Nurses Performance Regarding Bundle of Care for Prevention of Wound Site Infection

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Abstract

Background: Surgical Site Infection (SSI) is associated with increased morbidity, increased patient's hospital length of stay, re-admission, and excess utilization of health care resources. The bundle approach ensures consistent implementation of all measures to reduce SSI. **Aim of the study**: was to assess nurse's performance regarding bundle of care for prevention of wound site infection. **Design**: A descriptive exploratory design was utilized in carrying out this study. **Settings**: The study was conducted at the general surgical units and the operating rooms at Bahtim Hospital affiliated to Ministry of Health. **Study subjects:** A convenient sample of all available nurses (40) (male and female**)** and purposive sample of all available patients during six months of the study duration. **Data collection tools:** 1. Nurse's self-Administered Questionnaire. 2. Nurse's practice observational Checklists and 3. Patients' clinical data check list. **Results:** It was revealed that, 67.5% of the studied nurses had unsatisfactory level of total knowledge regarding bundle of car for prevention of SSI. While 77.5% of them had unsatisfactory level of total practice regarding to bundle of car for prevention of SSI. **Conclusion:** It was concluded that there was a statistically significant correlation between the studied nurses' total level of knowledge and their total level of practices regarding to bundle of car for prevention of SSI **Recommendations:** Health education program regarding application of bundle of care for prevention of SSI, should be incorporated into comprehensive surgical nursing quality improvement programs to improve nurses' performance and maintain patient safety.

Keywords: Nurses' performance, Bundle of care, wound site infection.

Introduction:

Surgical site infection is one among the second commonest healthcare associated infection that happens among thirty days when an operation causes redness, fever, pain and swelling. According to Centers for Disease management and control (CDC) five hundred surgical site infections occur annually and account for third-dimensional of surgical mortality, prolonged lengths of hospital keep, and redoubled medical prices. Around the world, at least 312.9 million surgical procedures were performed yearly, 11% of patients who undergo surgery are infected in this process, it is associated with significant morbidity, mortality, and expanded health care costs ***(Moghazy et al., 2021).***

Care "bundles" in infection prevention and safety are simple sets of evidence-based practices that when implemented collectively, improve the reliability of care delivery and improve patient outcomes. A number of specific bundles are available and can be implemented at health care facilities in resource-limited settings. Bundle packages of care contribute to infection prevention, reduce unnecessary antibiotic prescribing, and may limit the development of antibiotic resistance in health care facilities ***(De León et al., 2018).***

Existing bundles promoted by the Institute for Health Care Improvement (IHI) are a good place to begin. In addition, bundle elements should not be static, but must adapt to changing evidence and best practices as new evidence emerges, obtain approval, commitment and endorsement from hospital leadership, clinicians, nursing staff and other members of the healthcare team ***(Qasem & Hweidi, 2017).***

The purpose and collective goal of the desired process must be clear create awareness through the necessary training and provide the team with the applicable guidelines, evidence, toolkits and supplies to execute the implementation of a bundle and frequently assess its effectiveness ***(Baghdadi et al., 2020).***

It is greatly vital for surgical nurses to completely understanding the essentials of pre and post-operative surgical site bundle of care in order to apply infection avoidance and

control measures. It is estimated that nurses can avoid 25 percent of infections by actualizing standard safety measures during the care of surgical patients. Besides, the nurses can help prevent SSI, decrease the financial burden of patients and hospital costs, and improve patients' quality of life by applying evidence-based knowledge and prescribed practices ***(Abu Alkishik et al., 2020).***

Significance of the study:

SSIs complicate about 1.9% of surgical procedures in the United States, and result in excessive health care costs. In contrast, infection is the most common postoperative complication in African countries, occurring in 10% of procedures; it is associated with a 9.7% case fatality rate. It has been estimated that approximately half of SSIs are preventable ***(National Institute for Health & Clinical Excellence, 2019; Mengesha et al., 2020).***

In Egypt the incidence rate of wound site infections is around (3.3% - 4.2%) and most commonly occur in burned patients and debridement also it occur frequently in surgical procedures that require external drainage .The rates of SSI vary depending on the type of surgery, depending on the degree of contamination, for clean surgery SSI occurs at rate of 2.1 for every 1000 operations and for clean contaminated surgery it occurs at rate 3.3 for every 1000 operations, whenever, SSI occurs at rate of 6.4 for contaminated surgery and 7.1 for every 1000 operations, for dirty surgery a wound site infection typically occurs within 30 days after surgery ***(Abdel-Hady et al., 2020; Mohsen et al., 2020).***

Wound site infections identified as the third most frequent hospital-acquired infections, wound site infections complicate ~1.9% of surgical procedures in the world, and result in excessive health care costs ***(Mengesha et al., 2020).***

In my observation the surgical site infections had serious complications that might had negative impact on patients' health condition, worsen the patients' prognosis and increase length of stay at hospital, might require ICU admission. Surgical site infections might occurs due to lack on nurses' performance of bundle of care, so that the investigator conducted the study in order to assess nurses' performance regarding bundle of care to prevent SSI.

Aim of the study:

This study aimed to assess nurse's performance regarding bundle of care for prevention of wound site infection, through the following:

1. Assessing nurse's knowledge regarding bundle of care for prevention of wound site infection.
2. Assessing nurse's practice regarding bundle of care for prevention of wound site infection.
3. Assessing patient's signs and symptoms of wound site infection.

Research Questions:

1. What is nurse's performance regarding bundle of care for prevention of wound site infection?
2. Are there signs and symptoms of wound site infection of their patients?

Subjects and Methods

Research Design:

A descriptive exploratory design was utilized in carrying out this study.

This design helps the investigator to describe and document aspects of a situation as it naturally occurs. As well, this design helps to establish database for future research ***(Sileyew, 2019).***

Setting:

This study was conducted at the general surgical units (two units, male general surgical unit (15nurses) and female general surgical unit (15nurses) and the operating rooms (10 nurses) at Bahtim Hospital affiliated to Ministry of Health. The Male general surgical unit was located in the second floor, consists of three rooms containing ten beds, female general surgical unit was located in the third floor, consists of 15 beds and Operating department was located at the second floor, consists of (recovery room, endoscopy room, minor operations room, intermediate operations room, major operations room, sterilization room, sterilized equipment room and store).

Subject

1. A convenient sample of all available nurses (40) in general surgical units (male and female) at Bahtim Hospital**.**

2. A purposive sample of all available patients during data collection period who met the inclusion criteria.

- **Inclusion criteria:**

1- Patient undergoing general surgeries.
2- Able to communicate and agree to participate in study.

- **Exclusion criteria:**

1. Patient with comorbid diseases (diabetic & cardiac disease).
2. Patient performed pervious general surgery

Tools of Data Collection:

The data was collected through the following tools:

I. Self-Administered Nurse's Questionnaire: it was developed by the investigator in an Arabic language after reviewing the recent and relevant literature

It was divided into two parts:

Part one: Nurses' personal characteristics include (age, gender, level of education, years of employment, experience in surgical ward and attending related training sessions).

Part two: Nurses' knowledge regarding bundle of care for prevention of surgical site infection, it was adapted from ***(Tanner et al., 2016; WHO, 2016; Waltz & Zuckerbraun, 2017; Sadaf et al., 2018; Woldegioris et al., 2019)*** to assess nurse's level of knowledge regarding bundle of care for prevention of wound site infection. It included 62 questions as following, surgical site infection (7 questions), and recommendations to reduce surgical site infection (5 questions), SSI bundle of care at preoperative phase (13 questions), SSI bundle of care at Intra-operative (14 questions) and SSI bundle of care at post-operative phase (23 questions).

❖ **Scoring system:**

Answers were either Yes or No with total score (62 mark), one score was given when the response was correct and zero when it was incorrect.

According to Sickder, (2010), who recommended that the total scoring system to be calculated as following:

- 85% or more was considered satisfactory level of knowledge (≥53marks).
- Less than 85% was considered unsatisfactory level of knowledge (<53 marks).

II. Nurse's Practice Observational Checklist: it was developed by the investigator in English language after reviewing the recent and relevant literature to assess nurses' practices related to bundle of care for prevention of infection ***(Sadia et al., 2017; Mohsen et al., 2020, Sun et al., 2020 & Tomisic et al., 2020)*** it included 58 steps. Consistuting the following procedures:

- Preoperative SSI bundle of care observational checklist **(19 steps).**
- Intraoperative SSI bundle of care observational checklist **(16 steps).**
- Post-operative SSI bundle of care checklist **(23 steps).**

❖ **Scoring system:**

One grade was given to the step which was done correctly and zero was given to step which was done incorrectly or not done and the step that done incorrectly was considered not done. So, total score of 58 questions were 58 degrees.

According to *Sadia et al., (2017),* who recommended that the total score to be classified as following:

- 90% and more was considered satisfactory level of practice (≥ 64 marks).
- Less than 90% was considered unsatisfactory level of practice (<64 marks).

III. Patients' clinical data; it was developed by the investigator; to assess signs and symptoms of infection for patient undergoing general surgery and included the following:

1. The studied patients' personal characteristic included (Age, gender, Marital status, educational level and place of residence).
2. **Patients' characteristic** included (Smoking, healthy diet, ICU admission, number of days, postoperative complications, length of stay in hospital, presence of drains and number of drains).
3. **Patients' Physical parameters**, it included (temperature, heart rate, respiration, capillary refill, body mass index and laboratory tests).
4. **Signs& symptoms of infection** include (pain at surgical site, Oozing blood at surgical site, redness around surgical site, discharge from surgical site, swelling at wound site, tenderness at surgical area, hot

or warm to touch, fever and increased WBCs count).

II- Operational design:

The Operational design included preparatory phase, content validity and reliability, pilot study and fieldwork.

Preparatory phase:

It included reviewing of related literature, and theoretical knowledge of various aspects of the study using periodicals, magazines, articles, books and internet.

Validity and reliability of the study tools: It was ascertained and tested through jury of seven experts (5 professors, one assistant professor and one lecturer in the field of medical surgical nursing, faculty of nursing, Ain Shams University who reviewed the content of the tools for comprehensiveness, accuracy, clarity and relevance and necessary modifications was done accordingly.

Face validity: refers to the extent to which a test appears to measure what it claims to measure based on face value ***(King et al., 2020).***

Content validity: is the degree to which a test or assessment instrument evaluates all aspects of the topic, construct, or behavior that it is designed to measure ***(Hong et al., 2019).***

Reliability: The tools were measured to ensure that an assessment tool produces stable with consistent result overtimes. The reliability coefficient for the study tools were calculated using the correlation coefficient Cronbach's alpha test as:

Tool	No of questions	Cronbach's Alpha
Knowledge	62	0.97
Practices	58	0.993

Pilot Study:

It was carried out on seven nurses (10% of the total number of nurses) and 5 patients (10% of total number of patients) after developing the tool and before starting the data collection to evaluate the clarity, applicability and to estimate the needed time to fill out of the study tools. No necessary modifications were done. Therefore, the pilot study samples were included in the total sample.

Field work:

- The sample of the study was recruited according to the inclusion and exclusion criteria.
- The researcher started data collection by introducing herself to the nurses and explaining the aim of the study and oral approval from nurses to participate in the study was obtained prior to any data collection.
- Assessing nurses' practice firstly, then assessing the knowledge regarding SSI Bundle of care for prevention of surgical site infection by using questionnaire tool.
- The observational checklist was filled by the investigator based on observing nurses' performance regarding application of SSI Bundle of care, it took from 20:30 minutes.
- Nurses distributed the questionnaire to the nurse in the morning and afternoon shifts, it took about 20-30 minutes for each nurse to complete the questionnaire.
- Data collection was done 4 days per week (Tuesday & Sunday& Wednesday & Thursday), it took about 4 hours from (9 am to 1 pm and some-times from 3 pm to 7 pm) it took six months starting from the first of November 2021 up to the end of April 2022, in the previously mentioned setting in morning and afternoon shifts.
- Also the researcher met with studied patients during data collection period, they were 50 patients met the inclusion criteria in the previously mentioned setting, and introduced herself to them, explaining the aim of the study, the effect of this study on reducing SSI and oral approval from patients to participate in the study was obtained prior to any data collection.
- Assessing patients' clinical data was done by assessing of patients' physical conditions and monitoring patients' surgical site signs of infection, it was done by the investigator.

III- Administrative design:

An approval to carry out this study was obtained from director of Bahtim Hospital and director of surgical unit. An Issued litter from the Dean of Faculty of Nursing at Ain-Shams University and official permission was obtained from the director of the Bahtim hospital and the head of surgical department.

Ethical considerations:

The ethical research considerations in this study included the following:

The research approval was obtained from the Scientific Research Ethical Committee Ain shams university faculty of nursing before starting the study, oral consent was obtained from the nurses and patients under study after clarifying the aim of the study to them. The researcher assured maintaining anonymity and confidentiality of the study subject/data in addition, nurses and patients were informed that participation is voluntary.

IV- Statistical Design:

The data obtained was synthesized, analyzed, and presented in numbers, percentage, in the form of tables and figures. Recorded data were analyzed using the Statistical Package for Social Sciences (SPSS), version (20.0). Quantitative data were expressed as mean and standard deviation (SD). Chi-square (X_2) test was used when comparing between related sample. P-value <0.05 was considered significant, P ≤0.001 was considered as highly significant and P value >0.05 was considered insignificant.

Results:

Table (1): shows that , 45.0% of the studied nurses their age between 30<40 years with**, Mean age 34.0 ± 7.44** years, 70.0% of them were females and 50.0% of them had technical institute of nursing. Also, 47.5% of the studied nurses their experience was from year to less than five years in general surgical unit and 72.5% didn't receive any training courses regarding infection control.

Table (2): shows that the mean age of the studied patients was **43.0 ±10.59** years, 62.0% of them were males. Concerning marital status and educational level 40.0% of the studied patients were married and had intermediate education. Also, 84.0% of the studied patients were from urban area.

Figure (1): Shows that, 67.5.0% of the studied nurses had unsatisfactory level of total knowledge while, 32.5 % of them had satisfactory level of total knowledge.

Figure (2): Shows that, 77.5 % of the studied nurses had unsatisfactory level of total practices, while 22.5% of them had satisfactory level of total practices.

Table (3): Shows that there was a statistically significant correlation between the studied nurses' total level of knowledge and their total level of practices **(p=≤0.05*).**

Table (4): Shows that there was a negative statistically significant correlation between the studied nurses' total level of practices and studied patients' total signs of infection **(p=≤0.001**).**

Table (1): Number and percentage distribution of the studied nurses regarding their personal characteristics (n=40).

Items	No.	%
Age/ years		
18: <30	13	32.5
30: <40	18	**45.0**
≥40	9	22.5
Mean ±SD		**34.0 ± 7.44**
Gender		
Male	12	30.0
Female	28	**70.0**
Educational level		
Diploma	8	20.0
Technical institute of nursing	20	**50.0**
Bachelor of Nursing degree	5	12.5
Post graduate	7	17.5
Years of experience		
0<1years	13	32.5
1<5 years	19	**47.5**
5<10 years	3	7.5
≥10 years	5	12.5
Training courses regarding infection control		
Yes	11	27.5
No	29	**72.5**

Table (2): Number and percentage distribution of the studied patients regarding their personal characteristics (n=50).

Personal characteristics	No.	%
Age / years		
Mean ±SD		**43.0 ±10.59**
Gender		
Male	31	**62.0**
Female	19	38.0
Marital Status		
Single	30	30.0
Married	20	**40.0**
Educational level		
Illiterate	11	22.0
Primary education	13	26.0
Intermediate education	20	**40.0**
Higher education	6	12.0
Residence		
Rural	8	16.0
Urban	42	**84.0**

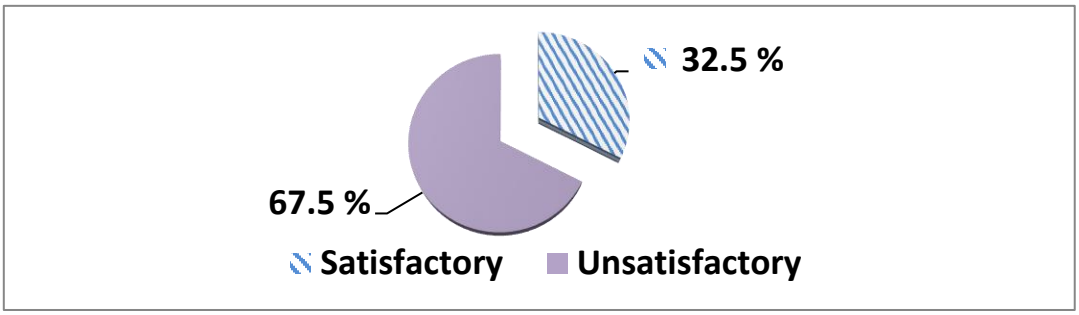

Figure (1): Percentage distribution of the studied nurses regarding their total knowledge level (n=40).

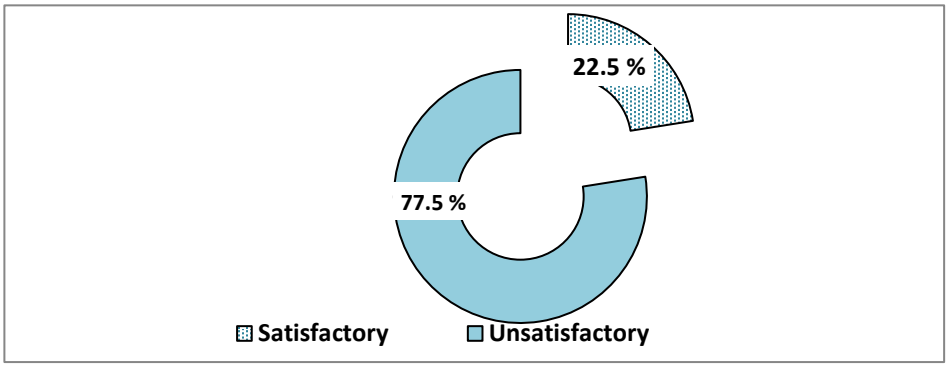

Figure (2): Percentage distribution of the studied nurses regarding their total level of practices (n=40).

Table (3): Correlation between total level of knowledge and total level of practices among studied nurses (n=40).

Scale	Total practices	
	r	**p- value**
Total knowledge	0.393	0.012*

R= correlation coefficient test * p<0.05 (statistically significance)

Table (4): Correlation between total level of studied nurses' practices and studied patients' total signs of infection.

Scale	Patients' signs of infection	
	r	p- value
Nurses' total practices	- 0.855	0.000**

**** p≤ 0.001 (highly statistically significance)**

Discussion:

Surgical site infection is a serious and undesirable outcome of surgery; that considered the foremost frequent complication in surgery. Although SSIs are among the most preventable HAIs, it has been recorded as a critical issue that's influencing the quality of health care and contains a genuine effect on patients' security. SSI prevention is complex as the risk results from several factors arising from the surgical patient journey, including sometimes after discharge, but similar to any other HAI, SSI is largely avoidable and up to one-half can generally be prevented through the successful implementation of clinical practice guidelines using a multimodal improvement strategy **(Allegranzi et al., 2018).**

Care bundles were first introduced by the Institute for Healthcare Improvement to improve the quality and consistency of care. Care bundles comprise three to five evidence-informed clinical interventions (referred to as 'elements'), to improve patient outcomes when performed collectively and reliably. Care bundles aim to change the behavior of healthcare workers; therefore, the use of behavior change theory is key. SSI can be prevented or reduced by many methods such as surgical scrubbing; nutritional support; preoperative bathing; mechanical bowel preparation; use of oral antibiotics; hair removal; and surgical site skin preparation. Since nurses are spent their most time with patients and cover most of the SSI prevention measures, they are the most significant responsible bodies, that can play a central and broad role in preventing SSIs by improving the quality of care they deliver, for example; improving the improper use of prophylactic antibiotics, poor hand hygiene and skin preparation practices and proper implementation of all other surgical safety care bundle **(Lavallée et al., 2019).**

Concerning demographic characteristics of studied nurses, the results of the current study revealed that more than two fifth of nurses aged between 30<40 years with**,** Mean age **34.0 ± 7.44** years, from the researcher point of view, this could be due to that young age nurses works at inpatients units and operating rooms while operating rooms while older age women work at administrative positions. Also, the current study revealed that nearly three quarters of them were females which could be interpreted that old perception that nursing profession is caring job that more suitable for females more than males, the higher proportion of the nurses in Egypt were females and may also be related to the nursing study in the Egyptian Universities was limited for females only till fifteen years ago. The results of the current study agreed with **Said et al., (2020)** who studied "Effect of Pediatric Orthopedic Bundle guideline on Nurses' Performance Regarding Surgical Site Infections" and revealed that nearly three fifth of nurses aged from 30<40 years old with mean age Mean ±SD: 32 ± 2.3 and most of them were female. Conversely, the study was disagreed with but these findings were disagreed with **Haleim et al., (2017)** who studied "Surgical site infection and associated risk factors in Egyptian orthopedic patients" and indicated that the majority of the nurses' staff were males with mean age was 35 years.

The result of the current study also revealed that half of nurses studied at technical institute of nursing from the researcher point of view, this could be interpreted that some nurses prefer technical nursing institute for early graduation and catching job also due to difficult of studying in nursing faculties that require high scores in secondary school and also require hard studying. The results of the current study also illustrated that nearly three quarters of nurses didn't attend training courses regarding infection control, from the researcher point of view, this could be related to work overload and absence of hospital policy regarding training attendance. The study was supported by **Sickder et al., (2017)** who studied "Nurses' surgical site infection prevention practices in

Bangladesh" and revealed that most nurses had diploma and technical institute education and also didn't attend training courses about prevention of surgical site infection.

Regarding years of experience, the current study illustrated that nearly half of them had 1<5 years of experience, from the researcher point of view, this could be due to their young age. The current result consistent with the study of **Mohsen et al., (2020)** who studied "Compliance and Barriers Facing Nurses with Surgical Site Infection Prevention Guidelines", and noted that more than one-third of the sample was in the age group of 20 - 30 years, the two thirds of the studied sample were females, and majority of nurses did not attend surgical site infection prevention guidelines training program previously and the highest percentage of them were having 1 - 5 years of experience.

Conversely the study was incongruent with the study of **Getaneh et al., (2019)** that examined the "Surgical Site Infection Prevention Practices and Associated Factors among Nurses Working in Government Hospitals of Harari Regional State, Eastern Ethiopia" who revealed that the mean (±SD) experience of study participants was 8.91 (±7.59) years and almost two-fifths of them were trained on infection prevention activities moreover, the majority of study participants were bachelor of sciences (BSc) nurses.

Concerning the demographic characteristics of studied patients, the results of the present study illustrated that more than two fifths of the studied patients aged between 45<55years with Mean age 43.0 ±10.59 and the majority of them were from urban residence, from the researcher point of view, this could be related to that higher age is associated with more comorbid conditions and more health related complications that sometimes require surgical interventions and the majority of them were from urban area. The study was supported by **Bhangu et al., (2018)** who studied "Surgical site infection after gastrointestinal surgery in high-income, middle-income, and low-income countries" and revealed that the mean age of studied patients was 43·5 ± (21·3) and most of them were from high income and urban areas.

The result of the current study revealed that two fifth of patients stayed at hospital from 5-10 days and most of them had surgical site drain, from the researcher point of view, this could be due to the complicated surgical procedure that require hospitalization for proper sterile wound dressing by the health care providers. The study was agreed with **Wassef et al., (2020)** who study "Care Bundle Approach to Reduce Surgical Site Infections in Acute Surgical Intensive Care Unit, Cairo, Egypt" and revealed that most of them stayed at hospital from 8 to 14 days and more than half of them had surgical drains.

In relation to studied nurses' total knowledge level, the results of the current study revealed that more than two thirds of the studied nurses had unsatisfactory level of total knowledge while, less than one third of them had satisfactory level of total knowledge. The current results confirmed by **Bagga, et al., (2020)** who studied "Does preventive care bundle have an impact on surgical site infections following spine surgery? An analysis of 9607 patients" and revealed that most of participants had lack of baseline awareness about SSI that improved post program also, agreed with **Mohsen et al., (2020)**, who clarified that most of the participants have inadequate knowledge about surgical site infection, as about two-thirds of nurses were in a low level of knowledge with a mean knowledge score of (6.00 ± 5.97). Also, **Bamoosa et al., (2020)** who studied "Awareness and level of knowledge of Surgical Site Infection among surgical staff in King Abdullah Medical City in Hajj" and stated that about more than one third of respondents had poor knowledge, half of them had fair knowledge while only minority of them had good knowledge. Also, **Zucco et al., (2019)** who studied "Adherence to evidence-based recommendations for surgical site infection prevention: Results among Italian surgical ward nurses" and revealed that there were some knowledge gaps among nursing staff. Indeed, about half of the sample had inadequate knowledge.

While the current results are in disagreement with **Abd Elhay et al., (2016)**, who studied "Nurses' knowledge and practice regarding wound infection in surgery unit at Assuit University Children Hospital" and noticed that majority of nurses had a

satisfactory level of knowledge related to wound infection and preoperative care. Also, disagree with **Abd-Al Rahman, (2015)**, who studied "Assessment of nurses' knowledge and practice regarding Infection control in operating room at main Assuit University and Al Eman Hospital" and revealed that the majority of nurses had high scores of knowledges.

Regarding studied nurses' total level of practice, the results of the current study revealed that more than three quarters of the studied nurses had unsatisfactory level of total practices. From the researchers' point of view, unsatisfactory practice of the studied nurses in may be attributed to lack of studied nurses' knowledge, experience and training or absence of written policy and poor supervision from infection control team. The study was supported by **Moghazy et al., (2021)** who studied "Effect of Evidence-Based Measures protocol on Nurses' Performance regarding Prevention of Surgical Site Infection" and revealed that slightly more than half of the studied nurses had an incompetent practice of evidence-based preventive measures for SSI in the pre-intervention phase.

The current results are in agreement with the study of **Mengesha et al., (2020)** who studied "Practices of and associated factors regarding avoidance of surgical site infection among nurses working in the surgical units of public hospitals in Addis Ababa city" and revealed that, the highest percentage of the participants have inadequate practice regarding avoidance of SSI, and stated that training nurses are making SSI prevention guidelines more accessible and ensuring acquired knowledge by nurses is strong enough to be translated into desired actions. Also, **Mohsen et al., (2020)** who illustrated that the lowest percentage of studied nurses always performed the items of SSI prevention guidelines. As well, most of the nurses have poor practice about SSI, as nearly three quarters of them were in the low level of practice with a mean practice score of (14.71 ± 4.65).

Furthermore, the current results are supported by **Getaneh et al., (2019)**, who studied "Surgical Site Infection Prevention Practices and Associated Factors among Nurses Working in Government Hospitals of Harari Regional State and Dire Dawa City Administration" and mentioned that only two fifth of study participants reported good practices in SSI prevention activities, and the mean (±SD) practice score of nurses on SSI prevention was 6.14 (±3.38). In addition, **Sadaf et al., (2018)** concluded that the practice of the nurses regarding surgical site infection is not satisfactory.

Conversely, the current results contradict with the study of **Weiser et al., (2018)** who studied "Multidisciplinary Surgical-Site Infection Reduction Team. Effectiveness of a multidisciplinary patient care bundle for reducing surgical-site infections" who revealed that most nurses had satisfactory compliance with SSI bundle of care. Also, the study was incongruent with **Alabdulrazaq et al., (2018)** at Saudi Arabia, about "Knowledge and practice towards prevention of surgical site infection among healthcare professionals in Buraidah city" who found that the proportion of Charge and Staff nurses who were applying a good practice to the prevention of SSI is 100% out of 28. In which this indicates a perfect practical level of preventive measures towards the prevention of SSI. Furthermore, the current results conflict with **Sadia et al., (2017)** who revealed that the overall practice of nurses regarding preventing and managing SSI was at a good level.

Concerning the correlation between total level of knowledge and total level of practices among studied nurses, the results of the current illustrated that there was a statistically significant relation between the studied nurses' total level of knowledge and their total level of practices. from the researcher point of view this could be related to that nurse who got unsatisfactory knowledge had unsatisfactory practice, this means that the level of nurses' performance depends on the nurses' knowledge. This may be explained that when nurses have adequate knowledge about bundle of SSI prevention, practice satisfactory and vice versa when there is a lack of knowledge the practice was incompetent also, may be explained that nurses' level of information showed a great impact on their knowledge and skills for patients care and that the effective professional education requires close and more appropriate connection between theory and practice.

The current results are in agreement with **Mengesha et al., (2020)** who demonstrated that insufficient knowledge, inadequate resources to implement surgical safety checklists, insufficient performance monitoring systems, lack of surgical site infection assessment and preventive measure feedback systems, lack of training, and insufficient orientation programs during unit rotation were identified as factors affecting the nurse's practice regarding prevention of SSIs. Furthermore, the current results coincide with **Getaneh et al., (2019**) who mentioned that the knowledge and attitude of nurses were significantly associated with SSI prevention practice. Meanwhile, **Sadaf et al., (2018)** demonstrated that the link between knowledge and practice is positive and association is critical. As well, knowledge could be necessary that affects performance. Also, **Sickder et al., (2017)** identified that insufficient knowledge among nurses regarding SSI prevention tended to routinely affect their degree of proper practice in their clinical settings.

As regard to the correlation total level of studied nurses' practices and studied patients' total signs of infection, the current study revealed that there was a negative statistically significant correlation between the studied nurses' total level of practices and studied patients' total signs of infection, from the researcher point of view, this might be related to that adequate practices and application of all elements of care bundle results in decreasing the incidence of post-operative complication and surgical site infection. The study was congruent with **Bagga et al., (2020)** who revealed that there was significant correlation between application of preventive care bundle and decreasing the incidence of surgical site infections. In addition the study was congruent with **Mohsen et al., (2020)** who illustrated that there was highly significant correlation between practice of SSI care bundle and low occurrence of signs of wound infection.

Conclusion:

Based on the result of the present study and research questions, the study concluded that:

More than two thirds of the studied nurses had unsatisfactory total level of knowledge regarding bundle of care for prevention of wound site infection while, less than one third of them had satisfactory level of total knowledge. Concerning nurses' practice, the results of the current study revealed that more than three quarters of the studied nurses had unsatisfactory level of total practices, while less than one quarter of them had satisfactory level of total practices. Also, there was a statistically significant relation between the studied nurses' total level of knowledge and their total level of practices about bundle of care for prevention of wound site infection

Recommendations:

In the light of the result of the present study, the following recommendations are suggested:

1. Health educational program and bundle of preventive measures of SSI should be incorporated into comprehensive surgical nursing quality improvement programs to improve nurses' performance and maintain patient safety.
2. Routinely updating knowledge and practice of nurses through in-service continuing education programs associated with clinical training on the latest evidence-based practices of infection prevention especially SSI.
3. Develop a system for continuous, strict follow up for nurses during work, with a periodical evaluation of their attitudes and their adherence to evidence-based preventive measures for SSI.
4. Illustrated simplified booklet about bundle of prevention of SSI should be available at all surgical units.
5. Further studies need to be done focusing on implementing guidelines to improve the application of bundle of prevention of SSI.
6. New commissioned research is needed to measure compliance levels with bundles, instead of focusing on individual component implementation and relate compliance with improved outcomes.
7. Recognition and encouragement of operating theatre discipline/team work is needed to assist following care bundle and develop significant behavioural change, particularly by surgical team leaders.

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