

Compliance and Barriers Facing Nurses with Surgical Site Infection Prevention Guidelines

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Abstract

Background: Surgical Site Infection (SSI) is defined as infection that occurring within 30 days after surgical procedure or within a year of implantation of prosthesis. Surgical Site Infection can happen in up to 30% of surgical procedures and records for up to 14% of Hospital Acquired Infection (HAIs). **Aim of the Study:** The aim of this study was to assess levels of nurse's Compliance; knowledge and practice regarding prevention of surgical site infection Guidelines and identify the barriers facing nurses' compliance with surgical site infection prevention Guidelines. **Design:** Cross sectional descriptive study design self-reported survey. **Settings:** Data was collected from surgical departments from selected Menoufia Governorate Hospitals, Egypt. **Sample:** A large convenience sample of 450 nurses was selected. Initially 600 questionnaires were distributed, of which only 400 returned completed, a response rate of 66.6%. **Tools:** was comprised of the: 1) Pre-designed structured questionnaire to assess nurses' socio-demographic characteristics' and Nurses' knowledge, 2) Likert-scale: to assess nurses' compliance, nurses' practice and nurses' barriers facing nurses with surgical site infection prevention guidelines. **Study period:** The study was conducted from July to November 2019 in the selected hospitals. **Results:** nurses' compliance mean scores were in low level with a mean of 13.01, it is clear that most of the nurses have poor knowledge, most of the nurses have poor practice about surgical site infection, concerning the most barriers of compliance facing nurses with surgical site infection prevention guidelines, were lack of a professional model, having no enough time, and some measures for the prevention of surgical site infection are not nurses' responsibilities. **Conclusions:** Nurses working in the surgical related wards reported a low level of knowledge, practice and compliance regarding the prevention of surgical site infection guidelines. The most barriers of compliance with surgical site infection prevention guidelines that reported by nurses were, lack of a professional model, nurses do not have enough time,

and some measures for the prevention of surgical site infection are not nurses' responsibilities. **Recommendations:** Evaluation of nurses' and hospitals' application of the guidelines is important to improve the quality of care. Education and training program should be conducted to improve nurses' knowledge and practice in some areas using evidence-based practice.

Keywords

Surgical Site Infection, Compliance, Knowledge and Practice

1. Introduction

Surgical site infections (SSIs) are the most preventable hospital acquired infection (HAI) related with any surgery [1] [2]. SSI is defined as infection that occurs within 30 days after a surgical procedure or within a year of implantation of a prosthesis. SSI can happen in up to 30% of surgical procedures and records for up to 14% of HAIs [3]. It was reported a huge weight in terms of patient morbidity and mortality and costs to healthcare around the world due to Surgical site infections (SSIs) [4]. The fundamental danger of contamination is microorganisms (viral or bacterial) entering surgical incisions. The development of SSIs depends upon on virulence, bacterial load, and the patient's ability to withstand infections [5]. Transmission of microorganisms can be minimized through following evidence based guidelines for prevention of transmission of them, including the aseptic technique. Hand washing techniques in pre-operative aseptic strategies consist of a number of factors such as preliminary hand washing, method of rubbing, drying of hands, wearing an operating gown, and wearing sterile gloves. One of the factors that affect the success of hand washing is the degree of compliance with the recommended standard procedures [6] [7].

Prevalence study found that wound contaminations after surgery represent SSIs happen in 2% - 5% of patients experiencing surgical procedure extending from 160,000 to 300,000 cases for each year in the US, [8] [9]. SSIs are related with delayed term of hospitalization, readmissions, re-intercessions, changeless incapacity or even passing [10].

Throughout the literature, SSIs were associated with factors including advanced age, malnutrition, metabolic diseases, smoking, obesity, hypoxia, and immune-suppression. Moreover, factors like application of skin antiseptics, preoperative shaving, antibiotic prophylaxis, preoperative skin preparation, inadequate sterilization of instruments, surgical drains, surgical hand scrubs, and dressing techniques were among the most frequently reported risk factors [11] [12]. The most critical issue in preventing surgical site infections is the entire and absolute compliance of health professionals with the recommendations in the guidelines [13] [14].

Although the occurrence of surgical site infections (SSIs) is a great deal higher in low- and middle-income nations in contrast to high-income countries, SSIs

are nevertheless a common motive of infection in high-income international locations [15]. Clearly, better SSIs prevention is needed. Preventing SSI requires a multifactorial strategy as the increasing improvement of antibiotic resistance makes it essential that the operating room (OR) is free from infection as possible [16].

Wound contamination can be prevented by implementing certain guidelines from the nurses and other health care workers that minimize the risk of SSIs. Actions such as all staff complying with Preventing SSI guidelines including hygienic practices and correct cleaning of the OR between operations are examples of measures that can reduce SSI load in all health care facilities [17].

There is a general agreement that up to 60% of SSI would be reduced by applying sufficient counteractive action and checking nurses compliance with SSI [15] [17], since sets of measures (or “packages”) have exhibited a decrease in SSI rates [18] [19].

As most SSIs are avoidable [20], all details preoperative, intraoperative and post-operative care should be investigated and evaluated to make certain high-quality practices are evidence-based. Prevention of SSI is a balance between harm, cost, and patient value [15]. Surgical patients, who meet many fitness care specialists on their perioperative period, rely on OR nurse to provide advantageous care as properly as to make sure the prevention of SSIs. That is, OR nurses are accountable for enforcing hygiene and aseptic principles in the OR to stop and limit the spread of infections. In addition, OR nurses are responsible for perioperative care together with different professionals in the crew [21].

Nurses play a major comprehensive role and span of continuum care in preventing surgical site infections. Therefore, they can modify SSI risk factors in their daily practice such as improper hand hygiene and skin preparation, in order to prevent SSI. [7] [8]. Many sets of guidelines in this area have been proposed in the past decade by the organizations working in the area of SSI prevention, such as the Center for Disease Control and Prevention (CDC) [22], WHO, [23], and the National Institute for Health and Clinical Excellence (NICE). [24]. However, adherence to the recommended best practices according to the guidelines for SSI prevention remains low among nurses [22] [24]. Multiple studies have reported that proper practices for the prevention of infection among nurses have been affected by some barriers, such as Lack of knowledge, resources and SSI preventive guidelines, lack of direct leadership involvement, lack of dedicated time for implementation of the improvement activities, lack of dedicated time for training and education, poor access to supplies in support of identified and agreed action, poor communication, lack of awareness of the need to address the problem, lack of data to support and track improvement efforts, non-attendance or non-compliance with educational activities, absence of local standard operating protocols (SOPs) or an implementation manual for SSI prevention [9] [24].

1.1. Significance of the Study

Surgical site infection (SSI) is a significant clinical problem that affects the qual-

ity of health care outcomes globally, particularly in developing countries. This infection can have serious impacts including: prolonged hospital stay, reduced quality of life, increased mortality, additional cost for patients and their family, and rising health care cost. In Egypt, a little nursing research has been done to assess the level of nurses' compliance, knowledge and practice regarding surgical site infection prevention guidelines and investigating the correlation among them, as well as, identifying the barriers facing the nurses to comply with guidelines of SSI. All over the world, the use of SSI prevention guidelines is supported by scientific research. However, In Menoufia Governorate in Egypt, the extent to which nurses implement these guidelines in surgical departments is still unclear. Therefore, there is a standing need to provide all Menoufia hospitals with written guidelines for nurses, patients and other health care employees to gain knowledge and practice regarding surgical site infection prevention (SSIs). Moreover, it might generate attention and motivation for further researches into this area.

1.2. Aim of the Study

The aim of this study was to assess levels of Nurse's Compliance, knowledge and practice regarding prevention of surgical site infection Guidelines and to identify the Barriers facing nurses' compliance with surgical site infection prevention Guidelines.

1.3. Research Questions

- 1) What is the level of Nurses' knowledge regarding prevention of surgical site infection Guidelines?
- 2) What is the level of nurses' practice regarding prevention of surgical site infection Guidelines?
- 3) What is the level of nurses' compliance with surgical site infection prevention Guidelines?
- 4) What are the barriers facing nurses' compliance with surgical site infection prevention Guidelines?

2. Methodology

2.1. Design

A cross-sectional descriptive study, design self-reported survey was conducted.

2.2. Setting

Data was collected from surgical departments from selected Menoufia Governorate Hospitals: (Menoufia University Hospital, Shebin El-Koom Teaching Hospital, Quwesna Central Hospital, Berkt El-Saba Central Hospital, Ashmoon General Hospital) as they represent a capital of big town in Menoufia Governorate-Egypt.

2.3. Sample Size Estimation

In this study, it is used the Raosoft sample size calculator [25]. in which, margin of error was 5% is a common choice, confidence level was 95%, the population size, 20,000, the response distribution was 50%, the recommended sample size was 377 which calculated electronically based on the Raosoft sample size calculator. A large convenience sample of 450 nurses was selected to compensate for the expected low response rate and uncompleted questionnaires. The participants were from Shebin El-Koom University Hospital (175 participants), Shebin El-Koom Teaching Hospital (130), Quwesna Central Hospital (45), Berkt El-Saba Central Hospital (30), Ashmoon General Hospital (20). Initially 600 questionnaires were distributed, of which only 400 returned completed, a response rate of 66.6%. Respondents were different genders, age, and years of experience.

Surgical site infection (SSI) is a significant clinical problem that affects the quality of health care outcomes globally, particularly in developing countries. This infection can have serious impacts including: prolonged hospital stay, reduced quality of life, increased

2.3.1. Inclusion Criteria

Staff nurses;

Nurses who will voluntarily participate and give consent.

2.3.2. Exclusion Criteria

Head nurses;

Student nurses;

Nurses who will refuse to participate in the study.

2.4. Tools for Data Collection

1) **Pre-designed structured questionnaire** was designed by the researchers in Arabic language after reviewing of the related literature. This tool was comprised of the following sections:

a) **Section 1: Nurses' socio-demographic characteristic** as regards their age, gender, educational level, working experience and attended surgical site infection prevention guidelines training programme previously.

b) **Section 2: Nurses' knowledge:** to evaluate the nurse's knowledge regarding application of surgical site infection prevention guidelines [26]. This part also was designed by the researchers based on literature review, which contained another 22 multiple choice questions,

Scoring System: the correct answer was given a score of one and the incorrect a score of zero. The total score of knowledge ranged between 0 - 22. Levels of knowledge as the following: Low = 0 to 7.3, Moderate = 7.4 to 14.6, and High = 14.7 to 22.

2) **Likert-scale:** It consisted of:

a) **Part 1: Likert-scale to assess nurse's compliance** with surgical site infection prevention guidelines. It was designed by the researchers on the basis of the

published and updated guidelines on prevention of surgical site infection from the WHO Surgical Site Infection Prevention Guidelines, (2016) [26]. This tool consisted of 9 items, of Likert-scale scores (never = 1, sometimes = 2, and always = 3) to measure nurses' compliance with the guidelines. Scoring System: The score of nurses' compliance ranged from 9 - 27, levels of nurses' compliance as the following: Low = 9 to 15, Moderate = more than 15 to 21, and High = more than 21 to 27.

b) Part 2: Likert scale to assess Nurses practice: regarding surgical site infection prevention guidelines. This part was adopted from Sickder *et al.*, (2014) [27] contained another 10 questions in which responses were answered in a 3-point Likert scale (never practiced, sometimes practiced, and always practiced). Responses range from 1 to 3. The higher scores will indicate higher level of practice, Levels of practices: Low = 10 - 16.6, Moderate = 16.7 - 23.3 and High = 23.4 - 30.

c) Part 3: Likert Scale to assess Nurses' Barriers facing nurse's compliance with surgical site infection prevention guidelines. It consisted of 11 items [26]. Questions in which responses were answered on a 3-point Likert scale (Disagree, Undecided and Agree).

2.5. Procedure for Data Collection

2.5.1. Study Period

The study was conducted between July to November 2019 in the selected hospitals.

2.5.2. Approval to Conduct the Study

An official letter was issued to the directors of Menoufia Governorates Hospitals, Egypt.

2.5.3. Protection of Human Rights

Each subject was informed about the purpose and the nature of the study. The subjects were informed that their participation is totally voluntary and the confidentiality and anonymity were assured.

2.5.4. Ethical Considerations

This study was approved by the Ethical Committee for scientific research review in Faculty of Nursing of Menoufia University. Ethical considerations were performed in accordance with the Declaration of Helsinki (World Medical Association, 2013). All participants received written and oral information about the study. Before the interviews took place, the participants signed a written consent and were ensured confidentiality. The heads of the departments in all the surgical departments were informed about the study and agreed to let their nurses be interviewed during work hours at work or another place of the nurses' choosing.

2.5.5. Validity and Reliability

Compliance, knowledge, practice, and barriers items showed an acceptable

Cronbach α , 0.75, 0.80, 0.73, and 0.75 respectively.

2.5.6. Pilot Study

The tools were administered to 50 nurses in a pilot study, the panel of experts approved all the sections of the tools, as well as the scoring systems to evaluate its applicability. Minor rewording for some items was made to improve readability and understandability for practice section, as it was adopted.

The questionnaire was distributed to the nurses working in the surgical department in the previously mentioned hospitals for filling it.

The questionnaires were completed by nurses in their surgical departments

3. Statistical Analysis

Data were analyzed using SPSS [28] version 21. The sum of scores for the items in the compliance, knowledge, and practice, parts were calculated. Frequencies of responses were determined. Differences between nurses' compliance were measured using the independent sample T test and analysis of variance test. The F-test of association was conducted to analyze the frequencies of nurses' responses.

4. Results

From 600 questionnaires were distributed, only 400 returned completed, a response rate of 66.6%. The participants were from Shebin El-Koom University Hospital (175 participants), Shebin El-Koom Teaching Hospital (130), Quwesna Central Hospital (45), Berkt El-Saba Central Hospital (30), Ashmoon General Hospital (20). Respondents were different genders, age, and years of experience.

Table 1 shows that about two thirds of the studied sample were females (65.8%), more than one third (39.0%) of the sample were in the age group of 20 - 30 years and more than half (56.0%) were having bachelor degree in nursing. Regarding Work experience in surgical ward, it is indicated that, (44.8%) were having 1 - 5 years experience in surgical ward. As well as, it indicates that (81.5%) of nurses did not attend surgical site infection prevention guidelines training programme previously.

Table 2 describes frequency of nurse's responses concerning compliance of surgical site infection prevention guidelines. It is evident that, among 400 nurses, limited compliance with the surgical site infection prevention guidelines was obvious in several topics. Three quarters (75.0%) of the nurses reported that they never ensure patients bathe or shower and (77.3%) never limit the number of people and doors being opened, and (69.0%) never check wounds for infection and use standard dressings on primary wounds.

Table 3 indicated that, nurses' compliance mean scores were in low level with a mean of 13.01 (SD = \pm 3.00), and majority (84.75%) of the nurses were classified in low compliance, (13.25%) in moderate compliance, and (2%) in high compliance.

Table 4 describes frequency of Incorrect and Correct Knowledge regarding

Table 1. Distribution of demographic characteristics of the studied sample (N = 400).

Items		No.	%
Sex	Male	137	34.3
	Female	263	65.8
	Total	400	100.0
Age	20-	156	39.0
	30-	129	32.3
	40-	89	22.3
	50+ year	26	6.5
	Total	400	100.0
	Mean SD	39.08	±8.98
Work Experience in Surgical Ward	<1 year	76	19.0
	1-	179	44.8
	5-	114	28.5
	10+ years	31	7.8
	Total	400	100.0
Educational Level	Diploma	147	36.8
	BA	224	56.0
	M.A.	29	7.3
	Total	400	100.0
Attended Surgical Site Infection Prevention Guidelines Training Programme Previously	Yes	74	18.5
	No	326	81.5
	Total	400	100.0

Table 2. Nurses compliance with surgical site infection prevention guidelines.

Nurses Compliance with Surgical Site Infection Prevention Guidelines	Never		Sometimes		Always	
	No.	%	No.	%	No.	%
A. Before Surgery						
1) Ensure patients bath or shower	300	75.0	59	14.8	41	10.3
2) Do not shave patients	274	68.5	54	13.5	72	18.0
3) Only use antibiotics when recommended	255	63.8	67	16.8	78	19.5
4) Use chlorexidine alcohol) based antiseptic solutions to prepare skin	169	42.3	212	53.0	19	4.8
5) Surgical hand preparation should be performed by scrubbing with either a suitable antimicrobial soap or water or using a suitable alcohol) based hand rub before donning sterile gloves	277	69.3	83	20.8	40	10.0
B. During Surgery						
6) Limit the number of people and doors being opened	309	77.3	50	12.5	41	10.3
7) Ensure all surgical equipment is sterile and maintain asepsis throughout surgery	297	74.3	84	21.0	19	4.8

Continued

C. After Surgery						
8) Do not continue antibiotics to prevent infection	258	64.5	82	20.5	60	15.0
9) Check wounds for infection and use standard dressings on primary wounds.	276	69.0	72	18.0	51	12.8

Table 3. Score of nurses compliance with surgical site infection prevention guidelines.

Score of Nurses Compliance with Surgical Site Infection Prevention Guidelines	No.	%	f-p-Value
Low Compliance	339	84.75	363.90***
Moderate Compliance	53	13.25	
High Compliance	8	2.00	
Total (Mean + SD)	13.01 ± 3.00		

Table 4. Knowledge regarding surgical site infection prevention guidelines for nurses.

Knowledge regarding Surgical Site Infection Prevention Guidelines for Nurses	Incorrect		Correct	
	No.	%	No.	%
A. Preoperative Measures				
1) Preoperative timing for preoperative bathing	280	70.0	120	30.0
2) Optimal surgical antibiotic prophylaxis	295	73.8	105	26.3
3) Hair removal	314	78.5	86	21.5
4) Surgical site preparation	308	77.0	92	23.0
5) Surgical hand preparation	335	83.8	65	16.3
B. Perioperative and/or Intraoperative Measures				
6) Enhanced nutritional support	239	59.8	161	40.3
7) Perioperative discontinuation of immunosuppressive agents	287	71.8	113	28.3
8) Perioperative oxygenation	282	70.5	118	29.5
9) Maintaining normal body temperature (normothermia)	266	66.5	134	33.5
10) Use of protocols for intensive perioperative blood glucose control	299	74.8	101	25.3
11) Maintenance of adequate circulating volume control/normovolemia	322	80.5	78	19.5
12) Drapes and gowns	345	86.3	55	13.8
13) Wound protector devices	306	76.5	94	23.5
14) Incisional wound irrigation	285	71.3	115	28.8
15) Prophylactic negative pressure wound therapy	258	64.5	142	35.5
16) Use of surgical gloves	264	66.0	136	34.0
17) Changing of surgical instruments	265	66.3	135	33.8
18) Antimicrobial coated sutures	268	67.0	132	33.0
19) Laminar airflow ventilation systems in the context of operating room ventilation	286	71.5	114	28.5

Continued

<u>C. Postoperative Measures</u>				
20) Surgical antibiotic prophylaxis prolongation	313	78.3	87	21.8
21) Advanced dressings	298	74.5	102	25.5
22) Antibiotic prophylaxis in the presence of a drain and optimal timing for wound drain removal	284	71.0	116	29.0

surgical site infection prevention guidelines for Nurses: which shows the overall responses of the participants to knowledge questions indicate that the participants have little knowledge about the surgical site infection. Responses of the nurses to the five questions of pre-operative measures shows that majority of them responded incorrect, as well, minority of nurses answered correct for perioperative and/or intraoperative measures questions, moreover, concerning postoperative measures questions, it is clear that, only (21.8%) of nurses answered correct for the question asking about the surgical antibiotic prophylaxis prolongation.

From **Table 5**, it is clear that most of the nurses have poor knowledge about surgical site infection, as about two thirds of nurses (65.5%) were in the low level of knowledge with mean knowledge score of (6.00 ± 5.97) .

It is obvious that minority of nurses always practiced the ten items of surgical site infection prevention guidelines in **Table 6**. As only (5.8%) of nurses always practiced washing hands before and after changing wound dressing touching the surgical site, (6.0%) of them always practiced advising their patients to take preoperative showering bathing with anti-microbial agent, (8.3%) always use an aseptic technique during surgical wound dressing, and (9.0%) always use sterilized dressing material for cleaning surgical wound dressing.

Table 7 shows the levels and the mean total score of Nurses practice with surgical site infection prevention guidelines. It is clear from this table that, most of the nurses have poor practice about surgical site infection, as about three quarters of nurses (74.5%) were in the low level of practice with mean practice score of (14.71 ± 4.65) .

In **Table 8**, concerning Barriers of Compliance with surgical site infection prevention guidelines, about two thirds (59.0%) of nurses agree that, lack of a professional model, nurses do not have enough time (64.0%), and some measures for the prevention of surgical site infection are not nurses' responsibilities (60.0%), are the most barriers facing them with surgical site infection prevention guidelines.

Table 9 illustrates the correlation among Age, experience, compliance, Knowledge, and practice. It is shown from this table that there was a strong statistical significant correlation among Age, experience, compliance, Knowledge, and practice for nurses in relation to surgical site infection prevention guidelines.

Table 10 revealed that, there was no statistical difference among nurses who attended surgical site infection prevention guidelines training programme previously and who did not.

Table 5. Total score of nurses knowledge with surgical site infection prevention guideline.

Score of Nurses Knowledge with Surgical Site Infection Prevention Guidelines	No.	%	F-p-Value
Low	262	65.5	1377.68***
Moderate	90	22.5	
High	48	12.0	
Total (Mean ± SD)	6.00 ± 5.97		

Table 6. Nurses practice response regarding surgical site infection prevention guidelines.

Nurses Practice Response regarding Surgical Site Infection Prevention Guidelines	Never		Sometimes		Always	
	No.	%	No.	%	No.	%
1) I wash my hands before and after changing wound dressing touching the surgical site	138	34.5	239	59.8	23	5.8
2) I wash my hand before wearing the surgical glove	277	69.3	83	20.8	40	10.0
3) I perform pre-operative shaving right before surgery	272	68.0	84	21.0	44	11.0
4) I administer pre-operative prophylactic antibiotic within one hour before surgery	290	72.5	78	19.5	32	8.0
5) I advise my patient to take preoperative showering bathing with anti-microbial agent	265	66.3	111	27.8	24	6.0
6) I use sterilized dressing material for cleaning surgical wound dressing	255	63.8	109	27.3	36	9.0
7) I use an aseptic technique during surgical wound dressing	291	72.8	76	19.0	33	8.3
8) I Assess and monitor surgical site condition	251	62.8	110	27.5	39	9.8
9) I separate infected dressing from non-infected dressing	223	55.8	115	28.8	62	15.5
10) I use face mask during cleaning surgical wound dressing	233	58.3	118	29.5	49	12.3

Table 7. Total score of nurses practice with surgical site infection prevention guidelines.

Score of Nurses' Practice	No.	%	F-p-Value
Low	298	74.5	1005.63***
Moderate	73	18.2	
High	28	7.3	
Total (Mean ± SD)	14.71 ± 4.65		

Table 8. Barriers of compliance with surgical site infection prevention guidelines.

Barriers of Compliance with Surgical Site Infection Prevention Guidelines	Disagree		Undecided		Agree	
	No.	%	No.	%	No.	%
1) Inadequate supply of surgical consumables (cap, mask, scrub, antiseptic solution)	95	23.8	102	25.5	203	50.8
2) Lack of supervision of hospital infection control committee	119	29.8	52	13.0	229	57.3

Continued

3) Inadequate knowledge about disinfection and sterilizing techniques	126	31.5	63	15.8	211	52.8
4) Lack of training about measures for the prevention of surgical site infection in hospital	120	30.0	61	15.3	219	54.8
5) Lack of providing Evidence) based recommendations on measures for the prevention of surgical site infection in hospital	133	33.3	41	10.3	226	56.5
6) Unsuitable nurse patient ratio	97	24.3	83	20.8	220	55.0
7) Lack of a professional model	106	26.5	58	14.5	236	59.0
8) Poor integration of research findings in practice	113	28.3	68	17.0	219	54.8
9) Nurses do not have enough time	78	19.5	66	16.5	256	64.0
10) Nurses lack required skills	113	28.3	66	16.5	221	55.3
11) Some measures for the prevention of surgical site infection are not nurses' responsibilities	91	22.8	69	17.3	240	60.0

Table 9. Correlation among age, experience, knowledge, practice, compliance.

Items	Age	Experience	Knowledge	Practice	Compliance
Age	1.00				
Experience	0.828**	1.00			
Knowledge	0.273*	0.333**	1.00		
Practice	0.367**	0.262**	0.384**	1.00	
Compliance	0.313**	0.342**	0.094**	0.006**	1.00

Table 10. Effect of attending surgical site infection prevention guidelines training programme previously on compliance score.

Items	Mean	±SD	t-p-Value
Yes	13.01	3.00	0.98
No	12.81	3.00	ns

5. Discussion

Effective surgical site infection prevention requires redesigning systems to reduce barriers and to optimize prevention strategies and guidelines based on evidence-based processes of care; all nurses should comply with the surgical site infection prevention guidelines which are essential for lowering surgical site infection rate [29].

The current study explores the nurse's compliance, Knowledge, and practices of surgical site infection prevention guidelines at Menoufia Governorate. The current study findings revealed that, among 400 nurses, limited compliance with the surgical site infection prevention guidelines was obvious in several topics. Three quarters (75.0%) of the nurses reported that they never ensure patients bathe or shower, and (77.3%) never limit the number of people and doors being

opened, and (69.0%) never check wounds for infection and use standard dressings on primary wounds, moreover, nurses' compliance mean scores were in low level with a mean of 13.01 (SD = 3.00), and majority (84.75%) of the nurses were classified in low compliance, (13.25%) in moderate compliance, and (2%) in high compliance. These findings are similar to other studies such as Aloush, *et al.*, [30], Jahansefat *et al.*, [31], and Narendranath *et al.*, [32], who reported poor compliance among nurses. As well, Alhirish *et al.*, [33] in Egypt, and Rizwan *et al.*, [34] who reported a significant increase in nosocomial infection in Pakistan as a result of poor compliance with infection prevention guidelines.

On the other hand, our findings contradict those of several other studies. El-Saed *et al.*, [35] reported a high compliance rate for nurses. Aysha *et al.*, [36] found satisfactory compliance after implementation of a nursing care program, and Sherpa *et al.*, [37] revealed higher compliance of nurses for the guidelines, including hand washing, and using sterile gloves.

In addition, the current study findings describe frequency of incorrect and correct knowledge regarding surgical site infection prevention guidelines for nurses and indicated that the participants have little knowledge about the surgical site infection. As the answers of the nurses to the five questions of pre-operative measures show that majority of them responded incorrect, as well, minority of nurses answered correct for perioperative and/or intraoperative measures questions, moreover, concerning postoperative measures questions, it is clear that, only (21.8%) of nurses answered correct for the question asking about the surgical antibiotic prophylaxis prolongation.

As well, it is clear that most of the nurses have poor knowledge about surgical site infection, as about two thirds of nurses (65.5%) were in the low level of knowledge with mean knowledge score of (6.00 + 5.97).

These results were in accordance with Sadaf., Shafqat, Hussain, 2018, [38] who concluded that, nurses had poor knowledge concerning surgical infection and this study revealed that the nurses' information was poor regarding interference of surgical site infection. Responses of the nurses to knowing the simplest technique for pre-operative shaving indicated that the majority (50) were response to affirmative that show that they understand it and thirty four nurses were response to NO that was a negative response.

Other study conducted by Zucco, Lavano, Nobile, Papadopoli, Bianco (2019) [39], they reported that, only 53.8% knew that preoperative hair removal, if necessary, should take place shortly before surgery, and 28.9% of the sample did not know the right definition of "bundle". Over three quarters of participants stated that they always perform hand antisepsis before and after biological sample collection while 9.7% considered that wearing gloves during this practice is sufficient to prevent SSI. Furthermore, 91% of nurses reported that they always performed hand antisepsis before and after invasive procedures. Their study findings highlight the areas that were most lacking in nurses' training and for which targeted activities are needed. These data could support healthcare managers to implement interventions focused at enabling adherence to effective pre-

vention practices to reduce risk to all patients.

Moreover, other study reported that when assessing knowledge on strategies for SSI prevention, more than two thirds (73%) of the participants knew that the appropriate time for shower or bath with an antiseptic agent is the day before surgery, but only 53.8% knew that preoperative hair removal, if necessary, should take place shortly before surgery. Moreover, 28.9% of the sample did not know the right definition of “bundle”. When nurses were asked to rate the effectiveness of some interventions for SSI prevention, dressing change if it is visibly soiled received the highest score (8.9) [39].

In addition, it is obvious that minority of nurses always practiced the ten items of surgical site infection prevention guidelines. As only (5.8%) of nurses always practiced washing hands before and after changing wound dressing touching the surgical site, (6.0%) of them always practiced advising their patients to take preoperative showering bathing with anti-microbial agent, (8.3%) always use an aseptic technique during surgical wound dressing, and (9.0%) always use sterilized dressing material for cleaning surgical wound dressing.

As well, most of the nurses have poor practice about surgical site infection, as about three quarters of nurses (74.5%) were in the low level of practice with mean practice score of (14.71 + 4.65).

These results were in accordance with Sadaf, Shafqat, Hussain, 2018 [38] who concluded that, the current study also revealed that the practice of the nurses regarding surgical site infection is not satisfactory. Most of the participants were agree 41 (35.1%) to the question that they wash hands before and after changing wound dressing, 23 (13.5%) were strongly agree, 30 (28.7%) were disagree and only 7 (4.1%) strongly disagreed which show that most of the participants have good practice regarding hand washing. Responses of the participants to another question that performing pre-operative shaving before surgery is necessary, in which 26 (26.9%) was agreed.

Another study was in accordance with our study such as Zucco, Lavano, Nobile, Papadopoli, Bianco, (2019) [39] stated that, over three quarters (75.2%) of participants stated that they always perform hand antisepsis before and after biological sample collection, while 9.7% considered that wearing gloves during this practice is sufficient to prevent SSIs. Furthermore, 91% of nurses reported to always perform hand antisepsis before and after invasive procedures (e.g. peripheral intravenous catheter insertion, urethral catheterization, etc.). A vast majority of respondents (93.2%) “always/often” reported the utilization of single-use protective equipment in patients with an infectious disease. Only (14.1%) of respondents reported the proper duration of antibiotic prophylaxis (<24 hours after surgery) in their unit (77%) of the sample self-reported that a wound culture was performed in case of SSI signs and/or symptoms. When investigating the replacement of the wound dressing, only 55.1% of the sample reported the correct frequency for changing of the dressing, and 61.9% of nurses reported the utilization of adhesive drapes.

Furthermore, concerning barriers of compliance with surgical site infection prevention guidelines, about two thirds of nurses agree that, lack of a professional model, nurses do not have enough time, and some measures for the prevention of surgical site infection are not nurses' responsibilities, are the most barriers facing them with surgical site infection prevention guidelines. Aloush, *et al.*, (2017) [30] their finding were in accordance with our study, as in their study, the Participants reported several barriers that prevented their compliance with the guidelines, especially lack of education, lack of a professional model, and poor integration of research findings in practice. They also stated that, (63%) of the participants, had received no education about the guidelines in their schools. This finding supports the significance of education in the improvement of nurses' compliance, as reported in other studies [40] [41].

In relation to the correlation among age, experience, compliance, Knowledge, and practice, the current study indicated that there was strong statistical significant correlation among Age, experience, compliance, Knowledge, and practice for nurses in relation to surgical site infection prevention guidelines; indicating those older nurses who are more knowledgeable and practice, the more compliance with surgical site infection prevention guidelines. As well, our study indicated that, there was no statistical difference among nurses who attended surgical site infection prevention guidelines training programme previously and who did not.

These results were in accordance with Sadaf, Shafqat, Hussain, 2018 [38] who explained that, the link between Knowledge and practice is positive and association is critical. As well, Knowledge could be necessary that affects the performance. The study shows that nurses have poor Knowledge and practices concerning surgical infection this study reveals that the nurses' knowledge was poor regarding interference of surgical site infection. In a study that was in accordance with our study, previous education with VAP, more years of experience, and was important factors seeming to increase nurses' compliance. These findings highlighted the significance of education and training in the improvement of nurses' compliance and quality of care, and support the reports from previous studies [31] [42].

6. Strengths and Limitations

- A major strength is that the current study evaluated nurses' knowledge, practice, compliance and barriers of the guidelines of SSI.
- On the other hand, one limitation is the use of self-reported measures to evaluate nurses' knowledge, practice, and compliance.

7. Conclusions

- Nurses working in the surgical related wards reported a low level of knowledge, practice and compliance regarding the prevention of surgical site infection guidelines.

- The most barriers of compliance with surgical site infection prevention guidelines that reported by nurses were: lack of a professional model, nurses do not have enough time, and some measures for the prevention of surgical site infection are not nurses' responsibilities.
- The current study indicated that there was strong statistical significant correlation among age, experience, compliance, knowledge, and practice for nurses in relation to surgical site infection prevention guidelines.

8. Recommendations

- Evaluation of nurses' and hospitals' application of the guidelines is important to improve the quality of care.
- Education and training program should be conducted to improve nurses' knowledge and practice in some areas using evidence-based practice.
- Improve compliance with the surgical site infection prevention guidelines through comprehensively modified and updated nursing curriculum to include the prevention of surgical site infection.
- Future studies are recommended to conduct observational measurement to enhance the reliability of the findings.
- The hospital administrators need to conduct education and training programs to enhance knowledge of SSI prevention to improve the quality of nursing care in this area.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Abbreviations

Surgical Site Infections (SSIs);
Hospital-Acquired Infection (HAI);
Operating Room (OR);
Control and Prevention (CDC);
World Health Organization (WHO);
National Institute for Health and Clinical Excellence (NICE).