

## Intraoperative Nurses' Safety Practices: Its Effect on Postoperative Adverse Events among Surgical Patients undergoing General Anesthesia

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### Abstract

Improving intra operative nurses' safety practices regarding surgical patients can be achieved through assessing how patients can be harmed or experienced further adverse events as result of improper practices and errors. Therefore, the study **aimed to** assess the effect of intraoperative nurses' safety practices on postoperative adverse events among surgical patients undergoing general anesthesia. **Convenient Sample** of two different groups (19 operating room nurses who assigned for caring of intraoperative general surgical patients & 78 surgical patients who had major general surgery undergoing general anesthesia and experienced adverse events in post-operative care departments) had been recruited in the study. **Two tools** were used to collect data (1) observational checklist (adapted by investigator), (2) global trigger tool (developed by investigator). **The Results** revealed that total practice score of studied nurses was unsatisfactory (78.9%) along three phases of surgery so one half of studied patients (50%) experienced surgical wound infection or sepsis as adverse event in post-operative departments. In addition, more than two thirds of studied patients (70.5%) had experienced prolonged hospitalization as result of occurrence of adverse events " moderate level of harm" (category F). **Conclusion.** When intraoperative nurses' safety practices regarding surgical patients was unsatisfactory along three phases of surgery (sign in, time out, sign out), those patients had experienced adverse events and harm in post-operative departments regardless their age, gender, type of operation, and pervious surgical and general anesthesia history. **the study recommended** that strict observation and evaluation of nurses` performance during their work as well as correction of poor practices is essential, the need for continuous educational programs for operating room nurses to improve their practices regarding patient safety, and establishing a data base for patients who experienced adverse events in postoperative departments is necessary.

**Key words:** adverse events, general anesthesia, safety practices, surgical patients

### Introduction

An estimated 234 million major surgical operations are performed annually worldwide

to diagnose or treat illness, correct deformities and defects, repair injuries, and cure certain diseases (*Alaaa-Eldeen, Saad & Elrefaee, 2012*). As volume and importance of surgery in healthcare world widely, growing attention is being focused on patient

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safety and quality of care provided to surgical patients because half of all surgery related iatrogenic events and complications are preventable (*Fajemilehin, Oyediran, Faronbi & Ajibade, 2016*).

All surgical patients should pass through three phases called perioperative phases which include preoperative, intraoperative, and post-operative phase of surgical experience. During intraoperative phase, operative procedures can take place including incision, excision, and manipulation or suturing of tissue that usually requires local, regional anesthesia, and profound sedation or general anesthesia to control pain. (*Goodman & Spry, 2016*). It can be induced by administration of inhaled gases and I.V medications during the following stages: Induction (unconsciousness is induced), maintenance (during which procedure can be performed) and emergence (when the procedure is completed and patient return to consciousness) (*Dewit & Kumagai, 2013*).

Although each member of surgical team (consisting of the surgeon, anesthetist, and perioperative nurses) has specific tasks in each phase of surgical experience, the primary responsibility and accountability for meeting patient needs and ensuring safety is assigned to nurse (*Le-Mone et al., 2015*). Patient safety referred to reduction of risk of unnecessary harm associated with health care team; it covers both absence of harm to patient and actions taken for harm prevention and also includes structuring of care processes that eliminate known causes of common errors (*Schildmeijer, 2013*).

More recently, *Townsend, Beauchamp, Evers and Mattox, (2015)* stated that surgical patients undergoing general anesthesia may experience harm as result of occurrence of the following adverse events; sepsis, deep venous thrombosis, physical injury or trauma, drug related events as allergic reactions or skin rashes, myocardial infarction, cardiac arrhythmias, cardiac arrest, intra or post-operative patient death, in addition to technique related events as organ

laceration, post-operative bleeding, removal of an organ during operative procedure, unplanned change in the procedure, and re-operation.

Acts of omission and Human errors that threaten patient safety play an important role in occurrence of surgical adverse events. These errors may be improper practice for identifying the patient, inadequate preoperative evaluation, ignorance of important clinical history as drug allergies. In addition to, anesthesia equipment problems, failure to confirm availability of necessary equipment, unanticipated blood loss, and omission of surgical items (e.g. sponges, needles, towels) inside patients. In addition to, breakdown in communication, ineffective teamwork, and non-adherence of operating room nurses to standard practice regarding sterilization and aseptic technique (*Dirckx, 2010*).

Therefore, intra operative nurses' safety practices should be performed effectively during three phases of surgery (sign in, time out, sign out) to reduce surgical and anesthesia errors and complications through ensuring that all critical tasks are performed well, encouraging a non-hierarchical team-based approach, enhancing communication, catching near misses early, anticipating potential risks or critical events, and having technologies to manage anticipated and unanticipated complications (*Treadwell, Lucas & Tsou, 2014*).

### **Significance of the study**

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According to annual statistical report of Benha University Hospital for 2014, it was shown that about 762 major surgeries of 2084 total number of operations were performed (*Benha university hospital statistical office, 2015*). Also systematic review suggested that the most common location of adverse events in hospital was the operating theatre. Most were associated with a surgical care provider (although few directly related to anesthesia), and 43% of the

incidents were preventable using the current standards of care (*Walker, Reshamwalla & Wilson, 2012*). In addition, the study findings can;

- Generate new trends in patient safety research that would address many issues for higher-quality and safer care (*Pronovost et al., 2009*).
- Help in preparing future nurses who are competent to provide safe care through improving nursing educational curriculum (*Vaismoradi, 2012*).
- Improve nursing practice through clear identification of deficiencies and increase nurses' awareness regarding their vital role in saving patient life through safe practice (*Abd Elaty, Hassanin & Roufail, 2014*).

### **Aim of the study**

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This study aimed to assess the effect of intraoperative nurses' safety practices on postoperative adverse events among surgical patients undergoing general anesthesia

### **Research Question:**

To achieve the aim of this study the following research question was formulated:

1-What is the effect of intraoperative nurses' safety practices on postoperative adverse events among surgical patients undergoing general anesthesia?

### **Subjects and method**

#### **Research Design**

A descriptive research design was utilized in this study.

#### **Setting**

This study was conducted at operating rooms of general surgery and post-operative care departments at Benha University

Hospital.

### **Sample**

A convenient sample consisted of two different groups had been recruited in the study those were:-

**Group I:** All operating room nurses (19 nurses) who assigned for caring of intraoperative general surgical patients.

**Group II:** All available surgical patients during 6 months (from July 2016 to December 2016) who had experienced adverse events in post-operative care departments. Total number was 78 patients.

### **Tools of data collection**

⇒ **Tool I: Intraoperative Nurses' Safety Practices Observational Checklist:** It consisted of 2 parts:-

- **Part one:** Personal and background data sheet which consisted of the following two sections:

a. Socio- demographic data sheet which includes: gender, age, marital status, qualification, years of experience in nursing practice and OR units.

b. Nurses' work related information as; current job description, position, previous attendance of training programs related to intraoperative care.

- **Part two:** Observational Checklist: it was adapted from (*Alaaa-Eldeen, Saad & Elrefaee, 2012*) and modified by the investigator to assess intraoperative nurses' safety practices throughout three phases of operation (Sign in, Timeout, and Sign Out) according to their roles in operating theatre. The designated observational checklist comprised of three main categories of nurses' safety practices that can be performed from the moment when the scheduled patient enter the operating room until completion of

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operation and recovery from anesthesia:

a) Safety practices during sign in phase (prior to induction of anesthesia) comprised of (11 items and 5 sub- categorized procedures) involving; Environmental safety, preparing operating room, Ensure availability of anesthesia equipment and needed supplies, confirmation of patient identity, type of operation, site marked, and written consent, patient preparations for surgery and anesthesia, bleeding risk management, safe positioning of patient, diathermy padding, assessing the patient for the risk of difficulty airway or aspiration and allergy.

b) Safety practices during time out phase (The time after induction of anesthesia until skin closure) consisted of (7 items and 6 sub- categorized procedures) including: induction of anesthesia, scrubbing, gowning , gloving , preparing sterile field for surgical procedure, counting surgical instruments, handling surgical equipment during the operation).

c) Safety practices during sign out phase (the procedure is completed but the patient doesn't leave the operating room) involving (8 items and 2 sub- categorized procedures); Repeat count of the instruments, needles, sponges and towels, Safe handling with laboratory and tissue specimen (pathological biopsy), caring of surgical instruments, environmental hygiene, immediate post-anesthesia care (during recovery from anesthesia), and safe transferring of patient to post anesthesia care unit.

### Scoring system

Each item was evaluated and scored in terms of done correctly (2), done incorrectly (1), not done = Zero. The total scores of the checklist were (224). The checklist was carried out three times by the investigator and the average mean was considered as the final score for each nurse.

### Toll II: Institute for Healthcare Improvement (IHI) Global Trigger Tool: comprised of 2 parts:

- **Part one:** Demographic data sheet of studied patient that includes: age, sex, diagnosis, comorbid disease, type of operation, surgical and general anesthesia history.
- **Part two:** Global Trigger Tool <sup>15</sup>: This tool was developed by the investigator guided by the original tool developed by *Griffin & Resar (2009)* .Then, it was utilized to assess post-operative adverse events among surgical patients undergoing general anesthesia. The triggers of this tool derived from Care, medication, surgical, and emergency modules. While Perinatal and intensive care triggers had excluded because they weren't relevant to the study. According to juries' opinion and pilot study results, a set of 56 triggers prepared for identifying the following 11 surgical adverse events; excessive bleeding, surgical wound infection, deep venous thrombosis or pulmonary embolism, pneumonia, retention of surgical instrument, cardiac arrest, physical trauma, Allergic reactions related to anesthetic drugs, extreme hypoglycemia postoperatively, cardiac complications (acute myocardial infarction), and prolonged paralytic ileus. While severity of patient' harm as result of occurrence of adverse event was categorized according to National Coordination Council for Medication Error Reporting and Prevention index (*NCCMERP severity scale*) as following:

- **Category E (mild):** event contributed to or resulted in temporary harm and required intervention

- **Category F (moderate):** event contributed to or resulted in temporary harm requiring outpatient care, readmission or prolonged hospitalization

- **Category G (severe):** event contributed to or caused permanent patient harm

- **Category H (life threatening):** event that required lifesaving intervention

- **Category I (death):** event contributed to patient's death.

#### **Scoring system:**

Trigger tool was assigned a score according to:

- ◀ Presence of the triggers in patient' record if, Yes = 1, No = zero.
- ◀ Occurrence of adverse event if, Yes = 1, No = zero.
- ◀ Severity of adverse event (E- I) scored as follows:
  - Category E (mild): = 1
  - Category F (moderate) = 2
  - Category G (severe) = 3
  - Category H (life threatening) = 4
  - Category I (death) = 5

#### **Method**

1. Approval to conduct the study was obtained from the responsible authorities of Benha University Hospital after providing an explanation of the study aim.

2. The tools were developed by the investigator based on the recent relevant literature. Content Validity was tested by 5 (professors) experts in the field of medical surgical nursing(three assistant professor from faculty of nursing Cairo University, one assistant professor from faculty of nursing Ain- Shams University, and one lecturer

from faculty of nursing Benha University). Accordingly, all necessary modifications were done.

3 Intra operative Nurses' Safety Practices Observational Checklist was tested for its reliability using *Cronbach's Alpha Coefficient Statistical test* which revealed that the reliability of the tool was **0.75** indicating high reliability. While IHI Global Trigger Tool was tested for reliability using *Cohen's Kappa Coefficient Statistical test* which indicated that (**Kappa = 0.55**) which represents a "Moderate" agreement level according to the Landis-Koch benchmark scale.

4. A pilot study was conducted on 10% of study' subjects (2 nurses & 8 patients) to test feasibility of the study, as well as objectivity of the tools. Modifications were minor and did not affect the main data so that the subjects who shared in the pilot study were included in the actual sample.

5. The investigator explained the purpose of the study to nurses and patients including in the study. Nurses' and patients' formal consent to participate in the study were obtained, and every nurse and patient informed that confidentiality would be assured.

6- The investigator utilized specific techniques to collect the data pertinent to the study as follows:

- Intraoperative nurses' safety practices observational checklist: these practices observed directly three times by the investigator and time spent to fill the observation sheet was 20- 30 minutes for each nurse.
- IHI global Trigger tool; was fulfilled through reviewing the patient' surgical records for the presence of the triggers. Time spent for reviewing the sheet was 30 minutes for each patient' record.

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8. The data was collected during a period of 6 consequential months (from July 2016 to December 2016).

### Statistical analysis:

- ◀ The collected data were scored; tabulated and analyzed using statistical package for the social science (SPSS) Program version 20.
- ◀ Descriptive as well as parametric inferential statistics was utilized to analyze data pertinent to the study.
- ◀ Quantitative variables were expressed as mean & standard deviation (SD).
- ◀ Number (N) and percent (%) were used for presenting qualitative variables.

- ◀ Chi-square test ( $X^2$ ) was used to examine the relation between qualitative variables.
- ◀ Correlation (r) test was used. Probable P error should not exceed 5%.
- ◀ The observed difference, associated was considered as following:
  - $P > 0.05$  ----- Not Significant
  - $P \leq 0.05$  ----- Significant
  - $P \leq 0.001$ ----- High Significant
- ◀ The scoring level was classified as following: A score equal or more than 195 ( $\geq 80\%$ ) was considered satisfactory level of practice. A score less than 195 ( $< 80\%$ ) was considered unsatisfactory practice level.

### Results:

**Table (1): Distribution of operating room nurses according to their socio-demographic characteristics (n=19)**

Subjects Variables	n= 19	
	No	%
<b>Age ( years)</b>		
<30	7	36.8
$\geq 30$	12	63.2
Mean $\pm$ SD	33.4 $\pm$ 8.9	
<b>Gender</b>		
Male	2	10.5
Female	17	89.5
<b>Marital status</b>		
Married	19	100.0
<b>Qualification</b>		
Secondary school	16	84.2
Technical institute	3	15.8
<b>years of experience</b>		
<15	9	47.4
15-	5	26.3
25+	5	26.3
Mean $\pm$ SD	16.6 $\pm$ 8.5	

The characteristics of the study sample are described in table (1): illustrates that less than two thirds of studied subjects (63.2%) within age of  $\geq 30$  years with the mean age  $33.4 \pm 8.9$  years old. Nearly most of studied nurses (89.5%) are female and all of them (100%) are married. In addition, nearly the majority (84.2%) was secondary school graduate and less than one half of them (47.4%) had experience less than 15 years with the mean years of experience  $16.6 \pm 8.5$  years.

**Table (2): Distribution of nurses' regarding their work related information (n=19)**

Subjects Variables	n= 19	
	No	%
<b>Current position</b>		
Operating room nurse	17	89.5
Head nurse	2	10.5
<b>Attendance of training programs regarding intra operative care</b>		
Yes	12	63.2
No	7	36.8
<b>Time of attendance (n=12)</b>		
◀ Since 3-6 months	9	75.0
◀ Since 9 months	3	25.0

As can be seen in table (2) that the minority of studied subjects (10.5%) act as head nurse and less than two thirds of them (63.2%) had been received training programs about intraoperative care and third fourths (75%) of studied group attended these programs since 3 – 6 months.

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**Table (3): Distribution of studied patients according to demographic characteristics (n=78)**

Variables		
	Number (N)	Percentage (%)
<b>Age (years)</b>		
≤ 25	33	49.3
≥ 35	45	57.7
<b>Mean ±SD</b>	33.47±8.9	
<b>Gender</b>		
Male	37	47.4
Female	41	52.6
<b>Comorbid Disease</b>		
No	50	64.1
Heart disease	1	1.3
Hypertension	7	9.0
Diabetes mellitus	10	12.8
Hepatitis	9	11.5
Others	1	1.3
<b>Type of operation</b>		
Cholecystectomy	17	21.8
Partial colectomy	11	14.1
Mastectomy	3	3.8
Appendectomy	12	15.4
Hernia repair	14	18.0
Splenectomy	1	1.3
Subtotal thyroidectomy	5	6.4
Others	15	19.2

As can be seen in table (3) that more than one half of studied patient (57.5%) their age is 35 years or more. It is worth mentioning that the mean age of the subjects is 33.47±8.9 years. More than one half of studied patients (52.6%) are female and more than two thirds of them (64.1%) don't suffer from comorbid disease. While more than one fifth (21.8%) had undergone to cholecystectomy operation.



Table (4): Distribution of studied patients according their surgical history (n=78)

Variables	n=78	
	Number (N)	Percentage (%)
<b>pervious surgery</b>		
No	30	38.5
Yes	48	61.5
<b>Pervious history of general anesthesia</b>		
No	34	43.6
Yes	44	56.4
<b>Frequency of general anesthesia administration (n = 44)</b>		
< 2 times	34	77.3
≥ 2 times	10	22.7
<b>Complications experienced from general anesthesia (n =44)</b>		
No	29	66.0
Yes	15	34.0

Surgical history of studied patients can be described in Table (4); Clarifies that more than one half of studied patients had pervious surgical and general anesthesia history (61.5%, 56.4% respectively). In addition, More than three fourths of them (77.3%) had previously administered general anesthesia less than 2 times and more than two thirds of them (66.0%) don't experience further complications.

Table (5): Total practice scores of studied nurses during each phase of surgery (n= 19)

	phase I (sign in)		phase II (time out)		phase III (sign out)	
	No	%	No	%	No	%
<b>Satisfactory</b>	3	15.8	6	31.6	2	10.5
<b>Unsatisfactory</b>	16	84.2	13	68.4	17	89.5

This table illustrates that the total practice scores of studied nurses is unsatisfactory during phase III (89.5%). But, it is satisfactory during phase II (31.6%).

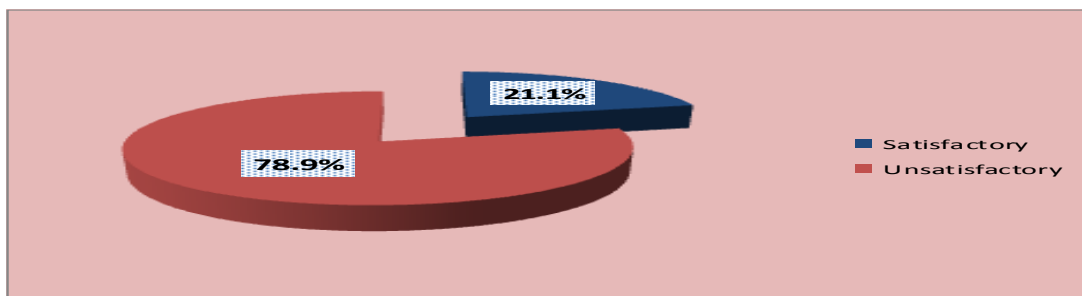


Figure (1): Total practice score of studied nurses during three phases of surgery "sign in, time out, sign out" (n =19)

This figure illustrates that studied nurses have unsatisfactory level of practice (78.9%) regarding patient safety along three phases of surgery (sign in, time out, sign out).

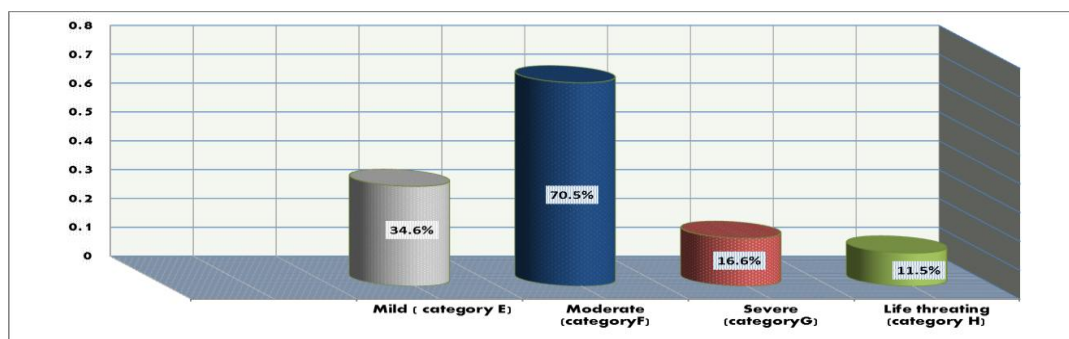
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**Table (6): Frequency of postoperative adverse event among surgical patients (n=78)**

Adverse event	Frequency (%)
Surgical wound infection or sepsis	39 (50%)
Physical injury or trauma	13 (16.6%)
Allergic reactions related to anesthetic drugs	11(14.1%)
Respiratory infection (pneumonia)	10 (12.8%)
Excessive bleeding postoperatively	9 (11.5%)
Prolonged paralytic ileus	7 (8.9%)
Cardiac complications( acute myocardial infarction, arrhythmia)	6 (7.7%)
Deep venous thrombosis or pulmonary embolism	4 (5.2%)
Extreme hypoglycemia postoperatively	3 (3.8%)
post-operative cardiac arrest	2 (2.6%)
Retention of surgical instrument, sponges, needles, towels	0 (0.0%)
<b>Total</b>	<b>104 (133.3%)*</b>

**\*Data not mutually matched**

This table illustrates that one half of studied patients (50%) experienced surgical wound infection or sepsis as adverse event in post-operative departments. While less than one fifth had Physical injury or trauma and allergic reactions related to anesthetic drugs (16.6%, 14.1% respectively). It was noticed that retention of surgical instrument, sponges, needles, towels doesn't take place at all among studied subjects (0.0%)



**\*Data not mutually matched**

**Figure (2): Severity of the patient harm as result of occurrence of adverse events (n=78).**

This figure illustrates that more than two thirds of studied patients (70.5%) have been experienced moderate level of harm (category F) that represents " prolonged hospitalization as result of occurrence of adverse events". On the other hand, the minority of them (11.5%) experienced life threatening level of harm (category H).

**Table (7): Correlation between occurrence of adverse event and severity of harm (n= 78)**

	adverse event	
	r	p-value
<b>severity of patient harm</b>	0.71	0.000**

(\*\*) Highly statistical significant difference ( $P \leq 0.001$ )

This table reveals that there is highly statistical significant positive correlation between occurrence adverse event and severity of patient harm as result of adverse events as ( $r = .71$ ) at  $P \leq 0.001$ .

**Table (8): Correlation between total safety practices scores and occurrence of post-operative adverse events**

	Total nurses' safety practices scores	
	r	p-value
adverse events	- 0.67	0.05*

(\*) Statistical significant difference ( $P \leq 0.05$ )

Table (8) illustrates that there is statistically significant negative correlation between total safety practices scores and occurrence of post-operative adverse events among surgical patients undergoing general anesthesia ( $r = - 0.67$ ) at  $P \leq 0.05$ . This result supports the research question which stated that what is the effect of intraoperative nurses' safety practices on postoperative adverse events among surgical patients undergoing general anesthesia?

### Discussion

The current study revealed that less than two thirds of studied subjects were within age of 30 years and more with the mean age  $33.4 \pm 8.9$  years old. This finding supported by *Mohammadi, Zarea, Rasouli and Haghighizadeh (2014)*, who stated that the majority of studied nurses were with an average age of 32 years or above. This finding is on the same line with (*Yuh Ang et al., 2016*), who revealed that most of studied nurses were less than 39 years of age. This may be due to the need of experienced personnel in operating room and experienced personnel age usually is more than 30 years.

As regards to gender and marital status, the current study results revealed that nearly most of studied nurses were female and all of them were married. This finding is on line with that of *Labrague, Arteche, Yboa and Pacolor (2012)*, who reported that majority of the study respondents were female and married. While this finding is in disagreement with *Al-Hussami, Darawad, Salehand Hayajneh (2014)*, who showed that more than two fifths of studied nurses were males and more than one half of them were single. This may be due to lack of male nurse graduate at Benha University Hospital.

Concerning years of experience, the study findings revealed that less than one half of studied nurses had experience less than 15 years with the mean years of experience  $16.6 \pm 8.5$  years. This comes in agreement with *Hemmat, Atashzadeh-Shoorideh, Mehrabi and Zayeri (2015)*, who

approved that average work experience of studied subjects was 7.95 years. Their highest duration of work experience was 19 years. While this finding is in contrast with that of *Labrague, Arteche, Yboa and Pacolor (2012)* clarified that length of clinical experience of most of the respondents had rendered 1 to 5 years of service. It may due to the need of highly skilled personnel to work in operating theatre and the stability of teams is seen as important in advancing skill, which may minimize errors and improve quality of care.

As regards to qualification and the current position, the current study results clarified that nearly the majority of studied nurses were secondary school graduate and the minority of them acted as head nurse. This finding is consistent with the study done by *Brasaité, Kaunonen, Martinkènas, Mockienè and Suominen, (2016)*, who explained that most of studied operating room nurses were medical school graduate and the main base-qualifications were a non-university bachelor. In addition, this is supported by *Adejumo and Olatunji (2013)* when they reported that above sixty percent of nurses had Diploma certificates. This may due to hospital management system which doesn't support surgical wards with bachelor graduated nurses in spite of availability of them.

Regarding pervious attendance of training programs about intraoperative care, the study findings clarified that less than two thirds of studied subjects had been received training programs. This is in disagreement with that of (*Alaaa-Eldeen, Saad & Elrefae, 2012*) who

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stated that most of the studied nurses had no training programs related to anesthesia and patient safety while only ten of them attended some sorts of training programs. This may be due to availability of training chances provided by nursing authorities.

As regards to age, the study findings revealed that the age of studied patients was 35 years or more. It is worth mentioning that the mean age of the subjects is  $33.47 \pm 8.9$  years. This result is in agreement with *Lankoande et al., (2016)*, who stated that one hundred and three surgical patients were involved in his study and the average age of them was 41.1 years. In contrast, *Kazaure, Roman and Sosa (2011)* clarified that, the majority of surgical patients who participated in the study were elderly (mean age 79 years). This might be due to general surgical operations carried out in specific age according to progress of disease and patient' condition changes.

The current study findings showed that more than one half of studied patients were female and more than two thirds of them didn't suffer from comorbid disease (52.6%, 64.1% respectively). This findings in agreement with that of *Dixon, Tillman, Wehbe-Janek, Song, and Papaconstantinou (2015)*, who stated that the majority of studied patients were female and without associated disease.

Regarding patient' surgical history, the current study findings showed that more than one half of studied patients had a pervious surgical and general anesthesia history. In addition, more than two thirds hadn't experienced further complications regarding general anesthesia. On the same line, *Abd El-Nasser and Mohamed (2013)* supported this result as the highest proportion of studied patients (76.9%) in his study had under-gone to general anesthesia while only (5.5%) has had local. Moreover, (62.8%) of them had previously underwent major operation procedure with minimal risks and complications.

Regarding nurses' total practice score, it was showed that studied nurses had unsatisfactory level of practice regarding patient safety along three phases of surgery (sign in, time out, sign out). These findings supported by *Alaaa-Eldeen, Saad & Elrefaee (2012)* who studied nurses' practices related to safety of intraoperative surgical patient undergoing general anesthesia at Main University Hospital and concluded that that

nurses' level of safety practices was unsatisfactory regarding studied surgical patients. In contrast, *Kylmänen and Spasic (2010)* stated that modern surgery requires a group of suitably skilled personnel who able to deal with the demands of their complex work environment and deliver safe care for surgical patient. This may be due to most of nurses were old age and unable to cope with operating room work, no bachelor graduate among studied nurses, shortage of the staff, lack of facilities and equipment, lack of job satisfaction, poor training, and work overloaded. In addition, increased number of patients documented in operation list than staff number made the nurse to experience burn out.

The study findings showed that one half of studied patients had experienced surgical wound infection or sepsis as adverse event in post-operative departments. While less than one fifth had Physical injury or trauma and allergic reactions related to anesthetic drugs. This finding was supported by *Bailey, Davis, Levy, Molinari and Johnson (2016)* who revealed that, adverse events which occurred after abdominal surgery in older adults were: Wound infection and Pneumonia (18%) followed by postoperative bleeding and ischemic bowel (17%), and paralytic ileus (12%). Similarly, *Nilsson (2016)* explained that surgical related AEs were: reoperation was the most common (32%), followed by organ laceration (18%), postoperative bleeding (16%)<sup>29</sup>. On the same line, *El-Hadary, Sallam, Saad and Zaki (2014)* stated that the highest percentage of surgical adverse events occurred among studied patients were: bleeding requiring blood transfusion within 72 hours, cardiac arrest, deep venous thrombosis, myocardial infarction, pneumonia, pulmonary embolism, surgical site infection, unplanned return to the operating room. Also, *de Vries et al., (2010)* reported that wound infection and wound dehiscence were the commonest adverse events occurring altogether. In this respect, *Zegers et al., (2011)* clarified that almost of the surgical AEs were infections (40%), bleeding (23%), and physical injury or trauma (22%). This may be due to inadequate safety practices regarding infection control, bleeding risk management, patient status evaluation pre, during, after surgery, and patient positioning and transferring were involved in the causation of these surgical AEs and can be prevented through quality assurance and training.

With respect to differences between intraoperative nurses' safety practices and occurrence of postoperative adverse events among surgical patients undergoing general anesthesia. The current study findings supported research question and pointed out that there is statistically significant negative correlation between nurses' safety practices scores and occurrence of post-operative adverse events among surgical patients undergoing general anesthesia. This result also supported by *Jones (2013)* who clarified that improving and enhancing nursing skills regarding surgical patient safety throughout identification of gaps in their practices can minimize occurrence of adverse events and further patient harm .

Also, *Schildmeijer (2013)* explained that many patients still encountered surgical – related events that could have caused harm as result of poor safety practices performed by surgical staff. Also, *Forster, Dervin and Martin (2011)* stated that effective interventions to improve the safety in patients would have the largest reduction on the institutional number of events. This is also supported by *Steelman & Graling(2013)* when they stated that, registered perioperative nurses are in unique position to understand and prevent adverse events and unrepeatable patient safety issues that occur every day in the theatre by virtue of their training .

In this respect, *Moura & Mendes (2012); Woodman&Walker (2016)* approved that 78.1% of the surgical AEs occurred in the operating rooms so it is important to adopt patient safety and monitoring measures in perioperative settings to minimize occurrence of such as these events. On the same line, *Haynes et al. 2011* demonstrated that improvement in patient outcomes is associated with improved perceptions of teamwork and safety climates among workers in surgical departments. Also, *Zegers et al., (2011) ; Levinson (2014)* stated that surgical AEs have a significant negative effect on postoperative quality-of life and in some cases this effect persists for several years so improving nursing safety practices must be intensified and target the leading causes of patient harm.

Furthermore, *Weiser, 2010; Scott et al., 2013; Haugan, (2014)* stated that after implementation of intraoperative safety practices in operating theatre utilizing (*WHO surgical safety checklist*), the complication rate decreased into

11.7% and death rates dropped from 3.7% to 1.4% following checklist introduction.

### **Conclusion:**

There is statistically significant negative correlation between intraoperative nurses' safety practices and occurrence of post-operative adverse events among surgical patients undergoing general anesthesia ( $p\text{-value} \leq 0.05$ ).When intraoperative nurses' safety practices regarding surgical patients was unsatisfactory along three phases of surgery (sign in, time out, sign out), those patients had experienced adverse events and harm in post-operative departments regardless their age, gender, type of operation, and previous surgical and general anesthesia history.

### **Recommendations:**

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**Based on the results of the present study the following recommendations can be suggested:**

- 1- There is a need for continuous monitoring and evaluating of operating room nurses 'performance regarding intraoperative patient' safety and correction of poor performance is essential.
- 2- There is a need for continuous educational programs for operating room nurses to improve their knowledge and skills regarding patient safety.
- 3- Develop Arabic version of WHO surgical safety checklist as guidance for patient safety strategy in operating theatre.
- 4- There is a need for monitoring and intervention strategies for surgical related adverse events.
- 5- Establishing a data base for those patients who experienced adverse events in postoperative departments is necessary:

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