrub nurse	14	28
▪ Circulating nurse	10	20

n: Number of studied operating room teamwork

Table (2): Illustrated **a comparison between the studied operating room teamwork knowledge pre and post-intervention**. It was observed that the majority (86.0 %) of studied operating room teamwork had incorrect knowledge pre implementing the program. Also, the majority (80.0%) of the studied operating room teamwork had correct answer following the educational program. Furthermore, there was a highly statistically significant relation P (<0.001*) between the pre and post-program.

Table (2): Comparison between the Studied Operating Room Teamwork Knowledge Pre- and Post-Intervention

Surgical Safety Checklist Knowledge	Pre -intervention (n = 50)		Post - Intervention (n = 50)		Chi-square test (p-value)	
	No.	%	No.	%	p1	p2
Incorrect answer	43	86.0	10	20.0	χ^2=0.439 (0.508)	χ^2= 15.909* (<0.001*)
Correct answer	7	14.0	40	80.0		
p_0	0.500		0.004*			

χ2: Chi-square test
p1: p-value for comparing between the studied groups in the pre-period
p2: p-value for comparing between the studied groups in the post-period
p_0: p-value for McNemar test for comparing between pre and post in each group
*: Statistically significant at p ≤ 0.05

Table (3): Illustrated a comparison between pre and post-intervention for the study group according to operating room teamwork attitude toward surgical safety checklist. Concerning **the norms dimension**, it was noticed that 48.0% of the studied group had negative attitude pre-interventions and the majority 72.0% of them had positive attitude post interventions. As regards the impact on teamwork and safety dimension, it was noticed that 44.0% of the studied group pre-intervention had a neutral attitude and following the program, 80.0% had a positive attitude. Concerning **the support dimension**, it was noticed that 40.0% of the studied group had negative and a neutral attitude pre-intervention while 68.0% of them had positive attitudes following the program. Also, initiation dimensions more than half (56.0%) and the majority (96.0%) of the study group had a positive attitude pre-intervention and post-intervention respectively. More and more, 100.0% of the studied group had barriers to the implementation of SSCL. Furthermore, there was highly a statistically significant relation P (<0.001*) between both groups.

Table (3): Comparison between Pre and Post Intervention of the Operating Room Teamwork Attitude toward Surgical Safety Checklist.

Attitude toward surgical safety	Pre - intervention (n = 50)		Post - Intervention (n = 50)		χ^2 (p-value)
	No.	%	No.	%	
Part 1: Norms					
Negative	24	48.0	8	16.0	13.621*
Neutral	16	32.0	6	12.0	(0.001*)
Positive	10	20.0	36	72.0	
Part 2: Impact on teamwork and safety					
Negative	16	32.0	4	8.0	15.710*
Neutral	22	44.0	6	12.0	(<0.001*)
Positive	12	24.0	40	80.0	
Part 3: Support					
Negative	20	40.0	10	20.0	11.981*
Neutral	20	40.0	6	12.0	(0.003*)
Positive	10	20.0	34	68.0	
Part 4: Initiation					
Negative	8	16.0	2	4.0	χ^2= 11.554*
Neutral	14	28.0	0	0.0	(MCp=0.001*)
Positive	28	56.0	48	96.0	
Part 5: Barriers of Implementation					
All	50	100.0	50	100.0	–

χ2: Chi-square test MC: Monte Carlo
p: p-value for comparing between the studied groups
*: Statistically significant at $p \leq 0.05$

Table (4): Comparison between pre and post-intervention of the operating room teamwork toward implementation of surgical.

This table illustrates that the level of performance of the health care team regarding the surgical safety checklist. Concerning Briefing (Sign-in) before induction of anesthesia, it was noticed that all (100.0%) study groups had an unsatisfactory level of performance preintervention. Also, the majority (88.0%) of the study group had an unsatisfactory level of performance before while after the program the majority (80.0%) of them had a satisfactory level of performance. As regards time out: Before skin incision, it was observed that all (100.0%) of the pre-intervention group had an unsatisfactory level of performance before and after the program. Concerning the study group, the majority (84.0%) of them had an unsatisfactory level of performance before the program and nearly two-thirds (68.0%) of them had a satisfactory level of performance after the program. Concerning Debriefing: Before wound closure/patient leave OR it was observed that all (100.0%) of the pre-intervention group had an unsatisfactory level of performance before and after

the program. Concerning the study group, the majority (84.0%) of them had an unsatisfactory level of performance before the program and nearly two-thirds (64.0%) of them had a satisfactory level of performance after the program. Also, there was a highly statistically significant relation P (<0.001*) after the program concerning the study and pre-intervention group.

Table (4): Comparison between Pre and Post Intervention of the Operating Room Teamwork Toward Implementation of Surgical.

Implementation of Surgical Safety	Pre-intervention (n = 50)		Post - Intervention (n = 50)		Chi-square test (p-value)	
	No.	%	No.	%		
A-Briefing (Sign in) Before induction of anesthesia						
- Unsatisfactory	50	100.0%	10	20.0%	p1	p2
- Satisfactory	0	0.0	40	80.0%	χ^2=3.191 (^{FE}p=0.235)	χ^2=33.333* (<0.001*)
B- Time out: Before skin incision						
- Unsatisfactory	50	100.0%	18	36.0%	p1	p2
- Satisfactory	0	0.0	32	64.0%	χ^2=4.348 (^{FE}p= 0.110)	χ^2= 9.524* (^{FE}p= 0.004*)
C-Debriefing: Before wound closure/patient leave OR						
- Unsatisfactory	50	100.0%	18	36.0%	p1	p2
- Satisfactory	0	0.0	32	64.0%	χ^2= 4.348 (^{FE}p= 0.110)	χ^2=23.529* (<0.001*)

χ2: Chi-square test FE: Fisher Exact
p1: p-value for comparing between the studied groups in the pre-period
p2: p-value for comparing between the studied groups in the post-period
p0: p-value for McNemar test for comparing between the pre and post in each group
*: Statistically significant at p ≤ 0.05

The percent compliance is calculated as follows:

$$\frac{\text{\# of times all three phases of the surgical safety checklist was performed}}{\text{Total surgeries}} \times 100 = \%\ \text{compliance}$$

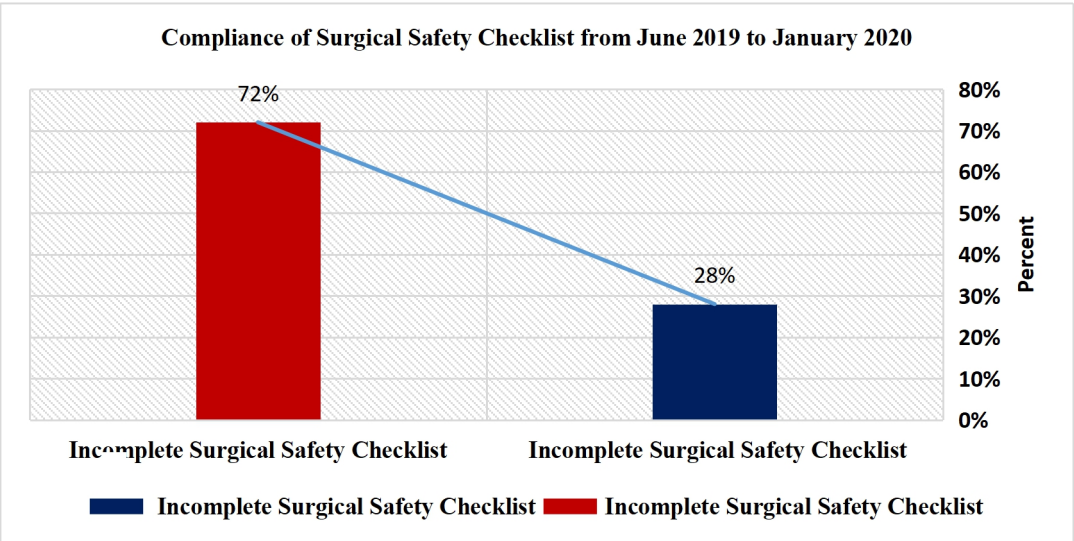

Figure 1: Illustrated the overall compliance of completed checklist was 72% with all items addressed in all phases where else 28% of the cases failed to complete the checklist ... one of the phases.

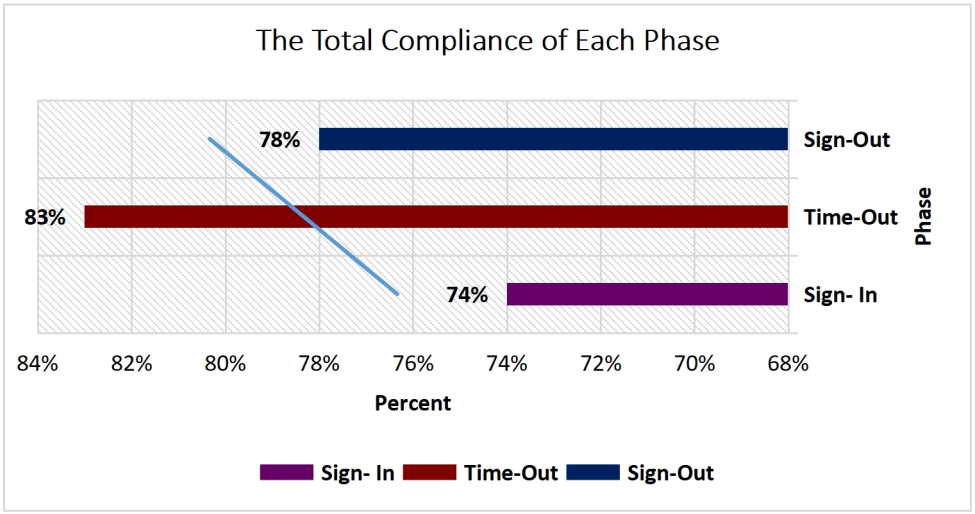

Figure 2: Illustrated another area observed within the period was the total compliance of each phase, as apparent from the bar chart, sign in phase has achieved 74%, while Time-out phase and Sign-out phase has achieved 83% and 78% respectively

Compliance of Surgical Safety Checklist according to Items WHO Surgical Safety Checklist in each Phase

As apparent, total compliance for the clear announcement made in the Sign-in phase is 78%, team response is 76%, silent cockpit observed during the phase was 16%, distractions were 15%, documentation completed accurately was 87% and documentation completed at each stage was 74%. Total compliance for time-out phase was, for the clear announcement made 61%, team respond appropriately was 81%, silent cockpit observed during the phase is 12%, distractions 13%, documentation completed accurately was 86% and documentation completed at each stage was also 86%. Sign-in phase, the clear announcement made 78%, team respond appropriately was 79%, silent cockpit observed during the phase is 13%, distractions 3%, documentation completed accurately was 70% and documentation completed at each stage was 76%.

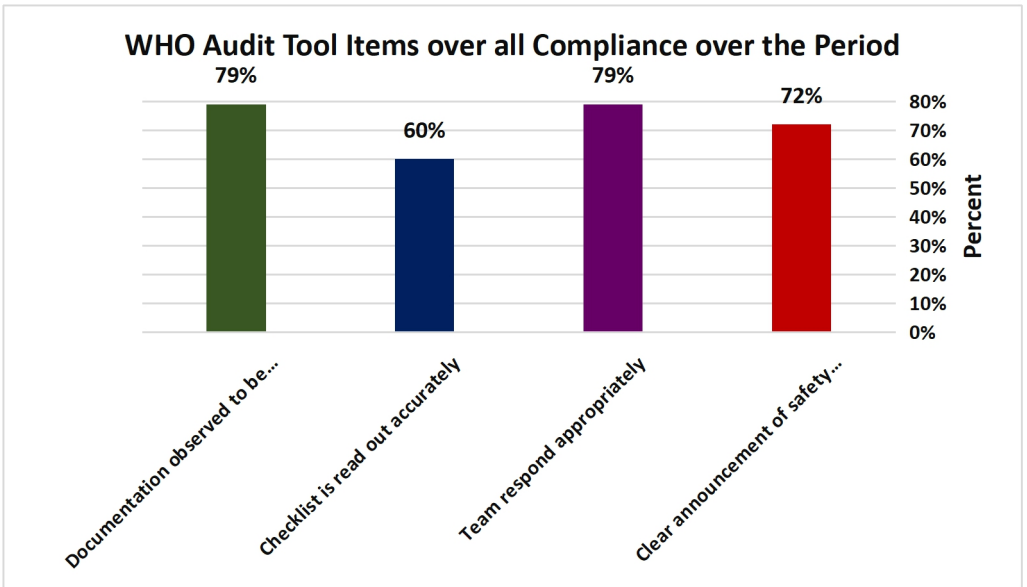

Figure 3: Illustrated the Audit Tool Items Over All Compliance over the Period

Issue	Required behavior/observations	Compliance over the period
Clear announcement of safety checklist?	A designated member of the team leads the team through the appropriate stages of the safety checklist. The team member is observed to use the checklist and to let the team know that the safety check is taking place.	72%
Team respond appropriately	On the announcement of the start of the safety check- the team focuses on the questions being asked. Any potential distractions such as phone calls are eliminated. No disrespectful comments are made about the process.	79%
The checklist is read out accurately	A distraction or interruption can be people chatting, using mobile phones, not focusing on the checklist, or people entering the theatre at the time of the check. If staff enter the theater but do not disturb the team undertaking the check, this is not classified as an interruption.	60%
Documentation observed to be completed at the time of undertaking the check	The observer should ensure all documentation is completed during the check. All documentation is required to be complete BEFORE the patient leaves the theatre and should not be completed retrospectively.	79%

Figure 4: Illustrated the total compliance of process indicators shows, for oral confirmation of the patient 91%, objective airway evaluation performed was 85%, pulse oximeter used in 100% of the case, 98% for two peripheral or one central IV catheters used, 96% shows usage of prophylactic antibiotics, sponge counts completed as 96% % and 94% of the cases have achieved all six safety indicators performed.

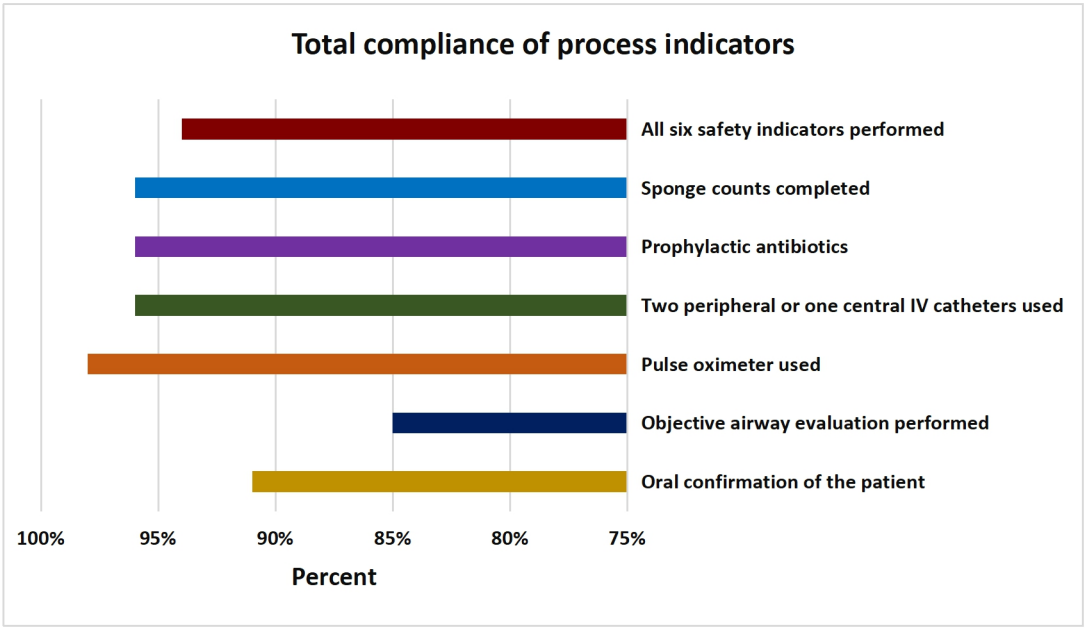

Figure 4: Illustrated the Total Compliance of Process Indicators

Discussion

The WHO surgical safety checklist was developed as part of a global initiative to improve patient safety, teamwork, and communication in the perioperative period. So, improving nursing knowledge and practice regarding patient safety is very essential that can be achieved through developing standards of intraoperative nursing interventions, clear identification of deficiencies in the provision of care, and increasing nurses' awareness regarding their vital role in saving patient life through safe practice **[Abd Elaty, 2016]**. In this respect, the result of the present study clarified that improving nursing knowledge following an educational program. This finding goes in the same line with **[Mukhtar, & Ahmed, 2019]** who found an improvement in nurses‟ knowledge mean score after implementing the training program with highly statistically significant differences (P = 0.05).

Structured interventions for team education and training are essential to succeed in using the SSC this was in the same line with **[Bleakley, Allard, Hobbs, 2012; Bergs, Lambrechts, Simons, Vlayen, et al., 2017]**. Furthermore, **[Danko, 2019]** clarified that a nursing training program on SSC has been shown to decrease error and increase the ability to solve problems, particularly for inexperienced professionals, whereas failure of training is often attributed as a major cause of complications and incidents. In the light of this the result of the present study showed that there was a satisfactory level of performance regarding the implementation of SSC during a briefing (sign-in) before induction of anesthesia, time out: Before skin incision and debriefing: Before wound closure/patient leave OR and there was a highly statistically significant difference post-implementation of the training program. This finding is consistent with **[Aboel-Seoud, El-Sabbagh, Zakaria, & Ibrahim, 2015]** who showed that operating room nurses, level of practice during sign-in, time-out, and sign-out phases had been greatly improved after implementation of the WHO surgical safety checklist items. Similarly, these results were consistent with **[Eshun, & Eshun, 2013]** who reported that the majority of nurses viewed a satisfactory level of practice after guidelines protocol for surgical patient safety. Also, **[Labrague, Arteche, Yboa, & Pacolor, 2012]** stated that the majority of studied nurses had a competent level of practice regarding principles of sterile technique and demonstrated it. Also, **[Agbuya-Gates, 2017]** revealed that a structured training program for scrub nurses had been significantly improved their practical performance regarding patient safety and minimize the occurrence of adverse events.

The implementation of a surgical safety checklist in these health units implies an integrated team effort, with greater participation and surgical team situation awareness. Besides, also, the WHO surgical safety checklist can modify the personal attitudes of professionals working in ORs and is seen as a tool that improves patient safety **[Santana, Rodrigues, & Evangelista, 2018]**. In this respect, the present study illustrated that there was a highly statistically significant difference following an educational program. These go in the same line with **[O'Connor, Reddin, O'Sullivan, O'Duffy, *et al*., 2016]** showed that the mean differences between all sub-scales; norms, impact on safety patient and teamwork, support, intention, and barriers were significant. This result is contradicted by **[Nilsson, Lindberget, Gupta, & Vegfors, 2019; Hurtado, Jiménez, Peñalonzo, Villatoro, *et al*.,2012; Hurtado et al., 2012; O'Connor, Reddin, O'Sullivan, O'Duffy, *et al*., 2016]** who reported that the participants had a positive attitude to the checklist.

The chief managers were the highest scoring barrier against the implementation of the checklist. as clarified by **[Mahajan, 2019; Kariyoi, Hightoweri, Ndihokubwayoii, Tumusiimei, *et al.*, 2017; Russ, Sevdalis, Moorthy, Mayer, *et al*., 2019]**. Moreover, **[Bergs, Lambrechts, Simons, Vlayen, et al., 2017]** highlighted physicians' hierarchical positioning, lack of knowledge, and lack of ownership as barriers in the implementation processes and the SSC execution. Also, according to **[Gillespie, Chaboyer, Wallis, and Fenwick., 2010]** low SSC compliance can be related to different perceptions of the SSC intentions within the team, lack of leadership, lack of management support, and no team discussions about the purpose and how the checklists are to be executed. More and more,

the majority of participants reported that the lack of time and training are the most important barriers to completing the checklist. The concentration of hospitals in Tehran which leads to a great number of patients attending can result in overcrowding, so staff may have insufficient time to complete the SSC. Also, supervisory structures and motivation can affect this issue. Regarding time **[Sewell, Adebibe, Jayakumar, *et al*., 2016]** reported that 20% of staff thought the checklist caused an unnecessary time delay. However, **[Agbuya-Gates, 2017]** reported that the WHO checklist took only about 2 minutes on average.

Conclusion

Preventable harm occurs daily during surgery across the world. The WHO checklist was introduced as one means of reducing harm and improving patient safety in the operating theatre. With the benefit of hindsight, trials and audit, we have gained experience and identified the key factors that enable successful use of the checklist. These are senior multidisciplinary support, surgical buy-in, ensuring underlying processes of care are in place and using local champions to enthuse and encourage staff. The checklist needs to become part of the routine surgical culture, even more so in an emergency or at the end of a long shift when simple tasks are easily forgotten. With consistent use, team members will become familiar with the checks, less embarrassed about using them, more time-efficient, and break down the barriers to success. And ultimately, patient harm will be reduced. The study showed that the implementation of such an education program had improved patient safety. In general, these efforts are viewed favorably by operating room personnel. However, the role of these checklists and other tools in reducing wrong-sided surgeries has not been proven. The goal of the health care professional should be to continue to improve on the advances that have been made in implementing surgical checklists and preventing wrong-site surgery. Implementation of the checklist was associated with a greater than the one-third reduction in complications among adult patients undergoing surgery in a diverse group of hospitals. The use of the world health organization's surgical safety checklist in major operations is feasible and should be considered.

Recommendations:

Based on the results of the present study, the following recommendations were derived and suggested:

Recommendations for the surgical team:

- Hospitals should consider implementing operating room briefings as a strategy to improve operating room efficiency and clinical and economic outcomes in surgical patients. Nurses 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 buy-in, 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 both surgeons 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.

Recommendations for Further Studies:

- **Study the factors that affect the adherence of the surgical team toward the implementation of the surgical safety checklist.**

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